EVALUATION OF THE INTEGRATED PEST AND VECTOR MANAGEMENT (IPVM) PROJECT IN SRI LANKA

MISSION REPORT

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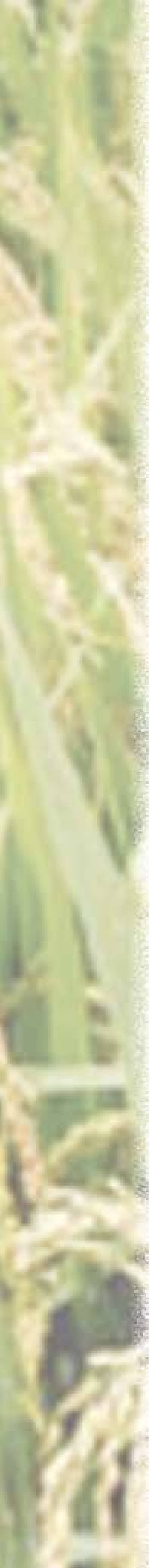

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LIST OF ACRONYMS

AESA	Agro-ecosystem Analysis
AMC	Anti-Malaria Campaign
BPH	Brown Planthopper
DAS	Days after Sowing
DOA	Department of Agriculture
DOPH	Department of Public Health
EOH	Environmental & Occupational Health
FA	Field Assistant
FAO	Food and Agriculture Organization of the United Nations
FBO	Farmer-based Organization
FFS	Farmer Field School
IPM	Integrated Pest Management
IPVM	Integrated Pest and Vector Management
ITN	Insecticide-treated bed Net
IVM	Integrated Vector Management
IWMI	International Water Management Institute
MASL	Mahaweli Authority of Sri Lanka
MOH	Ministry of Health
NGO	Non-governmental organization
PHI	Public Health Inspector
POP	Persistent Organic Pollutant
RMO	Regional Malaria Officer
SEARO	South East Asia Regional Office
T&V	Training and Visit system
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNICEF	United Nations Children's Fund
WHA	World Health Assembly
WHO	World Health Organization

EXECUTIVE SUMMARY

BACKGROUND

Integrated Pest and Vector Management (IPVM) builds upon the successful experience in Integrated Pest Management (IPM), which is based on the practical, field-based education of groups of rice farmers in weekly sessions of the Farmer Field Schools (FFS). Farmers learn the skills of observation-based crop management to grow better crops in healthier environments and reduce dependence on the use of insecticides. The wetland rice environment, while providing food and fodder, also supports breeding of the vectors of human diseases. The IPVM project in Sri Lanka, which started in 2002 with support from FAO and UNEP, has been unique in connecting vector management with agricultural activities thereby actively involving farming communities in observation-based decision-making on vector management. An evaluation mission was organized by WHO's South-East Asia Regional Office on the effectiveness, sustainability and replicability of the project to assist in the implementation of WHO's new strategy on Integrated Vector Management (IVM).

RATIONALE AND MISSION OBJECTIVES

Malaria and other vector-borne diseases like lymphatic filariasis, leishmaniasis, Japanese encephalitis and dengue are a major health problem in the South East Asia Region (WHO, 2004a). Moreover, the 2004 *tsunami* has increased several risk factors for a number of vector-borne diseases in coastal areas due to new vector breeding opportunities, worsened sanitary and housing conditions, breakdown of health services, movements of non-immune people and weakened nutritional status of the displaced population. In the wake of increased drug resistance and insecticide resistance in the vectors, there is a need for establishing integrated vector management strategies which are less reliant on chemical methods of disease control, and involve other sectors and local communities in ecosystem management to reduce health risks.

The Integrated Pest and Vector Management (IPVM) project in Sri Lanka has for the first time integrated vector management with farmer education in agriculture, thus involving rural communities in reducing the health risks of vector-borne disease. The new approach could potentially benefit other areas in the region, including those affected by the *tsunami*. Prior to preparation for a workshop related to integrated vector management and integrated pest management in the South East Asia region, in October 2006, an assessment is needed of the unique IPVM project in Sri Lanka.

Hence, the main objectives of the mission were:

1. To determine the effectiveness, sustainability and replicability of the IPVM approach in Sri Lanka
2. To explore prospects for replication in the country itself and in India

GENERAL FINDINGS

The mission team observed that the project is basically on the right track. Visits to IPVM Farmer Field School activities (see locations in Figure 1) and discussions with IPVM-FFS alumni demonstrated that farmers can identify and monitor larval and adult populations of the major mosquito genera. Farmers are able to analyze their agricultural and peri-domestic environments and make sound decisions on the management of not only vectors in a sustained manner, but also pests and crops. IPVM-FFS alumni reported a sharp drop in insecticide use attributable to the training. Vector management activities are being practiced after FFS training, including small-scale local rearing of fish, clearing of coconut shells and containers, covering water containers at regular time intervals, and group action on household and village sanitation and preventive measures such as bed net use. Initial research findings generated during the project suggest that the role of farmers in vector management is most crucial in the short, rainy season when clustered ecosystem management was associated with lower anopheline mosquito densities, which can potentially break the transmission cycle. This effect was not observed in the long rainy season. The role of agricultural use of insecticides on mosquito dynamics needs further study. IPVM lead to increased use of mosquito bed nets. The team developed frameworks for monitoring of project performance and evaluation of project impacts. Recurrent costs of the IPVM-FFS are approximately $10 per graduated farmer.

CURRICULUM

The reduction of health risks in irrigated agriculture can be made more explicit in the FFS curriculum. Health risks are not limited to vector-borne disease but include harmful effects of pesticide use in agriculture on occupational poisoning and food safety. The mission recommended inclusion of exercises on self-monitoring of signs and symptoms of acute pesticide poisoning into the IPVM-FFS curriculum. The mission also recommended broadening of the FFS activities to include field walks for other crops grown by rice farmers using pesticides, to address pesticide-related health risks in a more comprehensive way.

CONVERGENCE

The mission found that convergence between activities by the health and agriculture sectors have come a long way, producing effective cross-sector learning and a joint process of curriculum development. However, there is a need to further enhance convergence. In particular, the roles and activities of the two sectors could become better integrated. This can be achieved by district-level workshops for all local stakeholders and by better synchronization of mosquito surveys by the Anti-Malaria Campaign (AMC) with weekly IPVM-FFS activities to allow for interaction with farmers resulting in mutual benefits.

VECTOR CONTROL

The AMC has so far been playing a supplementary role by supporting a predominantly agriculture-driven project. The main challenge for AMC is to internalize IPVM into its own vector-borne disease control strategy. In fact, AMC has started to adopt IPVM as prevention strategy in low transmission areas, and there is prospect to extent this strategy to intermediate transmission areas because of the demonstrated synergistic effect between IPVM and bed net use. Moreover, the current surveillance system of the AMC, aiming to detect early warning signals of disease outbreaks to initiate action, is constrained by limited human and financial resources.

Surveillance could benefit from involving communities and developing local capability on monitoring and evaluation as part of an IPVM strategy. This would provide better coverage and intervals of data collection, allowing the AMC to target their interventions (FFS or bed net) more accurately and more timely. Community-based surveillance would also enhance local project ownership and preventive actions taken by local people.

NEXT STEPS

There was a strong overall consensus among the directors of AMC and Environmental & Occupational Health (EOH), Ministry of Health of Sri Lanka, WHO and FAO about the value of IPVM which involves local people in reducing and evaluating health risks related to vector-borne diseases and chemical pesticides. However, the sensitization of policy makers, particularly in the health sector, is a priority. WHO-SEARO will support the production of a short video film to publicize IPVM. The Director EOH, who joined the mission team's field visits, will introduce IPVM at a national session of the Health Development Committee Meeting to announce a seminar on IPVM. WHO-Sri Lanka agreed to organize and sponsor the seminar, which will bring together major players from the Health Ministry and other partners to discuss the value of IPVM and identify common objectives and possible synergistic effects. In parallel, the mission findings and the video will serve as inputs to the regional IVM workshop, planned for October 2006, probably in Pondicherry, India, to discuss the prospects of replication of IPVM in other countries and as part of the health emergency response in and after natural disasters.

MISSION MEMBERS

The mission members included experts in integrated vector management and/or integrated pest management with extensive experience in the South Asian region.

International experts:

1. Dr Henk van den Berg, Consultant on Integrated Pest Management and Integrated Vector Management, Wageningen, the Netherlands
2. Dr P.K. Das, Director, Vector Control Research Centre, Pondicherry, India
3. Mr Alexander von Hildebrand, Regional Advisor on Environmental Health. WHO South-East Asia Regional Office, New Delhi, India
4. Dr V. Ragunathan, Plant Protection Advisor to the Government of India, and IPM Consultant for FAO

National Experts:

1. Mr Nalin Munasinghe , Programme Associate, FAO Representative's Office. 202, Bauddhaloka Mawatha, Colombo-07, Sri Lanka
2. Mr K. Piyasena, Deputy Director Plant Protection, Plant Protection and Seed Certification, Department of Agriculture, Peradeniya, Sri Lanka
3. Mr Hector Senerath, National Consultant, IPVM Project. FAO, 51/2, Thotagamuwa, Palapathwela, Matale, Sri Lanka
4. Dr C.K. Shanmugarajah, Director. Environmental Occupational Health and Food Safety, Ministry of Health and Nutrition, Colombo, Sri Lanka

BACKGROUND

1.1 IPM in Asia

Traditional agriculture in tropical Asia was practiced in harmony with nature. It preserved the diverse life forms with the agro-ecosystems and promoted the conservation of bio-diversity within farming systems. However, with the introduction of chemical insecticides, plant protection specialists in the early 1950s recommended complete control of pests with chemical insecticides, ignoring the beneficial role of fauna. Subsequently, during the period of the Green Revolution farmers in developing economies were urged to use insecticides on a "calendar basis" or based on economic threshold levels of pests. The costs were considered an acceptable insurance "premium". However, farmers were unable to deal with the complexities of pest development under high input regime. Some governments contracted pesticide companies to provide large-scale aerial applications of insecticides with disregard to the negative impacts. Crop protection specialists and government-supported extension services assumed that they were better able to take decisions to control pests, than the farmers. However, their perceptions got jolted due to massive outbreaks of pests like brown plant hopper (BPH) in many rice-growing countries in South-East Asia. Researchers soon discovered that BPH outbreaks were insecticide-induced (Kenmore et al., 1984) and that breeding rice varieties resistant to BPH under continued pressure of insecticide use would be a futile exercise (Gallagher, 1984).

Despite these facts, many governments continued to promote large-scale use of pesticides under their sponsored plant protection programmes as well as by extending subsidy on pesticides, under the false notion of protecting the crop to ensure food grain production to provide food to a growing population. Such a biased approach by government agencies supported by plant protection specialists has led to the development of resistance among pests, pest resurgence and secondary pests emerging as major problems, environmental pollution, pesticide residue in food and food commodities and increasing health hazards to farmers and consumers (Peter Ooi, 1998; Ragunathan, 2002).

In response to the emergence of such problems associated with chemical pesticides which were used for the control of insect pests by governments, extension services and farmers, the search for solutions to these problems led to the development of a new form of Integrated Pest Management (IPM) through a farmer educational approach. The working definition of the participatory form of IPM is composed of four principles, which are:

1. Grow a healthy crop
2. Conserve natural enemies
3. Conduct regular field observations
4. Farmers become experts

The first principle refers to good agricultural practices necessary for growing a crop that is able to withstand environmental stresses such as infestation by plant feeding insects or plant diseases. The second principle refers to the aim of reducing the use of chemical insecticides to deliberately support the populations of beneficial organisms. The third principle refers to the need for farmers to regularly observe and analyse their crop ecosystem in order to make timely and evidence-based management decisions. The fourth principle implies that expertise on sound crop management has to be with the farmers themselves, who are in the best position to respond to local and dynamic field situations.

IPM programs in rice have relied on the Farmer Field School (FFS) approach to empower farmers to grow healthy crops in a cost-effective manner, while chemical pesticides are used only as last resort. The IPM-FFS is a modern form of farmer education which is field-oriented, practical and which used experiential learning methods ('learning by doing'). IPM-FFS activities, often held under a tree near the field, take place in regular sessions, starting from planting and continuing until harvest. Groups of 15–30 farmers observe and analyze their agro-ecosystem on a weekly basis, facilitated by a field trainer. They learn to make appropriate management decisions, the effect of which is evaluated in the next weekly observation.

These weekly learning cycles give farmers the confidence and capacity to grow a healthy crop. This learning process is assisted by additional exercises and simple experiments that enable farmers to understand aspects of field ecology and plant development (e.g. pests-natural enemy population dynamics and crop damage-yield relationships). Farmers can thus discover that insecticides are rarely needed in tropical rice ecosystems. In fact, insecticides can easily induce a pest outbreak problem, for example in the case of the brown planthopper. Group communication exercises incorporated into the FFS curriculum aim to enhance group building between participants, which can facilitate the emergence of concerted action after the FFS. IPM Farmer Field Schools in tropical rice commonly result in immediate benefits to farmers in terms of reduced agro-chemical inputs and stable or increased yields. Moreover, rice FFS are a proven entry point for further farmer-driven development and local programs.

IPM programs in Asia have added post-FFS training activities in order to strengthen three types of skills: (i) skills to conduct farmer-to-farmer education through field schools, (ii) organizing skills to conduct planning, management and evaluation of concerted activities and associations, and (iii) skills of experimentation to generate and use new knowledge to feed into local programs. Together, these three elements facilitated sustained community-based activities, such as farmer clubs, associations, farmer advocacy, and lead towards farmer empowerment and local programme ownership.

This has resulted in what has been called "Community IPM", a situation where farmers are organising and implementing their own IPM activities, as instigators rather than recipients of IPM. Hence, Community IPM is about farmers joining forces to promote farming practices which they know are healthier and more efficient (Pontius, Bartlett & Dilts, 2002). Government and NGO trainers thus have a new role to play in supporting farmers who are managing their own IPM activities. Community IPM has emerged from training programmes organised by Government agencies and NGOs in various parts of Asia.

1.2 IPM in Sri Lanka

As early as 1984, rice IPM was initiated under the transfer of technology model in the form of the Training & Visit (T&V) extension system. In this top-down, message-based system, technology was transferred to farmers by Contact Farmers. Despite strong policy support, the effect was limited. The model worked for simple prescriptions, for instance, on the use of improved varieties, but did not work for complex field problems, for instance, in pest management. Subsequently, the Contact Farmer concept was replaced with a Group concept called the Block Demonstration. Educational principles on IPM developed in the Philippines were incorporated in the curriculum in 1985, and initial results were positive. Thereafter, the programme was scaled up very fast with 35,000 farmers trained by 1987, but the content and quality of training had been compromised. A parallel development in Indonesia and the Philippines since the late 1980s gave rise to the IPM-FFS approach (see section 1.1). The programme on participatory IPM in Sri Lanka started from 1995, albeit at a small scale due to a consistent lack of funding throughout the 1990s with just thirty units per season. From 1999 onwards more funds became available, and larger numbers of trainers graduated from season-long training-of-trainers. By 2002 when the IPM project ended, there were 220 IPM master trainers, half of whom in irrigation systems of the Mahaweli Authority of Sri Lanka (MASL), and over 200 farmer trainers (farmers who have become FFS trainers), capable of facilitating FFS in a large number of locations (see van den Berg, Senerath & Amarasinghe, 2002). Human resources in the Northern and Eastern provinces have been small due to the history of the ongoing conflict .

1.3 WHO's strategy on IVM

In 2004, a Global Strategic Framework on Integrated Vector Management (IVM) was developed and is now the official strategy for WHO (WHO, 2004b). IVM involves the use of a range of locally appropriate and effective vector control interventions, often in combination, to reduce or interrupt disease transmission. Intervention options are selected on the basis of knowledge about local vector biology, ecosystem, disease transmission, and morbidity. Chemical insecticides are considered the last resort for vector control after all non-chemical options have been considered. IVM is based on the premise that effective planning and operations for vector management is not the sole preserve of the health sector but requires the collaboration of various public and private agencies. The active engagement of local communities is considered a key factor in assuring sustainability. The aim of IVM is to improve cost-effectiveness, ecological soundness and sustainability of vector-borne disease control.

IPVM IN SRI LANKA

2.1 The IPVM concept

The rice field, while providing food and fodder, supports pest and vector mosquito breeding. Vector borne diseases occur where there is a close interaction between host parasite and vector. Agricultural environments, irrigated crops in particular, and rural residential areas provide conditions well suited for breeding of vectors of several human diseases, such as malaria, Japanese encephalitis, lymphatic filariasis and dengue. Therefore, reducing vector proliferation and interaction by changing farming practices will reduce the disease risk.

Moreover, plant protection measures often lead to an increase in pesticide use, which can result in mosquito resurgence and cause resistance in vector populations against the insecticides used in current vector control interventions. Therefore, there is a need to converge the IPM and IVM strategies in such a way that farmers practicing IPM not only improve their crop productivity by adopting environmentally sound practices, but also minimize the health risks associated with farming practices and community behaviour.

Health risks associated with rice agro-ecosystems thus include exposure to hazardous chemical pesticides, depletion of beneficial fauna with the potential for resurging populations of pests and vectors of public health importance, and precipitating resistance in the vectors (Box 1). Farmers should play a key role in reducing these health risks, and at the same time improve sustainable productivity of their agricultural environment. There is need to educate farmers through the FFS on reducing their environmental health risks using the experiential learning approach of the FFS. This requires collaboration between the sectors of health, agriculture and irrigation to make the most efficient use of limited resources to reach common objectives. IPM Farmer Field Schools provide the opportunity

Box 1 **Health risks associated with agriculture**

1. Irrigated agricultural environments provide a breeding habitat for vectors of malaria, lymphatic filariasis, Japanese encephalitis, dengue, etc.
2. Use of insecticides in agriculture can cause resistance in
3. Disease-transmitting vectors breeding in agricultural environments, thereby reducing the effectiveness of insecticide-based vector control methods
4. Spraying of insecticides causes occupational poisoning besides poisoning at the household level
5. Spraying may leave toxic residues in food, thus adversely affecting consumers' health
6. Destruction of beneficial fauna by broad-spectrum insecticides can cause resurgence of disease-transmitting vectors
7. Domestic animals and livestock can serve as alternate or main hosts of diseases affecting humans
8. The level of income and food produced through agriculture influence the well-being and resilience of farming communities

for inter-sectoral collaboration and institutional learning through a field-based approach.

2.2 History of the project

The IPVM project originates from the request by the Stockholm Convention on POPs, the Bahia Declaration of the Intergovernmental Forum for Chemical Safety and World Health Assembly resolution WHA 50.13, to develop viable alternative strategies for the control of vector-borne diseases, malaria in particular, and to reduce the reliance on insecticides through promotion of integrated pest-management approaches. An international workshop facilitated by UNEP provided the entry point for inter-sectoral collaboration in project development in Sri Lanka, building on the experience of the IPM project in Sri Lanka. The FAO Sri Lankan office has been instrumental in facilitating the process of planning with the sectors of Agriculture, Health (Anti Malaria Campaign) and Mahaweli Authority.

The project was developed as a pilot with limited funding. FAO provided a grant of US$ 35,000 for initiation of the project and for field activities, which were the only source of external funding until May 2005. The project began on 14 March 2002 with an inception workshop in Colombo, attended by all major stakeholders representing the Department of Agriculture, the Anti-Malaria Campaign (AMC), Mahaweli Authority, International Water Management Institute (IWMI), UNDP and FAO. WHO was invited but could not participate at that time. Workshop objectives were to arrive at a consensus on project locations, course of action in the first year, and the roles of different institutional participants.

April 2002, a 4-day field-based workshop was held in Anuradhapura to educate IPM trainers from the selected project locations on mosquito biology, mosquito identification, breeding habitats, adult mosquito sampling, and vector management options. Staff from AMC and IWMI provided technical inputs on the vector component. The process of curriculum development was started. The participants developed a questionnaire to learn about farmers' knowledge about vector-borne diseases. The results of their survey served in curriculum development. Practical plans were made to initiate work on sampling, testing of methods/exercises, and mapping, and to conduct local baseline surveys. Six initial project locations were Mahaweli system H, Puttalam, Udawalawe, Monaragala, Vavuniya and Trincomalee (Figure 1; also refer to Table 2). In a follow-on workshop one month later, the initial field work and curriculum were evaluated and improved. Provisional curricula were then field-tested in ongoing IPM-FFS. Moreover, a plan was made by AMC teams in the districts, to monitor the impact of the interventions on mosquito larval and adult density.

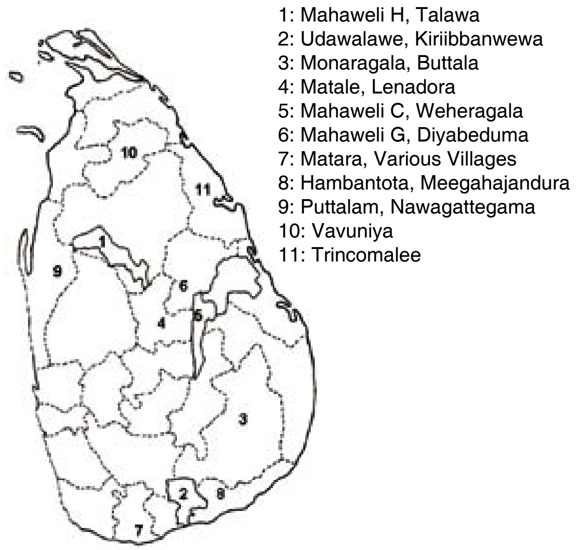


Figure 1: Map of Sri Lanka with IPVM locations indicated in the legend (district or Mahaweli system, and name of village; refer to Annex 2). Dashed lines indicate district borders; solid lines indicate borders of Mahaweli Authority irrigation systems.

IPVM Farmer Field School activities were implemented during the long rainy (Maha) and short rainy (Yala) seasons (subject to the availability of water) in the project locations, by clustering the interventions to achieve gradual coverage of most farm families in a contiguous area. At most locations, a comparison village was selected, situated 2–3 km away from the intervention village in order to evaluate the effects of intervention. Central level workshops were held at the beginning of every following season, with participation by the IPVM trainers, agricultural officers and AMC staff, to evaluate previous activities, plan for the new season, and to add technical content. Provision was made to allow trainers and farmers to address their research questions by doing mostly replicated field experiments related to the interaction between agricultural practices and vector breeding. From 2002–04, a doctoral research project was attached to the IPVM project to study the impact of the clustered IPVM-FFS interventions on mosquito populations and on farmer knowledge and farmer actions. The research findings have been published (see Yasuoka et al., 2006a, 2006b).

In January 2004, a stakeholder seminar was organized in Colombo to encourage increased project ownership of different partners and to initiate an alliance for further project development. Project partners from both the Agriculture and Health sector indicated the benefits of linking the two sectors in irrigated agriculture. There was interest among the MOH in using the Farmer Field School for broader health issues. However, there was some concern over the weak link between AMC and Public Health staff in the districts.

In June 2005, a two-day workshop was held in Kandy to discuss the strategy for the new Phase II of the project funded by UNEP Chemicals Division, with a budget of US$ 56,500, in support of continuation of the field activities over a period of two more years (2005-07). Objectives of the new phase were to (i) develop and implement participatory training for rural communities which would address both rice cultivation and vector management; and (ii) facilitate farmer-operated community programmes which address agricultural problems and human vector-borne diseases. A part-time national expert was recruited to assist the national counterparts in coordinating the field project. Also in 2005, several short courses were held to train more IPM trainers on the IPVM curriculum. The training of IPVM-FFS alumni farmers to become farmer trainers was considered important to achieve sufficient coverage and scale of the intervention locations. The timeline of the IPVM project are presented in Table 1.

Table 1 Timeline of the IPVM project in Sri Lanka

2002	Start of IPVM, with FAO funding (“Phase I”)
2005	Continuation of IPVM, with UNEP funding (“Phase II”)
2006	Evaluation Mission by WHO (SEARO)
2007	Projected end of present project

2.3 Institutional setting

The Plant Protection Service of the DOA at the central government level in Peradeniya has been FAO’s main counterpart in the preceding IPM project and likewise in the present IPVM project, with the Deputy Director Plant Protection as the main coordinator of the project to liaise with the other institutional associates. DOA’s role includes monitoring and evaluation through field visits, organizing planning meetings with the other partners and organizing and implementing technical workshops. The Farmer Field School approach conflicts, to some extent, with the department’s homemade ‘block demonstrations’ approach for rice intensification, which comes under the separate Extension division. However, it is increasingly recognized that the two approaches are complementary.

The provincial DOAs, being independent entities, are responsible for project implementation within their boundaries, and receive technical support from the central level DOA. Mahaweli Authority, which is a separate ministry, governs the larger part of the main irrigation schemes of the country. Mahaweli Authority has been a committed partner in the earlier IPM project and in the present IPVM project, and is continuing to implement 'conventional' IPM Farmer Field Schools with its own, though limited, funding. The Anti-malaria Campaign under the central government department of Public Health has so far been involved in the IPVM project by providing advisory functions and by conducting impact studies on mosquito populations.

2.4 Results

To date the project has completed 67 Farmer Field Schools on IPVM benefiting some 1000 individual farmers and their families in a total of 11 villages in 11 districts or Mahaweli systems. The field school participants were commonly neighbouring farmers from one irrigation tract. Women's participation has been 20–30%, which appears to be on the low side, in view of the substantial role of women in rice farming and family health. In each district or system, FFS activities were clustered to gradually cover all farmer families in a village. Clustering was considered necessary for the purpose of achieving area-wide effects on adult mosquito vector populations. Table 2 shows that two locations, Trincomalee and Vavuniya, were dropped earlier on, which was due to the lack of human resources and experience on IPM because of the conflict situation. Puttalam was dropped after several consecutive seasons of drought, despite strong backing by local IPM trainers. The location at Mahaweli H was completed by the long rainy season 2004/05, and was dropped thereafter due to transfer of field staff. In the long rainy season 2004/05, Mahaweli Authority and Southern Province organized upgrading Training-of-Trainer courses for their IPM trainers, with resource persons from the AMC and DOA. Following this training, new IPVM field activities were started in Mahaweli C, Mahaweli G, Matara and Hambantota (Table 2; also refer to Figure 1). Farmer-to-farmer training will be initiated in 2006. The Yala 2005 season was skipped due to drought (Annex 2A).

Table 2 Project locations, with their starting data and date they were discontinued.

	District or system	Village	Started	Discontinued
1	Mahaweli H	Talawa	2002	2005
2	Udawalawe	Kiriibbanwewa	2002	-
3	Monaragala	Buttala	2002	-
4	Matale	Lenadora	2005	-
5	Mahaweli C	Weheragala	2005	-
6	Mahaweli G	Diyabeduma	2005	-
7	Matara	Various villages	2004	-
8	Hambantota	Meegahajandura	2004	-
9	Puttalam	Nawagattegama	2002	2004
10	Vavuniya	Unknown	2002	2003
11	Trincomalee	Unknown	2002	2003

AMC's activities by the RMO and their entomological teams of 6 persons conducted fortnightly surveys in Mahaweli H and Udawalawe in the intervention village and the comparison village at 2–3 km distance. Sampling methods for adult mosquitoes and other aquatic insects were one cattle-baited net trap (to simulate outdoor biting), one cattle-baited hut trap (to simulate in-door biting) in each village, and larval populations were sampled with dippers taken from rice fields, tank beds, seepage pools and peri-domestic environments. Adult and larval mosquitoes were identified by the entomological teams to species level. AMC limited their activities to only few of the field locations, due to constraints of financial and human resources. Initially, the Mahaweli H and Udawalawe locations were covered, but in the former, AMC activities also stopped after the location was dropped. Instead, a new location was initiated in Matale in 2005 with FFS interventions and entomological surveys by the AMC (Annex 2B). AMC's regular activities by the Regional Malaria Officers (RMO) and their entomological teams are routine entomological surveys, community health activities and coordination of spray operations. AMC's future role in IPVM is discussed in section 3.2 and 3.3.

Trainers and farmers conducted a number of field experiments, 46 in total, to address their own research questions related mostly to the effects agricultural practices (planting method, herbicides, insecticides, chemical fertilizers, organic fertilizer) on populations of mosquito vectors and other aquatic insects in rice fields (Annex 2C). There is need to collect and evaluate the results of all these experiments. Since 2005, participatory planning exercises have been facilitated by the project for FFS alumni in 6 locations to allow for further farmer-driven action in accordance with local problems and opportunities.

Costs of a 20-week Farmer Field School on IPVM are US$ 170 per unit for 15-25 participants, or about $10 per farmer. Cost items are the allowance for the trainer, a field day, training materials and farmer refreshments.

As the present project is still considered a pilot activity, the achievements in terms of numbers of field activities have been modest. However, based on the experience acquired from the preceding IPM project, there is scope for expanding the project to a larger number of locations. For example, in 2001 the IPM project conducted 160 IPM Farmer Field Schools in one year. Furthermore, the project has recently started to facilitate participatory planning exercises and field studies for IPVM-FFS alumni to assist the community in deciding on their future course of action related to broader local problems concerning the general well-being of the community. These activities are expected to facilitate farmer-operated community programs which address agricultural problems and human vector-borne diseases.

IPVM – STRENGTHS AND CHALLENGES

3.1 General findings

Field visits by the mission team to IPVM Farmer Field School activities and discussions with IPVM-FFS alumni indicated that farmers have developed their skills to analyze their agro-ecosystems and are able to identify and monitor larval and adult populations of the major mosquito genera (*Anopheles, Culex, Aedes*), and to clearly distinguish between beneficial and harmful insects. These skills allow them to make ecologically sound decisions on the management of vectors, pests and crops (refer to Annex 1). IPVM-FFS graduates have cut down considerably on insecticide use in rice, were aware of the negative impacts of pesticide usage on the agro-ecosystem, and commonly started to incorporate rice straw into the soil to improve soil texture and organic matter content.

Various vector control methods involving environmental and biological control methods were adopted by the IPVM-FFS alumni, contributing to reducing risks of vector-borne disease at the community level. IPVM helped farmers to minimize insecticide inputs, improve productivity, and reduce the health risks associated with their ecosystem management practices. IPVM Farmer Field Schools generated a visible enthusiasm and self-confidence in the farming community. At one site visited, IPVM alumni reported that they proactively approached the anti-malaria staff operating in their area to learn about vector-borne disease issues. Follow-up activities after the IPVM-FFS have recently been started in the project locations but need to be given due attention in the remaining year of the project.

The project is relevant to a number of sectors, and is expected to have various health benefits (see Box 2).

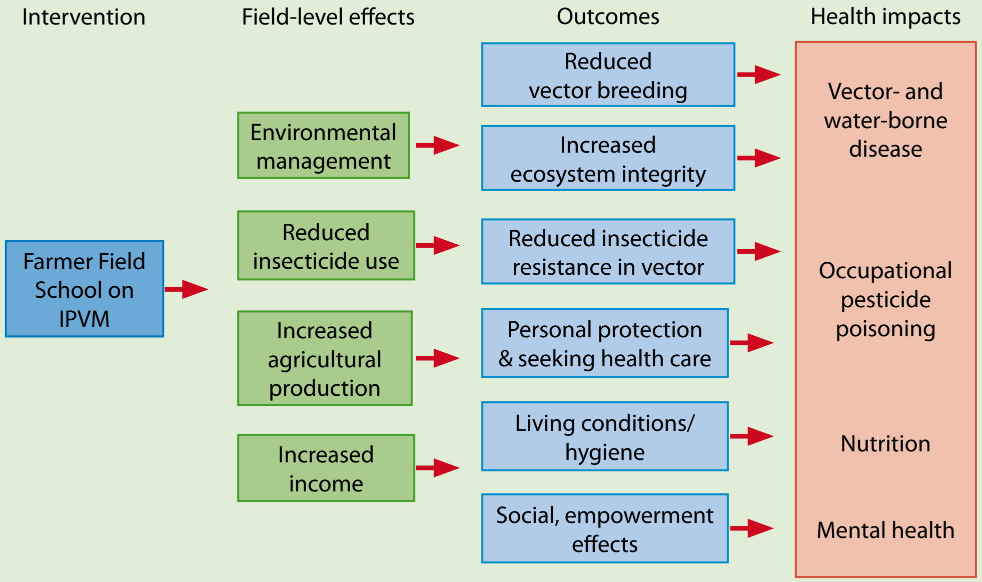
Annex 6 indicates the stakeholders of the project that have already been exposed to IPVM, mostly from the Department of Agriculture, Mahaweli Authority and the Anti Malaria Campaign, but various other potential stakeholders still need to be sensitized about IPVM, including policy makers and directors in sectors of health, agriculture, environment and education. Moreover, at the district level, there are several potential actors in the sectors of health, education and environment which need to be exposed to the project. For example, IPVM is a potential topic for project-based education in secondary schools. In fact, in the previous IPM project, field-based methodology on IPM has been successfully incorporated in the curricula of selected primary and secondary schools, mostly in the Central Province. IPM or IPVM education in schools is of particular significance as children are the most vulnerable to pesticide exposure.

3.2 Convergence between Agriculture and Health

A chronological overview of the activities by the agriculture and health sectors, and when convergence took place between their activities, is provided in Annex 3. During the past

Box 2 Health impacts of IPVM

The diagram below shows possible field-level effects, indirect outcomes and ultimate health effects of Farmer Field Schools on IPVM. IPVM Farmer Field Schools are expected to affect environmental management and crop management practices and thus, income from agriculture. The consequences of these effects are reduced vector breeding, increased ecosystem integrity, reduced risk of insecticide resistance, increased personal protection, living conditions and social and empowerment effects. These outcomes influence health with regard to vector-borne disease, pesticide poisoning, food safety, nutrition and mental health.



decade, IPM Farmer Field Schools have been implemented by the agricultural sector without direct linkages with the health sector. In parallel, the Anti Malaria Campaign has been conducting its own health-related activities. Its regular activities by the Regional Malaria Officers (RMO) and their entomological teams are: (i) routine entomological surveys for the main vector borne disease, (ii) community health activities to distribute bed nets and increase awareness about personal protection, and (iii) coordination of spray operations; the latter activity now being limited to areas with high transmission risk only. Monitoring of pesticide poisoning is the responsibility of the Pesticide Registrar, Department of Agriculture.

The project inception workshop brought together the stakeholders of AMC, DOA and Mahaweli Authority, to jointly discuss project objectives, and decide on the plan of action. In subsequent workshops on curriculum development there was effective cross-sectoral learning among the health and agriculture partners. This learning took place mostly in the field. Health-related exercises for possible inclusion in the IPVM-FFS curriculum were jointly developed and tested by these partners. Following these workshops, the agricultural trainers returned to their own locations for baseline surveys and experimental testing of the new curriculum in their ongoing Farmer Field Schools on IPM. The agricultural trainers were advised to involve Public Health Instructors (PHI) in field activities, but no specific guidance was provided on how to involve the PHI and for which mutual aims. Further fine-tuning of curriculum was always conducted jointly with the AMC partners in subsequent seasonal workshops. However, the actual IPVM-FFS activities in the project locations were implemented exclusively by the agricultural sector with some local involvement of the PHI. Likewise, the entomological surveys and their results were discussed at semi-annual workshops, but at the field level, no convergence of these activities with the IPVM-FFS activities by the agricultural sector took place.

Consequently, there were six-month gaps in convergence between the sectors. The AMC has so far been playing a supplementary role by way of providing advisory services to a largely agriculture-driven project, and by studying the impact of the interventions on mosquito populations in isolation from the agricultural activities. Possibly contributing to this situation, there has been lack of understanding among the agricultural actors about the objectives and strategy of the AMC.

Therefore, the AMC activities need to become better integrated with the project's field activities. This can be achieved by having interactions at common workshops at the field and district levels, and by having a larger AMC representation in central level workshops. In addition, the entomological surveys need to become better synchronized with the IPVM-FFS activities to allow for mutual interactions and mutual benefits. This can be achieved by conducting the entomological surveys only on FFS days, and staying on after the early morning surveys to participate in the FFS session. Also, increasing the intensity of surveys from 14-day intervals to weekly intervals coinciding with weekly agro-ecosystem analysis at the FFS should be considered, although such modification depends on the available funds.

IPVM-FFS sessions are occasionally attended by local Public Health Inspectors (PHI). These actors potentially play a more active role, for example in education on personal protection and pesticide-health risks.

3.3 Vector management through the FFS approach

Despite their different goals of raising agricultural productivity and reducing health risks due to vector borne diseases, the sectors of health and agriculture share the future objective of enhancing the role of rural communities in sound ecosystem management (Figure 2).

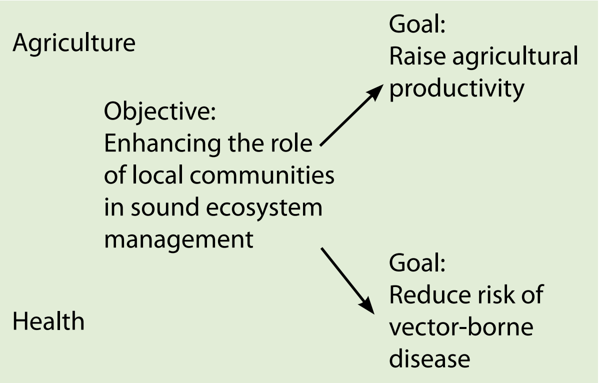


Figure 2: An example of how a shared objective contributes to sectorspecific goals in agriculture and health.

The main challenge for AMC is to internalize IPVM into its own vector-borne disease control strategy. In fact, the AMC has agreed to adopt the following strategy for malaria control: (i) In intensive transmission areas: Insecticide spraying (e.g. Trincomalee); (ii) In intermediate transmission areas: Insecticide-treated bed nets (ITN; mostly long-lasting bed nets); and (iii) In low transmission areas: IPVM Farmer Field Schools as method of risk reduction. There is a prospect to extend the IPVM strategy to intermediate transmission areas because of the demonstrated synergistic effect between IPVM and bed net use (see data on bed net use reported by Yasuoka et al., 2006b).

Furthermore, the current surveillance system of the AMC, aiming to detect early warning signals of disease outbreaks to initiate preventive action, is constrained by limited human and financial resources. The IPVM Farmer Field School approach provides an opportunity to test and/or establish a community-based surveillance system. Farmers have shown that they can identify and monitor larval and adult populations of the three major mosquito genera, *Anopheles*, *Culex* and *Aedes.*

Surveillance could benefit from the involvement of communities by the development of local capability on monitoring and evaluation. This would provide better coverage and intervals of data collection, allowing the AMC to target and evaluate their interventions (e.g., IPVM-FFS; bed nets) more accurately and more timely. Community-based surveillance would also enhance local project ownership and preventive actions taken by local people. Stronger, knowledge-based and sustained community participation in managing disease vectors could also be of utmost importance in the future, should ecosystem disruptions from climate change alter the geographic range (latitude and altitude) and seasonality of specific vector-borne diseases by boosting favourable conditions for mosquito vector populations (WHO, 2003).

3.4 Curriculum on IPVM

The current IPVM curriculum is based on IPM activities. Health-related activities have been added, strictly focusing on vector management. The agricultural operations in wetland rice and the constraints in crop management practices at different crop stages are presented in Annex 4. A comparison of the week-by-week curriculum of Farmer Field Schools on IPM versus those on IPVM is given in Annex 5. The duration of field schools was 16 weeks for IPM and 20 weeks for IPVM, to allow for more time at the beginning of the season which is the time when most mosquito breeding takes place. Modifications recommended by the mission team to improve the current IPVM curriculum are provided. Several modifications to the present IPVM curriculum are discussed in the paragraphs ahead.

The mission team recommended that IPVM-FFS participants are more involved in the tailoring of the curriculum according to their local needs or perceived problems, and that women's participation in the FFS is based on gender roles in activities related to agriculture AND health.

It was also recommended to include exercises on self-assessment of signs and symptoms of acute pesticide poisoning into the IPVM-FFS curriculum. Also, an exercise on household storage and disposal of pesticides was suggested for inclusion (see Murphy et al., 2002). The health risks associated with irrigated agriculture are not limited to vector-borne disease but include the potential harmful effects of agricultural pesticide use, in terms of occupational poisoning and food safety. Other health-related effects of pesticide use are the risk of insecticide-resistance in disease vectors and the destruction of natural enemies (refer to Box 1). Potential resource persons to assist in developing and incorporating these new exercises are the trainees of the 2001 workshop on pesticide exposure and poisoning held in Bandarawela. This participatory methodology has a demonstrated ability to capacitate farmers to monitor the health status in their community resulting in preventive action.

The mission also recommended a broadening of the IPVM-FFS activities to extend the rice-based training to other crops grown by the same rice farmers for which pesticides might also be used. For example, field walks during FFS sessions to observe other crops and utilize the knowledge and skills acquired in rice to these other commodities.

Hence, pesticide-related health risks of farmers are addressed in a more comprehensive way.

The mission team furthermore noted the opportunity for introducing income-generating activities to IPVM-FFS participants, such as vermi-composting, bio-composting, beekeeping, bio-control agent production, paddy-straw mushroom production and food processing. Consideration should be given to have a special topic in at least one FFS session on a selected income-generating activity, for example by inviting an expert farmer on the issue.

A final observation relates to practices of planting and weed management. Driven by a shortage of labour, Sri Lankan rice farmers are increasingly moving from transplanted rice and mechanical weeding towards broadcast-seeded rice and the use of herbicides. The study plots used in the IPVM-FFS are transplanted with rice seedlings and are mechanically weeded but the aspect of weed management is not specifically addressed in the curriculum. The aspect of herbicide application and their possible, but unknown effects of aquatic fauna need further consideration, but this is of lower priority than the above issues.

3.5 Farmer actions after the IPVM-FFS

At the field sites visited, farmers reported that they were practicing a number of non-chemical vector control methods as a consequence of the FFS. Rearing of fish in small water tanks for use in the community was being practiced by several farmers encountered, for release in some water bodies. Also, common vector-control activities in the residential area were the clearing of empty coconut shells and containers, keeping water containers upside down or closed with plastic bags. Concerted group action on sanitation was reported from the Udawalawe location. In the latter location, intermittent irrigation (4 days of watering alternated with 3 days of no water) was administered during the short rainy season by the Mahaweli irrigation authority for distribution of water. Therefore there was apparently no reason for farmers to control mosquito breeding in paddy fields through drainage.

All farmers reported a drastic reduction in their insecticide use as a consequence of their participation in the IPVM-FFS. This is consistent with an impact evaluation study of the IPM project conducted in 2002 which showed a reduction from 2.2 to 0.4 insecticide applications per season attributable to the IPM-FFS (refer to Box 3). Herbicide use was not affected by the IPM-FFS, and it appears that this is also the case for IPVM. Another impact of the FFS was the incorporation of rice straw in the soil practiced individually by alumni, resulting in higher organic matter content, retention of water in the soil and increasing biodiversity and production.

Mosquito nets for beds were present in all houses visited, but were not commonly used in the short rainy season because of high temperatures and because of the relatively low nuisance problem of mosquitoes during that season. Still, the study by Yasuoka et al. (2006b) conducted in the same area recorded that IPVM interventions resulted in a 60% increase in bed net use, indicating an effect on awareness about personal protection. Bed net use has so far not been part of the IPVM curriculum.

Apart from spontaneous activities after the IPVM-FFS, the project facilitated participatory planning exercises to assist the farming community in identifying their problems and causes of these problems, and to develop a strategy and practical work plan for addressing these problems. The project also facilitated farmer experimentation in their own fields by providing a small provision for materials and to cover possible yield loss.

3.6 Evaluating project implementation and impact

Monitoring and evaluation refers to an appraisal of a project's performance as well as its achievements towards reaching its objectives. Conversely, impact evaluation refers to an appraisal of the effects, and sustainability thereof, resulting directly or indirectly from the project activities, and is measured after a project or its local activities have come to an end and baselines are compared to achieved results.

Available data on impact

Initial research findings generated during the IPVM project to date indicate that anopheline mosquito densities were less in the short rainy season when vector breeding habitat is more or less restricted to irrigated fields, but not in the long rainy season when more alternative breeding habitat is available (Table 3). Despite the sketchiness of data (records from three seasons are missing), it is suggested that anopheline densities, and consequently malaria transmission, can most easily be interrupted in the short rainy season through ecosystem management (reduced spraying; improved agronomic and environmental practices).

Table 4 shows larval densities in dipper samples, based on the data by Yasuoka et al. (2006a). Paddy fields, because of their large surface area must have overwhelmingly contributed to adult densities of anophelines and culicines, whereas the *Aedes* species were restricted to residential areas. The agricultural use of insecticides in the early part of the season on aquatic fauna and mosquito population dynamics requires urgent study.

A study at two sites, Mahaweli H and Udawalawe with paired comparison villages, reported an increased knowledge about mosquito ecology and

Table 3 Average seasonal catches of adult Anopheles spp. in a cattle-baited net trap in each of one IPVM intervention village and one comparison village in Udawalawe during four recorded seasons of the IPVM project.

Season*	**Intervention villages**	**Comparison villages**	**Source**
Long rains, 2002/03	749	1,347	Yasuoka et al., 2006a
Short rains, 2003	279	1,232	Yasuoka et al., 2006a
Long rains, 2003/04	600	781	Yasuoka et al., 2006a
Long rains, 2005/06	691	1,016	AMC unpublished data, 2006

Table 4 Larval densities (no. per 144 dipper samples) of three major mosquito genera in five habitat types in two locations during the first 18 months of the IPVM project (Yasuoka et al., 2006a).

Habitat	**Anopheles spp.**	**Culex spp.**	**Aedes spp.**
Paddy fields	111	373	0
Irrigation canals	4	132	0
Seepage pools	125	210	0
Tank beds	67	97	0
Residential areas	11	132	493

disease prevention, changed agricultural practices and vector control actions attributable to the IPVM intervention (Yasuoka et al., 2006b). Also, a 60% increase in the use of mosquito nets in homes, was attributed to IPVM, even though the curriculum did not address bed net use. This indicates an increased awareness and behavioural change about personal protection and safety. Common vector control actions were elimination of breeding sites, applying oil, salt or fish to water bodies (storages/containers), and cleaning up surroundings.

Impact studies of the previous IPM Farmer Field School project (without the vector component) have shown an average reduction from 2.2 to 0.4 seasonal insecticide applications in rice, and a 23% increase in yield (Box 3). The impacts were durable over a period of at least 5 years (van den Berg, Senerath & Amarasinghe, 2002; Tripp, Wijeratne & Piyadasa, 2005). This suggests that Farmer Field School training is a medium- to long-term investment. Outcomes of IPM were not restricted to reduced input costs and

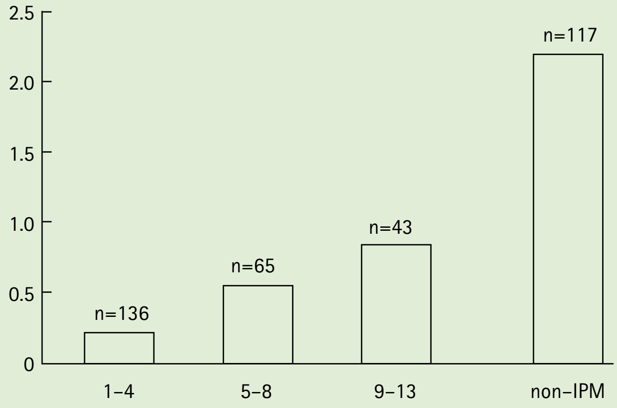
Box 3

Impacts of the IPM-FFS on pesticide use

A large-scale nation-wide impact study of the IPM-FFS project in 2002, which covered 275 IPM sites and 117 comparison sites, found that a 23% yield increase was attributable to the IPM-FFS. Also, the IPM-FFS had a profound effect on the number of pesticide applications. Insecticides were reduced by 81%. The organochlorines chlorpiriphos and dimethoate, and the carbamates carbosulfan and fenobucarb jointly accounted for almost 70% of insecticides used in rice. These chemicals have been classified as hazardous (Class II). Fungicide use was low and was further reduced by FFS training. Herbicide use was not affected by the FFS, and weed-management requires more attention in the training curriculum.

Type of pesticide	Non-IPM	IPM	t test
Insecticides	2.21	0.42	<0.0001
Fungicides	0.24	0.12	0.01
Herbicides	1.21	1.10	not significant

The graph below shows that insecticide applications per season were lowest among the most recently trained farmers (n indicates the number of sites). Applications were slightly higher among farmers trained longer ago, but even among the group trained 9-13 seasons ago, the number of applications was still only 38% the level of non-IPM farmers. This result suggests that the training effect erodes only slowly, with a substantial effect even 4–6 years after the training.



Source: van den Berg, Senerath & Amarasinghe (2002) increased yields. IPM was shown to benefit all assets of rural livelihoods (natural, human, social, physical and financial) and thus helped in alleviating poverty. In particular, farmers developed critical thinking and creativity to start new initiatives. In addition , farmer associations were built in many locations.

As mentioned earlier in the text, Yasuoka et al. (2006a; 2006b) conducted external evaluations of the pilot project. The results refer to the overall impact of IPVM and can be supplemented by an earlier evaluation of the IPM programme in Sri Lanka (van den Berg, Senerath & Amarasinghe, 2002).

The IPVM curriculum as it is provides good guidance for field activities, data collection and analysis, and for decision-making, at the farmer level. But the project still lacks a complete monitoring and evaluation framework to measure its performance.

Need for more precise monitoring and evaluation tools

For these reasons, frameworks for monitoring and impact evaluation were developed and are proposed in Annex 7 and 8. Annex 7 presents the indicators and measurements for monitoring Farmer Field School activities on IPVM to assess the level of implementation of a quality control and monitoring system for ensuring standards in the application of the IPVM in Sri Lanka and in other countries where the approach could be replicated.

Annex 8 presents a proposed framework for impact evaluation, and distinguishes the impact levels of knowledge and skills, resulting in changed practices and effects at the field level, community level and institutional level. At each level of impact, different types of impact are identified, and indicators and methods for evaluating impact criteria are suggested. The framework demonstrates the complexity of a comprehensive evaluation of impact on IPVM. The purpose of the comprehensive framework is to assist in the preparation of an operational plan for an impact assessment study. In a plan, certain types and indicators of impact are prioritized, in accordance with the objectives and clients of the study, and taking into consideration the limitations of human and financial resources for carrying out the study. Some of the indicators and methods in Annex 7 are already being addressed by the IPVM project. Specifically, the AMC is conducting fortnightly entomological surveys on mosquito population densities and keeps records on disease incidence of public health importance, which has been low or nil over the past few years.

A small-scale baseline survey involving 28 farmers was conducted in the new project location in Matale at the end of 2005 to collect socio-demographic characteristics and information on agricultural practices and agrochemical inputs. The baseline was limited in scope. Nevertheless, it is recommended that this baseline is used to establish longitudinal change during clustered implementation of IPVM activities in the coming seasons by revisiting the same farmers again during several seasons after completion of the IPVM-FFS. It is also recommended that baseline studies are started for new project locations, both in the intervention villages and in the comparison villages.

In addition, however, there is need for latitudinal comparisons (IPVM versus comparison villages) to capture an impact on a broader range of issues and from more locations as the project activity expands. Owing to the small size of the present project, all project locations should be covered in a study. Site selection criteria are therefore not yet needed. Selection of individual farmers within an FFS group needs to be conducted randomly (e.g. by selecting every third person from the FFS participant list).

The above paragraphs refer to a centrally developed and operated impact assessment study. It will also be useful to conduct a participatory impact study by involving IPVM-FFS alumni in the evaluation of what they considered impact in their own situation. This type of activity not only strengthens farmer ownership over their local program but also provides new insights into areas of impact that might be missed in externally planned studies. Recommended methodology for participatory impact evaluation is the use of cameras by farmers to capture impact and explain the reason for taking each photograph. This methodology has been previously used in the IPM project in 2002 and could be considered for use to evaluate impact of IPVM (refer to van den Berg, Senerath & Amarasinghe, 2002; Pontius, 2003).

3.7 Expansion and replication

The mission team noted the importance of the clustered IPVM-FFS strategy whereby at least one member of every farmer household in a village participates in an FFS. This will create critical mass needed for disease management. It is further recommended that after government trainers initiate IPVM-FFS in a village, alumni farmers are trained to become FFS facilitators and carry on with further Farmer Field Schools in the village.

To expand the IPVM activities in Sri Lanka, the mission recommends a lateral spread from the present villages towards comparison villages, which should also benefit from the interventions after serving for three years, as comparison. New comparison villages could then be selected at the new frontier of the expanding IPVM area. In addition, but depending on new funding becoming available, new IPVM locations need to be initiated in intermediate and high transmission areas with a similarly clustered implementation of IPVM-FFS to achieve impact on disease transmission. The mission team moreover noted the importance of facilitating follow-up activities after the FFS (for example, participatory planning, action research) to strengthen local project ownership and local initiative.

Hence, more IPVM facilitators are needed. In accordance with the modifications suggested in the curriculum (refer to 3.4), there is scope for training public health staff on facilitation skills and on new educational exercises on reducing health risks related to pesticide use and vector-borne disease.

Besides its suitability under Sri Lankan conditions, IPVM is potentially replicatable in other countries and other regions, as an adaptive educational approach, initially focusing on situations where vector-borne diseases are associated with irrigated rice environments.

3.8 Next steps

Meetings were held in Colombo with (i) Director Anti Malaria Campaign and Director EOH & Food Safety (MOH); (ii) WHO-Sri Lanka staff (Dr Puri, Dr Verma and Dr Tissera) and Director EOH & Food Safety; (iii) FAO Representative. There was a strong overall consensus about the value of the IPVM-Farmer Field School approach to involve local people in evaluating and reducing their health-risks related to vector-borne diseases and agro-chemical pesticides. The need for further data on effects and impacts was emphasised upon.

It was also agreed that sensitization within the Ministry of Health and interaction with counterparts of Agriculture at top levels is a priority. WHO proposed the following plan: The Director EOH, who had joined the mission team's field visits, would introduce IPVM at a session of the Health Development Committee Meeting, and at the same time announce a brief seminar on IPVM. The seminar will bring together major players from the Health Ministry, and Provincial directors of Health, and representatives from the Ministry of Agriculture, Mahaweli Authority, FAO and alumni farmers to discuss the value of IPVM and to identify common objectives and possible synergistic effects to the different stakeholders. The WHO agreed to organize and sponsor the seminar, a timeframe for which would have to be agreed upon soon.

In parallel, WHO-SEARO will support the production of a short video film on IPVM in Sri Lanka targeted at policy makers. The mission findings and the video will serve as inputs to the regional IVM workshop, planned for October 2006, probably in Pondicherry, India, to discuss prospects for replication of IPVM in other countries.

CONCLUSIONS

4.1 Conclusions

i) The project is on the right track, and the mission's findings suggest that farmers can become masters in analyzing their agro-ecosystems, including the vector component.

ii) The IPVM-FFS intervention results in drastic reductions in insecticide use in agriculture.

iii) Sustained environmental control of mosquito breeding is being practiced by IPVM alumni, mostly in the peri-domestic environment, contributing to risk reduction of vector-borne diseases at the community level.

iv) Use of Mosquito nets has reportedly increased after IPVM-FFS participation, which suggests that IPVM amplifies the benefits of public health services , that the approach improves public health and general well being, and could also play a key role in the performance of programmes such as "*Roll Back Malaria*", amplifying the benefits for public health delivery services.

v) IPVM alumni are empowered to proactively approach specialised health teams on issues related to vector-borne diseases, creating opportunities for better integration of community health programmes.

vi) The Anti Malaria Campaign has initially played a supplementary role in the IPVM project, but is agreeing to adopt IPVM as prevention strategy in low transmission areas.

vii) Convergence between health and agriculture sectors has come a long way, but needs to be further strengthened, at the field level and district level.

RECOMMENDATIONS

5.1 Recommendations

i) Document and publicize the results and effects of the IPVM project, e.g. by the preparation of a video film and presentations at national and international workshops.

ii) There is a need to further develop the existing monitoring and evaluation framework to ensure evidence-based recording of the project's performance.

iii) Involve more health staff at the local, division and district levels, notably the Public Health Instructors, as well as other stakeholders (school teachers, FBOs and NGOs) in field activities and workshops.

iv) Increase convergence between the entomological surveys and the Farmer Field Schools to optimize interaction and mutual benefits of these activities at the field level.

v) Collect data on the outcomes, effects and impacts of IPVM. Also, studies are needed on the effects of agricultural use of pesticides on mosquito population dynamics.

vi) Expand the curriculum to include health risks due to acute pesticide poisoning, and to include other crops grown by rice farmers where pesticides are used. Moreover, a participatory assessment of local problems is needed before the FFS as a basis for tailoring the curriculum to meet local needs.

vii) Carry out sampling of marketed food items to analyze the concentration of chemical residues before and after the IPVM interventions.

viii) Sensitize policy makers of the health, agriculture and other sectors and facilitate discussion about common objectives related to IPVM to jointly develop a final IPVM curriculum.

ix) Involve communities in the surveillance of mosquito vector populations and develop a community-based surveillance system to provide better coverage and intervals of data collection and to enhance the ownership of rural people in the evaluation and preventive action for vector-borne disease control.

x) Explore possibilities to integrate IPVM as part of the response package to reduce the potential increase in burden of disease from disease vectors due to climate change impacts.

Besides its suitability under Sri Lankan conditions, IPVM is potentially replicable in other countries (India, Myanmar, DPRK, Thailand) and other regions, definitely as an adaptive educational approach, initially focusing on situations where vector-borne diseases are associated with irrigated rice environments. This perspective would inscribe itself in the implementation of the 2020 Global Plan of Action of the Strategic Approach to International Chemicals Management (SAICM).

ANNEX 1.
PHOTO REPORT OF FIELD VISITS

International mission members discussing plant defoliation experiment with Director Environmental & Occupational Health and Deputy Director Plant Protection (left), and discussing IPVM agro-ecosystem analysis methods with farmers (right); Monaragala.

Farmers taking AESA samples in rice through direct observation, counting and measurements, tusing soup spoons as dippers for mosquito sampling in Monaragala.

Farmers preparing agro-ecosystem drawing based on their field observations with conclusions on management decisions, for presentation to the group.

Left: Agro-ecosystem analysis drawing by farmers displaying crop condition, weather, water availability, beneficial and plant feeding insects, aquatic insects including mosquito larvae and weeds at a particular week in the crop cycle, with an explanation of the main findings and decision on management actions needed in the coming week.

Right: A farmer presenting results of Agro-ecosystem analysis in IPVM and conventional field plots to the group of farmers, resulting in decision-making on management of the crop system and the vector component in the coming week.

Map of the Udawalawe location in the village of Kiriibbanwewa, showing rice tracts (in green) covered by IPVM Farmer Field Schools (the right portion of the map), residential areas (in red) and rice tracts not yet covered or being covered by IPVM FFS (on the left). The comparison village is positioned approximately 3 km from this village.

Water jars used by farmers to study the behaviour and lifecycle of aquatic insects. These jars contained anopheline mosquitoes (larvae, pupae and emerging adults), culicine mosquitoes and fish predators feeding on mosquito larvae.

IPVM alumni farmers staging a drama on mosquito nuisance, disease transmission, and environmental control methods.

Discussion about a participatory planning exercise by IPVM alumni farmers to analyse causes and effects of local problems, identify possible solutions and develop a work plan for community action.

Mission team members discussing entomological data with AMC entomological team at new project location in Matale.

AMC staff in Matale displaying cattle-baited net trap used for adult mosquito sampling. One trap is used in the centre of the intervention village and one in the comparison village. The other type of trap used is the cattle-baited hut trap. The former trap is considered better for catching outdoor biting mosquitoes, the latter for indoor biting mosquitoes.

Facilitator in IPVM field school session in Matara district introducing a special topic on mosquito identification and sampling at the beginning of the season in the wet zone of Sri Lanka.

Farmer explaining results of his own research based on observations of pest/predator interactions

ANNEX 2.
FIELD-LEVEL ACHIEVEMENTS OF THE PROJECT TO DATE

A. Farmer Field Schools on IPVM

Number of Farmer- Field -Schools on IPVM implemented in project locations per season

	District or system	Village	Yala 02	Maha 02/03	Yala 03	Maha 03/04	Yala 04	Maha 04/05	Yala 05**	Maha 05/06	Yala 06
1	Mahaweli H	Talawa (D)	1	3	3	4		3			
2	Udawalawe	Kiriibbanwewa	1	3	3	3	1	3		1	1
3	Monaragala	Buttala	1	2		2	2	2		2	1
4	Matale	Lenadora (N)								1	1
5	Mahaweli C	Weheragala (N)								1	1
6	Mahaweli G	Diyabeduma (N)								1	1
7	Matara	Various villages (N)						2		2	2
8	Hambantota	Meegahajandura (N)						2		1	1
9	Puttalam	Nawagattegama (D)	1	2	1	1					
10	Vavuniya	Unknown (D)	1	1	1						
11	Trincomalee	Unknown (D)	1								

B. Entomological surveys by the AMC

Fortnightly surveys of mosquito vectors conducted by the AMC in project villages and paired comparison villages, indicated by 'X'.

	District or system	Village	Yala 02	Maha 02/03	Yala 03	Maha 03/04	Yala 04	Maha 04/05	Yala 05**	Maha 05/06	Yala 06
1	Mahaweli H	Talawa (D)	X	X	X	X					
2	Udawalawe	Kiriibbanwewa		X	X	X	X	X	X	X	X
3	Monaragala	Buttala									
4	Matale	Lenadora (N)								X	X
5	Mahaweli C	Weheragala (N)									
6	Mahaweli G	Diyabeduma (N)									
7	Matara	Various villages (N)									
8	Hambantota	Meegahajandura (N)									
9	Puttalam	Nawagattegama (D)									

C. Field studies

Field experiments by trainers and/or farmers on the effects of agricultural practices on populations of mosquitoes and other aquatic insects

	District or system	Village	Yala 02	Maha 02/03	Yala 03	Maha 03/04	Yala 04	Maha 04/05	Yala 05**	Maha 05/06	Yala 06
1	Mahaweli H	Talawa (D)									
2	Udawalawe	Kiriibbanwewa			3	3	1	4		1	1
3	Monaragala	Buttala			1	2	2	2		2	2
4	Matale	Lenadora (N)								1	1
5	Mahaweli C	Weheragala (N)				1				1	1
6	Mahaweli G	Diyabeduma (N)								1	1
7	Matara	Various villages (N)						1		2	2
8	Hambantota	Meegahajandura (N)						2		2	
9	Puttalam	Nawagattegama (D)			3	1		1			
10	Vavuniya	Unknown (D)			1						

ANNEX 3.
OVERVIEW OF CONVERGENCE

Convergence of activities between agriculture and health sectors within the IPVM project. The centre column indicates activities where convergence occurred.

Timeline	Activities by Agriculture	Convergence of activities	Activities by Health
Before 2002	Farmer Field Schools on IPM and crop management	Talawa (D)	Routine entomological surveys; Community health activities; Insecticides application for vector control in high-risk areas
2001		Project development activities initiated jointly by project stakeholders	
Mar 02		Inception workshop: Stakeholders agreed on IPVM objectives and action plan	
Apr 02 *May 02*		Curriculum development workshops: AMC and agricultural partners involved in cross-sectoral learning in the field; joint experimentation with new training tools	
May 02	Survey on farmer knowledge/ perceptions by trainers in their own respective locations		
Jun-Jul 02	Field testing of new curriculum by IPVM trainers in their own specific locations		
Aug 02 (and again in Apr 03)		Technical workshops: Jointly fine-tuning of IPVM curriculum; discussion of entomological surveys	

Timeline	Activities by Agriculture	Convergence of activities	Activities by Health
Nov 02 - Feb 03	Farmer Field Schools on IPVM by agricultural trainers		Entomological surveys in intervention and control villages
Beginning of every season starting Apr 03		Seasonal planning workshops: Sharing of results of FFS and field experiments; separate planning by Agriculture and Health	
Every season	Farmer Field Schools on IPVM by agricultural trainers; occasionally attended by Public Health Inspector		Entomological surveys in intervention and control villages

ANNEX 4.

AGRICULTURAL OPERATIONS IN RICE

Agricultural operations

Agricultural operations and constraints in wetland rice crop management practices in relation to the FFS sessions and crop age. Refer to the corresponding FFS curriculum in Annex 5.

DAS*	Crop Stage	Agricultural Operations	Constraints in crop management practices
-35	n/a	n/a	n/a
-28	n/a	n/a	n/a
-21	n/a	Impound water to fields	Delayed water issuance; delayed rain
-14	Land preparation	First ploughing	Shallow ploughing depth
-7	Land preparation	Second ploughing; after 6 days: puddling, levelling and basal application of fertilizers	Short interval between first and second ploughing leading to poor weed control; unleveled field plots
0	Crop establishment	Sowing or transplanting; after 3 days: irrigating	High or uneven plant density; sub-optimal basal application of fertilizers; decline in transplanting practices; opportunities for mosquito vector proliferation; unleveled field plots
7	Seedling		Opportunities for mosquito vector proliferation; prophylactic application of insecticides
14	Tillering	Drainage; weed control; first top dressing	Dependency of chemical herbicides; prophylactic application of insecticides; opportunities for mosquito vector proliferation
21		Second weeding; irrigation	Sometimes second herbicide application; dependency on insecticides; opportunities for mosquito vector proliferation
28			Opportunities for mosquito vector proliferation; dependency on insecticides
35		Pest management; second top dressing	Dependency on chemical insecticides for insect control; improper timing and dosage of urea
42	Panicle initiation	Pest management, irrigation	Dependency on chemical insecticides for insect control

DAS*	Crop Stage	Agricultural Operations	Constraints in crop management practices
49	Booting	Pest management, irrigation	Same as above
56		Pest management	Same as above
63		Pest management	Same as above
70	Flowering	Third top dressing	Dependency on chemical insecticides for insect control; improper timing and dosage of urea
77	Ripening		Dependency on insecticides for rice bug control
84			Same as above
91			Poor drainage
98			None
105	Mature	Harvesting	None
112	None	None	None

* DAS = Days after sowing.

ANNEX 5.
CURRICULUM ON IPM VERSUS IPVM

Comparison of the curriculum of farmer field schools on IPM versus IPVM, and suggested additions or modifications to improve the IPVM curriculum. The time-specific FFS activities can be related to crop stage and agricultural operations by referring to the corresponding time scale in Annex 4.

DAS *	FFS **	Description of IPM FFS activities	FFS **	Description of IPVM FFS activities	Suggested modifications
-35					Develop M&E implementation plan; Selection of villages; Engage local agric. & health authorities & schoolteachers; Participatory baseline survey
-28				Pre-FFS meeting: Selecting of FFS group and participants, explaining FFS program, identifying local needs, baseline survey	No baseline survey
-21			1	Determining curriculum, identifying experimental plots, incorporating rice straw and/or other organic matter	Add: consolidating curriculum with FFS participants according to local needs
-14			2	Exercises: Identification of mosquito larvae (*Anopheles*, *Culex*); begin larval sampling	No modification
-7		Pre-FFS meeting: Selecting of FFS group and participants, explaining FFS program, identifying local needs, identifying experimental plots, incorporation of rice straw and other organic matter	3	Laying out field plots for studies; mosquito larval dipper sampling in ploughed fields; determining curriculum; determining seed rates and basal fertilizer for field plots	No modification

DAS *	FFS **	Description of IPM FFS activities	FFS **	Description of IPVM FFS activities	Suggested modifications
0	1	Laying out field plots, determining curriculum, determining seed rates & basal fertilizer for field plots.	4	Larval sampling in paddy fields; identification of mosquito genera facilitated by AMC Officers	Add: special topic on vector-borne disease cycle including transmission Add: assignment to study the life cycle of mosquitoes at home
7	2	Introduce agro-ecosystem analysis (AESA); collection and identification of natural enemies and plant feeding insects; group dynamic exercise; special topic on growth stages of rice plant and nutrition	5	Introduce agro-ecosystem analysis (AESA); collection and identification of natural enemies and plant feeding insects; larval mosquito sampling; group dynamic exercise; special topic on mosquito types and identification of larvae and adults	Add: presentation of results of life cycle study
14	3	AESA activities (field observations, drawing, analysis, group presentation, discussion); introduction of mechanical weed control; group dynamics exercise; special topic on weed control and fertilizer requirement for first top dressing	6	AESA activities (field observations, drawing, analysis, group presentation and discussion); larval mosquito sampling; mechanical weed control; group dynamic exercise; exercise on larval predation by aquatic natural enemies; special topic on weed control & fertilizer requirement for first top dressing	Add: village walk to identify mosquito breeding places in the surrounding environment; management practices to eliminate vector breeding
21	4	AESA activities; initiate field studies on defoliation & detillering; group dynamics exercise; special topic on leaf eating caterpillars	7	AESA activities; larval sampling; initiate defoliation & detillering studies; group dynamics exercise; special topic on growth stages of rice plant and early pests and their management; assignment to study the lifecycle of mosquitoes at home	Add: introduction of cup studies on predation of mosquitoes and assignment of cup studies at home Remove: assignment on life cycle study
28	5	AESA activities; maintenance of field studies; group dynamics exercise; special topic on internal feeders	8	AESA activities; maintenance of field studies; larval mosquito sampling; group dynamics exercise; presentation of life cycle study results; special topic on rice internal feeders and their management; introduce cup studies on predation	Add: presentation of results on cup studies on predation Remove: presentation on life cycle study

DAS *	FFS **	Description of IPM FFS activities	FFS **	Description of IPVM FFS activities	Suggested modifications
35	6	AESA activities; maintenance of field studies & cup studies; group dynamics exercise; fertilizer requirement for second top dressing; special topic on brown planthopper management and its natural enemies	9	AESA activities; maintenance of field studies; group dynamics exercise; fertilizer requirement for second top dressing; special topic on vector-borne diseases and transmission	Add: Special topic on self-assessment of signs and symptoms of acute poisoning Remove: special topic on vector-borne diseases
42	7	AESA activities; maintenance of field studies; group dynamics exercise; inspect plants for panicle initiation; special topic on booting stage and water requirement	10	AESA activities; maintenance of field studies; larval mosquito sampling; group dynamics exercise; inspect plants for panicle initiation; special topic on booting stage and water requirement	No modification
49	8	AESA activities; maintenance of field studies and cup studies; group dynamics exercise; inspect plants for panicle initiation; special topic on paddy bug management and its natural enemies	11	AESA activities; maintenance of field studies; larval mosquito sampling; group dynamics exercise; inspect plants for panicle initiation; special topic on paddy bug management and its natural enemies	Add: village walk to observe other crops and home gardening by participants to discuss pest management issues
56	9	AESA activities; maintenance of field studies and cup studies; group dynamics exercise; special topic on flowering, pollination and fertilization	12	AESA activities; maintenance of field studies & cup studies; larval mosquito sampling; group dynamics exercise; special topic on flowering, pollination and fertilization; village walk to identify mosquito breeding places in the surrounding environment	No modification
63	10	AESA activities; maintenance of field studies & cup studies; group dynamics exercise; special topic on ripening phase	13	AESA activities; maintenance of field studies and cup studies; larval mosquito sampling; group dynamics exercise; special topic on ripening phase; assignment to examine vector breeding places in their own gardens and homes and list them	No modification

DAS *	FFS **	Description of IPM FFS activities	FFS **	Description of IPVM FFS activities	Suggested modifications
70	11	AESA activities; maintenance of field studies and cup studies; group dynamics exercise; special topic on the importance and rate of the third top dressing	14	AESA activities; maintenance of field studies and cup studies; larval mosquito sampling; group dynamics exercise; special topic on the importance and rate of third top dressing; reporting of results on mosquito breeding places; management practices to eliminate breeding	No modification
77	12	AESA activities; maintenance of field studies and cup studies; group dynamics exercise; special topic on maintaining purity of rice varieties	15	AESA activities; maintenance of field studies & cup studies; larval mosquito sampling; group dynamics exercise; special topic on maintaining purity of rice varieties	Add: village walk to observe other crops and home gardening by participants to discuss pest management issues
84	13	Maintenance of field studies & cup studies; group dynamics exercise; special topic on varieties of rice	16	Maintenance of field studies & cup studies; larval mosquito sampling; group dynamics exercise; special topic on varieties of rice	Add: special topic on household storage and disposal of pesticides Remove: special topic on varieties of rice
91	14	Maintenance of field studies & cup studies; group dynamics exercise; special topic on producing good seed paddy	17	Maintenance of field studies & cup studies; larval mosquito sampling; group dynamics exercise; special topic on producing good seed paddy	No modification
98	15	Analyzing data on productive and non - productive tillers, pest & natural enemy counts, population fluctuations, etc.	18	Analyzing data on productive and non - productive tillers, pest & natural enemy counts, population fluctuations, etc. Examine mosquito breeding places in irrigation canals	Add: special topic on income generating activity, e.g. composting, poultry, beekeeping, bio-agent production, paddy straw mushroom production, food processing
105	16	After harvesting of study plots: analyzing of data on crop yields, natural enemies, pests, etc.	19	After harvesting of study plots: analyzing of data on crop yields, natural enemies, pests, etc.	Add: marketing and/or value addition of produce
112			20	Post-FFS meeting to discuss / obtain feedback from farmers and reinforce IPVM practices	No modification

* DAS = days after sowing; ** FFS = number of weekly FFS session

ANNEX 6.
PRESENT AND POTENTIAL STAKEHOLDERS IN IPVM

Bold text indicates stakeholders that have been exposed (either in the field or in meetings) to the IPVM Project. Text in italics indicates potential stakeholders that have so far not been exposed to the project.

Discipline/sector

Level

<table>
<tr><th></th><th colspan="2">Agriculture</th><th>Mahaweli settlements *</th><th colspan="2">Health</th><th>Environment</th><th>Education</th><th>Administration</th></tr>
<tr><td>Super</td><td colspan="2">Minister,
FAO</td><td>Minister</td><td colspan="2">Minister,
WHO</td><td>Minister,
UNDP,
UNEP</td><td>Minister,
UNICEF</td><td rowspan="4"></td></tr>
<tr><td>Policy</td><td colspan="2">Secretary</td><td>Secretary</td><td colspan="2">Secretary</td><td>Secretary</td><td>Secretary</td></tr>
<tr><td>Department</td><td colspan="2">DG
Aariculture</td><td>DG
Mahaweli</td><td colspan="2">DG Health Services,
Dy DG Public Health Services</td><td rowspan="2">Chair National Environment Authority</td><td rowspan="2">DG
Education</td></tr>
<tr><td>Division</td><td>Plant Protection</td><td>Extension</td><td>Director Aqricultural Development</td><td>Dir EOH & Food Safety; other directors</td><td rowspan="2">Dir Anti Malaria Campaiqn</td></tr>
<tr><td>Provincial</td><td colspan="2">Prov. Dir Aariculture</td><td>Resident Proiect Manaqer</td><td>Prov.Dir Health Services</td><td rowspan="2">DyDir Environment</td><td>Prov.Dir Education</td><td>Chief Minister,
Chief Secretary</td></tr>
<tr><td>District</td><td colspan="2">Dv Dir Aqriculture</td><td>Block Manaqer</td><td>Regioml Dir Health Services</td><td>Reqional Malaria Officer</td><td>DyDir Education</td><td>Distr Secretary</td></tr>
<tr><td>Segment/ division</td><td colspan="2">Asst Dir Aqriculture
Subiect Matter Specialists</td><td>Unit Manaqer</td><td>Medical Officer of Health</td><td>Survey team</td><td rowspan="2">Divisional Environment Officer</td><td>Divisional Dir Educ, Asst Dir (per discipline)</td><td>Divisional Secretary</td></tr>
<tr><td>Local</td><td colspan="2">AariculturalInstructors
IPM trainers</td><td>Field Assistants</td><td colspan="2">Public Health Inspectors; midwives</td><td>School principals, teachers</td><td>Grama Niladari (Village Head)</td></tr>
<tr><td>Field</td><td colspan="8">FARMING COMMUNITIES</td></tr>
</table>

*For Mahaweli Authority: provincial level = system level; district level = block level; segment level = unit level; local level = FA level

ANNEX 7.
PROPOSED INDICATORS FOR MONITORING FIELD ACTIVITIES

Category	Aspect	Indicators and measurements
General	Pre-FFS meeting	Did it take place? Number of participants; number of women
	When was first FFS session?	Indicate number of weeks before the time of planting
	Meeting place	Type (under the shade of a tree, shelter, house, school)
	Distance meeting place from field plot	In metres
	FFS field plots	Presence; area (m^2)
	IPVM plot	Transplanted/ seeded; rice straw incorporation (Yes/ No); type of weeding practiced
	Farmer practice plot	Genuine farmer practice or follows IPVM treatment?
People	FFS participants present	Number of persons attending FFS session
	Women participation	Number; involvement in aspects on agriculture/ health
	Public health inspector presence	Yes/No
	AMC staff present	Yes/No
	District or divisional staff present	Indicate
	Potential farmer trainers	Number of participants with qualities of FFS facilitator if given the opportunity of additional training
Materials	Refreshments	Available/provided; adequacy
	Stationary	Available/provided; adequacy (writing pads, pens, newsprint paper, colour markers; measuring ruler)
	Mosquito-related materials	Available/provided; adequacy (soup spoons as dippers, plastic cups, plastic containers, sweep nets)

Category	Aspect	Indicators and measurements
Activities	Field observations	Number of sub-groups; number of participants enter the paddy field for observations
	AESA drawing	Indicate aspects in drawing viz., plant, water level, natural enemies, pests, mosquitoes, weeds, weather condition, management decisions
	AESA presentation	Do participants take turns in presenting AESA data? Do women present? Is IPVM compared with the farmer practice? Is there a discussion after each presentation?
	Special topic	Takes place (Yes/No); type; relevance to crop stage; quality of process (e.g. lecture or discovery learning exercise?)
	Group dynamics exercise	Takes place (Yes/No); name of exercise; is explanation / interpretation of the exercise conducted?
	Defoliation & detillering trial	Practiced; quality (number of rice hills, treatments)
	Cup studies	Are cups or containers used by participants for home assignments on life cycles or predation studies?
	Miscellaneous activities	Give descriptions
Other	Facilitator	Does the facilitator enter the paddy field? Does facilitator provide ready answers/ instructions/ lectures? Are participants encouraged to find out the answers by themselves? Is there a lively interaction with participants?
	General atmosphere	Describe (e.g. formal, cheerful, indifferent, motivated)
	Starting time of FFS session (hr)	Time
	Duration of FFS session (hours)	Hours

ANNEX 8.
PROPOSED FRAMEWORK FOR IMPACT ASSESSMENT

Impact level	Impact type	Indicators	Methods
Knowledge and skills	Knowledge about agro-ecology	Able to identify pests, natural enemies, plant nutritional requirements; understand biology, functional relationships, nutrient cycles	Semi-structured questionnaire
	Knowledge about vector ecology, disease cycles and transmission	Able to identify mosquito genera; understand vector biology, breeding, and transmission and reservoir of disease	Semi-structured questionnaire
	Knowledge about pesticide effects	Knows toxicity categories; aware of effects on health and environment; aware of alternatives to pesticides (plant-based or biological products)	Semi-structured questionnaire
	Crop management skills	Knows appropriate agronomic practices and pest management decision-making	Open questionnaire
	Vector management skills	Knows when, where and how to eliminate vector breeding	Open questionnaire
	Critical analytic skills	Knows how to analyze complex agro-ecosystem data resulting in evidence-based decision-making; knows how to experiment; understands farm-level economic analysis	Open questionnaire
	Social skills	Ability to express and communicate views; understands the importance of collective action	Open questionnaire

Impact level	**Impact type**	**Indicators**	**Methods**
Change in practices	Improved crop management	Number of ploughings; rice straw incorporation in soil; balanced fertilizer application; planting method; weeding method; irrigation and drainage; farmers conduct economic analysis	Semi-structured questionnaire
	Pesticide use	Frequency, amount and type of pesticide; toxicity category of pesticides; mixing; targeting of pests; facility for household storage; disposal of pesticides	Semi-structured questionnaire; local pesticide outlet sales
	Vector management activities	Type of water storage structures/bodies drained or eliminated; frequency of actions; scale of operations; number of containers, coconut shells etc.	Open questionnaire
	Personal protection	Use of mosquito nets for beds by family members; use of repellents (plant-based; chemical)	Semi-structured questionnaire
	Innovations	New practices of crop management or vector management	Open questionnaire; interviews
	Change on social/political relations	Communicate IPVM with other stakeholders; engage in cooperative action on the management of vectors or crops	Open questionnaire; interviews
Field level effects	Agricultural production	Crop yield; quality of produce; pesticide residues in produce; marketability	Semi-structured questionnaire
	Vector larval and adult densities	Dipper samples of larval densities in various habitats; adult mosquito catches	AMC data; community driven surveys
	Ecosystem integrity	Density and diversity of aquatic fauna and fauna above the water surface; organic matter content in soil	AESA data; trainer studies
	Economic benefits	Input costs; labor cost; opportunity cost; sale of produce	Semi-structured questionnaire

Impact level	Impact type	Indicators	Methods
Community level impacts	Collective action for pest or vector control	Number of people involved; frequency and type of actions	Open questionnaire; interviews
	Change in gender roles	Women's role in decision-making on vector control or personal protection; women's role in field activities and concerted activities	Stratification of all data for gender; interviews
	Incidence of vector-borne disease of public health importance	Number of locally reported cases	Local hospital registry and laboratory data; AMC data
	Incidence of pesticide poisoning	Incidence of signs and symptoms among farmers and spray operators; incidence of poisoning at the household level; re-use or disposal of empty containers; chemical residues on food	Local hospital registry and laboratory data; community-driven surveys
Change at the institutional level	Increased inter-sectoral collaboration and integration	Joint workshops; joint field visits; integration of field activities	Documentation; interviews
	Change in immediate objectives, implementation strategy, policies	New activities; new regulations; job descriptions; budget allocations; involvement of public health inspectors	Documentation; interviews
	Impact on research agenda	Trans-disciplinary research initiated; field visits by researchers; researcher-farmer interactions; farmer participation in research forums	Documentation; interviews

ANNEX 9.
LITERATURE CONSULTED

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ANNEX 10.
MISSION PROGRAMME

Day	Date	Activity
Fri	9-Jun-06	Travel HvdB
Sat	10-Jun-06	Travel AvH
Sun	11-Jun-06	Travel PKD & VR
Mon	12-Jun-06	Meet with WHO, FAO; PM travel to Kandy
Tue	13-Jun-06	Meet with stakeholders at Plant protection, DOA Seminar on IPVM at PGGI, Peradeniya PM: travel to Embilipitiya
Wed	14-Jun-06	Visit Kiriibbanwewa field location (FFS alumni), meet local partners, discussions
Thu	15-Jun-06	Visit Monaragala field location (ongoing FFS); PM: travel to Kandy
Fri	16-Jun-06	Visit Matale field location (ongoing FFS), visit AMC activities; PM: debriefing with major stakeholders in Kandy
Sat	17-Jun-06	AvH departs; Discussion, reporting
Sun	18-Jun-06	PKD & VR Depart; HvdB travel with counterparts to Matara field locations
Mon	19-Jun-06	AM: Visit Seenipella field location; PM: visit Tallale field location (alumni)
Tue	20-Jun-06	Travel to Colombo; PM: meet with FAO Representative
Wed	21-Jun-06	Meeting with Director Anti Malaria Campaign and Director Environmental & Occupational Health and FAO; reporting
Thu	22-Jun-06	Presentation of mission findings and planning of next steps at WHO; reporting
Fri	23-Jun-06	Reporting
Sat	24-Jun-06	HvdB departs

Mission members:
AvH = A von Hildebrand; PKD = P K Das; VR = V Ragunathan; HvdB = H van den Berg

ANNEX 11.
CONTACT DETAILS AND PERSONS MET

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