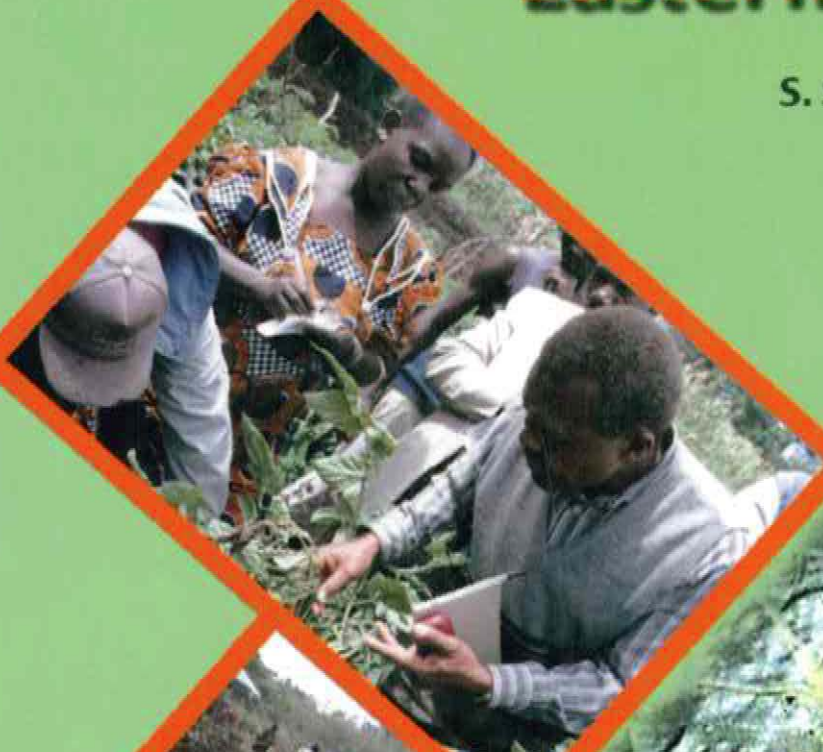


Development and Dissemination of IPM for Vegetables in Eastern Africa

S. Sithanantham



**International Centre of Insect
Physiology and Ecology (ICIPE)**

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Pest management research, capacity and institution building in Africa is going through an important phase, in response to the great demand from end-users for a new and wide range of ecologically sound and socio-economically sustainable control options.

For the multitude of smallholder farmers in the eastern Africa region, vegetable production constitutes an important source of income. An African regional seminar on Integrated Pest Management in Vegetable Crops, convened by the Food and Agriculture Organization (FAO) in Senegal in 1993, highlighted the urgent need to strengthen national research and extension capacity in IPM development and dissemination for these crops and to promote awareness and adoption of IPM at the farm level. The International Centre of Insect Physiology and Ecology (ICIPE), based in Kenya, has been a leader in research into developing eco-friendly pest management technologies, in building national research capacity and in the training of IPM trainers in Africa, both for staple food crops and horticultural crops.

This document presents the highlights of a regional network programme on Capacity Building for IPM Technology Development and Dissemination for Vegetables in Eastern Africa. The programme was led by ICIPE with participation of four partner countries, Ethiopia, Kenya, Tanzania and Uganda, during 1998–2001. Funding support was mainly provided by the International Fund for Agricultural Development (IFAD), with complementary support from the United States Agency for International Development (USAID).

The major accomplishments of the regional network include the testing of a self-sustaining model for IPM awareness building at grassroots level, as well as strengthening national research capacity in specialty areas of IPM. This document includes also the relevant IPM Technical Advisory Notes (TANs) developed by the programme and provides insight into the partnership activities undertaken and the capacity built, in addition to the lessons learned and experience gained from this regional initiative.

Hans R. Herren
Director General, International Centre of Insect Physiology and Ecology
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EXECUTIVE SUMMARY

1. Background

This document presents an account of the progress made and the experience gained during 1998–2001 in a regional initiative, 'Integrated Pest Management for Vegetable Crops: Development of Appropriate Technology and Dissemination Models in Eastern Africa'. This initiative was funded by the International Fund for Agricultural Development (IFAD), with co-financing from the United States Agency for International Development (USAID). Coordination and scientific leadership were provided by the International Centre of Insect Physiology and Ecology (ICIPE), while the national vegetable research teams (NVRTs), through the integrated pest management (IPM) advisory panels in the partner countries Ethiopia, Kenya, Tanzania and Uganda implemented the jointly planned model on IPM awareness building.

The implementation of the Initiative's objectives was conducted through farmer-participatory activities, including group learning and group testing of IPM options in common plots based primarily on the farmers' field school (FFS) approach developed by the Food and Agriculture Organisation of the United Nations (FAO). The focus was on developing a multi-season and multi-crop IPM awareness building model for empowering farmers through facilitating sustainable access to IPM technology options at the grassroots.

Another important goal was to build the research capacity of the national agricultural research and extension systems (NARES). This was addressed through MSc or PhD training aimed at filling critical gaps and widening the menu of promising IPM technology options for sustainable management of the major pest problems of vegetable crops.

2. Goal and objectives

The overall goal of the initiative was to contribute to sustainable vegetable crop production and enhanced income generation for smallholder vegetable farmers in the partner countries through improved means of pest management and awareness building on IPM.

The main objectives were:

- To develop more sustainable models for building awareness on IPM among farmers at the grassroots;
- To build the national research capacity to expand and refine the menu of IPM options for the major vegetable crops in the partner countries;
- To develop a strategy for building awareness on IPM among farmers at the national level.

3. Justification

In most of sub-Saharan Africa, cultivation and marketing of vegetables for urban and export markets is emerging as an important income-generating activity for many smallholder farmers. An FAO-supported African regional workshop on IPM

for vegetable crops in 1992 emphasised the need to strengthen the research and extension support for IPM as a major strategy for promoting the sustainability of the production of income-generating vegetable crops in the region (Ikin et al., 1993). Empowering farmers with information and knowledge through locally sustainable IPM awareness building models has been regarded as an essential component of this task. The success of the farmers' field school (FFS) approach in building awareness on IPM in Asia (Kenmore, 1991) provided the impetus for expanding it to these income-earning crops grown by multitudes of smallholder farmers in the region. ICIPE's experience in the region in developing and demonstrating sustainable IPM options for vegetables and other crops (Chitere et al., 1994; Sithanatham et al., 1999b) was an important component of this initiative.

4. Focus

Led by ICIPE, this regional initiative sought to strengthen farmer participation in awareness building on IPM at the grassroots to promote the dissemination of the IPM approach in Ethiopia, Kenya, Tanzania and Uganda. It also encouraged and facilitated NARES to develop more sustainable models for farmers' participation and group learning, by suitably strengthening and developing locally relevant features in the FFS approach for advancing IPM awareness and implementation among smallholder vegetable farmers.

5. The IPM awareness building model

Some of the salient features of the FFS IPM awareness building model that were validated in the project as a means of enhancing the sustainability of the project's impact are:

- Inclusion of a multi-season 'learning phase' to facilitate stepwise dissemination of IPM information on target vegetable crops among the farmers' groups;
- Training of two to three elected farmers from each group as 'farmers' cadre trainers', to serve as 'secondline extensionists' in disseminating IPM information and providing local guidance for IPM adoption;
- Fully involving farmers in selecting the priority knowledge gaps to be addressed and the IPM options to be validated or adopted;
- Focusing on 'enhanced sustainability' of access to IPM information at the grassroots by farmers, adopting 'self-help' and 'group' approaches.

6. Composition of participating farmers' groups

The farmers' groups participating in the IPM awareness building activities in the four countries included both men and women whose main source of income was production and marketing of vegetable crops. The farmers' cadre trainers were first trained before the start of the crop season. Through periodic (group sessions once every two to three weeks) these farmers trained the others on IPM-related themes considered as priority. The training sessions also catered for joint planning and testing of promising IPM technologies in the field (in a common plot). There were also demonstrations on methods, all based on the FFS approach. The IPM panel members provided the required scientific support through training the local trainers for each group and guiding the farmers' groups in the learning sessions on the methodology and principles of IPM technologies.

7. Collaborating institutions

The main partners and collaborators in the initiative are listed in Table 1.

Table 1. Partners involved in the IPM awareness building activities for vegetable crops in eastern Africa

Main partners	Collaborators
<i>ICIPE</i> : Lead partner	
Kenya : National Horticultural Research Centre, Thika	Fresh Produce Exporters Association of Kenya, Horticultural Crops Development Authority, Kenya
Uganda : Kawanda Agricultural Research Institute, Kawanda	USAID-Investment in Development of Export Agriculture (IDEA) Project
Ethiopia : Ethiopian Agricultural Research Organisation, Nazareth	IFAD development projects
Tanzania : Horticultural Research and Training Centre (Horti-Tengeru)	Asian Vegetable Research and Development Centre (AVRDC), Arusha; GTZ-IPM Project

8. Important activities and achievements

8.1 Establishment of model participatory farmers' groups and assessment of farmers' knowledge, attitudes and practices

Farmers' groups, each of 15–30 members, were established, four in Kenya and two each in Ethiopia, Tanzania and Uganda for undertaking the model IPM awareness building activities. These groups adopted some of the features of the FFS approach but added others considered essential for strengthening the sustainability and impact of IPM awareness building activities at the grassroots level.

Baseline information was assembled using a standard questionnaire survey by sampling about 60 smallholder vegetable farmers from the groups identified for the participatory model activities in each partner country, to assess their knowledge, attitudes and practices relating to pest management on the major vegetable crops.

8.2 Features included in the IPM awareness building activities

- 'Electing' of farmers' cadre trainers by the group and training them to work as locally based 'secondline' extensionists in the promotion of farmer-to-farmer extension of IPM;
- Adopting a stepwise approach in awareness building for IPM, starting with training farmers in correct diagnosis of pest problems and familiarisation with rational use of chemical pesticides, followed by farmers' learning about and adopting safer pest control interventions;
- Focusing on empowering the farmers' groups and building their competence through joint evaluation of IPM options in their common plots so as to develop their capacity for decision making on the adoption or refinement of IPM options.

8.3 Impact of group learning on farmers' attitudes to adoption of IPM

The assessment of the impact of the IPM awareness building activities on the participating farmers' groups in the four countries showed that they had gained competence in identifying pests, in addition to improving their awareness on new IPM options. The group-learning approach fostered farmer-to-farmer extension and resulted in high adoption of IPM options among the participating farmers. In addition, non-participating farmers (neighbouring participating farmers) also sought advice or assistance from the trained farmers in adopting IPM practices. Some of the participating farmers were even able to modify and adapt some of the practices. For example, some farmers demonstrated that burning maize straw on nursery soil could substitute the recommended nursery soil 'solarisation' method that requires using plastic sheets for heating and sterilising the top layer of nursery soil.

8.4 Assessment of sustainability potential of the group learning model

The IPM awareness building model was judged as effective and sustainable by the main stakeholders—farmers, extensionists and researchers. Farmers considered the strategy of training farmers' cadre trainers as secondline extensionists as affordable and highly effective in enabling access to IPM knowledge at the grassroots. All participating research and extension staff in the partner countries endorsed the usefulness of the model. The fact that the model is not dependent on external resource support makes it sustainable within the existing research-extension networks (Sithanantham et al., 2003a).

8.5 Interest in IPM awareness building model by other projects

Eight IFAD-supported development projects from six countries in eastern and southern Africa jointly evaluated the activities attached to the IPM awareness building model and rated them as highly appropriate and sustainable. The USAID-funded Investment for Development in Export Agriculture (IDEA) project in Uganda also showed keen interest in the model and funded some of the on-farm activities, as well as forging partnerships to strengthen the farmers' cadre trainers' training activities through ICIPE. The Eritrean national programme invited the IPM Project Coordinator to share the experience from this project during the country's vegetable IPM research planning (Sithanantham, 1999) and during a national IPM awareness planning workshop held in 2001 with DANIDA support (Sithanantham and Matoka, 2001a). The project was also entrusted with the convening during 2000 of a training and a refresher course for four senior Eritrean extension personnel as IPM master trainers, with funding from DANIDA (Sithanantham and Matoka, 2000).

8.6 Training of IPM trainers

The project supported the training of trainers in IPM awareness building for each partner country, who included frontline extensionists and representatives of non-governmental organisations (NGOs) and community-based organisations (CBOs), besides farmers' cadre trainers. Training materials were prepared in local languages

and distributed to extension personnel and NGOs. An experience-sharing workshop involving the IPM advisory panel members of the partner countries (Annex A), farmers and representatives of IFAD, FAO, GTZ-IPM projects and AVRDC was convened in June 2001 in Arusha, Tanzania. This workshop endorsed the utility of the model validated by the project as a viable means of building awareness on IPM. The workshop also recommended a follow-up programme for ensuring a multiplier effect through extending the model's activities to more farmers' groups and to other vegetable producing agroecozones in the four partner countries.

8.7 Enhancing IPM technology development capacity of NARES

The project enabled the training of young national researchers from the region in the speciality areas of IPM development: biocontrol products (one Ethiopian PhD student and one Kenyan MSc student), integration of the use of botanical products such as those from the neem tree (one Ugandan PhD student and one Kenyan MSc student), development of cultural practices (one Kenyan MSc student), and assessment of pest spectrum and yield losses in capsicum, okra and cucurbits (two Kenyan MSc students). In addition, postdoctoral training attachments on vegetable IPM technology themes were provided for two middle-level researchers, one Eritrean and one Kenyan.

8.8 Developing information products

Local language bulletins on IPM for vegetables were produced in Kiswahili (for Kenya and Tanzania), Luganda (for Uganda) and Amharic (for Ethiopia). Technical advisory notes (TANS) were also prepared for dissemination, on IPM themes, including the awareness building model and promising IPM technologies.

8.9 Developing a strategy for stepwise training for IPM awareness building at the national level

Based on the experience gained in this project phase, the ICIPE IPM Project Coordinator developed an approach for stepwise implementation of training of IPM trainers at national, provincial, district and village levels, along with plans for development of appropriate training materials. As a trickle-down impact, the Eritrean national programme convened a one-week national planning workshop to utilise our approach for developing a strategy for implementing stepwise IPM awareness building activities and training, with funding support from DANIDA (Sithanantham et al., 2001c, d).

UNDERSTANDING FARMERS' PRACTICES, ATTITUDES AND NEEDS

Assessment of farmers' knowledge and resources

Production of vegetable crops by smallholder farmers in sub-Saharan Africa is fast changing from a subsistence activity to intensive cultivation, especially in areas with supplementary irrigation (Sithanantham et al., 2002). Socioeconomic surveys conducted in some vegetable growing districts in Kenya show that women farmers are the major beneficiaries of vegetable production through their access to the income generated. Surveys conducted among the rural and peri-urban smallholder vegetable producers in the Nairobi and Central provinces of Kenya show that pests are a major constraint to production. Sithanantham and Matoka (2001a,b) have documented the importance of pests as a constraint to vegetable production in the eastern Africa region.

The most common method of pest control among vegetable farmers in the past was the use of chemical pesticides (ICIPE, 1999). However, the increasingly stringent regulations governing pesticide residues in fresh produce especially in the European Union (EU) necessitate the popularisation of IPM alternatives (ICIPE, 1999). To harmonise compliance with these regulations by smallholder vegetable producers, there is need to enhance the capacity of NARES in eastern Africa to develop safer alternatives to chemical pesticides and to demonstrate the use of such promising options to farmers (Sithanantham and Matoka, 2001b).

One of the major constraints to IPM awareness building and implementation programmes among vegetable farmers is the lack of adequate information about farmers' knowledge, perceptions and practices in pest management (Morse and Buhler, 1997). Scientists need to understand clearly the target farmers' constraints and their existing technical knowledge as they plan to work with farmers to improve crop production and protection techniques (Bentley, 1989; Kenmore, 1991; Morse and Buhler, 1997). Evaluation of farmers' knowledge and perception of pests and pest-control practices is useful to set research and training agenda, for planning campaign strategies and in developing communication messages (Van Mele et al., 2001; Fujisaka, 1992).

Survey methodology

Pilot surveys were undertaken during 1998–1999 in representative districts in the four countries: Nazareth in Ethiopia, Thika in Kenya, Arusha in Tanzania and Kampala in Uganda. In each area, the NARES partners identified two to four farmers' groups whose main source of income was vegetable production (Annex B). The respondents totalled about 60 farmers for each district, chosen randomly. The study aspects included farmers' literacy profile, crop production area, ability to recognise important pests (and diseases) and perception of the extent of yield loss the pests and diseases cause.

Standardised and structured questionnaires were used, and the farmers were interviewed individually in the local language. The questionnaires were pre-tested

and suitably modified by the enumerators, who were research/extension personnel and members of the IPM advisory panel. The data assembled on landholding and area under vegetable cultivation were subjected to analysis of variance. Frequency data on farmers' profile were subjected to Chi-square test.

Results of the survey

Farmers' profile

Over 68% of the sampled farmers in Ethiopia, 54% in Kenya, 49% in Tanzania and 85% in Uganda had only primary education. When the data were pooled for the four countries, the proportion of farmers with primary education was significantly higher (Chi-square = 142.6, $P < 0.001$) than of illiterate farmers and of those with higher education. Less than 30% of the farmers had attained secondary level or higher, while about 8% were illiterate.

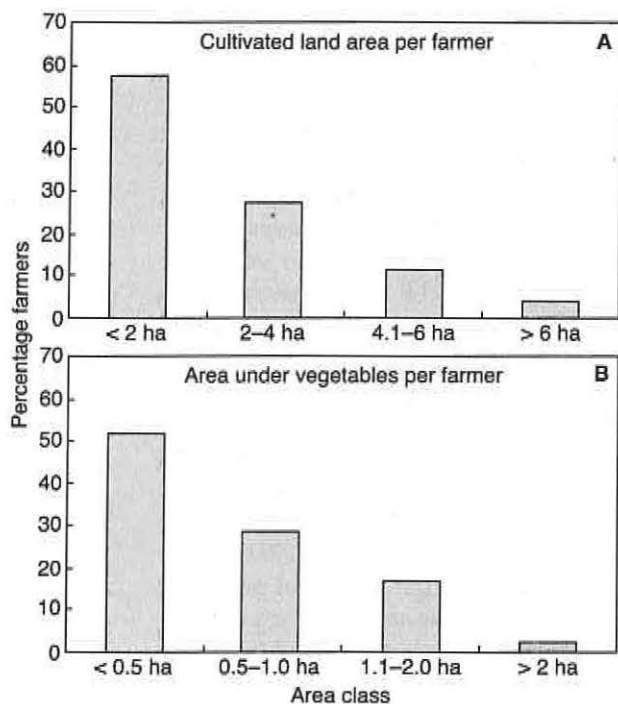


Figure 1. (A) Extent of cultivated land and (B) area under vegetables grown by the vegetable farmers in eastern Africa (overall of four countries)

The average age of the respondents was 32.3 ± 2.2 , 45.7 ± 1.9 , 35.5 ± 1.7 and 34.2 ± 1.2 for Ethiopia, Kenya, Tanzania and Uganda, respectively. The majority (63%) of the farmers in Kenya were older than 40 years. In Ethiopia, Tanzania and Uganda, all age groups equally ($P > 0.05$) planted one or another vegetable crop. Male farmers constituted a significantly higher ($\chi^2 = 55.2$, $P < 0.001$) proportion of the vegetable growers. Women constituted only 4, 15 and 7% of the vegetable growers in Ethiopia, Tanzania and Uganda, respectively.

The majority of farmers had an average cultivated area of less than 2 ha, and the area allocated to vegetable production was less than 0.5 ha (Figure 1). About 2, 9 and 12% of the respondents in Kenya, Tanzania and Uganda, respectively, farmed on leased land. This practice was not prevalent among farmers in Ethiopia. Only around 5% used 6 ha or more of land for vegetable production in these countries.

Vegetable crops grown

The farmers grew several vegetable crops, but only the most common eight—tomato, cabbage, onion, capsicum, French bean, okra, eggplant and cucurbits—were included in the survey. About 45, 59, 51 and 60% of the respondents in Ethiopia, Kenya, Tanzania and Uganda, respectively, reported growing one or more export vegetables. In addition, of these farmers, 59, 91, 60 and 71%, respectively, grew other vegetables for different purposes. In the four countries the area of land devoted to export vegetables ranged from 20–45%, while that allocated to other local vegetables was 15–35% (Figure 2).

In overall, the most popular vegetable crops among the smallholder farmers in the four countries were tomatoes, capsicum and cabbage, which were grown by 76, 57 and 56% of the farmers, respectively (Figure 3). The proportions of the farmers sampled in Ethiopia, Kenya, Tanzania and Uganda who grew these three crops were 92, 88, 97 and 45%, respectively. The commercial varieties of tomatoes grown were Marglobe, Cal-J, Money Maker, Heinz and Pioneer, among which the first two were the most common. Cabbage was grown by over 90% of the farmers sampled in Ethiopia and Kenya, but by only about 23% and 24% in Tanzania and Uganda. The varieties planted were Drumhead, Gloria, Copenhagen, Holland, Sugar Loaf and Frenso, the most common being Drumhead.

Some 48, 74, 40 and 62% of the farmers sampled in Kenya, Uganda, Tanzania and Ethiopia, respectively, grew capsicum. The varieties grown included Bullets, Long Cayenne, Marko, Scottish, Shorter and Red Yellow, the first two being the most popular. Onions were grown by 40, 10, 11 and 62% of the farmers in Kenya, Uganda, Tanzania and Ethiopia, respectively. The varieties grown were mainly Red Creole in Kenya and Adama Red in Ethiopia. French bean, okra, eggplant and cucurbits were grown by less than 30% of the farmers interviewed, except in Ethiopia, where they were not grown at all. Black Beauty and Dark Green were the only eggplant varieties recorded. Only Kenyan (33%) and Ugandan (10%) farmers grew French bean, mostly for urban and export markets. Most of them planted Monel variety.

Farmers' knowledge on insect pests and diseases

Data on the number of farmers who recognised the important insect pests by name or damage symptoms on the different vegetable crops are presented in Figure 4. The proportion of farmers aware of the pest problems varied from one crop to another in the four countries, with tomato recording the highest number

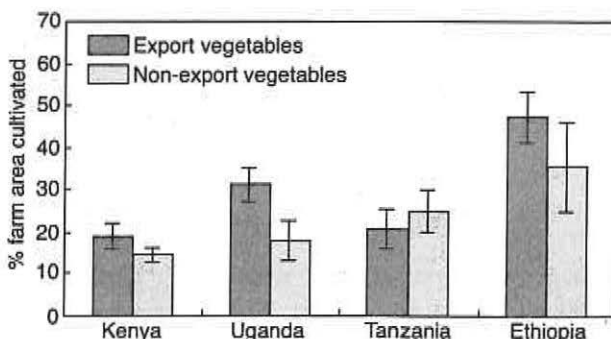


Figure 2. Relative area grown for export and non-export vegetables by sample farmers in four countries in eastern Africa (overall for four countries)

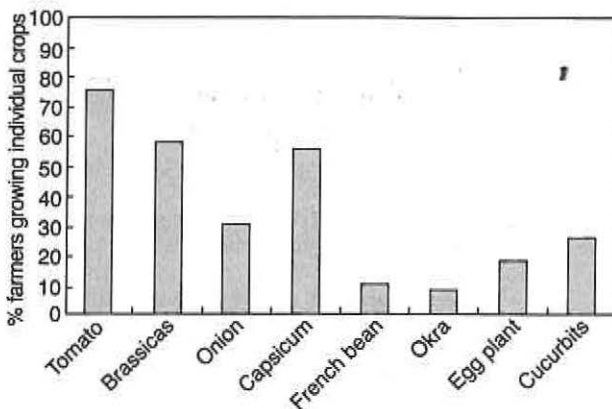


Figure 3. Percent sample farmers growing eight different vegetable crops in eastern Africa (overall of four countries)

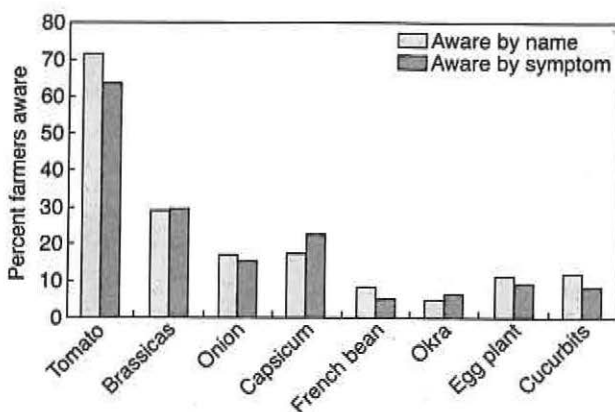


Figure 4. Farmers' awareness of insect pests on vegetable crops by name and by damage symptoms (over all for four countries)

of farmers with familiarity with its pest insects and damage symptoms. Over 70% of the farmers in Kenya, Tanzania and Ethiopia were aware of pest problems and damage symptoms in tomato, but this was only 40% for Uganda. Cabbage came second and capsicum third with some 20–30% of the respondents citing awareness of its insect and damage symptoms. Pest problems in onions, French bean, okra, eggplant and cucurbits were recognised by less than 20% of the farmers.

Bollworms, caterpillars and whiteflies were the frequently mentioned tomato pests in Kenya and Uganda. Aphids, the diamondback moth caterpillar and cutworms were cited as pests of cabbage by the majority of farmers in Kenya and Uganda. The majority listed bollworms, cutworms and aphids as pests of capsicum. Bollworms, thrips and spider mites were mostly mentioned as pests of French bean in Kenya, whereas

in Uganda the pests frequently associated with this crop were aphids and thrips. Pests of onions, eggplant, okra and cucurbits and their damage symptoms were the least recognised.

Farmers' recognition of the symptoms and names of diseases also varied among the countries. On the average, awareness of diseases was highest for tomato (71%) and lowest for okra (5%) (Figure 5). Some 82, 41, 86 and 73% of the farmers in Kenya, Uganda, Tanzania and Ethiopia, respectively, were acquainted with the disease problems of tomato, but this was

less than 40% of the respondents in each country for the other crops.

Blight was mentioned by the majority (55–84%) as a tomato disease in Kenya and Uganda. A smaller proportion of farmers also mentioned bacterial wilt and root rot. Among the diseases of cabbage, black rot was mentioned most frequently in both Kenya and Uganda.

Farmers' perception of extent of yield loss caused by pests and diseases

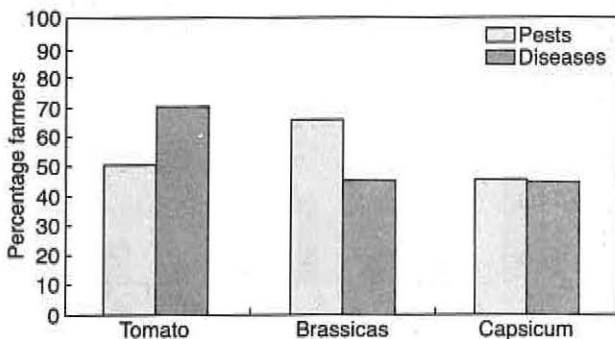


Figure 6. Proportion of farmers perceiving more than 50% loss in yield in three vegetable crops in eastern Africa (overall for four countries)

Farmers' overall perception of the extent of crop loss due to insect pests and diseases varied among the vegetable crops. Some 50, 60 and 40% of the tomato growers in Kenya, Tanzania and Uganda, respectively, reported having lost up to 50% of their tomato crop yield to insect pests (Figure 6). For cabbage, between 44 and 88% of the farmers reported losses of 50% or more, and for capsicum 26–84% reported similar loss levels. Over 50% of the farmers said that they had lost more than half of their tomato yield to diseases. Farmers' loss estimates for

cabbage were higher (> 50%) in Kenya than in Uganda and Tanzania, while loss estimates for capsicum were higher in Tanzania than in Kenya and Uganda.

Discussion and conclusions

The pilot survey broadly assessed the sample farmers' profile, their knowledge of the pests and diseases of the vegetable crops and their level of awareness of pests and diseases as constraints to vegetable production. The farmers sampled were predominantly literate, but most had up to primary level of education. They were predominantly men, mostly aged between 30 and 40 years. Further, they cultivated vegetables on less than 0.5 ha of land.

The results indicate that tomato, cabbage and capsicum were the most popular vegetables grown by smallholder farmers in the study areas. Distinctly more farmers appeared to be aware of insect pests and disease problems of tomato than of cabbage or capsicum. The number of farmers who recognised the insect pests and diseases by name was greater than those who could recognise the disease symptoms. This trend pointed to the need for suitable training to build the capacity of farmers to identify the common insect pest and disease problems on their crops. Further, this finding should help correct the commonly prevailing assumption among IPM promotion agencies that all farmers can recognise their pest and disease problems. There is therefore no reason for these agencies to limit their IPM awareness building activities on improved IPM practices. In addition, the local names of pests and diseases must be harmonised with the common names cited in the literature, and the training materials should include not only the pictures of life stages of pests or diseases but also their damage symptoms. The insect pests and diseases recognised by farmers were among those commonly reported in the literature (Bohlen, 1973). Bollworms and blight on tomato; aphids, the diamondback moth and root rot on cabbage; and caterpillars, fruit flies, bollworms and blight on capsicum are already recognised as major pests in East Africa (Bohlen, 1973; Hill, 1983; Hill and Waller, 1994).

In three crops, farmers' perception of the extent of the loss in yield due to pests was in general comparable to the available research results on the scale of the problem. Studies conducted in Asia also show that vegetable farmers tend to recognise pests as the main constraint to achieving adequate crop yields (Heong, 1984; Joshi et al., 2001). The importance of pests and diseases as major sources of yield loss in most vegetable crops grown in Africa and the need for adequate research and extension input to empower farmers to monitor them in their crops were recognised in an FAO seminar held in 1992 in Senegal on IPM needs for vegetable crops in Africa (Ikin et al., 1993).

The survey helped in identifying the gaps in IPM related awareness and knowledge among the sampled farmers. This information will be invaluable in developing an appropriate adaptive research agenda and in planning suitable training initiatives for the management of pests of vegetable crops in the region. Implementation of IPM approaches has been successful not only where the target crop is cultivated over a wide area (Morse and Buhler, 1997) but also where farmers recognise the pest problem as a production constraint (Norton and Mumford, 1983; Trumble, 1998; Heong and Escalada, 1999). Where there is a substantial gap in farmers' knowledge of pest and disease problems of vegetable crops, for example for okra, eggplant and cucurbits, introduction of IPM would need to be preceded by building farmers' capacity to correctly identify the pest and disease problems.

In addition to the perceived importance of the pest and disease problems, the education level of the farmers and the area of land grown to crops may be factors to be considered in IPM promotion initiatives. Similar observations have been made elsewhere among smallholder farmers growing different crops (Joshi et al.,

2001; Van Mele et al., 2001). Interest and ability of farmers to protect their crops against pests and diseases are known to be intrinsically linked to their sociopersonal circumstances (Dent, 1991; Heong and Escalada, 1999).

This study provided a basis for understanding the need to include capacity building in IPM awareness activities for vegetable crops, to ensure correct identification of the common pests and diseases. The rationale for focusing the project activities on the vegetables for which most farmers perceived substantial yield loss from pests and diseases such as tomato, brassicas and capsicum was also based on the results of this survey.

This baseline study was useful in measuring the impact of IPM programmes on the awareness and perception status of the beneficiary farmers. Although this study was limited to one vegetable growing district per country, these results may apply broadly to the majority of vegetable farmers in the target countries in eastern Africa.

Farmers' crop protection needs and practices

Introduction

Smallholder vegetable production for both local and export markets is expanding rapidly in sub-Saharan Africa (ICIPE, 1999; Sithanatham et al., 1999a, b; Sibanda et al., 2000). However, production of quality crops is constrained by pest and disease problems (Löhr and Michalik, 1995; Sithole and Chikwenhere, 1995; ICIPE, 1999; Sibanda et al., 2000; Matoka et al., 2001). In Ethiopia, pre-harvest losses in vegetable crops due to insects and diseases are reported to be as high as 39 and 48%, respectively (Abate, 1996).

While it is recognised that IPM options should be developed from farmers' traditional practices aiming to greatly improve the knowledge base (Herren, 1996), it is known that farmers tend to choose pest management options that appear to best meet their objectives based largely on their beliefs and attitudes towards damage and control (Bentley, 1989; Heong and Escalada, 1999).

The baseline survey also aimed at understanding farmers' pest control practices, especially their pesticide use patterns, their perception of the cost and safety aspects of pesticide use, and their perceived IPM information needs. Information was collected on the intensity of pesticide application and the quantities used, farmers' awareness on safety, cost of pesticide use and the sources of related technical information.

Results

Range of synthetic pesticides used

The vegetable farmers used a wide variety of chemical pesticides to control insect pests and plant diseases, with 89–100% of the respondents in each country using pesticides. Between five and nine different insecticides were used on vegetable crops in each country (Table 2). Organophosphates were the most popular types, accounting for 42% of all insecticides. The others were pyrethroids (25%), carbamates (25%) and organochlorines (8%). The numbers of farmers using individual products (Table 2) showed that metalaxyl plus mancozeb (27%) and mancozeb alone (25%) were the most frequently used among fungicides, while permethrin

(22%) and mercaptothion (21%) were the more common insecticides. Three of the insecticides—lambdacyhalothrin, carbofuran and endosulfan—belonged to WHO's toxicity class IB (hazardous chemicals). In addition, three to six fungicides were used in each country. Of these, chlorothalonil is classified as extremely hazardous (in WHO class IA).

Table 2. Insecticides and fungicides used by smallholder vegetable growers in eastern Africa

Pesticide group	Chemical name (trade name)	WHO toxicity class*	% farmers using
Organochlorines	Endosulfan (Thiodan)	IB	13
Organophosphates	Mercaptothion (Malathion)	II	21
	Dimethoate (Rogor)	II	11
	Diazinon (Diazinon)	II	8
	Chlorpyrifos (Dursban)	II	5
	Fenitrothion (Sumithion)	II	1
Carbamates	Carbofuran (Furadan)	IB	2
	Carbosulfan (Marshall)	II	1
Synthetic pyrethroids	Cypermethrin (Sherpa)	II	2
	Lambdacyhalothrin (Karate)	IB	19
	Bifenthrin (Brigade)	II	2
	Permethrin (Ambush)	II	22
Fungicides	Metalaxyl + mancozeb (Ridomil)	II	27
	Copper oxychloride (Green copper)	III	16
	Mancozeb (Dithane M 45)	IV	25
	Propineb (Antracol)	IV	6
	Propineb + cymoxanil (Milraz)	III	2
	Triademefon (Bayleton)	II	1
	Chlorothalonil (Daconil)	1A	2

WHO Toxicity classes: IA = extremely hazardous, IB = hazardous, II = moderately hazardous, III = slightly hazardous, IV = unlikely to be hazardous.

*Source: PAN (Pesticide Action Network) database: <http://data.pesticideinfo.org/>

Pesticide use intensity

The majority of farmers sprayed their crops 4–12 times in a single growing season. For tomato or capsicum, 20–79% of the farmers in the four countries sprayed more than nine times during a single growing season. Some 53–58% of the cabbage farmers sprayed more than nine times in a single season. Farmers used more than one range of pesticide dose (Figure 7). For instance, five different ranges of doses of Dithane were applied, while dimethoate and Ridomil dosages ranged from 1 to 4 g ai.

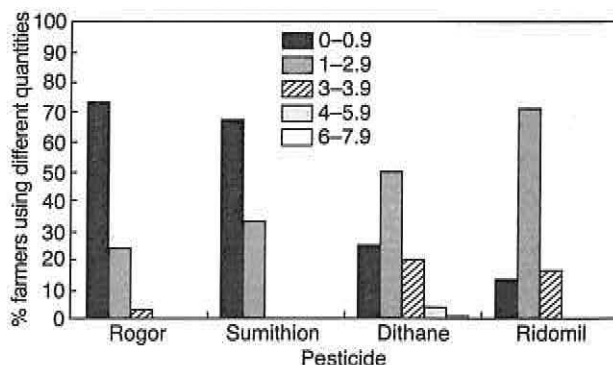


Figure 7. Proportion of vegetable farmers using different quantities of pesticides per spray tank (mg/ml for 15 litres) in three East African countries (Kenya, Tanzania, Uganda)

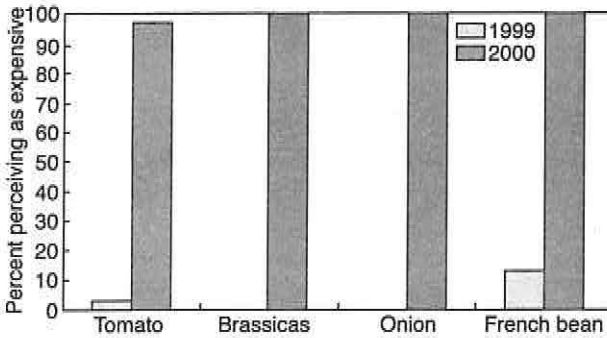


Figure 8. Overall trend in farmers' perception of 'expenses' of pest control comparing 'initially' and 'after three years' across four countries in eastern Africa

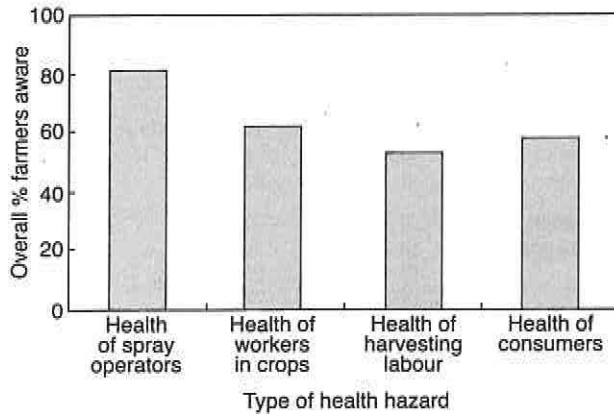


Figure 9. Extent of farmers awareness of the hazards associated with pesticide use in eastern Africa

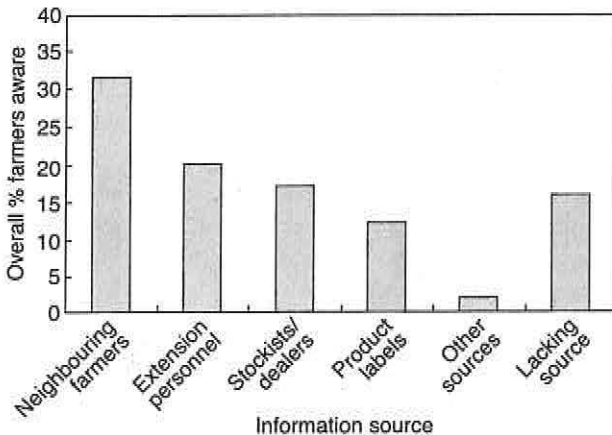


Figure 10. Sources of information on pesticide-based control locally available to smallholder vegetable farmers in eastern Africa

Farmers' perception of 'cost' of pesticide use

When the countries were considered together, the frequency of farmers saying that pesticides were expensive was significantly higher (likelihood ratio $\chi^2 = 36.8$, DF = 6, $P < 0.0001$) than of those who said they were not expensive or that they did not know. Farmers also perceived pesticide use as more expensive than it had been three years previously for all the vegetable crops (Figure 8). Up to 35% of the farmers believed that pesticides had become less effective (or the pests more resistant to pesticides) and that more applications were needed. Around 3 to 22% of the farmers attributed this to the quick increase in numbers of 'escaping' pests (resurgence).

Safety of pesticides for operators and consumers

The survey showed that most of the vegetable farmers were aware of the health hazards associated with pesticide use (Figure 9), with 71–95% of the respondents acknowledging knowledge of the health hazards associated with pesticide application, 30–80% of the hazards of working in pesticide-treated crops, and 48–70% of the hazards to consumers of produce of pesticide-treated crops. Farmers were also aware of pesticide residues in treated produce.

Farmers' information sources and perceived information needs

Generally, the major sources of information on pest control, especially pesticide use, for smallholder vegetable farmers were neighbouring farmers, extension personnel and pesticide stockists or dealers (Figure 10). Fellow farmers accounted for 32% of the information sources on pesticide use. Extension personnel accounted for only 20% of the information provided to the Ethiopian farmers.

The farmers recognised several information gaps on aspects of crop protection and production. For crop protection, information on choice of appropriate pesticides, correct identification of pests and correct method and doses of pesticide application was ranked as of priority (Table 3). Some 23% of the respondents ranked information on improved crop management practices as a priority need.

Discussion

The farmers use a wide variety of chemical pesticides to control insect pests and plant diseases on vegetable crops. Pesticide use has been reported to be widespread among smallholder vegetable farmers in other countries, for example Zimbabwe (Sibanda et al., 2000). Several sprays were applied every growing season. According to Nderitu et al. (1997) Kenyan farmers apply insecticides up to 15 times during a single cropping season for crops such as French bean.

The survey showed that the majority of vegetable farmers in the study area did not have adequate access to dependable sources of IPM related information, especially on the selection and appropriate dosage of pesticides. They mostly depended on neighbours and traders rather than extension officers for advice on pesticide use. According to the Pesticide Action Network, government agricultural extension services in countries like Uganda cannot provide adequate coverage or sufficient public information (PAN, 2000).

The survey also showed that most of the vegetable farmers were aware of the risks associated with pesticide use and the increasing cost of pesticide application. Therefore, there is need to strengthen farmers' access to technical information on appropriate and selective use of pesticides. Support and training that could encourage adoption of sustainable pest management practices by farmers through setting standards for residue levels, pricing and trade policies and effective regulation would help reduce environmental problems (Van Emden and Peakall, 1996). Training of farmers to empower them in decision making is a powerful tool in reducing pesticide dependence. The survey results confirmed the target farmers' need for guidance and training in IPM for vegetable crops.

Table 3. Need for crop protection and production information among smallholder vegetable growers

Information area	% of farmers per crop
Improved crop management practices	23
Appropriate choice of pesticides	18
Pest identification guidance	17
Pesticide application and dosages	15
Safe handling of pesticides	12
Source of quality seeds	10
'Dependable' sources of pesticides	8
Fertiliser application practices	7
Safer alternatives to pesticides	6
Record keeping on pest control	5
Crop rotation practices	4

FARMER-PARTICIPATORY IPM AWARENESS BUILDING ACTIVITIES

Most NARES in Africa are currently focusing on conservation and effective use of natural resources such as land and water as key elements in sustainable agricultural development. Intensive crop production systems based on supplementary irrigation tend to favour the build-up of pests. As a consequence, farmers often resort to unilateral, and often excessive, use of chemical pesticides. Indiscriminate pesticide use leads to pest problems such as resurgence, caused by destruction of the natural enemies and/or development of pesticide resistance within the pest populations (Sithanantham et al., 2002). Farmers are largely unaware of these limitations but realise that pesticide use becomes unaffordable over time, as either larger quantities or more frequent applications of pesticides become necessary to achieve satisfactory control. This renders pesticide-dependent control unsustainable both economically and ecologically. IPM, which focuses on rational use of pesticides or safer alternatives to pesticides, offers hope for African farmers as a means of sustainable crop protection and production (Kiss and Meerman, 1991; Sithanantham et al., 2002).

The task of creating IPM awareness among the multitude of needy farmers is challenging, since IPM is highly information intensive and so requires a fairly intensive farmer-extensionist contact for satisfactory implementation (Sithanantham and Matoka, 2001b). There is need for deployment of appropriately trained human resources at different levels, along with a self-sustaining system of access to IPM information by farmers at the grassroots.

Strengthening the research-extension-farmer linkages is a very important prerequisite for IPM awareness building among vegetable farmers in Africa (Ikin et al., 1993). The national agricultural research and extension institutions in eastern Africa at present have limited capacity to support the training of trainers in IPM awareness. Further, there is need to evolve more sustainable models to cope with the information load to be accessed at the grassroots for IPM promotion among smallholder farmers. Since the ratio of frontline extensionists to farmers in eastern Africa mostly ranges from 1:2000 to 1:4000, farmers' training should inevitably resort to group approaches to enhance access of IPM information from frontline extensionists. ICIPE's experience in IPM awareness building among smallholder farmers in cereal-based (Chitere et al., 1994) and vegetable-based cropping systems (Ogututu et al., 1999) in Kenya has shown that the group learning approach featuring a 'multi-season' IPM awareness building programme and the training of farmers' cadre trainers could help enhance the sustainability of FFS group activities at the grassroots (Sithanantham et al., 2001c). The experience gained in the present initiative in improving the IPM awareness building capacity at the grassroots is the focus of this section.

Focus of the IPM network

The model farmers' groups consisted of smallholder vegetable farmers, each with 15–25 members living in the same neighbourhood, who opted to participate in the stepwise IPM awareness building activities facilitated by two to three among

them, who were first trained as farmers' cadre trainers. There were two to four model farmers' groups per country involved in the IPM awareness participatory activities (Table 4). They also evaluated the potential for adopting such a group learning approach as a means of sustainable IPM empowerment at the grassroots devoid of dependence on external support (Sithanantham et al., 2001e,f).

Table 4. Details of smallholder vegetable farmers' groups participating in the vegetable IPM project's awareness building activities

Country	Farmers' group	Number of participating farmers in a group		
		Men	Women	Total
Ethiopia	1. Wonji	17	0	17
	2. Kuriftu	16	1	17
Kenya	1. Mothers Choice	3	14	17
	2. Ngoliba Mwangaza	10	5	15
	3. Kitoboto Women	0	24	24
	4. Chania River	6	9	15
Tanzania	1. Nduruma	19	5	24
	2. Ambureni-Moivaro	15	0	15
	3. Manyire	12	3	15
	4. Oldonyowasi	21	2	23
Uganda	1. Namulonge	18	8	26
	2. Buwama	21	6	27
	3. Busaku	11	0	11
Overall		169	77	246

Main features of the IPM awareness building model

Training of farmers' cadre trainers

The farmers' cadre trainers were trained in a pre-season IPM orientation session at their nearest research station in each country. The training involved visits to field plots, demonstrations, discussions and practical sessions spread over two to four days. These farmers later served as facilitators in their respective farmers' groups during the IPM participatory learning sessions.

The training of farmers' cadre trainers was found cost-effective and highly sustainable, even with the usual minimal resource input. The process of electing the farmers' cadre trainers from the farmers' groups positively affected the attitude of other farmers towards the trainers during the training and in the eventual adoption of IPM options (Box 1).

Box 1: Special features of the improved FFS IPM awareness building model

- 'Electing' farmers' cadre trainers by the group and training them as locally based secondline extensionists to promote farmer-to-farmer extension;
- Adopting a stepwise approach to IPM awareness building, with initial emphasis on correct diagnosis of pest problems as a basis for seeking appropriate control interventions;
- Focusing on empowering farmers' groups to confidently evaluate IPM options in their common plots, so as to build local capacity for decision making on the adoption or refinement of IPM options.

Stepwise and need-based IPM empowerment of model groups

To build awareness on IPM and competence among farmers to evaluate IPM options on their own, the model groups participated in stepwise orientation to IPM over three successive cropping seasons, ranging from three to five months per season.

In the first season the common learning plot was planted with two to three crops of farmers' priority. The activities focused on correct identification of pests and natural enemies of these pests. Farmers also brought samples of pests or damaged plants from their own fields. The emphasis was on using the appropriate local names in identifying pests. In the same season, the farmers also learnt about rational and safe use of pesticides as well as how to scout for pests in their crops. Photo guides on pests were prepared in the local language and provided to the farmers to help them identify pest and disease problems.

In the second season the common plot was used for testing improved practices (based on either research recommendations or indigenous knowledge) as IPM options. During this season, farmers were also made aware of a range of promising IPM options from which each group identified one or two for group testing:

- Cultural practices: nursery solarisation (e.g. for tomato);
- Botanical products: e.g. neem products on cabbage or French bean;
- Pest tolerant varieties: e.g. tomato;
- Biocontrol product: e.g. *Bt* on cabbage or kale.

These technology options have been found promising as potential additions to the IPM menu. In addition, indigenous pest control practices such as botanical-based concoctions used against caterpillars or sucking pests were included in such on-farm tests. Farmers were involved in planning, monitoring and record keeping in these plots. At the end of the season they also discussed the observed benefits and limitations of the practice tested, and decided on whether to adopt, refine or repeat the evaluation.

In the third season farmers in each group were encouraged to adopt on their farms any of the IPM practices they had found useful based on the results of the common plot trial the previous season. They also tested in the common plot any additional IPM practice of their interest. Group learning sessions and exchange of experience continued even as farmers adopted the acceptable IPM practices.

Group learning sessions to cater for local needs in IPM awareness

The farmers' group learning sessions in each season were based on their priority crop or pest problems and information needs. Each group met in the farm of a volunteer farmer, who offered a small plot (as the common plot) for the joint learning sessions (farmers' field school). These sessions took place for one to three hours every two to three weeks, depending on the activities. The time of the day was chosen taking into account the farmers' need for time for their other farming operations.

Training of farmers' cadre trainers

Training of farmers' cadre trainers as secondline extensionists

Annual pre-season training was provided at the research station for the farmers' cadre trainers. Resource persons were drawn from the national research systems,

the ministry of agriculture in each country (extensionists) and the ICIPE project. The training covered topics chosen by the farmers and on promising technologies that had been tested on-station as potential additions to the IPM menu. Frontline extension staff from the ministry of agriculture were also trained concurrently with the farmers.

The training content was tuned to cater for the technical information needs or guidance needed for the following farmers' cadre trainers' group learning sessions. Pre- and post-training evaluation was conducted to assess the level of knowledge acquired in the training. The positive impact of the training on different theme areas was confirmed by the evaluation of results (Figure 11).

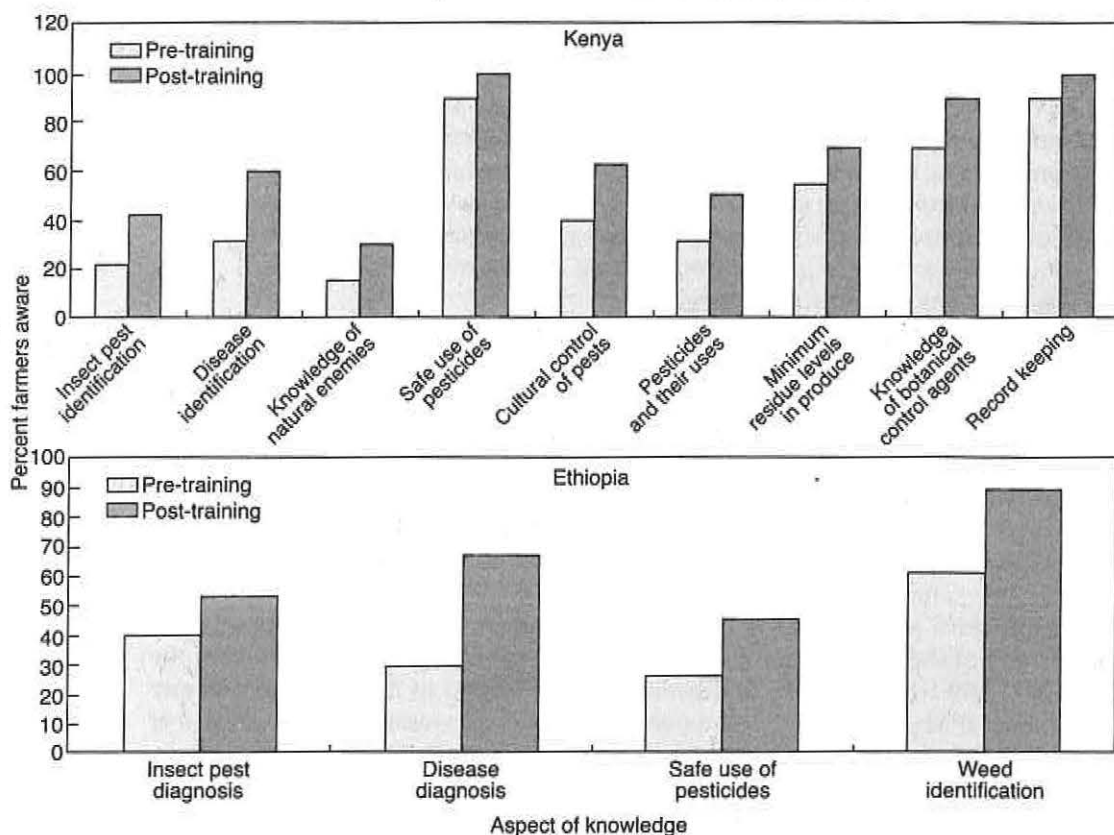


Figure 11. Knowledge status of farmers' cadre trainers relating to pest control before and after training 1999-2000, Kenya and Ethiopia

Training of farmers' cadre trainers in keeping farm records

Training in keeping farm records was an important aspect in empowering farmers to undertake joint on-farm trials. Farm records provided a valuable information source for making informed pest management decisions. The information recorded for each on-farm trial pertained to the crop variety grown, the cultivation operations carried out, the type and quantity of inputs used on the crop and the dates the activities were conducted. In addition, information on total marketable produce harvested under the treatment plots and the farm-gate price per unit quantity of produce were recorded. The group's opinion on the benefits and potential for adoption and sustainability of the IPM options was discussed. Based on the

data, the group collectively judged the extent of pest control achieved, the gain in marketable yield, profitability, ease of availability of inputs and ease of adoption of the IPM options.

Training of trainers in IPM FFS activities: Women's participation

The trainers' training focused on activities relating to the IPM awareness building model. Women were encouraged to participate as trainees in the farmers' cadre trainers' training. In Kenya, women constituted about 70% of the membership of the farmers' groups and more than 50% of the farmers' cadre trainers. Data on participation of women as trainers in different categories in the participating countries are summarised in Table 5.

Table 5. Trainers trained in IPM awareness by country and gender distribution

Country	Number of participants	Category of participants						% Women trained
		Farmers' cadre trainers		Frontline extensionists		Others (NGOs, CBOs)		
		Male	Female	Male	Female	Male	Female	
Ethiopia	14	4	1	3	2	3	1	29
Kenya	20	2	6	2	4	2	4	70
Uganda	16	3	2	2	4	3	2	50
Tanzania	18	4	3	3	3	3	2	44
Overall	68	13	12	10	13	11	9	50

Exchange of experiences during farmers' days

Farmers' days were held to provide an expanded forum for exchange of information and experiences on crop pest management in smallholder vegetable production for urban and export markets. In Kenya, such a day was held in June 2000 in Thika and included both participating and non-participating farmers, together with representatives of farmers and interested organisations or projects, and local coordinators from the other three partner countries (Tanzania, Ethiopia and Uganda). This provided an excellent opportunity to bring together stakeholders so as to develop a 'campaign' to wean farmers off dependence on pesticide use. It also was an opportunity for the farmers' cadre trainers to demonstrate their ability for the role of secondline extensionists, since they were encouraged to manage the stalls and to explain the technical aspects of the IPM options being tested on the farms.

The discussions were mostly in the local language (Kiswahili) to ensure adequate information sharing among the stakeholders. The day's activities were covered by the media (both electronic and print) to popularise the project by articulating its vision and future plans to the general public. The main objectives of the farmers' day were:

- To facilitate participating farmers' groups to meet or visit other farmers' groups to exchange ideas and experiences;
- To facilitate interaction of farmers with other stakeholders to share information on vegetable crop protection, production and marketing;
- To explain the features of the farmer-participatory IPM awareness building models.

Monitoring of farmers' attitudinal change and adoption of IPM options

On-farm adoption of the IPM practices among the participating farmers was expected to be high, since they had been involved in the joint testing of the options in the common plots, had gained competence and skills in the practices and had seen their benefits.

The assessment of the extent of the model's enhancement of the participating farmers' confidence in IPM options and of their attitudinal change towards adoption of these options was made through administering a standard survey questionnaire in the partner countries. The stepwise introduction of the improved IPM themes over the three years of group learning had ensured that the participating farmers' groups were familiar with the contents and themes of the group learning model

intended to enhance the sustainability of IPM awareness and adoption at the grassroots.

The survey also revealed that the awareness of non-participating farmers on safer pest control alternatives was enhanced, and a few of them even attempted adopting the practices.

The impact on the participating farmers was assessed based on the extent to which the project's activities enhanced or influenced their use of improved IPM methods. Overall, there was a high proportion of adopters of four technologies: botanical products, biocontrol products, tolerant varieties and nursery health (Figure 12). The country-wide scenario of adoption of one of the practices—botanical products—showed a consistent trend of adoption in the four countries (Figure 13). Farmers' rational and need-based pesticide use could be expected to reduce their crop protection costs by at least two sprays, which would also lessen the pesticide load on the produce and the adverse effects on the environment. The farmers said that their improved understanding of the vegetable production guidelines and pest management options through their interaction with the farmers' cadre

trainers had greatly helped reduce their dependence on frontline extension personnel for IPM information and guidance.

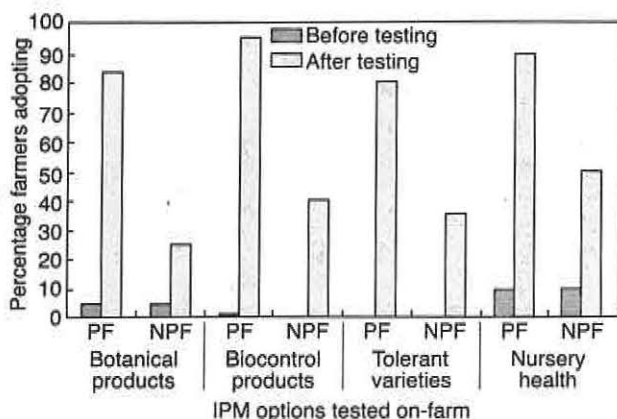


Figure 12. Overall impact of the IPM options tested in on-farm plots on the adoption levels among participating (PF) and non-participating farmers (NPF), 2001 (mean of four countries)

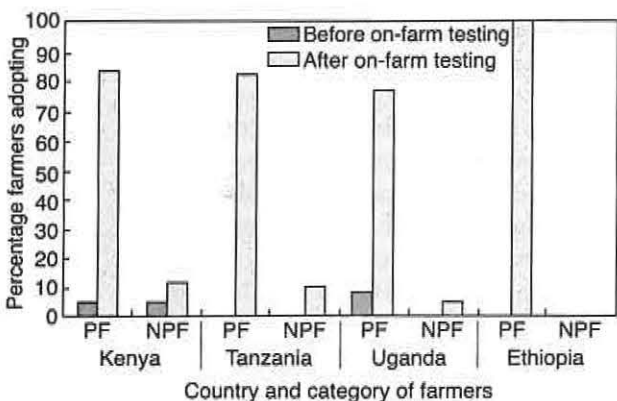


Figure 13. Levels of adoption of an improved IPM option (use of botanicals) among farmers in the four countries, 2001. PF = participating farmers, NPF = non-participating farmers

The participating farmers' groups generally benefited from the IPM awareness building activities. For example, four model groups of vegetable farmers in Thika

District confirmed having gained competence in identifying the pests by their correct local names and in testing improved pest control options jointly in a common plot. By the third year, 95% of them had adopted improved nursery management, 70% were planting pest-tolerant varieties, 65% were using botanical products such as neem, and 40% were using biological control products like *Bt*. It is expected that these farmers will reduce their chemical pesticide use by at least 20–25%. With a conservative estimate, a reduction by 2 from the usual 8–10 pesticide applications per crop season would result in substantial economic benefits, besides the reduction in the risk of pesticide residues and the conservation of beneficial fauna providing agroecosystem services.

Assessment of sustainability of the FFS model

The potential of the FFS model evolved in the project for sustainability was also assessed by all the stakeholders (researchers, extensionists and farmers). They all found the approach favourable and expressed interest in using it. The national researchers and extensionists participating in the evaluation of this model in the four countries expressed confidence in its sustainability and its potential future use in reaching many farmers in the effort to disseminate technologies to target groups.

Individual interviews with participating farmers and extensionists at the end of the third season confirmed their keen interest in sustaining the group learning activities on their own, especially since farmer-to-farmer extension is being promoted to enable the exchange of experiences within and between groups. The farmers perceived the model as a viable and affordable 'self-help' strategy for access of IPM knowledge at the grassroots, without depending on external support (Box 2).

Box 2: Stakeholders' evaluation of sustainability and potential impact of the fortified IPM awareness building FFS model at the grassroots level

- All participating farmers and frontline extensionists perceived the improved IPM awareness building model as potentially self-sustaining and effective for promoting farmer-to-farmer extension;
- Participating farmers confirmed acquiring confidence in correctly identifying the key pest problems on their target vegetable crops and in using appropriate local names;
- IPM model farmers developed confidence in the improved pest control options, and their adoption of IPM practices provided motivation for other farmers in the community to adopt the IPM practices.

This IPM awareness building model could be extended to farmers in other parts of eastern Africa through suitable training of IPM trainers. Training of such trainers at national, regional, district and village levels could provide the basis for accomplishing the multiplier effect over time and space (Sithanatham et al., 2001d). The training activities could be built into the existing research–extension–training infrastructure, so as to be self-sustaining after initial support to develop IPM training programmes and materials has been provided (Sithanatham et al., 2003).

Farmers' group learning activities

During the training sessions the farmers were trained to correctly identify the common pest and disease problems. Specimens exhibiting different symptoms of

pest or disease damage were used in verifying the identification capacity of the farmers. Periodic visits from IPM panel members or resource persons enabled farmers to discuss issues relating to crop pests and diseases. The learning sessions were programmed to focus on important crops and related management practices.

IPM and related topics covered in different FFS sessions included:

- Identification of important pests and diseases by name and symptoms;
- Identification and counting of natural enemies, such as predators;
- Nursery health improvement, for example by solarisation;
- Safety guidelines for handling and applying pesticides;
- Adoption of 'waiting periods' to minimise or avoid pesticide residues in produce;
- Use of biocontrol products (e.g. *Bt*);
- Use of botanical products such as neem products;
- Use of crop rotation and other cultural practices;
- Preparation and use of farm compost;
- Marketing information and assistance;
- Post-harvest processing and handling of surplus vegetable products;
- Use of indigenous pest-control techniques;
- Farmers' record keeping for on-farm trials;
- On-farm trial design and monitoring guidelines.

On-farm testing of indigenous and improved practices by farmers' groups

The IPM options tested for the important vegetables included:

- Tomato (fruit borer): use of pest tolerant varieties (Ethiopia);
- Tomato (soil pathogens): soil solarisation for nursery health (Tanzania and Kenya);
- Cabbage (caterpillars): use of biocontrol (*Bt*) products (Kenya and Uganda);
- Cabbage (caterpillars, aphids): use of botanical (neem) products (Kenya, Uganda, Tanzania and Ethiopia);
- Onion (thrips): use of botanical (neem) products (Ethiopia);
- Watermelon (fruit fly): 'bagging' of young fruits (Tanzania).

The promising indigenous and local practices tested on the farms by farmers' groups were:

- Use of local concoctions (mixing chilli powder and local plant extract with soap powder) for aphids and caterpillars, for cabbage (Kenya);
- Covering young watermelon fruits with soil for protection from fruit fly infestation (Tanzania);
- Use of cow urine or slurry to control caterpillars and aphids for cabbage (Tanzania).

During testing of the IPM options, monitoring of progress and problems was ensured through periodic visits by IPM panel members. The farmers were also trained to keep simple and basic farm records. They learned to compile, analyse and summarise data and to evaluate the benefits of the technology. Some of the examples of IPM options tested and their outcomes are:

- **Management of damping-off by solarisation in tomato nurseries:** Damping-off is one of the most important vegetable production constraints, especially during the seedling stage in tomato and pepper. Solarisation of the nursery was identified as the IPM option to control this problem. The farmers' groups evaluated solarised and non-solarised nursery beds in their common plots. The beds were solarised for a month using black polythene sheeting. The seeds were sown during the onset of the rains in early July, which is known to be the usual period when damping-off occurs. The farmers scored the seedlings for vigour and damping-off. In the trial at Wonji in Ethiopia, the solarised beds had distinctly higher seedling establishment than the non-solarised beds, which were severely attacked by damping-off (Figure 14) in addition to suffering infestation by various types of weeds.

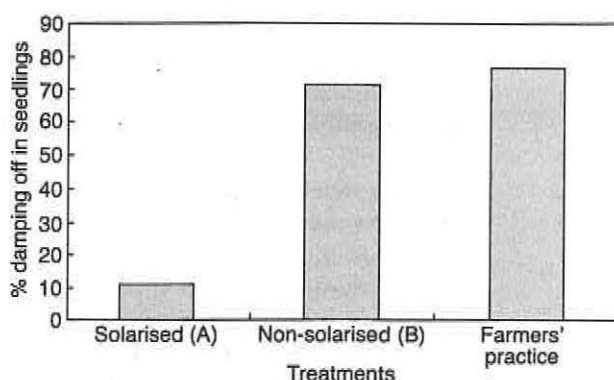


Figure 14. Performance of 'soil solarisation' against tomato seedling 'damping off' in on-farm nursery at Wonji, Ethiopia, 2001

- **Testing of disease-tolerant tomato varieties for late blight management:** Five tomato varieties four of which were tolerant to late blight, and one local variety were evaluated in on-farm tests in Korifitu, Ethiopia, for late blight caused by *Phytophthora infestans*. The traits evaluated were disease reaction and yield potential. The tests were conducted during the rainy season (July–September), which is conducive to development of late blight. Marglobe, the local variety, was found extremely susceptible and so was not preferred by the tomato growers. The farmers identified two tolerant varieties Tengeru 97 and Melkashola as promising, based on resistance to late blight and yield potential (Figure 15).

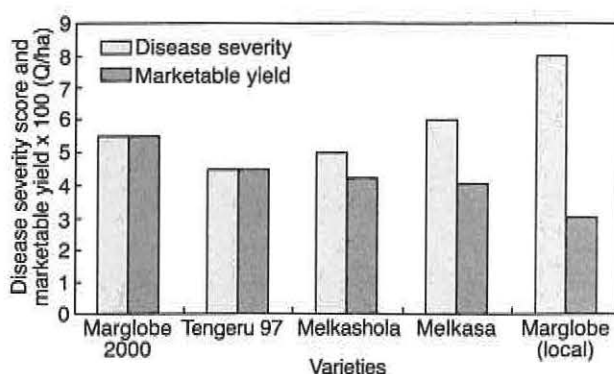


Figure 15. Performance of disease-tolerant tomato varieties tested on-farm at Korifitu, Ethiopia, 2001

- **Testing of botanical products for aphid and thrips control on French bean:** An on-farm trial conducted by the Kitoboto farmers' group in Thika, Kenya, evaluated the potential of botanicals in the management of aphids and thrips on beans. It was found that the neem products satisfactorily reduced thrips infestation. A similar field trial to test neem products was conducted by the Ngoliba farmers' group near Thika for the control of thrips in French bean. The results showed significant yield improvement in crops sprayed with neem compared with unsprayed crops. The plots in which neem was applied had a significantly lower thrips count than did the control (no spray) or those treated with local concoctions.

Details of the participating farmers' groups

In total 246 smallholder vegetable farmers in 13 groups, including 77 women, participated in the activities across the four countries. A list of the participating farmers' groups and their composition is furnished in Table 4.

Conclusions

Considerable attention is presently being given to filling of research gaps in the development of IPM options for vegetable crops and to effective dissemination of

IPM knowledge among the practitioners and farmers of Africa. The IPM awareness building models for the grassroots level currently being developed under the IPM Network Initiative in Eastern Africa appear promising, as they are not dependent on substantial external support. They offer good potential for adoption by most African countries after suitable adaptation to local needs. The strategy of creating a multiplier effect for IPM awareness, based on stepwise training in IPM backed by capacity building to produce relevant IPM training materials, offers a sustainable approach for promoting IPM adoption among smallholder farmers in Africa. The model evolved in this initiative could fortify ongoing and future initiatives for popularising IPM in Africa through the FFS approach.

NATIONAL RESEARCH CAPACITY BUILDING FOR DEVELOPING AND REFINING IPM OPTIONS

The twin objectives of building IPM research capacity in the partner countries and filling of gaps in IPM technology research were achieved through selected PhD or MSc research training projects (see Annex C for list of researchers trained). This section provides illustrations of the outcomes of these projects.

Use of biological control products

Use of NPV as a biocontrol product for pod borer (*Helicoverpa armigera*)

One of the capacity-building projects under this initiative is aimed at assembling native accessions (strains) of a well-known insect virus, nuclear polyhedrosis virus (NPV) and evaluating its potential for use in biocontrol of the African bollworm, *Helicoverpa armigera*. The bollworm is a damaging fruit borer on tomato, capsicum and okra and a pod borer on French bean, snow pea and pigeon pea. Ten accessions of the native NPV were assembled in a survey in different locations in Kenya (Figure 16). Based on larval mortality in bioassays, one promising strain (K-1) was identified and characterised as the single nucleocapsid subtype (SNPV) (Baya et al., 2001) (Figure 17).

Field-testing of NPV was conducted in collaboration with ICRISAT on pigeon pea at the Kiboko KARI centre in Kenya. The locally assembled NPV strain was evaluated as a spray for controlling the pod borer. A synthetic insecticide spray and a no-spray check were used as comparison treatments. The NPV treatment resulted in about a 40–55% reduction in pod damage, about 60–70% reduction in seed damage and an improvement in grain yield of 67% over the no-spray plots. In one of the trials, the yields in NPV plots were at par with those sprayed with Endosulfan, the synthetic insecticide

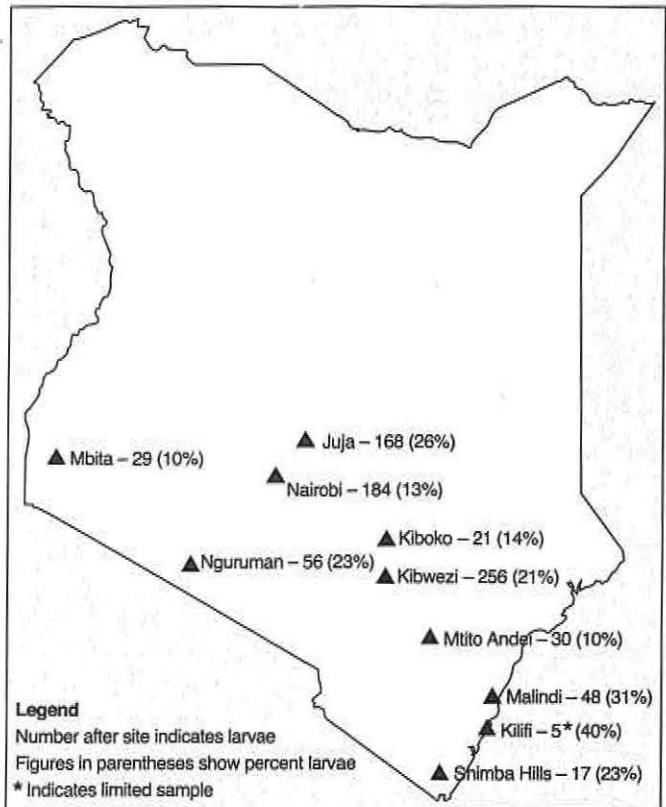


Figure 16. Results of survey on natural occurrence of Nuclear Polyhedrosis Virus (NPV) on *Helicoverpa armigera* at various sites in Kenya

(Minja et al., 2003). This activity made it possible to develop a biocontrol alternative to IPM. The results indicated the potential usefulness of a locally available bioagent

whose application could be extended to other vegetable crops in the eastern Africa region, such as tomato and chillies.

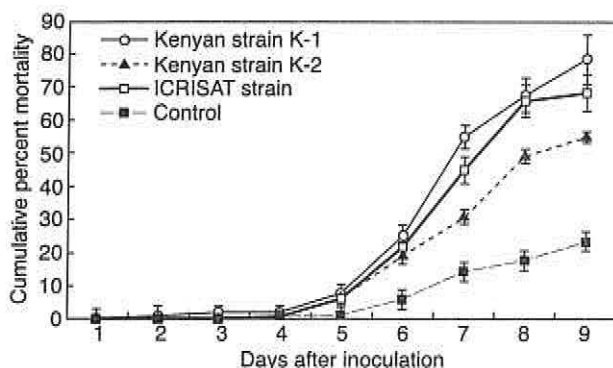


Figure 17. Cumulative percent mortality of *Helicoverpa armigera* larvae comparing two Kenyan and ICRISAT HaNPV strains in bioassays

Assessing the potential for egg parasitoids

Another capacity-building project focused on exploring the potential of another biocontrol agent, *Trichogramma*. This minute wasp is already used for suppressing a range of caterpillar pests on over 10 million ha globally (Li-Ying, 1994). A status paper on the potential of this agent in Africa has been prepared by Sithanatham et al. (2001a). A survey

of native *Trichogramma* in Kenya showed the occurrence of two major species, *Trichogramma* sp. nr. *mwanzai* and *Trichogrammatoidea* sp. nr. *lutea* (Abera et al., 2000, 2001). The temperature responses of these species were also studied (Abera et al., 2002a,b). Promising strains of the native trichogrammatid species were identified and retained for future use in the ICIPE *Trichogramma* gene bank.

Use of neem products for pest control

Capacity-building projects were undertaken to establish the potential of locally available neem products to control thrips in French bean (Gathu, 2000) and the major pests of okra, capsicum (Muchemi, 2000) and cucurbits (Matoka, 2001). The biosafety of neem sprays on the larval parasitoids of the diamondback moth, *Plutella xylostella*, was assessed in a capacity building project (Akol et al., 2001). This study confirmed the overall safety of neem on the parasitoid but indicated the disparity in sensitivity of some parasitoids to different neem products.

Assembling indigenous knowledge

Indigenous knowledge on the potential of cultural practices to reduce pest severity on vegetable crops was assembled with the goal of finding alternative cultural and indigenous pest-control strategies. The benefits to farmers from such practices include reduction in pest population, provision of nutrients to the vegetable crop and reduction of input costs. The following cultural practices were found to be common among the vegetable farmers in all the four countries:

- Most farmers are familiar with **crop rotation**; however, the reasons for rotation were mainly for soil fertility improvement and to meet farmers' income or food needs. Pest control was a minor reason. Rotations are often thought to prevent across-season carryover of pests.
- Although **destruction of volunteer crops and crop residues** is routinely done to remove weeds, it is recognised by some farmers as contributing to the reduction of breeding and spreading of pests. For example, levels of brassica pests like diamondback moth and aphids are known to be lowered by these practices.

Covering young watermelon fruits on the ground with soil when they are about the size of a table tennis ball protects them from damage by melon flies (fruit flies). This is common among watermelon farmers in Nduruma, Tanzania.

Guard or border crops (such as zucchini) act as trap crops to reduce the severity of melon flies in sweet melon. Melon flies seem to prefer zucchini to sweet melon. Planting sweet melon or watermelon in the irrigation furrow and allowing the vines to spread on the raised beds reduces fruit rotting. Planting on ridges reduces root rot in capsicum and chillies.

Use of farm manure is believed to encourage healthy growth of plants, which enables them to withstand damage or loss from pests or diseases. For instance, providing adequate organic manure to tomatoes is known to reduce early blight attack.

Identifying promising cultural practices (companion crops) or pest control

Rude leaf extracts of the indigenous leafy vegetable *Cleome (Gynandropsis) gynandra* have been reported as useful in reducing pest infestation when applied as a spray. A follow-up field trial at Mbita in Kenya had shown that a *Cleome*-French bean intercrop offered distinctly lower infestation by flower thrips than would a French bean monocrop. Based on the results of that study further research was initiated to find out how indigenous leafy vegetables could reduce pest infestation when intercropped or planted as companion crops, through the 'push-pull' or 'repellent-attractant' approach (Raini, 2002; Sithanatham et al., 201d). The results of these studies under 70 capacity building projects (Figure 18) showed that *G. gynandra* and coriander could help reduce infestation by diamondback moth (*Plutella xylostella*) when planted as intercrops in cabbage.

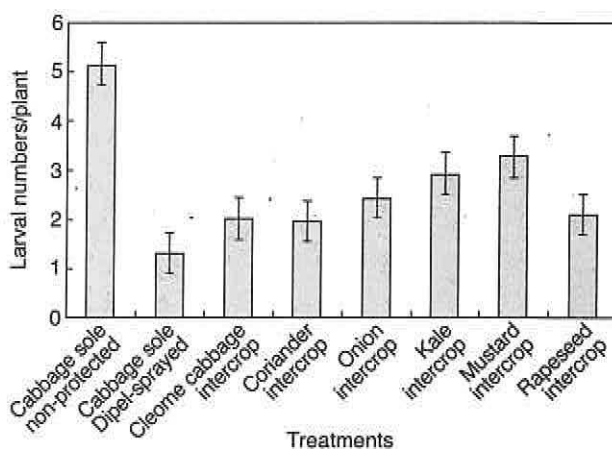


Figure 18. Mean Diamondback moth larval infestation in cabbage with intercrops, Juja, Kenya, 2002

Testing of non-chemical pest control products for onion thrips control

Non-chemical pest control products were evaluated for control of onion thrips at the request of the NARES partners. Exploratory field trials testing naturalyte (Tracer/Spinosad) and a petroleum product (DC Tron Plus) were conducted at two sites in collaboration with the NARES in Kenya. The fungal metabolite (Tracer/Spinosad) was found to adequately protect onions from thrips (Figure 19).

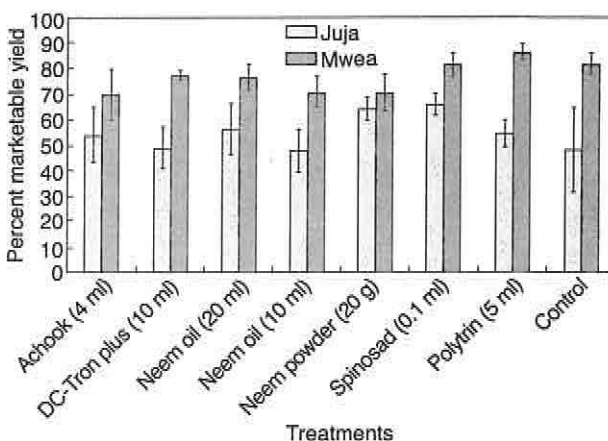


Figure 19. Effect of improved alternatives for thrips in onion on marketable yield in two sites in Kenya, 2000-2001

Assessing the pest spectrum of Asian export vegetables

Studies resulted in the documentation for the first time of the full pest spectrum on Asian export vegetables and estimates of the extent of the losses due to pest on these crops. This provided useful baseline information for further research to develop suitable pest management technologies for these high-value vegetable crops (Muchemi, 2000; Matoka, 2001).

INFORMATION DISSEMINATION AND COLLABORATION

Preparation and distribution of local language bulletins for farmers on IPM options

Local language bulletins

To provide information to a larger group of farmers in each country, local language handouts were prepared jointly by ICIPE and NARES partners on important IPM options. Use of the local language enhances the transfer of IPM knowledge and technologies, since it facilitates understanding of instructions and builds keen interest in the application of the technology. The technology bulletins were prepared in Amharic in Ethiopia and in Kiswahili in Kenya and Tanzania. In special circumstances, translations were made in the farmers' native language such as Kamba and Kikuyu in Kenya and Luganda in Uganda. A list of the titles of bulletins prepared in the local languages is provided in Annex D.

Illustrated pest identification guide

To facilitate correct pest identification by farmers and farmers' cadre trainers, guides using Kiswahili names of pests and diseases were developed and distributed jointly by the Kenya Agricultural Research Institute (KARI) and ICIPE in Kenya.

Preparing and distributing technical advisory notes on IPM options and awareness building model

Three important technical advisory notes (TANs) were developed by the project, covering:

- Development of an improved model for IPM awareness building among smallholder vegetable farmers in eastern Africa;
- Soil solarisation for improving vegetable nursery health;
- Potential for utilising pest-tolerant varieties of tomato in the eastern Africa region.

Details on these notes are provided in Annex E.

Collaborative linkages

Other projects collaborating with the IPM export vegetable project included the Fresh Produce Exporters' Association of Kenya (FPEAK), which also linked farmers and exporters through offering information and services on vegetables produced for export. In Uganda, the Investment in Development of Export Agriculture (IDEA) project funded by USAID-Uganda collaborated with the IPM project by assisting farmers with market information and related services. The Horticultural Crops Development Authority (HCDA) in Kenya, a governmental body promoting the growing of

horticultural crops, also worked with the IPM project. The Kenya Plant Health Inspectorate Service (KEPHIS), which deals with quarantine issues to ascertain the quality of imported or exported plant materials, especially seeds, maintained close links with the IPM project in training. To enhance the role of collaborators, an IPM orientation workshop for IFAD managers was held (Annex F).

FAO representatives helped to strengthen FFS activities in Kenya, Uganda and Tanzania. Collaboration with universities [Makerere in Uganda, the Jomo Kenyatta University of Agriculture and Technology (JKUAT) in Kenya, and Addis Ababa University in Ethiopia] enabled the broadening and ensured the suitability of IPM options developed for adoption. The partnership with the Asian Vegetable Research and Development Centre (AVRDC)'s African Regional Programme (ARP) based in Arusha, Tanzania, provided complementarity in issues relating to improved vegetable crop varieties such as okra varieties from India and the two high yielding tomato varieties in the region.

IPM awareness planning input for Eritrea

Special input was provided for IPM awareness building planning in Eritrea, on invitation of the Ministry of Agriculture, Eritrea, building upon an earlier consultancy on IPM research priorities for vegetable crops (Sithanatham, 1999). The project hosted two training courses for four senior extension officials from Eritrea as master trainers in preparation for IPM awareness building activities among smallholder farmers (Sithanatham and Matoka, 2000) and offered training at different levels on adoption of the farmers' group learning model. The recommendations from these activities are illustrated in Annex G (Sithanatham and Matoka, 2001a; Sithanatham et al., 2001c, d). These recommendations led to evolving a stepwise strategy for IPM awareness creation at the grassroots in the five provinces (zobas) in the country (Annex H). A week-long workshop was held after this training (Annex I), which focused on IPM awareness planning at the provincial, district and village levels (Sithanatham et al., 2001c).

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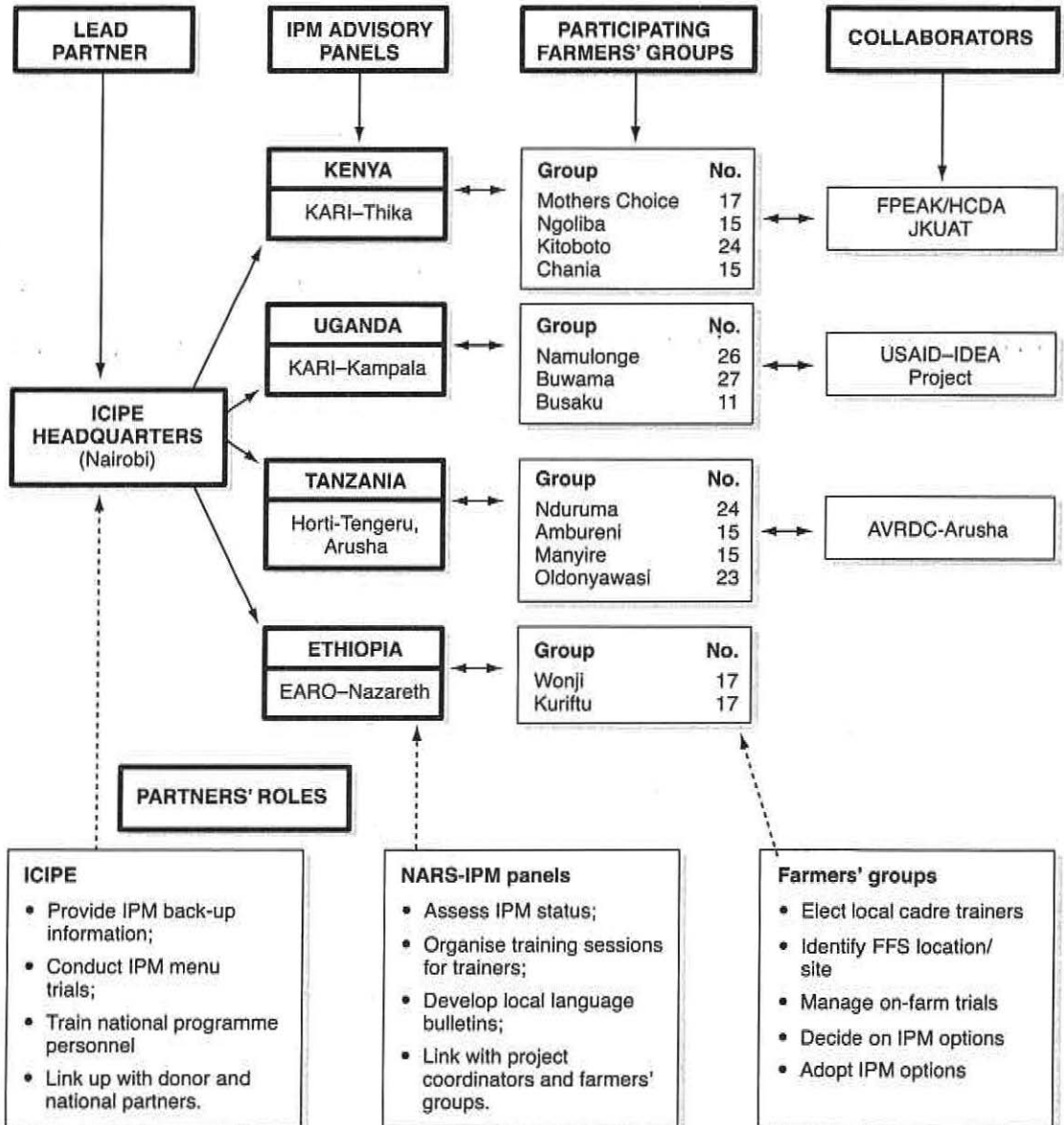
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IPM PROJECT PARTNERS



KARI: Thika, Kenya Agricultural Research Institute;
 KARI: Kampala, Kawanda Agricultural Research Institute;
 EARO: Ethiopian Agricultural Research Organization

MEMBERS OF IPM ADVISORY PANELS IN PARTNER COUNTRIES, 2000/2001

Ethiopia

- Mr Mohamed Yesuf, *pathologist, EARO (local coordinator).*
- Dr Lemma Dessalegne, *breeder/team leader.*
- Dr Giref Sahle, *weed scientist, EARO.*
- Dr Aberra Deressa, *extension linkage specialist/centre director.*
- Mr Lidet Setotaw, *agronomist, EARO.*
- Mr Adam Bekele, *agricultural economist, EARO.*
- Ms Kebnesh Gemetchu, *extension agent, Ministry of Agriculture.*
- Mr Tibebe Tesfaye, *extension agent, Ministry of Agriculture.*
- Mr Girma Tefera, *farmers' representative.*

Kenya

- Mr J. Kibaki, *pathologist, NHRC/KARI, Thika (local coordinator).*
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- Mr G. Kinyua, *pathologist, NHRC/KARI, Thika.*
- Mr S. Wepukhulu, *biometrician, NHRC/KARI, Thika.*
- Mr C. Kambo, *entomologist, NHRC/KARI, Thika.*
- Mrs S. Munene, *socioeconomist, NHRC/KARI, Thika.*
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- Mr P. Kiuru, *agronomist and breeder, NHRC/KARI, Thika.*
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Tanzania

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- Dr A. Mgonja, *pathologist and director, Horti-Tengeru.*
- Mr H. Mndiga, *social scientist, Horti-Tengeru.*
- Mr A. Massawe, *entomologist, Horti-Tengeru.*
- Mr Samali, *weed scientist, Horti-Tengeru.*
- Mr P. A. Marandu, *horticulturalist, Horti-Tengeru.*
- Ms M. Lelo, *farmers' representative, Duruma farmers' group.*
- Mr H. Gumbo, *farmers' representative, Nduruma farmers' group.*
- Mr Gregory Shayo, *farmers' representative, Manyire Farmers' Group.*

Uganda

- Dr Christine Akemo, *agronomist and horticulturist, KARI (local coordinator).*
- Mr Charles Ssekyewa, *pathologist, GTZ-IPM Horticulture, KARI.*
- Dr Silim Nahdy, *centre director and agronomist, KARI.*
- Mr J. R. Ocen Ayer, *entomologist, horticulturist, KARI.*
- Dr J. P. Kagorora, *pathologist, horticulturist, KARI.*
- Mr J. Sabiti, *research extension liaison officer, KARI.*
- Dr Stephen New, *ADC-IDEA project coordinator, USAID.*
- Mr Umran Kaggwa, *ADC-IDEA project agronomist, USAID.*
- Mr C. Nsamba, *farmers' representative, Namulonge farmers' group.*
- Mr E. Bakka, *farmers' representative, Butwama farmers' group.*
- Mr Sserubo, *farmers' representative, Busaku farmers' group.*

PHD AND MSc TRAINING PROJECTS FOR NATIONAL SCIENTISTS

Topic	ARPPIS Research Scholar (Nationality)	University [#] (Year)
PhD:		
Bioecology of egg parasitoids on <i>Helicoverpa</i> and <i>Plutella</i>	Abera Teklemariam Haile (Ethiopian)	Kenyatta University (1997–2000)
Tritrophic effects of use of neem on <i>Plutella</i> cabbage ecosystem	Anne Margaret Akol (Ugandan)	Kenyatta University (1998–2001)
Bioecology and preventive management of onion thrips, <i>Thrips tabaci</i>	Monicah Waiganjo ⁺ (Kenyan)	Kenyatta University (2000–2003)
MPhil./MSc:		
Non-target effects of neem use on okra ecosystem	Zachary Ngalo Otieno (Kenyan)	Moi University (1997–1999)
Pest control efficacy and non-target effects of neem in French bean ecosystem	Ruth Kahuthia Gathu (Kenyan)	Kenyatta University 1997–1999)
Pest spectrum, yield loss and potential for pest control in okra and capsicum	Samuel Kagumba Muchemi (Kenyan)	Kenyatta University 1997–1999)
Pest spectrum, yield loss and potential for neem in pest control on cucumbers	Charles Mboya Matoka (Kenyan)	Kenyatta University 1998–1999)
Survey and evaluation of native baculoviruses for control of <i>Helicoverpa armigera</i>	Joseph Baya Msanzu (Kenyan)	Kenyatta University (1998–1999)
Exploring the scope for push-pull strategy for <i>Plutella</i> management in cabbage	Rebecca K. Raini ⁺ (Kenyan)	Kenyatta University (2000–2001)
Behavioural studies on egg parasitoids of <i>Helicoverpa</i> and <i>Plutella</i>	Zipporah Osiemo ⁺ (Kenyan)	Jomo Kenyatta University of Agriculture and Technology (2000–2001)
Evaluation of native strains of <i>Bt</i> and <i>Metarhizium</i> on <i>Plutella</i> in cabbage ecosystems	David Kahuro Thumbi (Kenyan)	Kenyatta University
Non-target risk management for native egg parasitoids (<i>Trichogramma</i> spp.) in Kenya	Constance Andeyo Muholo (Kenyan)	Addis Ababa University (2001–2002)
Interaction of companion crops with the incidence of foliar pests and diseases in cabbage/kale in Kenya	Jacqueline Makatiani (Kenyan)	Kenyatta University (2001–2002)

⁺Research costs supported by the Dissertation Research Internship Programme (DRIP).

[#]All in Kenya except for Addis Ababa University, Ethiopia.

TOPICS OF LOCAL LANGUAGE BULLETINS

Kiswahili	Amharic	Luganda
Methods of testing integrated pest management (IPM) options	Major vegetable crop varieties and their production techniques	Major vegetable crop varieties and their production techniques
Methods of preventing vegetable diseases	Vegetable weeds and their control methods	Major vegetable diseases and their management
Nursery health management	Major vegetable diseases and their management	Major vegetable pests and their management
Neem products preparation and application	Vegetable seedling management techniques	Vegetable seedling management techniques
Major vegetable pests and their control	Major vegetable insect pests and their management	On-farm trials (demonstration)
Methods of vegetable pest control	Vegetable seedling raising methods	On-farm record keeping
Major vegetable crop varieties and their production techniques	On-farm trials (demonstration) Farm record keeping	Nursery health management

TECHNICAL ADVISORY NOTES DEVELOPED

Technical Advisory Note 1

Topic: Development of improved farmer-participatory model for IPM awareness building among smallholder vegetable farmers in eastern Africa region

Goal

To provide the national programmes with a more effective and sustainable model for IPM awareness building among the target farmers at the grassroots level.

Justification

IPM is highly information-intensive and calls for adequate access to extensionists/trainers at the grassroots for effective awareness building among target farmers. Presently, the ratio of frontline extensionists to farmers in the partner countries is around 1:2000–1:4000. There is need to narrow this gap: The training of farmers' cadre trainers to serve as second line extensionists appears as an important component in addressing this constraint. Also, there is need to spread out the IPM awareness building sessions for farmers' groups through two–three seasons instead of a single season of intensive sessions as in the commonly adopted FFS model. This refined model, while incorporating some useful features of the FFS, is seen to be more sustainable and less dependent on external resources, so as to be within the reach of the financial and human resources of the national agricultural and extension systems.

Features of the improved model



- Each farmers' group identifies one to two people among their cadre for training as local trainers in IPM.
- The farmers' cadre trainers act as facilitators in on-farm IPM group learning sessions.
- Farmers use specimens of pests and crops instead of charts for pest and disease identification.
- To cater for the adequately spaced learning approach, the group learning sessions are spread out over several seasons instead of a single season as is the case in the IPM awareness strategy in the monocrop farmers' field school.
- Emphasis is placed on building capacity for correct identification of the pest problem by farmers as a basis for seeking appropriate remedies.
- Testing of the new (IPM) options in the common plots of farmers is important, and empowering farmers to make informed decisions on adoption rather than passive adoption is the focus.



Assessing the impact of the improved model on the participating farmers awareness

The NARES teams adopted a standardised methodology involving individual interviews using a questionnaire among the participating farmers. Some comparisons were also made with non-participating farmers in the same locality. The extent of awareness and adoption of the new (IPM) options among the participating farmers evaluated in the farmers' field school sessions was found to be generally substantial. Even non-participating farmers in the localities were found to show interest in learning or adopting the new options.

Stakeholder evaluation of the features and sustainability of the adapted FFS model

The participating farmers, the farmers' cadre trainers, extensionists and researchers were all interviewed individually using a standardised questionnaire to assess their perceptions of the utility of the adapted FFS model. All the stakeholders sampled were highly positive about the efficacy of the model in grassroots level IPM awareness building. The farmers appreciated the emphasis on building their capacity to correctly identify the pest problems as an important step for securing the correct remedies, as they previously were heavily dependent upon others for advice and assistance, besides indiscriminately using chemical pesticides. They also found that the learning sessions were not crammed up, giving them time for other duties in the farm in the cropping season. The NARES perceived this model to be highly compatible with the existing research-extension-linkage infrastructure. They reckoned that the available human and other resources of the NARES could sustain the adapted FFS model activities without external support except for starting up.

Follow-up in dissemination

A stepwise plan for implementing trainers' training from the national to the village level for extending the adapted FFS model approach has been prepared and provided to NARES. A complementary plan for preparing suitable training materials for different levels of trainers has also been prepared. At the invitation of Eritrean NARES, the project provided advisory input and assisted in convening a one-week national IPM awareness planning workshop with complete support from DANIDA. Four national level IPM master trainers were also trained by the project. The IFAD loan project managers in eastern and southern Africa were given a presentation and field exposure during their annual workshop in Ethiopia in 2001. Selected IFAD loan project IPM specialists were also exposed to the adapted FFS model in a three-day workshop organised in liaison with United Nations Operations and Projects Support (UNOPS) at ICIPE in 2001. Some of the IFAD loan projects also participated in the experience sharing and final consultation workshop of the project held in Arusha in June 2001.

Technical Advisory Note 2

Topic: Soil solarisation for improving vegetable nursery health

Goal

To provide the farmers with cheap and simple techniques of raising healthy seedlings in solarised nursery beds as insurance against seedling loss and soil-borne diseases, and to ensure timeliness.

Justification

Smallholder farmers are not aware of the simple methods such as solarisation for sterilising the topsoil of nursery beds to ensure the health of vegetable seedlings. However, due to the lack of simple techniques to sterilise nursery beds, they often face the risk of soil-borne diseases in nursery-raised seedlings. Such loss in seedlings due to soil diseases not only means extra costs to replace the diseased seedlings but also results in delay in transplanting the seedlings and eventual failure to meet the market demands and earn a good price for the produce.



Solarisation technology validation

The technology involves 'solarising' the soil by covering the nursery bed with black polythene sheeting for 4 to 5 weeks before seeding the nursery. Since the nursery beds in smallholder farms are mostly of 1–2 m long, the cost of locally available polythene sheets used for this purposes was found to be negligible considering the benefit it was expected to confer. The preliminary moistening of the top soil of the nursery before covering with polythene and keeping the edges of the polythene covered with soil or mud paste to retain the air tightness were also demonstrated to the farmers' groups involved in testing IPM options.



Farmers' groups compared nursery beds based on their present practice (without solarisation) with beds raised after soil solarisation, the new practice. They inspected the proportion of disease-free seedlings, vigour of seedlings and the presence of weeds in the nursery beds.

Results of validation trials

Farmers were convinced that the method of soil solarisation was simple to adopt and effective in soil heating as a means of minimising disease risk to seedlings in the nursery. The percentage of seedlings that established well (healthy) was found distinctly high in solarisation treatment, while farmers' practices showed a higher proportion of seedling mortality due to damping off, as seen in the results from on-farm trials in Tanzania (Figure 1).

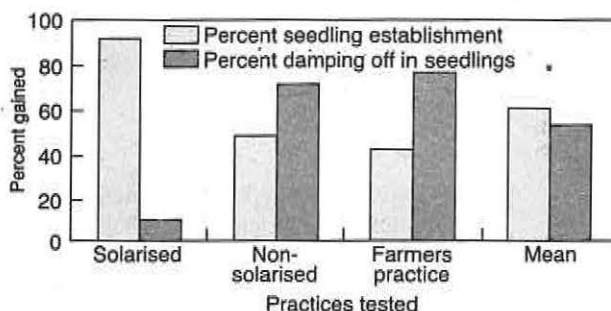


Figure 1: Impact of solarised nurseries on seedling vigour and disease management, Tanzania

Innovations of participating farmers

Some farmers' groups, such as those in Tanzania, tried to substitute the solarisation method with direct heating of the topsoil by burning crop residues on the nursery bed. Since crop residues are inexpensive to fetch, this method was found to be a cheaper substitute. Further, they could undertake this treatment just 2–3 days before seeding the nursery, whereas polythene sheet covering had to be done at least 4–6 weeks earlier. They found that the ash left after burning the nursery site also added to the nutrient value in the top soil, resulting in vigorous seedlings. Soil heating also controlled the germination emergence of weeds in the nursery beds.

Follow-up

- The partner national vegetable research teams in the four partner countries have included this topic in the training programme for IPM trainers;
- A local language bulletin was prepared and circulated to NARES, extensionists, NGOs and CBOs and IFAD loan projects during the experience-sharing workshop in Arusha in June 2001;
- These results have also been shared during field days with FAO and the African Regional Programme of the Asian Vegetable Research Development Centre (ARP-AVRDC), Arusha.

Technical Advisory Note 3

Topic: Potential for utilising pest tolerant varieties of tomato in the eastern Africa region

Goal

To provide farmers with safer alternatives to pesticides for vegetable production systems in the region

Justification

Presently farmers grow vegetables almost year round, which results in increased build-up and severity of pests. The farmers tend to depend almost solely on pesticides as

a means of protecting their crops, which becomes unaffordable over time due to the increased intensity of protection needed. Recently, the national programmes in three partner countries (Kenya, Tanzania and Ethiopia) identified tomato varieties tolerant to pests; their usefulness in reducing the pest-caused losses on-farm is yet to be verified. The NARES partner teams undertook the evaluation of the promising varieties on farm with farmer participation, to assess their potential for acceptance by the participating farmers' groups.

Features of the tomato and cabbage varieties tested

Variety name	Source	Tolerance to	Farmers' group testing
Tengeru 97	AVRDC	Blight	Arusha, Tanzania
Melkasola	EARO	Fruit borer	Nazareth, Ethiopia
Neema	KARI	Root knot	Thika, Kenya
Tanya	AVRDC	Blight/good keeping and marketing quality	Arusha, Tanzania

Strategy for testing by the farmers' groups

The collaborating national vegetable team experts discussed the characteristics of the new varieties with the FFS model farmers' groups, which identified the variety to be included for comparison and participated in designing the on-farm trial. Trained farmers' cadre trainers facilitated the implementation of the trial and keeping of records of pest severity and yields. Interested farmers were helped to visually score for relative pest severity in the trial plots for comparing the new variety with the locally used variety. Farmers' groups participated in the field day and discussed the potential benefits and also the acceptability of the new varieties.



Impact of the on-farm varieties testing on the participating farmers' groups

The participating farmers' groups were able to verify the potential benefits of the new varieties. They recognised that the pesticide spray requirement for the new varieties was much lower than for the locally grown varieties. They could confidently choose the more acceptable new variety for further utilisation.

Follow-up initiatives of the project

The NARES teams provided the model groups with seeds for their individual needs to initially test on small areas in the first season. The NGOs in the region and seed companies were invited by the NARES teams to join in to cater for the expected future increase in demand for the seeds of the new varieties.

HIGHLIGHTS OF THE IPM ORIENTATION WORKSHOP FOR IFAD DEVELOPMENT PROJECT MANAGERS, 13–15 SEPTEMBER 2000, NAIROBI, KENYA

Introduction

ICIPE hosted an IPM orientation workshop for IFAD project managers, 13–15 September 2000 at ICIPE, Duduville, Nairobi. The workshop had two objectives:

- To enable a cross-section of IFAD-supported development projects in eastern and southern Africa to learn about opportunities for utilising the IPM experience and expertise available in the ongoing ICIPE-IFAD IPM network project with partners in eastern Africa;
- To identify potential IPM-related inputs that could be availed to IFAD-supported development projects in the region.

Background to the workshop

To extend the benefits of the IPM training and awareness building expertise available in this ICIPE-IFAD-USAID IPM network for IFAD-supported development projects in the region, UNOPS-Nairobi office invited the ICIPE project coordinator (S. Sithanatham) to their annual workshop in Bulawayo, Zimbabwe, in November 1999, to make a presentation on opportunities for IPM impact in IFAD agricultural development projects in eastern and southern Africa. As a follow-up to that presentation, the UNOPS-Nairobi office invited the ICIPE-IFAD IPM project coordinator to convene an IPM orientation workshop for a cross-section (eight) of IFAD projects in the region as a further step towards exploring opportunities for inter-project collaboration. This workshop was held 13–15 September 2000, with the participation of one to two senior officials of each IFAD development project.

Recommendations of the workshop

The workshop participants made the following recommendations:

- **Recommendation 1: Understanding IPM in the African context.** Based on recent experiences in Africa, the workshop recognises the critical role of IPM in sustainable production of income-generating crops by smallholders. Further, the workshop clarifies that IPM is not to be regarded as a rigid set of guidelines and packages but a 'flexible' and 'commonsense' approach to selection and utilisation of pest-control options that are compatible with stakeholder expectations and favourable for the sustainability of African farming systems. IPM options need to be regarded as a menu, with additions and deletions taking place over time.
- **Recommendation 2: Need to strengthen and expand the ICIPE-IFAD-IPM pilot programme in eastern Africa.** The IFAD development projects in eastern and southern Africa would greatly benefit from the experiences and expertise of the pilot IPM programme under ICIPE leadership and IFAD funding. The workshop recommends to IFAD to further strengthen and expand this initiative. Doing so will provide the

scope to extend IPM impact to more beneficiaries, both through the ongoing NARES partnership and through backstopping the needy IFAD development projects in the region.

- **Recommendation 3: Need to establish a regional IPM consortium for access to IPM information and expertise.** The IFAD development projects in the region would directly benefit from IFAD support to establish a consortium to cater for their IPM information and expertise needs. The ICIPE led IPM project has shown excellent capacity to link with institutions focusing on IPM at the international, regional and national levels, as well as to work closely with NARES partners in the region. The workshop therefore recommends to IFAD to expand the role of the IPM project to lead a regional IPM consortium and to establish an appropriate IPM resource and information network for catering to the major IPM needs of IFAD development projects in the region.
- **Recommendation 4: Potential for integrating an IPM vision and incorporating an IPM focus during IFAD projects' planning sessions.** It is important that the vision for IPM be integrated into IFAD development projects at the planning stage. The workshop therefore recommends that the ICIPE IPM project be given the responsibility by IFAD for providing backstopping and consultancy input for ensuring appropriate IPM focus in planning sessions of needy IFAD projects in the region, since this project has the most appropriate expertise and experience to cater for this important need of IFAD projects.
- **Recommendation 5: Importance of incorporating the self-help approach and sustainability concerns in IPM awareness building activities in IFAD's projects' cycle.** The workshop recognises the importance of motivating farmers participating in IPM projects to develop a self-help approach and to consider the sustainability of each IPM awareness building activity both within and beyond the IFAD project period. The ICIPE IPM project is recommended as a future focal point for the IFAD development projects for enabling the incorporation of a sustainability focus in the IFAD projects' cycle. This will also help to keep up the IPM momentum in the post-project era.
- **Recommendation 6: Technical backup for IPM trainers' training.** The IFAD development projects in the region would be able to undertake systematic and comparable initiatives in training of senior and middle-level IPM trainers if they could obtain the appropriate technical support from the ICIPE IPM project. The technical inputs required include support for planning the sequence and structure of different levels of trainers' training and providing the scientific content for important IPM participatory technology development FFS themes. The IFAD development projects would benefit from assigning at least one specialist from the project for IPM training and specialisation on a continuing basis.
- **Recommendation 7: Need to continue support to IPM technology development research.** The workshop appreciated USAID's co-financing component for gap-filling research by ICIPE. This helped to provide NARES partners with a wider range of IPM technology options for vegetable crops. The workshop recommends that such support be continued.

RECOMMENDATIONS OF THE AWARENESS PLANNING IPM WORKSHOP IN ERITREA

Topic 1: Planning for trainers' training programme

- Recommend that a stakeholder participatory planning workshop (3 to 4 days) be convened at the national level to prepare a comprehensive vision for multilevel trainers' training programme focusing on IPM awareness building for farmers.
- Recommend an intensive training workshop (4 to 5 weeks) for senior trainers from research and extension for familiarisation with IPM approaches and options and with the group learning system among farmers by suitably adapting the FFS approach in preparing for implementation of the plans.

Topic 2: Capacity building for preparation of appropriate training materials for IPM awareness initiatives

- Recommend that upgrading of human resources for providing appropriate technical and logistical support be undertaken on a systematic basis, to cater for needs of trainers' training at different levels and farmers' training.
- Recommend the acquisition of the latest technologies for local production of printed, audio and video materials, including electronic access to IPM information for training material preparation.

Topic 3: Strengthening of grassroots level IPM awareness building activities

- Recommend that formation of farmers' groups as a necessary means of improving the frequency of contact with frontline extensionists (and contact farmers) be encouraged and their suitable linking with the subzoba (district) level be visualised through 'clusters' at the village level.
- Recommend that training of farmers' cadre trainers be encouraged as a useful means of improving the efficiency of access to IPM information by farmers' groups, with suitable incentives being considered for their role as second line extensionists.

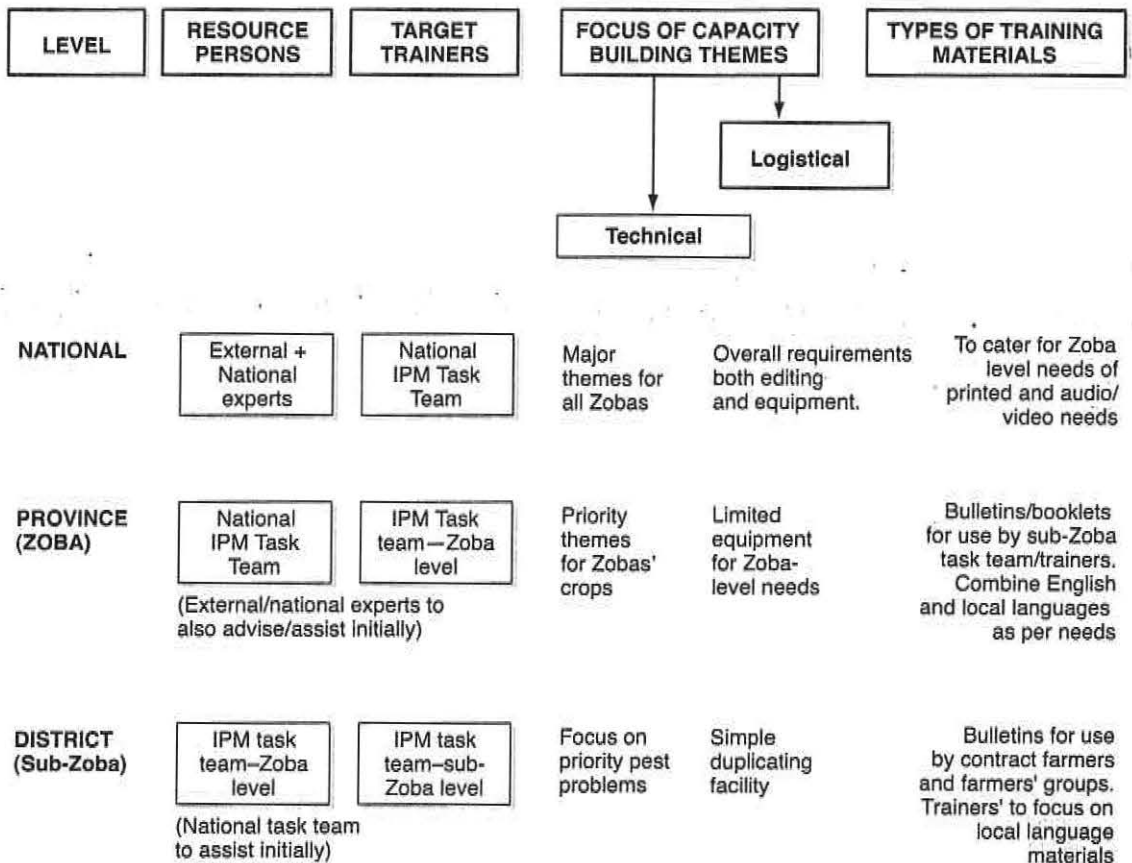
Topic 4: Farmer participation in joint testing of improved (IPM) options

- Recommend that, to encourage their effective participation and partnership, farmers be given priority in on-farm testing of IPM options, so that they are empowered to decide locally on the suitability of each option for adoption.
- Recommend that appropriate back-up training be provided to enable objective choice of new options, especially by training farmers in on-farm trial design, record keeping and group evaluation of IPM options.

STRATEGY FOR STEPWISE TRAINERS' TRAINING AT DIFFERENT LEVELS IN ERITREA

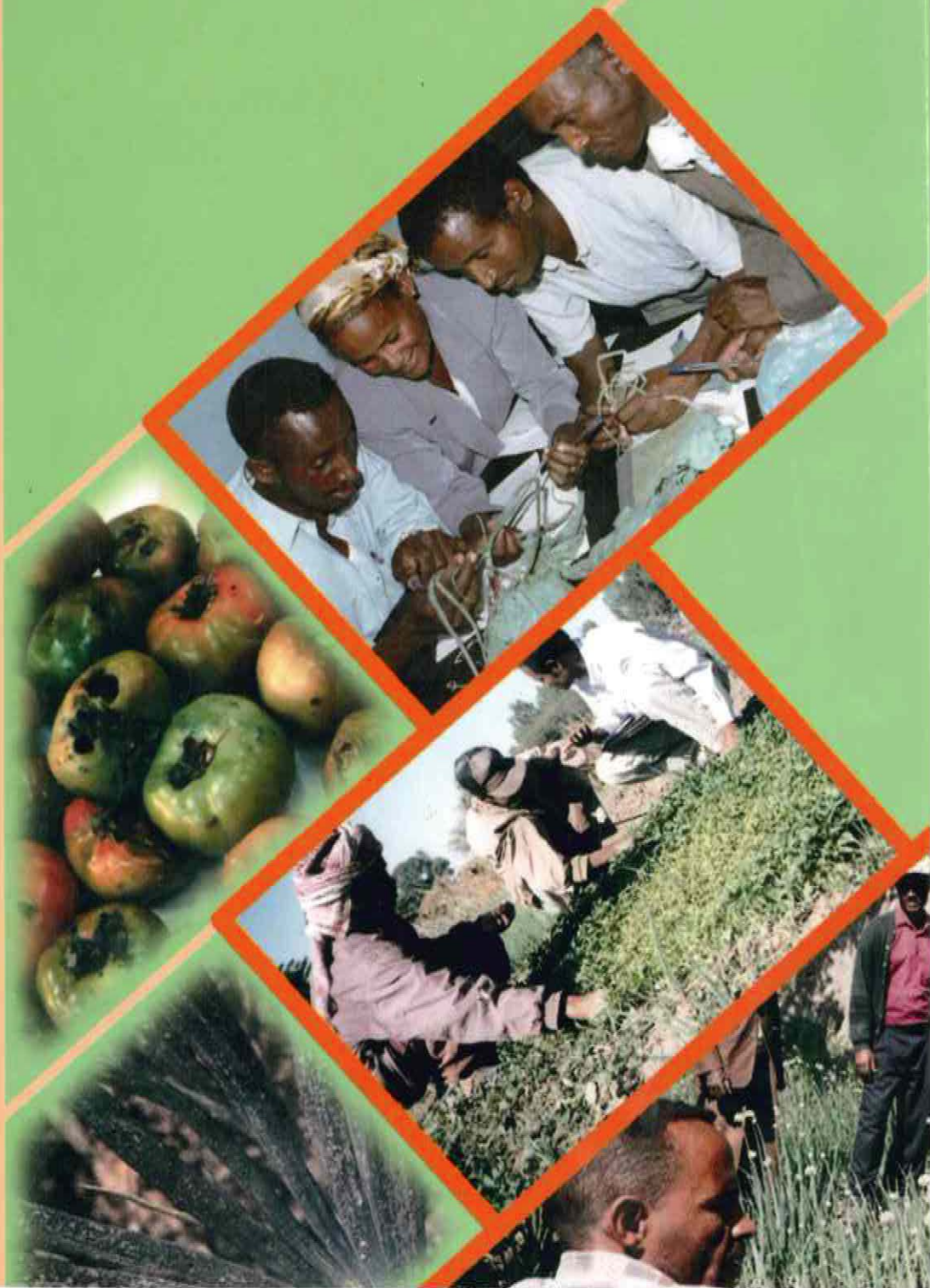
LEVEL	TARGET TRAINERS	RESEARCH THEMES	EXTENSION WORKERS	SUGGESTED DURATION	SUGGESTED SITE
National	National IPM task team (research + extensionist)	<ul style="list-style-type: none"> • IPM approach • IPM components • Stakeholder consultation • IPM validation 	<ul style="list-style-type: none"> • FFS approach • Training needs • On-farm validation • Farmers' group dynamics 	2 weeks	National site
Regional (Zoba)	Zoba IPM task team (research + extensionist)	<ul style="list-style-type: none"> • IPM approach • IPM components • IPM needs assessment 	<ul style="list-style-type: none"> • FFS approach • How to form groups • Training needs • Training materials 	1 week	Zoba site
District (Subzoba)	Subzoba IPM task team	<ul style="list-style-type: none"> • IPM approach • IPM components • IPM needs assessment 	<ul style="list-style-type: none"> • FFS approach • How to form groups • Training needs • Training materials 	3–4 days	Subzoba site
Administrative village	Contact farmers plus village level 'clusters'	<ul style="list-style-type: none"> • IPM approach • IPM components • IPM needs assessment 	<ul style="list-style-type: none"> • FFS approach • How to form groups • How to learn jointly • How to test IPM jointly 	2 days	Administrative village
Village	Farmers' cadre trainers from each group within cluster	<ul style="list-style-type: none"> • IPM approach • IPM components • IPM needs assessment 	<ul style="list-style-type: none"> • FFS approach • How to form groups • How to learn jointly • How to test IPM jointly 	1 day	Village site

SCHEME FOR IPM TRAINING MATERIAL PREPARATION FOR TRAINING OF TRAINERS IN ERITREA



LIST OF ACRONYMS

AAIS	African Association of Insect Scientists
ARPPIS	African Regional Post-graduate Programme in Insect Science (ICIPE)
ASPAC	Asia Pacific
AVRDC	Asian Vegetable Research and Development Centre
CBOs	community-based organisations
CIAT	Centro Internacional de Agricultura Tropical
DANIDA	Danish International Development Agency
EARO	Ethiopian Agricultural Research Organisation
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FFS	Farmers' Field School
FPEAK	Fresh Produce Exporters' Association of Kenya
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit
HCDA	Horticultural Crops Development Authority, Kenya
ICIPE	International Centre of Insect Physiology and Ecology
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IDEA	Investment in Development of Export Agriculture
IFAD	International Fund for Agricultural Development
IPM	integrated pest management
IWMI	International Water Management Institute
JKUAT	Jomo Kenyatta University of Agriculture and Technology, Kenya
KARI	Kenya Agricultural Research Institute
KEPHIS	Kenya Plant Health Inspectorate Service
NARES	national agricultural research and extension systems
NGOs	non-governmental organisations
NPV	Nuclear Polyhedrosis Virus
NVRTs	national vegetable research teams
PAN	Pesticide Action Network
PPRI	Plant Protection Research Institute
SNPV	Single nucleocapsid subtype of NPV
TANS	technical advisory notes
USAID	United States Agency for International Development
WHO	World Health Organisation



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