

Country reports

on the Status of Integrated Pest Management (IPM)

STATUS OF INTEGRATED PEST MANAGEMENT (IPM) IN BANGLADESH

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Summary

IPM provides a long term approach for minimizing crop losses caused by pests with least possible cost to the farmers and without adverse environmental impact. Now a day, IPM has been considered as one of the best method in this regard. In Bangladesh, IPM embodies the total crop production system. The IPM training provided to farmers by different projects is contributing not only in the development of human resources and empowering farmers in decision making on crop management but also contributes to reduce poverty of the poor and marginal farmers through the reduction of production cost and also by increasing crop yield on sustainable basis. The use of harmful pesticides has been reduced much as the farmers practice IPM in their fields, which in turn, enhanced the production level and improve the environment and the public health. Safe food production through IPM approach created a great enthusiasm among the producers and consumers under the direct and positive guidance of the different projects in Bangladesh. The farmers feel encourage in regular field visit and become expert in decision making for crop management. IPM club helps in spreading IPM activities among the neighboring farmers. Pesticide free crop production is now become popularized among the farmers and consumers in Bangladesh.

Key words: *Environmental impact, Development of human resources, Empowering farmers in decision making, IPM approach, Pesticide free crop production.*

Fact and figures of the country national IPM programme

Operational since: 1981 Concept IPM introduced through FAO's Inter-Country IPM programme with FFS training on rice.

Implementing agency:

- Department of Agricultural Extension (DAE)
- Bangladesh Agricultural Research Institute (BARI)
- Bangladesh Agricultural Research Council (BARC)
- Bangladesh Agricultural University (BAU)
- Cotton Development Board (CDB)
- Bangladesh Water Development Board (BWDB)
- CARE Bangladesh
- AID Comilla

Key partner institution: DANIDA, Research Organization, NGOs.

Government funding and donors:

- FAO and its donors (Netherlands, Australia)
- UNDP
- DANIDA (Present)

- European Union (EU)
- USAID (Present)
- DIFID
- Asian Development Bank
- International Fund for Agricultural Development
- Government of Bangladesh (Present)
- CARE.

FFS conducted: Approximately 37,000

Farmers trained: ± 925,000 (10-20 % female)

Trainers active: 1200 DAE trainers (2% female), 2000 Farmer Trainers (7% female)

Main crops in which IPM interventions are focused: Rice, Vegetables (Eggplant, Cucurbits, Beans, Cabbage, cauliflower & potato), Cotton and Fruits (Mango, Litchi, Guava, Banana & Papaya)

Introduction

Agriculture is the main economic backbone of Bangladesh which contributes about 24% to the country's gross domestic product (GDP). About 75% of the 152 million population of Bangladesh are dependent on agriculture for their livelihood. For the first time in 1956, Bangladesh used three Metric tons of pesticides to control insects and diseases. After that the pest management in Bangladesh was heavily dependent upon the use of chemical pesticides. At the initiative of the Food and Agricultural Organization (FAO) IPM activities started in Bangladesh in 1981

PART I: Historical perspectives

1. Crop production

Bangladesh is one of the most densely populated countries in the world, with an economy dependent largely on agriculture. Agriculture provides about 19.29% of the gross domestic product (GDP) (BBS 2012). In Bangladesh 01 percent land is going beyond agriculture per year. Although at present our annual food production is 37million metric tons and side by side another 20 lakh new mouths are adding in our population every year. In the last 40 years from 1970-71 to 2010-11, there has been 350 percent increase in food production. Within the crop sub-sector food grains, particularly the rice crop dominates in respect of both area and production. At present, rice covers about 75 percent of the cultivated land in Bangladesh. Area coverage by other crops are: pulses 4.64 percent, wheat 3.92 percent, oilseeds 3.77 percent, jute 3.71 percent, sugarcane 1.23 percent, potato 2.11 percent, fruits 2.84 percent and vegetables 2.39 percent. Thus growth of rice crop has got substantial impact on the sectoral performance of agriculture. Although there has been an increase in the food grain production in recent years, reaching a level of about 25 million metric tons, the country has to further increase its food grain production on a sustainable basis to feed the ever increasing population.

2. Pest management

In Bangladesh, chemical control has been the primary method of pest control in the past. Up to 1974, the Government promoted the use of pesticides by supplying them free of cost to farmers (100 percent subsidy). The subsidy was reduced to 50 percent in 1974. The Government withdrew subsidy completely in 1979 and the pesticide business was transferred to the private sector. However, to deal with emergency situations, the government should maintain a buffer stock of 15-20 metric tons of pesticides.

After the withdrawal of subsidy, although the use of pesticides declined during early years, their use has been on the increase again reaching 14,340 metric tons of formulated products or 2,462 metric tons of active ingredients in 1999 costing over one billion Taka in foreign exchange. Increased rice area, increase in cropping intensity and an increase in the area under high yielding varieties led to the increased consumption of pesticides. At present 248 pesticides (including three bio-pesticides) with 3307 trade names have been registered in Bangladesh. In the year 2010, 48989 tons of active ingredients of pesticides were used in Bangladesh over an area of 8.20 million hectare. All these pesticides are imported every year expending hard-earned foreign exchange. The use of pesticides has been increasing rapidly over the past two decades.

According to an estimate, annual yield loss due to insect pest alone is 16 percent for rice, 11 percent for wheat, 20 percent for sugarcane, 25 percent for vegetables, 15 percent for jute and 25 percent for pulse crops.

3. IPM development

In Bangladesh, IPM activities first started in 1981 with the introduction of the first phase of FAO's inter-country programme (ICP) on IPM in rice crop. However, it was in 1987 that IPM activities began to expand and became a popular topic among people from all walks of life. From 1989 to 1995, the ICP played a strong catalytic role in promoting the IPM concept and approach among the government officials and donor community. This programme provided IPM training to build the training capacity of the Department of Agricultural Extension (DAE) and introduced Farmer Field Schools (FFS) for training of farmers. A number of persons from the non-government organizations (NGOs) were also given training on IPM. As a result of the success of this programme and on the basis of the need for IPM in Bangladesh, a number of IPM projects in rice and vegetables have come into existence which are being executed by different government departments and NGOs.

Through the activities of such projects, a large number of core IPM trainers have been produced in Bangladesh. By the end of 2001, a total of 1,137 persons from DAE and about 300 from different NGOs have been trained as IPM trainers. Also, DAE/UNDP/FAO Project and DAE/DANIDA SPPS Project have so far produced 829 farmer trainers (FTs). In addition to these activities on human resources development, the IPM projects have been active in establishing IPM field schools for the male and female farmers; development and promotion of IPM farmer clubs and in the testing and usage of bio-pesticides, bio-control agents, etc. So far 46 DT TOTs have been conducted through DAE implemented project and

provided training to about 2300 DAE personnel. Over 4000 FTs have been developed. Thus, with the strong support of the Government, an effective IPM base has already been established in Bangladesh.

PART II: Current status of IPM

1. Extension approach in IPM

1.1 IPM extension approach through sustainable crop production. During the last two and half decades, different organizations have been contributing to sustainable, profitable and environmentally sound production of rice, vegetable and cotton crops, through the development, promotion and use of IPM in Bangladesh. The Ministry of Agriculture strengthened holistic approach to crop production and increased the number of FFS programs to help farmers adopt IPM. IPM reduces pesticide use and results in higher crop yields and safe and more profitable rice, fruit and vegetables. The government of Bangladesh approved a National IPM Policy in 2002. The strategies are to sustainably expand IPM by establishing a national IPM program and to co-ordinate all IPM activities in Bangladesh. Ongoing IPM programs also influenced the agriculture ministry to encourage further development of IPM policies. This has been reflected in the National Agriculture Policy. Supported by different IPM projects, the Farmer's Field School Training Program help farmers diversify their crop production using IPM concept. IPM practices have been transferred among the farmers through IPM-FFS of different projects.

1.2 IPM extension approach through Community IPM. IPM trained farmers have developed IPM clubs with memberships from neighboring farmers. So far 18000 IPM clubs have been established and 4000 FTs have been developed in Bangladesh. The members gather in the club at particular times at certain intervals and discuss their crop related IPM issues and they try to find out the means to solve the problems after discussing among them. IPM trained farmers also organize, manage and implement their own IPM activities, analyze problems, design field studies and carryout some simple experiments and undertake efficient farming practices. Some clubs developed by the farmers trained by different projects are generating funds through monthly subscriptions of the club members. This fund is being used to generate income through various means by the members of the club. IPM clubs are taking the responsibility to managing pests following IPM methods in exchange of little amount of fee. A number of clubs have established poultry farms, dairy farms, fish culture, tree plantation, seed production program, etc to generate additional income. These are a few examples of how community IPM could be useful to the IPM farmers. The steady increase in the numbers of IPM clubs clearly indicates that the possibility of quick spread of community IPM in Bangladesh is high.

The IPM clubs have been established based on the constitution duly approved by the concerned authority. The existing IPM projects and the govt. organizations, particularly DAE are giving moral and technical support to the effective running of the IPM clubs. The enthusiasm and the love of the IPM trained farmers to IPM have enabled them to start the IPM clubs in their locality.

1.3 IPM extension approach through Organic agriculture and Biological pest management demonstration: Biological pest management is an environmentally sound and effective means of reducing or mitigating pests and pest effects through the use of natural enemies. Various technologies will be demonstrated in the farmer's field. The demonstration will be around 30 decimal. Demonstration will focus mainly on organic agriculture and biological pest management.

A number of 923 demonstrations on organic agriculture and also 373 numbers of demonstrations on biological management on vegetable crops had been established under the IPM 2nd phase project during July 2010 to June 2013. Now total 2750 numbers of demonstrations on Organic agriculture and Biological pest management have been planned in the Safe Crop Production Project through IPM Approach of DAE. Through adopting organic agriculture and biological management, small and marginal farmers have improved agricultural production (safe & healthy crop) in their small lands in a sustainable manner and efficiently have increased their income and that might be the key for reduction of poverty. IPM activities are also disseminated among the farmers through this demonstration.

2. Link to International IPM programmes

2.1 Foreign Training: The Safe Crop Production project through IPM Approach committed to support in the human resource development in all categories of officers working in IPM program. Foreign training will be provided on fruit and vegetables IPM. Officers those who are getting involved in IPM activities as a facilitator in the TOT, they will get preference to perform the foreign training on fruits and vegetable IPM. Total 25 officers of DAE may take the opportunity to go abroad such as Thailand, Vietnam, Indonesia, Malaysia, China, Egypt, Bhutan etc This training will enrich the knowledge, skilled and expertise of the officers regarding the respective fields, at the same time linkage will be developed with international IPM programmes.

2.2 Foreign Study Tour: There is a provision in the Safe Crop Production project through IPM Approach for foreign study tour to enrich the knowledge and experience on fruits and vegetables of the officers of different stakeholders in this project. the total 15 officers from different organizations will get the opportunity to participate in the tour which will be held in Thailand, Vietnam, Malaysia, Indonesia, Bhutan, India etc.

Linkage to international IPM programmes is being developed with the arrangement of foreign training and foreign study tour in the internal arena.

3. National IPM programmes

Many agencies are actively involved in IPM activities in Bangladesh and more IPM projects covering a range of crops are forthcoming. For the promotion, expansion and sustainability of IPM, it is imperative that a national IPM programme together with an organizational set-up for its implementation is developed. In accordance with the National Agriculture Policy (NAP) and the New Agricultural Extension Policy (NAEP), the organizational set-up and the IPM implementation system will have a decentralized, community-based approach that puts farmers at the front, as indicated below:

The DAE is the lead agency for implementing national IPM programme. Now IPM is the cardinal principle of plant protection. The organizational set-up for implementing national IPM extension programme is constituted recently in DAE for coordinating the IPM activities at National, Regional, District and Upazila (sub district) level. One deputy director and two additional deputy director post are created in plant protection wing under DAE. They will coordinate the over all IPM program in DAE. At the grass-root level there are IPM teams consisting of IPM-trained DAE staff and farmer-trainers. These grass-root level IPM staff will, in addition to conduct training of farmers in IPM, undertake community IPM-related activities (e.g. farmer-to-farmer training, formation and registration of IPM clubs and associations,

formation of village IPM teams, mobilizing of farm women, participatory action research involving farmers, participatory monitoring and evaluation and FFS follow-up to ensure the promotion, expansion and sustainability of IPM.

Universities and research organizations are also conducting research on IPM. The research findings on IPM are implemented by DAE and NGO. Government of Bangladesh (GOB) is now ensuring reallocation of national resources and also looking for external resources to support IPM activities. Specifically, GOB makes an annual budget allocation for IPM activities and places the fund for running the National IPM Programme/project.

The National IPM Programme is strengthening the implementation of bio-control and plant quarantine activities as well as pest surveillance and monitoring. In the meantime plant protection wing of DAE is introducing registration for bio-control agents and bio-pesticides.

A regular system for monitoring and evaluation and follow-up to IPM activities and its impacts at the farmers level has been established in Bangladesh.

4. IPM policy for sustainable crop production intensification (SCPI) in support to practical implementation of the FAO Save and Grow guidelines.

Realizing the importance of IPM, the Government of Bangladesh (GOB) has developed a national Integrated Pest Management Policy in 2002. The Policy will pursue two main strategies, a) to expand IPM on a sustainable basis by establishing a national IPM programme; and b) to facilitate co-ordination of all IPM activities in Bangladesh. The IPM policy also calls for better pesticide regulation and enforcement thereof. GOB has banned all WHO Class 1a (extremely hazardous) pesticide formulations for use in agriculture and is progressively phasing out registration of all Class 1b (highly hazardous) products. The government has given emphasis on IPM and this is reflected in the national Agricultural Policy. In all the donor funded IPM projects, the government supported about 10% of the total budget. Moreover, the government has also been implementing IPM 1st and 2nd phase project through its own funding. Now the Safe Crop Production project through IPM Approach is running from July 2013 with government funding for 5 years.

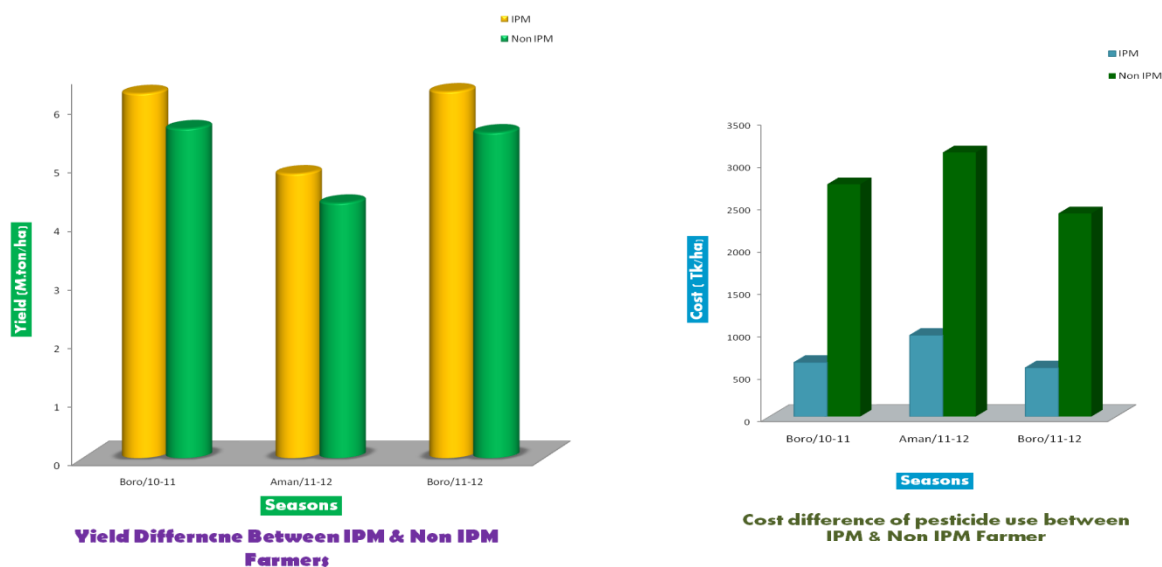
The FFS is now considered by the government and various civil society organizations as an effective vehicle for extension and farmer education. The establishment of IPM clubs (IPM farmers associations) at the end of the FFS season has greatly facilitated sustainability of benefits obtained by farmers from FFS training. DANIDA, through its Agricultural Extension Component (AEC), encourages these clubs/farmer groups to further organize at union, upazila (sub-district) and district levels to protect their interests and rights. These Unions have benefited from short training on organizational management and small business development. Farmer trainers can play a major role in upscaling of FFS training. Hence, a total of about 4000 farmer trainers have benefited from rice and vegetable IPM training, of which some 2,000 farmer trainers are now actively involved in FFS training.

PART III: Impact assessment of IPM programmes

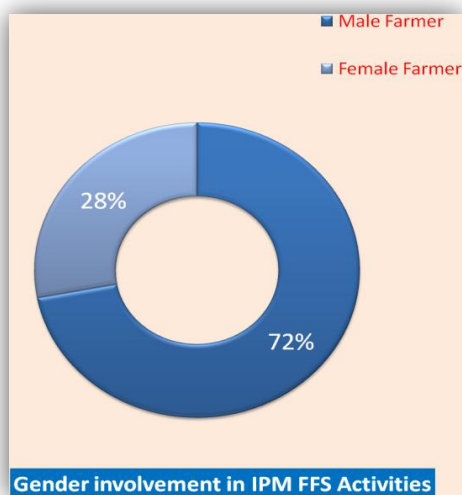
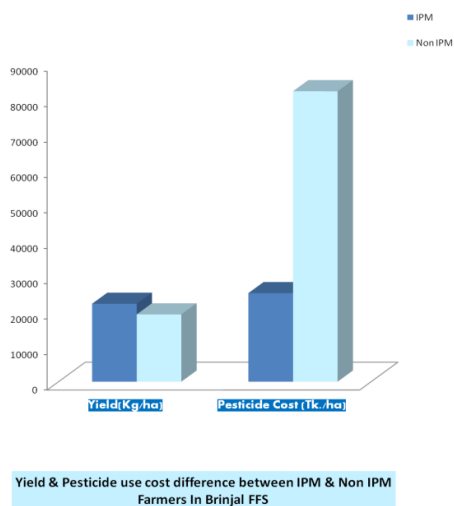
1. Impact assessment of IPM programmes/projects: according to an impact assessment of IPM 2nd phase project, the rice farmers, have been able to reduce the use of pesticides by about 75-85 percent with an increase of yield of about 10-16 percent compared to that of the untrained farmers. Similarly, IPM trained vegetable farmers have been able to reduce the use of pesticides

use by about 55-80 percent with an increase of yield of about 12-20 percent. Moreover farmers feel encourage in regular field visit, they become motivated in using sex pheromone trap and they could identify harmful and beneficial insects easily.

To measure the impact of IPM training a review and planning workshop has been conducted by IPM 2nd phase project, DAE, Khamarbari on last 2011-12. Collection of data was done on money spent on pesticides and yield. The data from 896 boro rice FFSs and 490 winter vegetables FFSs that were conducted by farmers were used for the analysis. Data were collected from FFS farmers before the start of the training and at the end of the FFS season.



Results are more impressive, when data of before IPM training and after IPM training are compared. Trained FFS farmers spent during boro 2011-2012 season 1320 taka per hectare less on pesticides, compared to the previous boro 2010-2011 season, which is a reduction of 86.8%. At the same time, they produced a 550 kg higher yield per hectare, which is a yield increase of 10.19%.

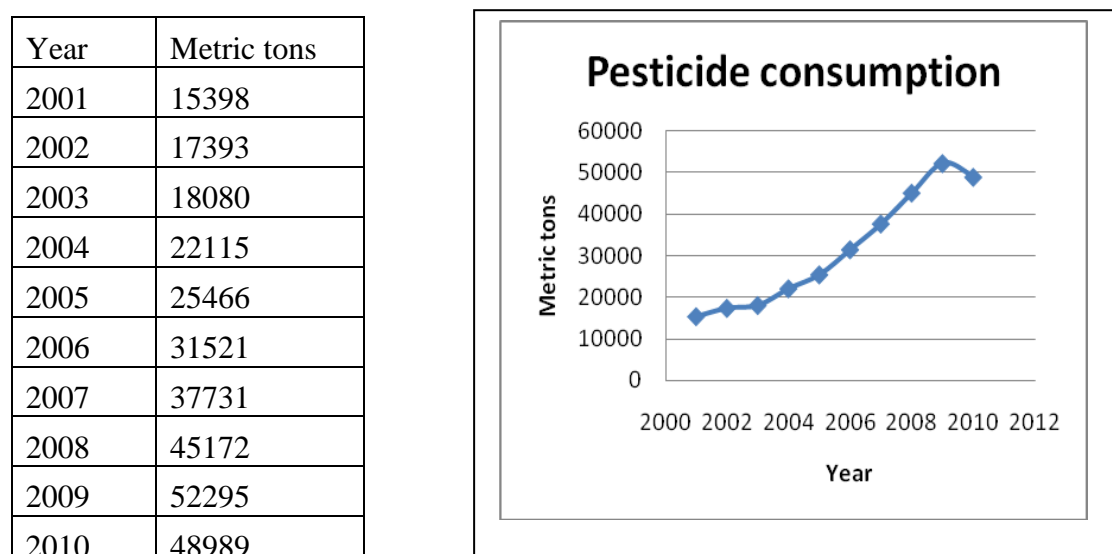


In case of egg plant trained FFS farmers spent 60000 taka per hectare less on pesticides, compared to the previous season, which is a reduction of 63.0% and they produced a 2000 kg higher yield per hectare, which is a yield increase of 9.09%. It also has showed from the analysis that in all aspects farmers after IPM training were found to be more aware about the importance of rice eco-system, pests and defenders. These are some of the positive indicators of IPM training to farmers. IPM has made a remarkable impact in the country. It has reduced the frequency of pesticide applications, thereby reducing the cost of pesticides and increasing yield.

2. Impact of pesticide use

Like many developing countries, Bangladesh has promoted the use of pesticides to expand agricultural land and increase output per hectare. Promotional activities have included extension services. Figure 1 shows that pesticide use has more than tripled since 2001, rising from 15,398 metric tons to 48,989 metric tons of formulated products in 2010. Increase crop area, increase in cropping intensity and an increase in the area under high yielding varieties & hybrid led to the increased consumption of pesticides.

Figure: Trends in Pesticide Use, 2001-2010



Source: Plant Protection Wing, DAE, Bangladesh

The encouraging sign on the other side is that the sale of pesticide has been decreased by 6.33 percent in 2010 from 2009, probably due to increased awareness and recognition of the benefits derived from IPM and organic agriculture. Farmers in Bangladesh are also cost concern; they use pesticide only when it is really required for safeguarding their crop and production.

Use of Alternatives of Chemical Pesticides in Bangladesh

Alternatives	Use
Bio-control Agents	Bio-control agents such as predator & parasitoids. Some of these agents such as LBB, lace wing, trichogramma & bracon are used in field
Botanical Pesticides	Neem has been found to possess special chemicals (specially

	Azadirachtin) that have insecticidal, repelling, anti-feeding, growth inhibiting effects. Besides this Baicao & Mehogohi oil are use as botanical pesticides.
Insect Attractants	Some sex pheromones.
Resistant Crop Varieties	Crop varieties resistant to various insects and diseases have been developed and widely used in rice, vegetables and several other crops.

3. Economic impact (cost benefits analysis)

Bangladeshi farmers have benefited substantially from their participation in FFS-based IPM training. FFS-trained farmers have become ecology-literate and have learned to conserve and make sustainable use of natural biological control systems for various crops. FFS farmers also benefited from cost savings resulting from reduced use of pesticides and higher yields. According to an impact assessment study by the Bangladesh Rice Research Institute, IPM-trained rice farmers have cut their use of pesticides by 90 percent with an increase in crop yield of 10 percent. IPM-trained eggplant farmers reduced their use of pesticides on average by 75 percent with an increase in crop yield of 12 percent (Anonymous, 2011). As a result, the profit margin of the IPM/FFS-trained farmers increased substantially compared to conventional farmers.

An impact study on IPM 2nd phase project, DAE has been conducted on last 2011-12. The study showed that the rice farmers, have been able to reduce the use of pesticides by about 75-85 percent with an increase of yield of about 10-16 percent compared to that of the untrained farmers. Similarly, IPM trained vegetable farmers have been able to reduce the use of pesticides use by about 55-80 percent with an increase of yield of about 12-20 percent. So IPM approach enhanced crop production with less cost.

4. Environmental impacts

With the reduction of pesticide use, IPM approach contributes to pesticide risk reduction, fewer poisoning incidents and less environmental pollution in rural communities. It is expected that by end of 2015, about 1million farmers or some 6.60 percent of the 15.1 million farming families in Bangladesh will have benefited from FFS training.

5. Social impacts

Currently IPM farmers have access to adequate amount of safe, nutritious food to sustain a healthy and productive life. Bangladeshi farmers also have access in market network and getting demanded price of their products. IPM is also a human resource development program. Here in Bangladesh IPM trained farmers have learned how to organize themselves and their communities, how to create a strong working network with other farmers and with extension workers and researchers.

6. Policy impacts

Government of Bangladesh is now ensuring reallocation of national resources and also looking for external resources to support IPM activities. Specifically, GOB makes an annual

budget allocation for IPM activities and places the fund for running the National IPM Programme. The National IPM Programme is strengthening the implementation of bio-control and plant quarantine activities as well as pest surveillance and monitoring. In the mean time plant protection wing of DAE is introducing registration for bio-control agents and bio-pesticides as per the guidelines of National IPM Policy 2002.

PART IV: Challenges

Bangladeshi farmers have to deal with a number of challenges – from increasingly unpredictable threats. In Bangladesh nearly 152 million people live in a small area and the population is expected to expand by about two million per year. The country has managed to triple its rice production in the 40 years since independence, but feeding such a rapidly growing population, requires strong IPM strategies, technologies and innovation. However, some of the challenges are:

- a) Farmers of Bangladesh are not so much literate as a result they are not aware about their rights; lead them less access to understand the benefit of environment friendly IPM approach.
- b) Field level extension workers under DAE have multidimensional activities; as a result it is not possible for them to concentrate in the IPM activities effectively.
- c) Weak cooperation and coordination among the different IPM partners and stakeholders
- d) Rapid population growth, Land scarcity due to industrialization is major important issue in agriculture.
- e) Frequent change of agro-climate conditions (flood, heavy rain, drought, heavy winter).
- f) Agriculture has been highly susceptible to pest attacks due to climate change.
- g) Absence of expertise personnel in fruits IPM.
- h) Biological pest control method is not so prioritized in plant protection.

Steps to combat challenges

Faced with the challenges of an increasing population, decreasing availability of agricultural land, increasing environmental pollution and costly food prices, the options before Bangladesh include:

- a) Increasing farmers literacy so that they can understand the benefit of IPM strategies and able to acquire power to access to safe and nutritious food.
- b) In the field, core IPM extension workers should be there. They will search new options of IPM technologies and strategies and will demonstrate in farmers' field, train them effectively.
- c) Strengthening cooperation and coordination among the different IPM partners, stakeholders, research organizations and Department of Agricultural Extension on IPM approach.
- d) Population growth should be controlled and agricultural land utilization policy should be formed.
- e) Stress tolerant technology or crop variety (Flood tolerant variety BRRIdhan51, BRRIdhan52, BINAdhan-11, BINAdhan-12 & Salt tolerant variety BRRIdhan47,

BRRIdhan54, BRRIdhan61, BINAdhan-08, BINAdhan-10 etc.) should be developed to cope with the climate change.

- f) Pest resistant variety should be introduced.
- g) Expertise should be developed in fruits IPM through training both home and abroad.
- h) Strengthening biological pest control activities in plant protection to produce safe crop without affecting the environment.

References

- Anonymous 2011. Bangladesh and FAO achievements and success stories: a report published by FAO representation in Bangladesh, May 2011, page no. 7.
- Anonymous 2012. Impact study report on IPM 2nd phase project, DAE, Khamarbari, Dhaka, Bangladesh
- Anonymous 2012. Krishi Diary, 2012 published by Agriculture information service under Ministry of Agriculture, Dhaka, Bangladesh
- BBS, 2012. Bangladesh Bureau of Statistics, Ministry of Planning, Agargaon, Dhaka, Bangladesh.

STATUS OF INTEGRATED PEST MANAGEMENT (IPM) IN CAMBODIA

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Summary

The Ministry of Agriculture, Forestry and Fisheries (MAFF) initiated the pilot phase of the Integrated Pest Management (IPM) Programme from 1993 to 1995 after “The Environment and IPM” workshop which was held at the Royal University of Agriculture, Phnom Penh. In 1998, MAFF officially declared Integrated Pest and Crop Management (IPCMA) as one of the country's key crop production strategies with the aim of making IPM the standard approach to crop management in Cambodia. In 2002, the MAFF issued a Ministerial Proclamation (Prakas) on the establishment of “The National IPM Programme” to facilitate and coordinate all IPM activities in Cambodia irrespective of crop commodities and donor agencies involved.

The National IPM Programme is positioned within MAFF and the General Directorate of Agriculture is responsible for its implementation. The Programme has been operating in all major agricultural production provinces in close cooperation and collaboration with other concerned ministries, provincial departments of agriculture, local and international organizations and research institutions at all levels to develop the capacity of agricultural trainers and extension workers and to educate farmers on appropriate agricultural technologies and effective managing crops skills to increase productivity and profitability in an environmentally friendly and health safety manner.

Integrated Pest and Crop Management or "IPM" is a holistic crop management system that integrates a variety of methods to manage and protect crops. IPM enables farmers to grow healthy crops with high yields leading to production sustainability and socio-economic effectiveness, while safeguarding human and animal health and protecting the natural environment.

The overall goal of the Cambodian National IPM Programme is to improve Food Security and Safety in Cambodia by enhancing the sustainability and economic efficiency of intensified crop production systems through the promotion of Integrated Pest Management skills at the farm level.

The main objectives of the Programme are (1) to reduce the dependence of farmers on agricultural chemicals, especially pesticides, in agricultural production (2) to develop the capacity of agricultural trainers and extension workers in conducting training and experiments and providing appropriate service to farmers and (3) to educate farmers on agricultural technologies by enhancing their knowledge on field ecology and by developing skills in managing crops effectively.

The Programme has adapted the strategy of "learning by doing" using the Farmer Field School (FFS) model and the training methods are based on the principles of non-formal adult education with emphasis on a discovery learning approach. This approach allows farmers to participate in a season long training covering one full crop cycle with intensive field practice. To support the training exercise a crop is grown for field study activity. Farmers observe and analyse the field situation to discover the dynamic relationship between plants, pests, natural enemies, nutrients, soil, water and other components in the crop ecosystem. After thoroughly analysing the field

situation the participants discuss findings and together make decisions about crop management. In addition the Programme has co-ordinated with research institutions to find new agricultural technologies and good experiences to be tested and adapted in response to the needs of the farmers.

Key words: *IPM approach, environmental Impact, pesticide*

Implementing agencies:

- Ministry of Agriculture, Forestry and Fisheries (MAFF),
- General Directorate of Agriculture

Key partner institutions: There were many international and local organizations that have been providing support and involved in IPM programme including mainly FAO, Danida, World Bank- APIP, IFAD, EU, PRASAC, UNICEF, CARERE, HI, REDDBANA, CWS, CRS, NPA, OXFAM, PADEK, ANS, APHESA, CAAEP, CARE, CARITAS, CASD, CIDSE, CONCERN, GRET, HEKS, JVC, MCC, NAPA, READ PROJECT, SAMAKEE, WVC, ADDA, ZOA, CIDA and so on.

Current Status of the National IPM Programme

Part II: Current status of IPM:

1. Extension approaches in IPM

The IPM Programme was considered to be appropriately institutionalised at national and provincial levels. At national level the IPM Programme is structured under MAFF and the General Directorate of Agriculture (GDA) is responsible for the implementation. At provincial level the Programme is coordinated by a coordinator and implemented the activities by district trainers and farmer trainers under the supervision of the Provincial Department of Agriculture (Ngin Chhay, 2004).

2. Link to International IPM Programmes

The IPM Programme has made a good link with international IPM agencies and worked in close cooperation with national and local organizations.

The FAO Inter-country Programme (FAO-ICP) has provided assistance to the IPM programme in Cambodia since 1993. But the core funding for IPM activities from FAO was started in 1996. Since 1996 FAO-ICP for IPM in rice has provided financial assistance to the National IPM Programme to develop a strong IPM training capability. This capability has been used to implement TOT and a large number of IPM Farmer Field Schools (FFS) funded by a wide range of donors.

The Cambodian National IPM Programme joined the FAO Southeast Asia Regional Vegetable IPM Programme in 1997. FAO -and various partner organizations- have since provided core technical and financial support for farmer training in vegetable IPM. The overall development objective is to support small holder vegetable and rice farmers in achieving more sustainable livelihoods by assisting with the efficient, profitable, healthy and environmentally sound production of vegetable and rice through Integrated Pest Management training, and the sustained application of its principles and methods.

The Cambodian National IPM Programme joined FAO's Regional Project on Pesticide Risk Reduction (GCP/RAS/229/SWE) in 2007. Overall development objective of the ten years project (2007-2018) is to improve conditions of smallholder farmers in terms of incomes, food security, food safety, market access, occupational health status and productive environment through community education on pesticide risk reduction and application of IPM. The Pesticide Risk Reduction Project is focusing on strengthening vegetable IPM and pesticide risk reduction training in six provinces namely Battambang, Siem Reap, Kampong Cham, Kampong Chhnang, Kandal and Kampot. Given the substantial risk of pesticide overuse for Brown Plant Hopper outbreak control, rice IPM training is supported by the Project in three additional provinces namely Prey Veng, Svay Rieng and Takeo.

The Cambodian National IPM Programme joined FAO's Regional Project on Sustaining and Enhancing the Momentum for Innovation and Learning around the System of Rice Intensification (SRI) in the Lower Mekong River Basin (GCP/RAS/288/AIT). The overall goal of the project is to enhance rainfed smallholder farmers' capacity confronting climate change sustainably by applying SRI through Participatory Action Research in order to improve food security, income and occupational health status. The purpose of the project is to increase crop yield, productivity and profitability on sustainable basis at smallholder farmers' field in rainfed areas of LMB. The project is being implemented in three provinces namely Takeo, Kampong Speu and Kampot.

2.1 Achievement of the National IPM Programme:

With the support of MAFF and various NGOs, the National IPM Programme implemented several IPM activities for building up the capacity of government officers and farmers on IPM. The major training activities implemented are training of trainers courses on rice, vegetable, water melon, rice-fish-vegetable and mung bean; training of farmer trainers; farmer field schools on the above mentioned crops; farmer life schools; refresher courses for district and farmer trainers; living soil training; training on farmer self-studies on pesticide health hazards; pesticide risk reduction training; farmer congress; study tour and exchange visits; workshops and meetings; field studies and experiments; development of community IPM and establishment of farmer clubs; organic rice; chemical-free vegetable associations; monitoring and impact assessment; and so on.

In close collaboration with all involved organizations the Programme has achieved from 1993 to December 2014 as summary in following table:

No.	Description	IPM Trainers		Farmer Trainers		Farmers	
		Total	Women	Total	Women	Total	Women
1	Rice Crop	319	143 (44.82%)	2,673	948 (35.46%)	110,007	43,923 (39, 92%)
2	Vegetable Crops	98	37	124	37		7,862

			(37.75%)		(29.83%)	16,392	(47, 96%)
3	Watermelon Crop	41	17 (41.46%)	0	0	3,097	1,238 (39.97%)
4	Mungbean Crop	25	7 (28%)	0	0	651	299 (45.92%)
5	Organic Chili Crop	0	0	0	0	69	36 (52%)
6	Fruit Flies	13	4 (30,76%)	0	0	165	101 (61%)
7	Integrated Farming System	193	70 (36.26%)	30	12 (40%)	32,006	15,221 (47.55%)
8	Students and Teachers	0	0	0	0	6,754	3,038 (44.98%)
9	PADEE project	211	62 (29%)	218	95 (43, 57%)	46,153	29,640 (64, 22%)
10	Cassava	18	6 (33%)	0	0	276	98 (36%)
11	MALIS project	38	5 (13%)	0	0	2624	1300 (49, 54%)
12	SRI-LMB project	0	0	81	23 (28, 3%)	1032	667 (64, 63%)
Total		956	351 (36, 71%)	3126	1115 (35, 66%)	219,226	103,423 (47, 17%)

3. National IPM Programme

The National IPM Program has developed internal expertise over more than two decades which in turn has supported the field level government extension system very effectively. The system not only includes and supports the GDA but works together with NGOs, other government departments such as the Fisheries Administration and Department of Animal Health Production. This expertise has also been used effectively to train a very sizeable group of farmers and their organizations, IPM Farmer Clubs. The overview of the current IPM Extension System in Cambodia including the central level, provincial level, district level and farmer level trainers (Kevin Kam 2007). The function of every level as following:

National IPM Program Office (central level): It coordinates all IPM activities in Cambodia regardless of implementing agency or donor. It has implemented a number of donor-supported programs in Cambodia such as FAO, Danida, IFAD, EU, World Bank and others. It coordinates with NGO efforts in IPM and represents Cambodia in regional IPM activities. The staff are dedicated, experienced professionals. The National Team educate the Provincial Coordinator, District Trainers and Farmer Trainers and provide technical backstopping to IPM trainer at all level.

Provincial Coordinators and District Trainers: Provincial Coordinators and District Trainers have been trained by the National IPM Program. There is one Provincial Coordinator in every IPM target province who has been coordinating IPM activities in his/her respective province. District Trainers are responsible to implement IPM field activities in their target district.

Farmer Trainers: Farmer Trainers who were trained by the National Team and District Trainers are responsible to carry out IPM field activities with District Trainers. The Farmer Trainers are also providing technical assistance to other farmers in their community.

Overall the National IPM Program extension system is one of the most extensive, technically competent and experienced in participatory training in Cambodia. The system is an asset to Cambodian development initiatives.

4. IPM policy for sustainable crop production (SCPI) in support of practical implementation of FAO Save and Grow guidelines:

In 1998 MAFF officially declared Integrated Pest and Crop Management (IPM) as one of the country's key crop production strategies with the aim of making IPM the standard approach to crop management. This aims to make IPM the standard approach to crop management in Cambodia, with an emphasis on rice, vegetables, fruit and field crops with pursuing a policy of sustainable food production to ensure food security in Cambodia.

Further, on the 4th of July 2002, MAFF issued a Ministerial Proclamation (Prakas) No. 205 on the establishment of an Integrated Crop Management Programme, called "the National IPM Programme" to facilitate coordination of all IPM activities in Cambodia irrespective of donor agencies and crops involved. The National IPM Programme steering committee was also formed to provide direction and policy framework for the implementation, monitor concepts and technical aspects, discuss and approve annual work plan and report, discuss and solve major problems that may occur as the obstacles in implementing the IPM Programme in Cambodia (National IPM Programme, 2003).

Many agricultural materials sold in the markets are illegally imported and are fake or substandard in quality. Some of these products concern pesticides banned for use in the Cambodia as well as in other countries due to their harm to health and environment. On 28 October 1998 the RGC issued the Sub-decree No. 69 on Standards and Management of Agricultural Materials aiming to guarantee consistent high quality agricultural material inputs. This aims to enhance agriculture production and to promote a highly efficient and sustainable agriculture in the country by providing appropriate quality standards and regulatory mechanisms to protect the end-users, the manufactures, distributors, and dealers of these inputs as well as the environment (MAFF, 1998).

In order to implement the above Sub-decree efficiently and effectively, MAFF developed and issued detailed guidelines for the implementation in October 2002. Subsequently, MAFF has issued the Prakas No. 598 on pesticide registration in the Kingdom of Cambodia on December 2003. This document includes the list of pesticides banned for use (116 products), the list of pesticides restricted for use (40 products) and the list of pesticides permitted for use (136 products) in the Kingdom of Cambodia (MAFF, 2003).

PART III: Impact assessment of IPM programmes

1. Impact assessment of IPM programmes

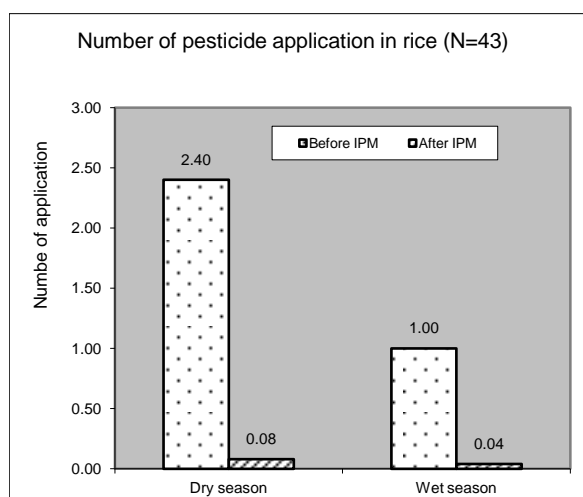
The success of the IPM can be measured not only by the impact on the farmer's agricultural production, but also on many other aspects. Benefits can be direct and indirect and can be evaluated not only in terms of economic returns, but also in terms of social and environmental indicators (Pontius, 2001).

What is seen as impact of IPM depends on a project's objective and a person's view. The impact can be considered as reduced insecticide use, enhanced sustainable pest management and adaptive crop management, increased yields and profits, changed attitude of farmers and policy makers, improved critical thinking skills and information network, knowledge spread, improved livelihoods and so on. Although impact in terms of efficiency and effectiveness of pest control are mostly quoted, assessing the returns to the FFS as an educational investment is equally important.

2. Impact on pesticide use

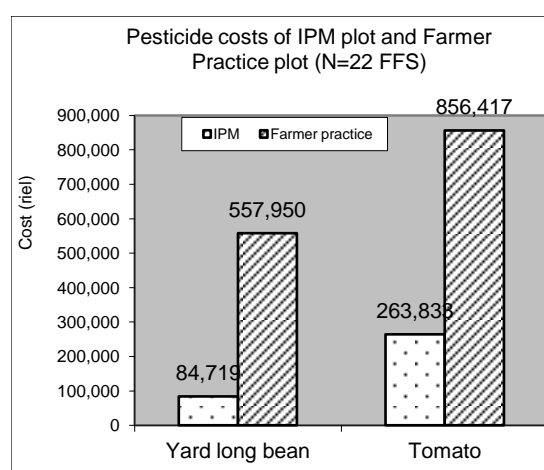
The result from a case study on the Impact of IPM on Landlessness indicated that IPM farmers could reduce their expenditures on items such as chemical fertilizers, seeds and especially pesticides and they could increase their rice yield. In this context, IPM training could be said to be intrinsically beneficial; improve farmers' health by increasing awareness of the hazards of pesticide use and reducing unnecessary use of pesticides (Chea, Pan and Mom, 2000).

The result from a study on the Assessment of the Impact of IPM Programme at Field Level amongst 528 farmers confirmed that the IPM farmers significantly reduced the use of pesticides on rice in terms of percentage farmers using them at all, frequency of application, amounts used and types of pesticides: 38.6% of the IPM farmers did not use any pesticides (against 13.9% of the non-IPM farmers) and when they used them, they used 50% less amount than the non-IPM farmers. The report also stated that a 43% reduction in insecticide use from 2.9 to 1.6 applications per season was associated with training; for pesticide volume the reduction was 64% and the reduction was most pronounced for WHO class 1A and 1B chemicals (Duuren, 2003).



The result of a study on the Impact of IPM Farmer Field School (FFS) in Kandal and Takeo indicated that farmers who have completed IPM training sharply reduced the use of pesticides on rice crop. The trained farmers sharply reduced pesticide application from 2.40 times to 0.08 times per season in dry season and from 1.00 times to 0.04 times in wet season in average (Phal, 1997). Normally farmers applied pesticide about 0.9 litres per application per hectare. As the number of application significantly dropped the amount and cost pesticides also reduced considerably.

The result from 22 vegetables FFS conducted in Kandal, Kampong Cham, Battambang and Siem Reap in 2003 showed that pesticide use in IPM plot was significantly less than in farmers practice plot in terms of the number of application, amount as well as expenditure. For example on yard long bean crop the cost of pesticides in IPM plot was 84,719 riels/ha, 85% less than the pesticide cost in farmer practice plot (557,950 riels/ha). For tomato the costs were 263,833 riels/ha in the IPM plot compared to 856,417 riels/ha in farmer practice plot (70% less) (FAO Vegetable IPM Project, 2003).

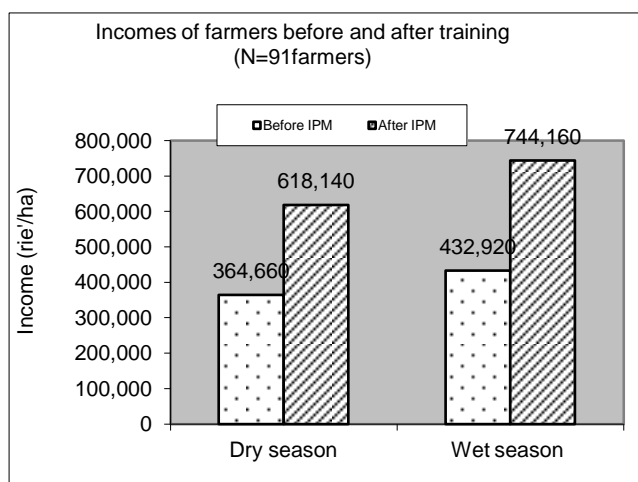


It is evident that IPM programme is able to reduce the use of pesticides. This reduction leads to more cost-effective production, reduced water contaminations, reduced frequency of farmer poisoning and public health risks, improved biodiversity, improved marketability of agricultural produce and all of these lead to poverty reduction.

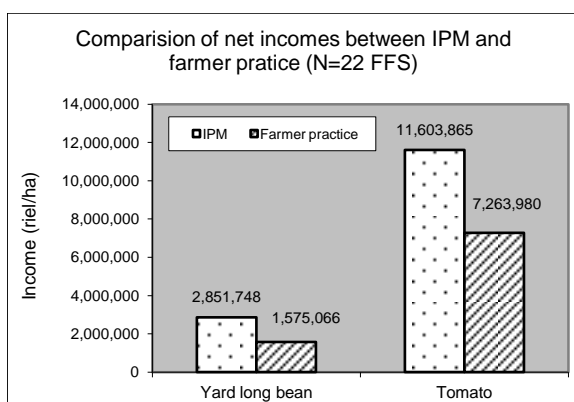
3. Economic impact (cost benefits analysis)

The results from case study on the Impact of IPM on Landlessness showed that the IPM farmers reduced the costs of rice farming (using less seeds and pesticides) and increased their yield. This saving can improve farmer's living standards and help reduce farmer's burden on paying tax when they borrow money for purchasing inputs to be invested in their farming activities (Chea, Pan and Mom, 2000).

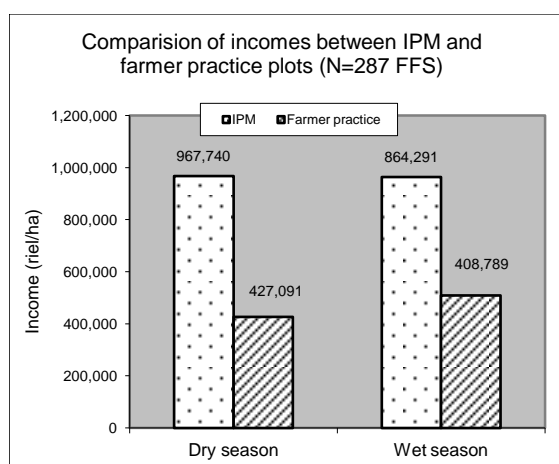
The result of a study on the Impact of IPM Farmer Field School (FFS) in Kandal and Takeo in 1997 indicated that farmers who have completed IPM training raised the net incomes from their farming activities. In average the net incomes increased from 364,660 riel/ha to 618,140 riel/ha in dry season and from 432,920 riel/ha to 744,160 riel/ha in wet season (Phal, 1997).



The result from 22 FFS on vegetables crops (yard long bean and tomato) conducted in Kandal, Kampong Cham, Battambang and Siem Reap in 2003 showed that the net incomes obtained from IPM plot was higher than from farmer practice plot in both crops. For yard long bean the net income was 2,851,748 riel/ha against 1,575,066 riel/ha, while for tomato the net income was 11,603,865 riel/ha against 7,263,980 riel/ha (FAO Vegetable IPM Project, 2003).



The information from 287 FFS on rice



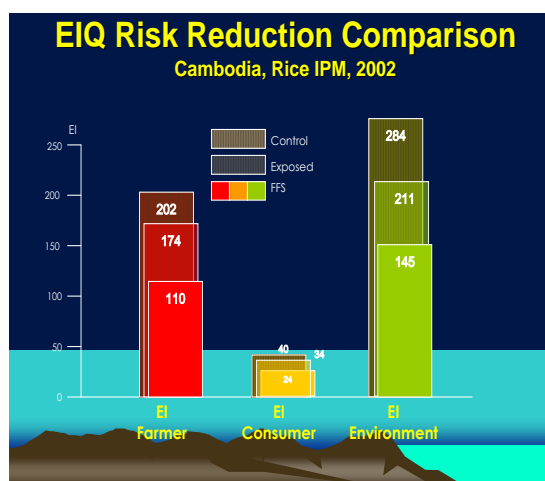
conducted in year 2002 in 7 provinces (Prey Veng, Svay Rieng, Kampong Thom, Kampong Chhnang, Battambang, Banteay Meanchey and Oddor Meanchey) showed incomes gained from the IPM plot was significantly higher than from farmer practice plot. In average the incomes in IPM plot was 967,740 riel/ha compared to 427,091 riel/ha in the farmer practice plot in dry season and in wet season the incomes were 864,291 and 408,789 riel/ha respectively (Danida IPM Project, 2003).

4. Environmental impacts

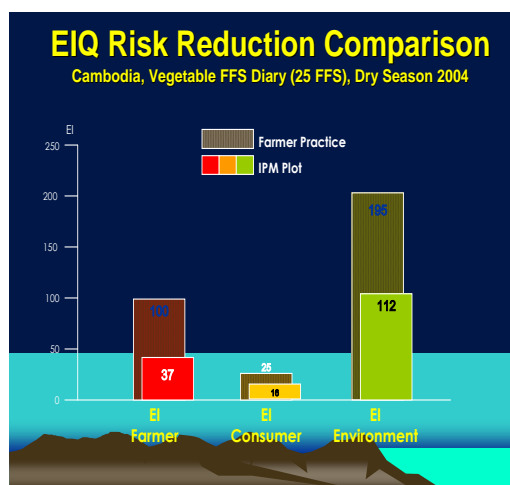
Very little has been done to assess the environmental impact of the IPM/FFS program in Cambodia in terms of human health as well as the environment as a whole. And with good reason:

it is very difficult to do. Recently, however, the National IPM Program has explored a methodology being promoted by FAO to look at environmental impacts of IPM programs across the region referred to as the Environmental Impact Quotient (EIQ). The EIQ was developed to look at the environmental and human toxicity impacts of pesticide use. It is a non-economic assessment which uses pesticides as the basis of the calculation but differentiates between crop type, pesticide type, quantity used as well as the toxicity to users, consumers and the ecology. Using the EIQ, below graphs present the situation in Cambodia for pesticide use in rice and vegetables, respectively. The higher the EIQ, the higher the risk to the humans and the local ecology.

EIQ Risk Reduction in Rice



EIQ Risk Reduction in Vegetable



Source: Kevin Kamp, April 2007

The EIQ provides an additional indicator of the impact of the IPM/FFS program in terms of how pesticide reductions and changes in pesticide types relate to farmer health, consumer health and the environment. Due to the relatively large reductions in pesticides for vegetables as compared to rice the EIQ shows greater positive environmental and health impacts for vegetables. The author suggests, however, that the EIQ may not accurately estimate the impact of pesticides on aquatic systems as compared to terrestrial systems. It is not unreasonable to assume that the quantity of aquatic organisms in rice fields would increase by two kilograms per hectare [very low figure] just from reducing pesticide use in the quantities documented in this Project. Extrapolating such gains at a value of \$1.50 per kilogram [low figure] for 200,000 hectares would be valued at \$600,000 per year. (Kevin Kamp, April 2007)

5. Social impacts

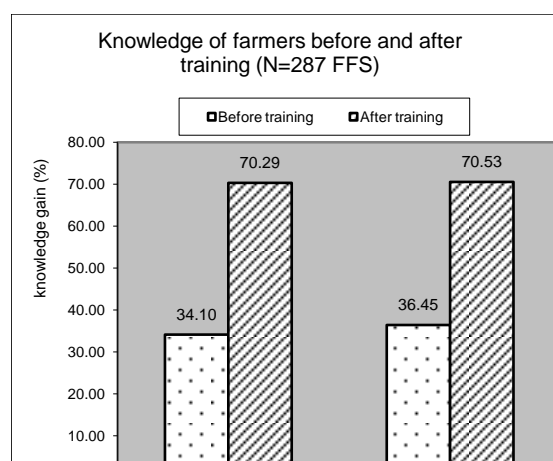
A study on the Assessment of IPM/FFS Training Activities on District Trainers and Farmer Trainers in 2002 showed that technical knowledge of farmer trainers on rice pests, diseases, pest control methods, improvements on cultivation practices and pesticide and health issues is sufficient to set up action research on local field problems with farmers in a FFS. In addition, trainers are capable FFS facilitators: they can independently organize FFS and train farmers to a satisfactory level at which they eliminated pesticide use by 50% and reduced the number of

applications and costs considerably. The study also showed that IPM farmers and especially farmer trainers gained 'access' and 'leverage'; they are more capable and confident to identify, analyse and design projects or actions to further enhance their opportunities and increased bargaining strength to obtain the resources they need. The study further indicated that some IPM farmers and farmer trainers have improved their position in the village/commune or had the opportunity to obtain a better job after attending IPM activities, for example becoming village leaders, Commune Council/Commune Development Committee members, co-operators with IOs/NGOs, becoming VDC members and so forth. Although it would need further research, the hypothesis could be that increased self-confidence, a positive sense of identity or increased analytical and planning skills as a result of attending IPM FFS helped in enhancing the status of these IPM graduates (Duuren, 2002).

A study on the Impact of IPM Activities on Landlessness also indicated that IPM training increased the quality of relationships between farmers by improving information flow, sharing their farming experiences, problem analysis and local farmer organization. Moreover, IPM could potentially improve social relationships and interaction between farmers by providing assistance to issues of concern for farmers and improving farmers problem solving capacity, including location specific field problems and social constraints (Chea, Pan and Mom, 2000).

A study in 2003 on the Assessment of the Impact of IPM Programme at Field Level confirmed that FFS farmers knew more types of beneficial organisms and alternative pest control methods, were better aware of pesticide health risks, and were more often asked for advice by other farmers, than were non-FFS respondents. More than 50 % of the IPM farmers did some experiments on their own field after participating in the FFS, in particular in fertilizer use, seedlings (age, number and spacing) and crop protection trials (Duuren, 2003).

Based on the results of pre-test and post-test from 287 FFS conducted in year 2002 in 7 provinces (Prey Veng, Svay Rieng, Kampong Thom, Kampong Chhnang, Battambang, Banteay Meanchey and Oddor Meanchey) showed that the knowledge on identification of insect pest and disease including their symptoms, natural enemies, crop physiology, nutrient management and making informed decision of farmers have increased remarkably. The farmers' knowledge has been a sharp rise from 36.35% to 70.53 % in the wet season and from 34.10 % to 70.29 % in the dry season (Danida IPM Project, 2004).



The result from 144 FFS on rice conducted in year 2002 in the provinces of Takeo, Kampot, Kampong Speu, Kandal, Pursat, Kampong Cham and Siem Reap under the APIP/IPM Sub-component also indicated that the farmers' knowledge has been a sharp rise from 38 % to 78 % in the wet season and from 36 % to 75 % in the dry season.

6. Policy Impact

Because of great achievement of the IPM Programme, MAFF officially declared Integrated Pest and Crop Management (IPM) in 1998 as one of the country's key crop production strategies with the aim of making IPM the standard approach to crop management. Further, on the 4th of July 2002, MAFF issued a Ministerial Proclamation (Prakas) No. 205 on the establishment of an Integrated Crop Management Programme, called "the National IPM Programme".

On 28 October 1998 the RGC issued the Sub-decree No. 69 on Standards and Management of Agricultural Materials aiming to guarantee consistent high quality agricultural material inputs. In order to implement the above Sub-decree efficiently and effectively, MAFF developed and issued detailed guidelines for the implementation in October 2002. Subsequently, MAFF has issued the Prakas No. 598 on pesticide registration in the Kingdom of Cambodia on December 2003.

On 21st December 2011, the National Assembly adopted the law on “The Management of Pesticides and Fertilizers” and the Senate adopted this law on 30th December 2011 aiming

1). to support the policy promoting the effectiveness potentiality of Agricultural sector, for the development of social and National economy; 2). to ensure the safe and effective control of pesticides and fertilizers, whether in consistent with the international standards; 3). to enhance public awareness on the implementation of standard requirements of pesticides and fertilizers for all relevant activities related to these products; and 4). to reduce risks caused by the use of pesticides and fertilizers, for the beneficiary of farmers and people in the nationwide, by ensuring food security, food safety, public health, and the sustainability of environment.

Conclusion

It is without doubt to conclude that IPM programme can help farmers to significantly increase their yield and incomes and considerably reduce the amount of pesticide use. As a result this can lead to more sustainable and cost-effective production, reduction of ecological disruption and environmental contamination, reduction of public health and toxic residues in food and improvement of livelihood, biodiversity and marketability of produce.

Moreover, general knowledge of farmers related to crop production and protection increased and farmers increased their chances to become active in village development committees, commune councils and/or work with NGOs. Also farmers gained self-confidence and are more eager to communicate and take action on cultivation practices and community development issues.

From the policy context IPM Programme received a strong support from the RGC and IPM has been considered as one of the country's key crop production and protection strategies. More importantly IPM programme is a key player in contributing to the achievement of sustainable agricultural growth that is of important to poverty reduction on a sustainable use of natural resources and sound environmental management.

References:

- Annual Report of the Danida IPM Project, 2003.
- Annual Report of the FAO vegetable IPM Project, 2003.
- Chea Samnang, Pan Sodavy and Mom Sitha (2000), Impact of IPM Activities on Landlessness in Kampong Speu Province.

- Duuren, B. van (2003), The Assessment of the Impact of IPM Programme at Field Level. Consultancy Report Danida IPM Project.
- Duuren, B. van (2002), The Assessment of IPM/FFS Training Activities on District Trainers and Farmer Trainers. Consultancy Report Danida IPM Project.
- Kevin Kamp, April 2007, Impact from the Cambodian National IPM Program
- Ngin Chhay, April 2004, Impact of IPM Program in Cambodia
- Phal, Phanny (1997), Impact Study of IPM Farmer Field School, Kandal and Takeo, 1997, BSc thesis, Royal University of Agriculture, Department of Agronomy Sciences, Phnom Penh, Cambodia.

STATUS OF INTEGRATED PEST MANAGEMENT (IPM) IN CHINA

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Summary

China accepted the concept of integrated pest control in 1953 and established the national policy for the integrated pest control (IPC) by the former Ministry of Agriculture & Forestry in 1976. During the past 30 years, China strengthened the extension of the IPM and obtained significant achievements. Before the FAO-FFS programs, National IPM programs were implemented at a top-down approach, IPM technologies usually developed by research institutes, extension specialists would advise control measures based on economic threshold levels and field demonstrations or classroom lecture training used for the transfer of new IPM technologies to farmers. The FFS-based national IPM programs in China were first developed in rice since the implementation of FAO rice IPM program in 1988. So far, more than 50 TOTs and 6, 000 FFSs were carried out, totally, over 1,500 facilitators and 180,000 farmers were trained and the IPM-FFSs approach was gradually implemented nation-wide and extended to major crops. Several IPM impact assessment programmes have been conducted in rice, cotton and vegetable IPM-FFS programmes and revealed that IPM-FFS can decrease pesticide use without lowering crop yields, can improve farmers' income and health, and protect the environment. IPM policies in China recently reoriented towards reduction in pesticide use or giving priority to less toxic products, bearing with the implementation of the new concept "Public Plant Protection, Green Plant Protection" and "Law on Agricultural Product Quality Safety". Challenges remain on how to institutionalize and develop national IPM policy in support of SCPI under the FAO Save and Grow guidelines for integrating into ongoing or future national plant protection programs as well as networks of various stakeholders with their substantial roles relating to reduction of pesticide risks.

Key words: Integrated pest management, Green Plant Protection, Farmer Field School, Impact assessment, Sustainable Crop Production Intensification, Save and Grow, Scaling up, Policy Orientation

Facts and figures of Country National IPM-FFS Programme:

Operational since: 1989

Implementing agency: General Station of Plant Protection, Ministry of Agriculture (1989-July, 1995), National Agro-technical Extension Service Centre (NATESC), Ministry of Agriculture (August 1995 to present)

Key partner institutions: Plant Protection Stations at Provincial and County levels.

Government funding and donors: Ministry of Agriculture

FFS conducted: 6000

Farmers trained: 180,000 (55% female)

Trainers active: government extension agents 1500; (40% female); farmers: 20 (40% female)

Main crops in which IPM-FFS interventions are focused: Rice, cotton, vegetables, fruits trees and tea etc..

Introduction

China, being the largest country in term of population in the world, presently had a population of over 1.3 billion to feed in 2014, and will be 1.5 billion to feed in 2020. Since the “economic reform” started in 1978, its economic has made dramatic progress. People’s life also experienced obvious improvement as their income increased remarkably, and consumptions of agriculture products increased and diversified dramatically. Even with the continuous intensification of agriculture production in recent three decades, food security is still one of the most challenging issues in Chinese economic, politic & social stability and development. China has changed from the net exporter to net importer of major food crops such as maize, rice & wheat, and to the largest importer of soybean in the world at a span of recent 20 years.

The majority of Chinese farmers are small holders, among the 260 million Chinese farmer householders, there are about 230 million holding with an average farm size of less than 0.5 hectare. Agricultural production is both labor and input intensive. In general, farmers use chemical pesticides and fertilizers heavily along with the intensification of agriculture production. In several crop systems, repeated failures in some local areas have been experienced, mainly due to poor pest management strategy and over-reliance on chemical pest control (Yang and Jiang 1995; Wang et al. 1999; Bernard 2001; Xia 2008). Thus, finding improved means of agricultural practices, in particular sound pest management, that will ensure sustainability and are free of the negative concerns, is of utmost importance to the agricultural sectors in China. This paper describes the efforts undertaken in integrated pest management (IPM) towards achieving the agricultural sustainability along with the intensification of agriculture production, with commenting the current issues and challenges in China.

PART I: Historical perspectives

1. Crop productions

Based on the tremendous intensification of grain productions from 1950 to 2014, China has basically achieved food security at national level by feeding 22% of the world population from only 10% of the world’s arable land. Recently, the production of grain crops has experienced a continuous 11 years of increases since 2004. In 2014, the sowing acreages of grain crops were increased to about 113 million hectares, with an annual production of 607 million tons and per unit yield of 5,385 kg/ha. Along with the continuous intensification of grain crop production, the annual grain production has climbed up to 300 million tons in 1978, 500 million tons in 2007 and 600 million tons in 2013. Many other crops such as vegetable & fruit productions have also been

intensified & extended significantly during the past three decades. The acreage of vegetables was only 3.8 million ha in 1980 with an annual yield of approximately 80 million tons. However, the acreage of vegetables had been increased to about 20 million hectares in 2014, with an annual production of over 740 million tons and average possession of vegetables per capita approximately climbed up to 500 kg per annum. The acreage and production of fruits have also been increased steadily and reached to 12.6 million hectares with an annual production of 161 million tons in 2014.

During the past three decades in China, intensification was the prime driver of increased per capita food production nationwide. But intensification of agriculture in China now faces unprecedented challenges due to lacking of arable lands and water resources. The desire for agriculture to produce more food without environmental pollutions is also urgently called for that the current agriculture practices heavily dependent on chemical inputs such as chemical fertilizers and chemical pesticides. In the recent 15 years, there have substantial increases in pesticide use in China, with consumption growing 43.5%. Currently, the overuse and misuse of pesticides are rampant in major crops, and the development followed essentially that of the “pesticide treadmill”, whereby more and more pesticides were used without effective control of the crop pests and ultimately lead to unprofitable crops productions. Overuse of pesticides caused the development of crop pests’ resistances and serious outbreaks of certain crop pests in some crop seasons. To date, about 30 species of major insect pests and mites, 20 species of plant pathogens and 7 kinds of weeds have developed resistance (Xia 2008). Unless this trend was reversed, it was unlikely that many of the current problems associated with over-reliance on pesticides would be averted. It was clear that the excessive and often unnecessary applications of pesticides had remained an important impediment to agricultural sustainability in China.

2. Pest management

The history of crop pest control in China can be dated back to Zhou Dynasty (about 2000 years ago) and it were common practices for that the governments responsible for the pest control (Pan, 1988). 1800 years ago, botanic and mineral pesticides had been introduced to control pests, and tobacco with nicotine had become an important material for controlling rice pests 200 years ago (Zhao, 1983). The early farming systems in China always used traditional techniques devised in accordance to the unique features of each particular area. Cultivation practices, including pest management methods were environmental-friendly and blend in well with the ecosystem. In general, the pest management practices encouraged low material inputs, recycling, high labor inputs, and balancing the use of different techniques with traditional agronomic practices (Pan 1988; Guo 1998; Xia 2008; Xia 2010). Under the traditional farming systems, pest outbreaks were usually related to changes in the natural environmental factors. For example, locust outbreaks were the result of dry weather in Northern or Eastern China (Wu 1951; Lei 2004; MOA 2010). Because traditional crop varieties planted possess genetic diversity, the epidemics of crop diseases rarely occurred (Wu 1951; Guo 1998).

However, the situation began to change three decades ago when the “green revolution” was launched in Asia. Due to this development, the small farm holders in China had better access to natural resources plus chemical inputs and thus able to improve their agricultural production dramatically, especially those with easy access to improved irrigation system, high yielding crop varieties, chemical fertilizers and pesticides. Agricultural productivity increased substantially from

1970s to the middle of 1990s. However, helping the small farm holders establish sustainable agricultural production system proved much more difficult than envisioned. This was because technologies developed in the “green revolution” were extended as “packages” to farmers in a direct and top-down manner (Roling and Van 1998; John et al.2000; Kevin and Yang 2000; Matteson 1993). The initial success in technological transfer rendered the top-down extension networks’ development rapid. Although the top-down extension approach succeeded in introducing small farmers to new inputs, many new problems soon emerged. Farmers adopting the technologies without the knowledge of using them appropriately soon used both fertilizers and pesticides indiscriminately and excessively (Pretty et al 2001; Pretty 2008). This resulted in widespread disruptions in agroecosystems. In the case of pesticides, it led to serious problems of residues, pest resurgence and resistance (Elliott 1995; Zhao 1983; Guo 1998; Xia 2010; Wang 1999). Other problems included farmer poisonings, reduced farm income because of higher inputs and induced pest outbreaks, and contaminated residues in agricultural produce.

3. IPM development

China accepted the concept of integrated pest control in 1953 and established the national policy for the integrated pest control (IPC) by the former Ministry of Agriculture & Forestry in 1976 (Guo, 1998). At that time, the principle of Chinese plant protection is mandated as “integrated management with emphasis on mainly prevention”. In late 1970s, crop IPM programs were launched out in China. Until mid-1980s, the IPM programs placed priorities on fundamental research to understand crop ecosystem, major pests and their natural enemies (Guo 1998). Laboratory and field studies were carried out on the basic biology and ecology of major pests and natural enemies. IPC methods in targeting single pest were developed and demonstrated in schemed zones of different ecological features. Economic threshold levels (ETLs) for major pests were used for decision-making in pest control. The conservation and utilization of natural enemies were promoted.

From Mid-1980s to Mid-1990s, the control tactics of IPM were packaged based on the diverse ecosystems in different ecological zones (Guo 1998). As time went on, ETLs were revised, taking into account plant compensation capacities, availability of BT and NPV formulations as they were developed and introduced for pest control. Gradually, implementation of IPM strategies went down through the traditional top-down extension approach, because in transformation of the former planned economy to the contemporary market economy. Especially, when the agricultural policy shifted the responsibility of decision-making on agricultural practices to farmers, the top-down extension system could not meet to the new agricultural policy that made farmers gradually to become more open and competitive in the transfer of market economy. Besides the recovered traditional top-down extension approach, other approaches were emerging and being tested. Support from international cooperation helped to strengthen existing national IPM programs. In 1988, China joined the FAO Inter-Country IPM Programme for Rice that first introduced farmer-led IPM in rice through TOTs and FFSs. From 1994 to 1995, the World Bank Cotton IPM Program funded research on cotton IPM technologies and training methods. ADB/CABI, from 1993 to 1996, supported benchmark survey, on-farm research and training of farmers in cotton IPM.

From Mid-1990s to Present, the agricultural policy changed again so that greatly was bearing to the national IPM programs. Highly toxic pesticides such as monocrotophos, parathion,

methamodophos, and some other organophosphates and cabamates were banned. Increased investment in research and industrialization of biological control agents promoted widespread applications of bio-pesticides and natural enemies for pest control. In 1994, transgenic Bt cotton was introduced. It has expanded rapidly following its application approval in 1997 (Piao et al. 2001).

During the past 30 years, China strengthened the extension of the IPM and obtained significant achievements. In order to meet the new challenge of pest control caused by climate change, cultivar improvement and excessive use of agricultural chemicals, China updated the conception of plant protection including IPM as “Public Plant Protection, Green Plant Protection”. Public Plant Protection is to define plant protection including IPM to bear the functions of social management and public service responsibilities, an important component of agriculture sustainable and rural development. Green Plant Protection is to strengthen the role of plant protection on support and safeguard ecological and sustainable agriculture.

PART II: Current status of IPM

1. Extension approaches in IPM

As the extension approach changes over time through both the national and international IPM programs, much has been learnt in terms of IPM implementation. Moving from a top-down approach to one of farmer-led has generated much interest, opportunities, and challenges (Ooi 1998; Ooi 1996; Henk 2000). Currently, farmer-led IPM is still yet to be implemented fully in most agricultural regions in China.

The Chinese extension network has its headquarters in the National Agro-Technical Extension and Service Center (NATESC) under the Ministry of Agriculture. It provides the provincial, county and township plant protection stations with necessary technical guidance, demonstrations, and pest monitoring and forecasting technologies, including organizing urgent pest control activities (Xia 2010). The current extension network was built with a top-down approach, with technology transfer dependent on a well-organized governmental system to support. Farmers do only to follow the guidance and recommendation from the extension stations.

Before the FAO-FFS programs, NATESC and several research institutes used to organize and implement national IPM programs in a top-down approach. IPM technologies were usually developed by research institutes, supported by pest monitoring and forecasting network. Extension specialists would scout the fields and predict the trend of pest development, then advise control measures based on ETLs. Control recommendations may be extended directly through face-to-face meetings, or news broadcast, or disseminated through newsletters. For the transfer of new IPM technologies, field demonstrations or classroom lecture training was conducted.

After the “economic reforms” in early 1980s, the centralized top-down extension approach faced great difficulties, because farmers then owned the land were small holders and might divide their fields into smaller parts and sub-contract to other farmers. Under such a situation, individual farmers usually made their decision, such as types of crops, and related farming practices. The farming ecosystems have been changing to become more diversified in terms of the range of crops, cultivation practices and cropping patterns. The decision making in pest management has

thus become more complex. This is because pest levels might vary dramatically on a micro-geographic scale. Pest populations could easily build up in diverse fields and at diverse times. To minimize risks, a natural reaction for most farmers is to rely on calendar and preventive spraying with pesticides.

To resolve the problems of the top-down approach, a shift has been made towards the farmer-led approach through FFS developed and promoted by FAO. The farmer-led approach empowers farmers through the participatory and non-formal education process (Roling 1998; John et al. 2000; Matteson 1993). Such an approach has been found to be highly effective in a large number of national programs in many Asian countries (Ooi 1996; Ooi 1998; John et al. 2000).

In China, one of the biggest challenges is engaging current agriculture extension agents to the new form of extension approach which is at odds with their past experiences and practices of information dissemination and technology transfer developed over a long period by top-down extension system. This has a long history in both agriculture and culture in China where extension has been carried out by technicians or specialists whose roles were clearly defined, understood and accepted as providers of knowledge to the farmers who were lacking it (Xia 2010).

2. Link to International IPM programmes

Like other Asia countries, the FFS-based national IPM programs in China were first developed in rice because of the implementation of FAO rice IPM program in 1988. So far, more than 20 TOTs and 30, 000 FFSs in rice were carried out, totally, over 3000 facilitators and 100,000 farmers in rice were trained in a number of provinces, for instance, Sichuan, Hubei, Hunan, Henan, Anhui, Zhejiang, and Guangdong. Through joint efforts by FAO and the national counterparts, the IPM-FFSs approach was gradually implemented nation-wide and extended to major crops. From 2000 to 2005, China was involved in the EU/FAO regional cotton IPM program which supports FFS training in 5 major cotton growing provinces. The FAO-supported vegetable IPM-FFS program was launched in Yunnan Province in 2003 and Guangxi Province in 2007, the program concentrated its efforts initially on capacity building for IPM FFS training on three types of vegetable crops (tomato, Chinese cabbage and sugar pea) in eight major vegetable growing prefectures in Yunnan Province, additional vegetable crops covered in the IPM-FFS included lettuce, broccoli, capsicum, pumpkin, squash, cauliflower, garlic, cucumber, potato, watermelon and cherry tomato, etc. In Guangxi province, the IPM-FFS training programme is now operational in 33 counties, conducting on rice, potato, corns, vegetables and fruit trees, etc.

The FAO IPM programs provided technical assistances to government-supported vegetable IPM training activities in other provinces/municipalities (Sichuan, Shandong, Beijing, Chongqing, Hebei and Shanghai, Guizhou, Jiangxi). Assistances were also provided to other donor-funded projects such as the World Bank-funded Anning Valley Project in Panzhihua and Liangshan, Sichuan province, GTZ-funded “Environmental Strategies of Intensive Agriculture in the North of China” Project, the CIDA-funded “Agriculture and Agri-food” Project in Western China, FAO TCP “Enhancing food security and improving livelihoods in concert with environmental protection for farmers and herders in poverty-stricken ethnic minority areas of Western Sichuan Province”, FAO TCP “Applied research on integrated pest management technology of Actinidia root-rot in Leye county, Guangxi” and EU/FAO/China “Model development and capacity building

for agro-biodiversity innovation and system management in Sichuan, Yunnan and Xinjiang”, IFAD program “Yunnan Agricultural and Rural Development”.

3. National IPM programmes

Facing the challenges along with sustainable crop production intensification, current national IPM programs put priorities on the use of multiple non-chemical control strategies, so called “green pest control technologies”, to reduce the use of chemical pesticides, in order to protect the environment, increase the yields and profits of grains, and ensure the quality and safety of agricultural products (Yang et al 2010). Up to 2014, the acreages applied with the green pest control technologies reached about 6.7 million ha-times, accounting for 15% of the crop pest occurring area and 12% of the total pest controlled area. In general, the green pest control technologies are referred to biological, physical, agricultural and ecological control techniques, some key green pest control technologies used in the national IPM programmes are described as follows:

A. Physical control: Most crop insect pests are either photo-taxis or chemo-taxis, this kind of biological behaviours of insect pests could be used by designing traps in IPM programmes. Frequency trembler grid lamp, ultraviolet lamp, colour sticky card, insect-proof net and pheromones traps are the most popular trapping methods used in national IPM programmes (Wei et al., 2008; Wang et al., 2008; Yang et al., 2010). In 2013, the various trapping technologies are applied about 4.5 million hectares, covering about 0.75 million hectares of grain crops and 3.75 million hectares of cash crops.

B: Biological Control: Several species of predators and parasites have been artificially reared and released in field for controlling crop pests in national IPM programmes, *Encarsia formosa* Gahan, *Anastatus japonicus* Ashmead, *Microplitis*, *Coccinella septempunctata*, and *Neoseiulus cucumeris oudermans* are the most commonly used species. During the past 20 years, several factories have been set up for massively producing *Trichogramma spp* in Northern Chinese provinces. *Trichogramma spp* were widespread released in major corn zones for controlling corn borers & sugar cane borers (Liu et al., 1996), applied acreages have reached over 1 million hectares of crops (mainly corn and sugar cane), and about 1 million hectares of forest in since 2012.

C: Ecological control: Ecological control is to manipulate the biodiversity and regulate the ecological factors for balancing the components of the ecosystem, enhancing the ecological service functioning, reducing yield losses caused by the damage of pests, and thus to reduce the use of chemical pesticides. Current national IPM programmes organized and established different ecological control demonstration zones on rice, cotton and wheat pest management. For example, 769,200 hectares cotton was applied the ecological control in Xinjiang, Henan, Hebei, Jiangxi provinces and 692, 000 ha rice fields were used the ecological control in the main production area of rice in 2009.

D: Bio-pesticides: In current national IPM programmes, *Bacillus thuringiensis* (Bt) is the most popular bacteria being used for controlling many species of crop insect pests. Almost every province in China has built factories for producing Bt formulations. So far, various kinds of Bt formulations were applied about 6 million hectare annually (Xiao et al., 2008). Among the commercialized fungus bio-pesticides, *Beauveria bassiana* and *Metarhizium anisopliae* were the

most popular used for controlling pine caterpillar moth (*Dendrolimus punctatus*), European corn borer (*Ostrinia furnacalis*), the oriental migratory locust (*Locusta migratoria manilensis*) and so on (Zeng et al., 2008). Bio-pesticides were used about 82.6 million ha. times in 2009, 88.04% of them was applied on grain crops such as rice, wheat, and corn; 11.17% was on cash crops such as cotton, vegetables, tea, and fruit.

Current national IPM programs are mainly implemented and based on either the commodities or the targeted major crop pests, some programs are briefly described as follows:

A. Locust IPM management: The oriental migratory locust, *Locusta migratoria manilensis* (Meyen), has been listed as one of serious pests in ancient China since 707 BC (Wu 1951). Its outbreaks caused great losses in ancient Chinese history in term of food security and society stabilities (Wu 1951; Zhu 1999). Nowadays, in order to reduce locust potential damages and avoid chemical residue problems, the national IPM programs of locust control put priorities on the exploration and extension of IPM technologies based on ecological control. For example, In 2010, cotton, alfalfa and winter dates were planted in the habitats of oriental migratory locust in Hebei Province, vegetation manipulations were successfully implemented about 8000 ha (Lei and Wen 2004; Zhang et al. 2006; Peng and Pang 2008; Zhang et al. 2009; Li 2010; Yang et al. 2010). In recent decade, the areas covered by the vegetation manipulations of locust habitats was about 12,000 ha each year, which significantly reduce the occurrences of the locusts. In addition, about 129.8 tons of bio-pesticides were used for substituting chemical pesticides (Chiu 1989; Zhu 1999; Zhang et al. 2006; Cheng et al. 2007). The national locust IPM program has driven the portions of the ecological and bio-control on locust increased from 20% to 38% from 2001 to 2011.

B. Rice IPM program: The Ministry of Agriculture launched out a national rice IPM program in 2006, which mandates that plant protection agencies must provide public services, and ensure rice production security. National Agro-technical Extension & Service Center (NATESC), in cooperation with different levels of plant protection departments, coordinated and organized a series of activities on technical developments, field trials, demonstration and farmer training of rice IPM techniques with significant achievements (Han et al. 2009; Xia 2010). Eco-engineering is one of the most active research and extension programs in recent years. Rice eco-engineering is through artificial design of ecosystem based on landscape ecology, to protect habitats and food sources of natural enemies, manipulate and enhance biodiversity, thus ecosystem services are improved to ecologically control of rice pests and reduce irrational use of pesticides, the rice plant hoppers could be keep under the level of economic thresholds to ensure rice sustainable production. The eco-engineering techniques are applied in this national rice IPM program included the use of resistant varieties, adjustments of cropping dates, extending rice-ducking system, planting flowering plants on bunds, application of light trap and insect sex pheromone trap, etc. (Schnef et al. 1998; Qi et al 2005; Wei et al 2008; Xia 2010). The rice ecosystem services was improved by the adoption of eco-engineering techniques, for example, the populations of egg parasites and predatory spiders against the rice pests were doubled in the eco-engineering demonstration fields comparing with those of farmer's practice fields, the populations of dragonflies and frogs were increased 5 to 10 times as well. Normally, the eco-engineering demonstration fields need not spray pesticides to control rice plant hoppers without yield loss.

C. Tea IPM program: Tea, *Camellia sinensis* (L.) O. Kuntze, is an important cash crop in China. The areas of tea planted were 32 million ha and the production reaches 1.6 million tons in

China in 2010. Annual damage resulted from pest infestations was about 25% yield loss. Another important issue is the consumers' concerns with pesticide residues in tea product, which is the greatest threat to tea production and international trade. Emphasises were put on substituting chemical pesticide in Chinese national tea IPM program, mechanical, physical, biological and ecological control tactics are considered as safe strategies. In tea fields, black-light traps, the Pest-O-Flash traps that emit near-UV light of 350-nm wave length or the some insect killer lamp are used for capturing adults of *lepidopterans* (Han and Chen 2002; Qi et al.2005; Wei et al. 2008; Jiang et al. 2010). Color stick board is used as an effective method to control tea pests such as *Empoasca flavescens*, and Spiny Black Whitefly (*Aleurocanthus spiniferus* Quaintance) (Liu et al. 2010). In tea IPM program, the biodiversity of tea plantation were enhanced by Intercropping. The tea varieties intercropping with appropriate other crop can inhibit the whitefly populations. Trimming and plucking can also change the pest's habitation and reduce the tea pest damage.

D. Vegetables IPM program: The photo-taxis techniques were widely implemented in national vegetable IPM programs. Different vegetable pests had different sensitivities to different colours. *Phyllotreta striolata* preferred to yellow and white colours, and *Myzus persicae* and *Liriomyza sativae* were sensitive to yellow colour, while *P. xylostella* was apt to approach green (Chen et al. 1995; Zhou et al.2003; Zeng et al.2008). Insect sex pheromone was also applied in controlling Diamond Back Moth (DBM) (Zhong 2005; Zhong 2008). The alcohol extracts from *Amaranthus retrofl* L, *Rubia tinctorum*, *Calystegia hederacea* Wall, *Scirpus wallichii* Nees, and *Stepkania longa* Lour had been used as repellents to *P. xylostella*. The non-alkaloid extracts from *Tripterygium wilfordii* had a strong antifeedant and growth inhibition effectiveness to DBM (Xu et al. 2006). Ecological measures based on cultivable and biological control, played an effective role in suppressing DBM.

4. IPM policy for sustainable crop production intensification (SCPI) under the FAO save and grow guidelines

IPM policies in China recently reoriented towards reduction in pesticide use or giving priority to less toxic products. With the implementation of the new concept “Public Plant Protection, Green Plant Protection” and “Law of the People's Republic of China on Agricultural Product Quality Safety”, IPM policies are strengthened on the safety of agricultural product and environment.

From 1960-1990, pesticides including insecticides in particular, were overused, predominantly because government programmes subsidized pesticides routinely as much as above 85%-100%. Major IPM policy reforms from 1986-1992 reduced these subsidies. From mid-1990s to present, pest and pesticide management related policies have continued to change radically, having great bearing on the policy environment in which the national IPM program has taken place.

The State Council issued the principal regulation of pesticide management “Regulation on Pesticide Administration” in 1997. Local provincial governments also established relevant regulations to implement this national regulation at local levels. Ministry of Agriculture (MOA) and the former Ministry of Chemical Industry established and issued the “Implementation Procedure Regulation on Pesticide Administration” respectively in 1999 and 1998. MOA and State Administration for Industry and Commerce (SAIC) jointly issued “Pesticide Advertisement Inspection Measures” in 1995. MOA and Ministry of Health (MOH) issued “Guideline on Pesticide safe Use” to specify and implement the national “Regulation on Pesticide

Administration”. China ratified the Rotterdam Convention (PIC) in 2005. The Customs Office started to supervise PIC listed pesticide products for import and export in an effort to effectively curb the illegal acts of producing, import and export of international banned and restricted pesticides. The Standing Committee of the National People’s Congress issued a Law on Agricultural Product’s Quality and Safety on April 29, 2006, including clauses on rational pesticide use and agricultural product quality and safety.

The Ministry of Agriculture proclaimed 2008 as the Year of Pesticide Registration Management and issued six new regulations to enhance pesticide management. In particular, these new regulations aimed at regulating pesticide names, label requirements and registration procedures. At various levels the government has taken concrete actions so that stakeholders like government officials, pesticide dealers, farmers, and manufacturers are aware of -and abide to- these new regulations. The Ministry of Agriculture defined the year 2009 as Pesticide Market Monitoring and Management year so as to build a better national pesticide monitoring and management framework to enforce the new regulations. As a result of effective policy and enforcement, China has phased out production and local use of all pesticides containing persistent organic pollutants (POPs) by May 17, 2009 as required by the Stockholm Convention. In July 2011, an announcement was made by the China Ministry of Agriculture, in a joint statement with four other ministries (Ministry of Industry and Information Technology, Ministry of Environment Protection, State Administration For Industry and Commerce, State Administration of Quality Supervision, Inspection and Quarantine), declaring a ban on the production of 10 more highly toxic pesticides by October 31, 2011 and ban on the selling and use of these 10 pesticides by October 31, 2013. The prohibition of highly toxic pesticides provides opportunities for intensified efforts to promote IPM and reduction of pesticide risks in China. In April 2012, the Chinese government announced the ban on domestic sale and use of paraquat (AS) in China starting from July 1, 2016. On 6 December, 2012, the Ministry of Agriculture and the Ministry of Health of China jointly released a new national food safety standard—Maximum Residue Limits for Pesticides in Food, which was effective on 1 March, 2013. The new standards set forth 2,293 residue limits for 322 pesticides in ten categories of agricultural products and foods, almost covering all the agricultural products in the daily consumption of domestic consumers in China. Comparing with the former standard carried out in 2005, 1,400 new items have been added into the new one, mainly on vegetables, fruits, tea and other fresh agricultural products.

PART III: IPM impact assessment

1. IPM impact assessment programmes

Several IPM impact assessment programmes have been conducted in rice, cotton and vegetable IPM programmes, recorded valuable data, evidences and results for documenting the impacts of IPM in China. The cotton IPM impact assessment was launched out from May 2001 according to the China/EU/ FAO cotton IPM program and is the first systemic effort to measure changes, intended or unintended, brought about by the cotton IPM program. Cotton IPM impacts have been identified on the levels of outputs, results and effects of project activities on farmer levels in this study. The cotton IPM impact assessments were implemented in the three pilot sites, namely Yingcheng city of Hubei province, Dongzhi county of Anhui province and Lingxian county of

Shandong province. Farm-household surveys, TOF/FFS log analysis, case studies and secondary data collection and analysis including the published and unpublished statistics were conducted in the IPM impact assessment studies.

Under the framework of FAO vegetable IPM programme in Yunnan province, a comprehensive impact assessment of vegetable FFS were carried out from 2003 to 2007 to measure major changes (or no changes) brought about by vegetable IPM-FFS trainings, and to profile those changes for identifying needs and opportunities for upgrading IPM farmer training and directions for future IPM programmes. As one of the crucial components of the impact assessment, this study aimed at investigating the impacts of vegetable IPM-FFS on reducing pesticide risks in vegetable productions, and to find feasible approaches for effectively reducing pesticide risks in vegetable production in small holder farming systems. Upon completion of the Vegetable IPM FFS impact assessment study, a Workshop on Impact Presentation and Policy Recommendation was held in the year 2009. The study results were presented and discussed with farmers, project managers, policy makers and other stakeholders.

During the implementation of FAO/China IPM-Pesticide Risk Reduction programme from 2007 to 2013, case studies were conducted to investigate, analyze and document project innovations and impacts. The studies have collected the evidences of the project impacts on enhancing food safety, protecting environment, and improving incomes for small holder farmers along with SCPI.

2. Impact on pesticide use

Ample evidences from the IPM impact assessment studies on rice, cotton and vegetables indicated that IPM can decrease pesticide use without lowering crop yields. Under the FAO community IPM program in rice, an analysis undertaken in 6 participating provinces where 1,181 trained-farmers were compared with 395 untrained-farmers in 1999, IPM farmers achieved an average yield of 440 kg/Mu and 489 kg/Mu before and after training, while non-IPM farmers obtained an average of 457 kg/Mu. Net profit was also higher for FFS-trained farmers, at RMB 268 Yuan per Mu. That of untrained-farmers was only RMB 210 Yuan per Mu. Another study undertaken in 1998, also showed a similar trend. Under the cotton program, the same trend was also obtained. Data collected by both TOF participants and facilitators showed that the IPM treatment is consistently more efficient in terms of economic returns than the FP treatment. Findings by 30 TOF participants in Lingxian County, Shandong Province in 2000 indicated that pesticide sprayings in IPM plots were 7 times less than that in FP plots, resulting in cost savings of US\$58.31/ha and increase in net income of US\$115.62/ha. For 2001, the savings and increase in net income were respectively, US\$23.04/ha and US\$379.97/ha. Likewise, data obtained by 33 TOF participants in 2000 in Yingcheng County (Hubei Province) and by 30 TOF participants in 2001 in Dongzhi County (Anhui Province) showed a similar trend.

In addition to the above, many other data sets obtained by facilitators in numerous FFS have also lent strong support. In 2000, for instance, FFS farmers in Sanba Village (Yingcheng County) had reduced the amount of pesticide application by an average of 34.9% when compared with untrained and non-FFS farmers. The cotton yields and net income increased by 8.2% and US\$36.5/ha, respectively. Likewise, farmers of 6 FFS in Wenshang County, Shandong Province, decreased spraying by an average of 4.2 sprays/season and reduced the amount of pesticide used by 38%. Net income increased by 5.1% when compared with non-FFS farmers. For Lingxian

County, farmers of 6 FFS reduced the amount of pesticides by 57.9% with an increased net income of US\$90.3/ha (or 3.1%) as compared to non-FFS farmers.

The impact assessment studies on vegetable revealed that the establishment of IPM community is the best option for overcoming pesticide residue problems. In the IPM communities established by the FFS alumni, the trained farmers were able to distinguish correctly labeled pesticides from fake or illegal pesticides, and ban the entry of improperly labeled and illegal pesticides into the community. For examples, the IPM alumni established farmers' self-control systems in 213 vegetable communities in Kunming city until the end of 2007. Since the implementation of vegetable IPM communities, the rates of exceeding pesticide residue MTLs detected in sampled vegetables in Kunming city has been continuously reduced from 20.87% in 2003, to 10.2% in 2004, 2.5% in 2005, <1.0% in 2006 and <0.05% in 2007.

3. Economic impacts (cost benefits analysis)

The impact assessment conducted under FAO/China IPM-FFS Programmes demonstrated that the FFS farmers are more economically efficient than the control farmers. FFS farmers showed significant increases of total incomes and gross margin after FFS, while the control farmers did not. Under the FAO community IPM program in rice, an analysis undertaken in 6 participating provinces where 1,181 trained-farmers were compared with 395 untrained-farmers in 1999, IPM farmers achieved an average yield of 440 kg/Mu and 489 kg/Mu before and after training, while non-IPM farmers obtained an average of 457 kg/Mu. Net profit was also higher for FFS-trained farmers, at RMB 268 Yuan per Mu. That of untrained-farmers was only RMB 210 Yuan per Mu. Another study undertaken in 1998, also showed a similar trend. Under the cotton program, the same trend was also obtained. Data collected by both TOF participants and facilitators showed that the IPM treatment is consistently more efficient in terms of economic returns than the FP treatment. Findings by 30 TOF participants in Lingxian County, Shandong Province in 2000 indicated that pesticide sprayings in IPM plots were 7 times less than that in FP plots, resulting in cost savings of US\$58.31/ha and increase in net income of US\$115.62/ha. For 2001, the savings and increase in net income were respectively, US\$23.04/ha and US\$379.97/ha. Likewise, data obtained by 33 TOF participants in 2000 in Yingcheng County (Hubei Province) and by 30 TOF participants in 2001 in Dongzhi County (Anhui Province) showed a similar trend.

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4. Environmental impacts

IPM Programmes improved agro-ecosystem through reduced chemical input and generated more ecologically sound crop management practices. The complex knowledge of natural enemies, pest and crop ecology was the basis for farmers to adopt environmental friendly and sustainable pest

management practices such as conservation and utilization of natural enemies, use of bio-pesticides and prevention measures. The impact study by using environmental impact quotients (EIQ) under FAO/China Vegetable IPM Programme clearly demonstrated that vegetable FFS farmers significantly reduced their pesticides risks on environment.

In terms of ecological stability, there was a clear increase in biodiversity, in particular the beneficial natural enemy species of pests. This was because significant reduction in the use of pesticides in IPM plots has resulted in less negative impacts on them. For instance, in 12 FFS in Yuekou Township (Tianmen County, Hubei province) in 2001, the total predator population in IPM plots had increased by 98% when compared to that of the FP plots. Among these, ladybird accounted most, followed by lacewing, then others. Likewise, data of 6 FFS in Yangzhuang Village (Lingxian County) in 2000 showed that the overall predator population in IPM plots increased by 53.37%. Comparatively, ladybird, spider and lacewing increased by 52.27%, 63.75% and 42.84%, respectively.

5. Social impacts

The education investment through IPM-FFS can be expected to produce outcomes that go beyond IPM, which are farmers' contributions to their social and community developments. Ample evidences reflecting impacts of IPM-FFS on farmers' community and social developments, which could normally not be expected as results of the traditional training approach. It is difficult to draw whole picture of those impacts just based on the rather small sample of farmers represented in the previous IPM impact studies. The important social and community impacts of IPM-FFS from available evidences could be described as: FFS graduates conducted field studies after FFS, farmer experimentations organized or conducted by the FFS graduates were recorded from most counties which were engaged in IPM-FFS implementation. Development of IPM communities, The FFSs resulted in the establishment of a critical mass of IPM alumni in farmer communities. In most cases, FFS alumni organized IPM associations, and have been conducting several types of activities. Certification of IPM products, Up to the end of 2011, IPM farmers associations have been established in about 200 villages in the project areas in China. IPM associations in these villages are labeling agro-products produced by FFS alumni. FFS alumni were responsible for the season-long field inspections. If farmers cultivated the agro-products in compliance with the producing standards of safe products, they can submit requests to IPM association for approval for labeling their products. Connecting to markets: The development of IPM farmer associations in these villages has attracted attentions from agricultural marketing companies. Some of the certificated IPM products have entered into supermarkets, and several vegetable companies have signed purchasing contracts with IPM associations in recent years. Farmers reduced marketing risks by joining contract farming schemes with the vegetable marketing companies.

6. Policy impacts

Both directly and indirectly, the IPM programs have deep impacts on national policies on plant protection, in particular towards reduction in pesticide use or giving priority to less toxic products. Of particular significance is the influence on the government to provide increased support to IPM development with national funding.

During the past 30 years, the Ministry of Agriculture issued 5 decrees, 38 highly toxic pesticides have been banned on use and stopped their registrations, and 19 pesticides were prohibited to be

used on fruits, vegetables, tea and Chinese medicine crops. In particular, Methamidophos, Parathion, Parathion-methyl, Monocrotophos and Phosphamidon had been banned on use by 1st January 2007, and followed by a production ban, effective from 2008.

The IPM programs had a direct impact on the eradication of all pesticide subsidies since 1990 in China. Under the impact of the success evidences by both national and international IPM programs, the recent policy environment has shifted towards more supporting green pest control initiatives with significantly increasing investments both on technical and extension innovations of non-chemical pest control approaches. The Ministry of Agriculture issued a decree recently for taking actions on capping the use of chemical pesticides and fertilizers until 2020 and supporting the development and extension of non-chemical pest control approaches.

PART IV: Challenges

1. Scale up of IPM to reach small holder farmers

China has very huge numbers of small farm households, reaching up to 230 million in total, and among them, 14 millions in cotton, 120 millions in rice and over 150 million in vegetables. Community IPM in rice, even though already implemented for 25 years in China, could only reach 1/1400 of the total rice farmers who have the opportunity to the IPM-FFS training.

For scaling up of IPM to reach the huge amount of small holder farmers, the extension agents would play a key role. But the total numbers of plant protection specialists who could undertake this task is estimated to be only about 22,300 in 2013. Such limited numbers are clearly insufficient to address the needs of the overall farm households, not considering the fact that a portion will either soon retire or possibly be transferred to other activities. It is obvious that relying on public extension service alone will not suffice. Initiating community IPM activities seems a plausible alternative presently. Once a community IPM program is established, IPM alumni could take over the roles of implementers, including leaders of the local IPM program. Farmer-to-farmer diffusion, technical services provided both by civil societies and private enterprises, and extension innovations by resorting to modern information technologies are also important in scaling up IPM to reach the huge numbers of farmers in China.

2. Building sustainable national IPM programmes

The potentials of IPM are now well recognized. That IPM is the current best option for overcoming many of the problems of pesticide overuse cannot be denied. However, expanding IPM to the large number of farmers in China needs to build sustainable national IPM programs. Along with the success of the international funded IPM-FFS program, more and more other stakeholders have adopted the FFS approach. In addition to international projects, the local governments are now actively supporting local FFS program with their own funds. In China, local governments in Yunnan, Guangxi, Beijing and Chongqing provinces/municipalities have taken active commitments in IPM-FFS. Other relevant projects, including the Ministry of Environment project also provide funding for FFS in Shanxi, Shandong and Hubei provinces.

Recently, the Ministry of Agriculture launched a new initiative aimed at promoting the FFS model at policy level for institutionalization and up-scaling of the FFS-based Agricultural Science and Technology System Reform Stations in 800 agro-extension demonstration counties in China.

Funded by the central government, each county will reform and build up its new agro-extension system, in which a local county FFS program included.

3. Policy re-orientation to IPM for SCPI under the FAO save and grow guidelines.

In China, pesticide industry is very strong with an amount of about 2300 factories or companies producing or marketing pesticides. During the past three years, the principal regulation of pesticide management “Regulation on Pesticide Administration” is currently under the process of amending. Different voices belittling the role of IPM in supporting SCPI rose again and could be heard occasionally, the promotion of pesticides sellers and companies in the process of economic development are not rare cases, so policy re-orientation to IPM must be strengthened to enhance the sustainability of IPM programs, otherwise the trends towards SCPI in China will be aborted.

4. Institutionalization of IPM

Challenges remain on how to institutionalize and develop national IPM policy in support of SCPI under the FAO Save and Grow guidelines for integrating into ongoing or future national plant protection programs as well as networks of various stakeholders with their substantial roles relating to reduction of pesticide risks. For instance, global climate change in itself will probably come with a mix of positive and negative factors influencing pest outbreak, uncertainties on the outbreaks of some major crop pest have been increased significantly and been hardly for forecasting. Unforeseeable emergencies of “new” invasive pests have been also relatively common in recent years. Hence IPM technologies will have to be continuously updated as to deal with newly emerging invasive pest and disease problems as to avoid farmers using pesticides indiscriminately. All this aspects impose challenges for the institutionalization of IPM in China

References

1. Chen, W., Isman, M.B. and Chiu, S.F. (1995) Antifeedant and growth inhibitory effects of the Limonoid toosendanin and Melia toosendan extracts on the variegated cutworm, *Peridroma saucia*. *Journal of Applied Entomology* 119, 367–370.
2. Cheng, Y.Q., Sun, Y.F., Xia, L. Sun, B., Miao, H.Y. (2007) Evaluation of Effect of the Biocide and the Pesticide Stemming from Botany Eliminating *Locusta Migratoria Manilensis* Meyen. *Chinese Agricultural Science Bulletin* 23, 262-264.
3. Chiu, S.F. (1989) Recent advances in research on botanical insecticides in China. In: *Insecticides of Plant Origin*, Aranson, J. T., Philogene, B.J.R., and Morand, P. (eds), American Chemical Society Symposium Series 387, Washington DC, pp. 69–77.
4. Elliott N C. 1995. *Integrated Pest Management*. Springer, 1995.
5. Fan, Y.X., Gu, H.P., Xu, J.H. (2010) Extension and application of ecological control on organic rice pests. 3, 57-59.
6. Fu, J.W., Xu, D.M., Wu, W., You, M.S. (2005) Preference of different vegetable insect pests to color. *Chinese Bulletin of Entomology* 42, 532-533.
7. Guo, Y.Y. (1998) Review of China IPM research and prospect of its development in 21 century. *Plant Protection* 24, 35-38.

8. Han, B.Y., Chen, Z.M. (2002) Composition of the volatiles from intact and mechanically pierced tea aphid-tea shoot complexes and their attraction to natural enemies of the tea aphid. *Journal of Agricultural and Food Chemistry* 50, 2571-2575.
9. Han, B.Y., Lin, J.L., Zhou, X.G., Zhang, J.M. (2009) Investigation on morphology of eggs of tea green leafhoppers and morphology and parasitic percentages of mymarids parasitizing the leafhopper eggs. *Journal of Anhui Agricultural University* 36, 13-17.
10. Jiang, L.R., Liu, S.A., Han, B.Y., Ouyang L.M. (2010) Effect of odours from seven species of host and non-host plants on the adult behaviour of the tea geometrid, *Ectropis obliqua* (Prout). *Acta Ecologica Sinica* 30, 4993-5000.
11. Lei, Z.R., Wen, J.Z. (2004) Advance in locust with *Metarhizium anisopliae*. *China Plant Protection* 30, 14-17
12. Li, J.H. (2010) Experiments of locust control by raising chicken and ducks. *Xingjiang Technology of Farms and Land Reclamation* 2, 56.
13. Liu, S.S., Shi, Z.H. (1996) Recent developments in research and utilization of *Trichogramma* spp. *Chinese Journal of Biological Control* 12: 78-84.
14. Liu, F.J., Zeng, M.S., Wang, Q.S., Wu, G.Y. (2010) Control effects of ecological attractive cards on the *Empoasca flavescens* and *Aleurocanthus spiniferu*. *Tea Science and Technology* 2, 4-6.
15. Pan, C.X. (1988) The development of integrated pest control in China. *Agricultural History* 62, 1-12.
17. Peng, Y.F., and Pang, X.F. (2004) Studies on repelling action of extracts from 9 species of plants against *Plutella xylostella* L.. *Shandong Agricultural Sciences* 4, 40-43.
18. Peng, G.X., Wang, Z.K., Yin, Y.P., Zeng, D.Y., Xia, Y.X. (2008) Field trials of *Metarhizium anisopliae* var. *acridum* (Ascomycota: Hypocreales) against oriental migratory locusts, *Locusta migratoria manilensis* (Meyen) in Northern China. *Crop Protection* 27, 1244-1250.
19. Pretty J. 2008. Agricultural sustainability: concepts, principles and evidence. *Philosophical Transactions of the Royal Society B*. 363:447-465.19.
20. Pretty J, Brett C, Gee D, et al. 2001. Policy challenges and priorities for internalizing the externalities of agriculture. *Journal of Environmental Planning Management*, 44:263-283.
21. Qi, S.C., Jun, L.J., Zhong, X.H. (2005) Using the Jiaduo insect killer lamp to monitor and control the tea pests. *Chinese Bulletin of Entomology* 42: 324-325
22. Schnepf, E., N. Crickmore, J. Van Rie, D. Lereclus, J. Baum, J. Feitelson, D. R. Zeigler, D. H. Dean. (1998) *Bacillus thuringiensis* and its pesticidal crystal proteins. *Microbiol. Mol. Biol. Rev.* 62: 775-806.
23. Wei, Q., Kong, D.S., Hui, X.H., Zuo, X.F. (2008) Extension reports of the frequency trembler grid lamp applied in the green plant protection. *Modern Agricultural Technology* 9, 98, 100

24. Wu, F.L. (1951) Locusts of China. Yong Xiang Press, Shanghai, pp. 17–19.
25. Xia, J.Y. (2008) Outbreaks of major agricultural pests and the control achievements in China. *China Plant Protection* 28, 5-9.
26. Xia, J.Y. (2010) Development and expectation of public and green plant protection. *China Plant Protection* 31, 5-9.
27. Xu, H.X., Chen, J.M., Lu, Z.X., Chen, L.Z., Yu, X.P. (2006) Insecticidal activities of the non-alkaloid extracts from *Tripterygium wilfordii* against *Plutella xylostella*. *Chinese Journal of Eco-Agriculture* 14, 179-181.
28. Yang, P.Y., Xiong, Y.K., Yi, Z., Shan, X.N. (2010) Progress and prospect of the demonstration of green plant protection. *China Plant Protection* 30, 37-38.
29. Zeng, Z., Sun, Y. J., Qian, R.H., Ding, X. Z., Xia, L. Q. (2008) Present Situation and Prospect of Microbial Pesticide Research and Application in China. *Research of Agricultural Modernization* 29, 252-256.
30. Zhao, S.H. (ed.) (1983) Plant Chemical Protection. China Agricultural Press. Beijing, China.
31. Zhang, S.M., Liu, J.X., Wang, G.S., Li, H.Q., Zhang, Z.B. (2006) Study on the effects of ecological control on *Locusta migratoria manilensis*. *China Plant Protection* 26, 7-10.
32. Zhang, J.H., Ruan, Q.Y., Yu, Y.L., Ge, Q.L., Zhang, X.R. (2009) Effects of ecological factors in Binhu locust zone on the density of *Locusta migratoria manilensis*. *Modern Agricultural Technology* 2, 85-86.
33. Zhong, P.S. (2008) Mating Disruption Effect of Sexual Trap on Diamondback Moth, *Plutella xylostella* (L.). *Journal of Changjiang Vegetables* 10b, 66-68.
34. Zhong, P.S., Liang, G.W., Zeng, L. (2005) Studies on the effects of ecological measures against diamondback moth (DBM), *Plutella xylostella* (L.). *Acta Agriculturae Universitatis Jiangxiensis* 27, 417-421.
35. Zhou, F.C., Du, Y.Z., Sun, W., Yao, Y.L., Qin, J.Y., Ren, S.X. (2003) Impact of yellow trap to sweetpotato whitefly *Bemisia tabaci* (Gennadius) in vegetable fields. *Entomological Journal of East China* 12, 96-100.
36. Zhu, E.L. (1999) Occurrence and Management of Oriental Migratory Locust in China. China Agriculture Press, Beijing, pp. 3–38.
37. John Pontius, Russell Dilts, Andrew Bartett. (2000) From farmer field schools to community IPM, Ten Years of IPM Training in Asia, FAO Community IPM Programme. Jakarta, Indonesia.
38. Roling, N. and Van de Fliert, E. (1998) Introducing integrated pest management in rice in Indonesia: a pioneering attempt to facilitate large- scale change. In Roling and Wagemakers (Eds.). (1998) Facilitating sustainable agriculture. Participatory learning and adaptive management in times of environmental uncertainty. Cambridge. Cambridge University Press.

39. Matteson, P. C., Gallagher, K.D. and Kenmore, P.E. (1993) Extension of integrated pest management for planthoppers in Asian irrigated rice. *Ecology and Management of Planthoppers*. Ed. R.F. Denno and T. J. Perfect. London. Chapman and Hall.
40. Bernard H. Sonntag, David Norse. (2001) Impediments to sustainable agriculture in China. In *Promoting global innovation of agricultural science and technology and sustainable agriculture development*. International Conference on Agricultural Science and Technology, November 7-9, 2001, Beijing, China.
41. Fan Xiaojian. (2001) Agricultural science and technology and vertical integration in agriculture in China. In *Promoting global innovation of agricultural science and technology and sustainable agriculture development*. International Conference on Agricultural Science and Technology, November 7-9, 2001, Beijing, China.
42. Xia, J.Y. (2008) Outbreaks of major agricultural pests and the control achievements in China. *China Plant Protection* 28, 5-9.
43. Xia, J.Y. (2010) Development and expectation of public and green plant protection. *China Plant Protection* 31, 5-9.
44. Yang Puyun, Piao Yongfan, Yan Su et al. (2001) Cotton IPM implementation Strategies in China, *Proceedings of regional workshop on the strategies on the implementation of cotton IPM programs*. Ho Chi Minh City, Vietnam, September 15-19, 2001.
45. Piao Yongfan, Yang Puyun, Guo Rong. (2001) Status of Bt cotton and its impact on cotton production in China. *Proceedings of Regional workshop on Bt cotton study in China*, Bangkok, Thailand, May 4-5, 2001 PP: 2-3.
46. Wang Houzheng, Xiao Yunli, Yang Puyun. (2001) *Training guide of cotton IPM ToF*. Press of Shandong University, Jinan, Shandong province (Chinese).
47. Wu, F.L. (1951) *Locusts of China*. Yong Xiang Press, Shanghai, pp. 17–19.
48. Ooi, P. A. C. (1996). Experience in educating rice farmers to understand biological control. *Entomophaga* 41, 375-385.
49. Henk Van den Berg, (2000). *Facilitating Scientific methods*. FAO program for community IPM in Asia, Peradeniya, Sri Lanka.
50. Waibel, Herman. (1998) “Policy perspective of IPM evaluation”, in *Evaluation of IPM Programs-concept and methodologies*, H. Waibel, G. Fleisher, P.E. Kenmore, G. Fededar, editors, Pesticide Policy Project Publication Series, Institute for Economics in Horticulture, University of Hannover, Hannover.
51. Robbin Shoemaker, (2001). *Economic issues in agriculture biotechnology*. US Department of Agriculture. Agriculture Information Bulletin No.762.
52. Wang Houzheng, Hua Xiaonan, Mou Jiyan. (1999). *The IPM of cotton bollworm* (Chinese). China Agriculture Press, Beijing, China.

53. Yang Puyun, Jiang Ruizhong. (1995) Review on nation-wide IPM Strategies in the control of cotton boll worm in the year of 1994 and 1995 (Chinese). In Progress Report of IPM of Cotton Boll worm. China Agriculture Press, Beijing China.
54. Yang, P.Y., Xiong, Y.K., Yi, Z., Shan, X.N. (2010) Progress and prospect of the demonstration of green plant protection. China Plant Protection 30, 37-38.
55. Zhang, J.H., Ruan, Q.Y., Yu, Y.L., Ge, Q.L., Zhang, X.R. (2009) Effects of ecological factors in Binhu locust zone on the density of *Locusta migratoria manilensis*. Modern Agricultural Technology 2, 85-86.
56. Zhang, S.M., Liu, J.X., Wang, G.S., Li, H.Q., Zhang, Z.B. (2006) Study on the effects of ecological control on *Locusta migratoria manilensis*. China Plant Protection 26, 7-10.

STATUS OF INTEGRATED PEST MANAGEMENT(IPM) IN DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA

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Summary

DPRK pushes ahead successfully IPM of field crops such as maize and vegetable under the direct interest of government and the supports of international organization such as FAO.

The Plant Protection Department of Ministry of Agriculture is mainly responsible for IPM. The Central Plant Protection Station (CPPS) has responsibility for the implementation and technical guidance of IPM who has Plant Protection Substations in every province and county.

Every Plant Protection Substation surveys the crop pests and reports the information of pest occurrence to CPPS and County Plant Protection Substation trains the farmers on IPM under the relationship with the County Farm Management Boards.

AAS solves the scientific and technical problems arising at IPM application.

Key words: *MoA, CPPS, AAS Plant Protection Substation.*

Facts and figures of IPM Programme in DPRK

Operational since: 2000

Implementing agency: MoA and CPPS

Key partner institutions: AAS, Plant Protection Substations,

Government funding and donors: government funding is increasing year by year, and donors are FAO, CABI, Europe Union,

FFS conducted: by County Plant Protection Substations

Farmers trained: many

Trainers active: officers concerned to plant protection at Province Rural Committee and County Farm Management Boards and officers of Plant Protection Stations, researchers of science research institutions and technicians of farm

Main crops in which IPM interventions are focused: rice, maize, potato, cabbage.

PART I: Historical perspectives

1. Crop production t

The main crops of DPRK are rice, maize, potato, maize, barley and vegetable such as Chinese cabbage and turnip. The intermediary areas cultivate mainly the rice, maize, wheat and barley and north areas cultivate potato and wheat.

2. Pest management

Before 2000, the crop pests were controlled by chemical pesticides. The chemical factories produced the chemical pesticide and MoA imported the chemical pesticide and supplied them to cooperative farms, which sprayed chemicals to control the pests under the assistance of technicians of farm.

3. IPM development

There were appeared the damage by main chemical usage in some area. In 1980s, some agencies began to develop the Trichogramma production technique and use Trichogramma to control the corn borer, *Chilo suppressalis* under the direct interests, which was the origin of the pest management by using the biocontrol agent without chemical pesticides.

From 2000 the experts and consultants of FAO trained the IPM. They focused the surveillance methods of pest and natural enemies in the fields for pest management, concepts of economic threshold, pest management by biological and mechanical methods and trains in FFS. Since then the researchers of AAS, concerned officers of MoA and trained farmers recognized on concept of IPM.

PART II: Current status of IPM

DPRK has well organized system of pest management from MoA to co operated farms by which IPM is extended to farmers and pests are managed.

1. Extension approaches in IPM

1.1 IPM training to farmers. IPM is extended to many farmers through the well organized system of science and technical extension on a national scale. MoA organizes two workshops on farming every year when the new issues of pest management are trained to senior officers of Province Rural Committee with common farming methods. And CPPS arranges two experience exchange workshops of officers of province plant substations in the fields of pest surveillance/forecasting, crop pest protection, and biopesticide every year. The province plant substations also organize similar workshops of county plant protection substations in their province. The county plant protection substation give demonstration training on pest management to technicians of co farm work team at every pest outbreak period who trains the concerned farmers in every sub work team.

1.2 Surveillance/forecasting of pest. The CPPS has surveillance/forecast section which includes surveillance persons in main pest occurrence area who surveys the pests and report the information to CPPS periodically. Meanwhile surveillance persons of all province and county plant protection substations also survey the pest in their area and report the information to CPPS and their Province Rural Committee and County Farm Management Board regularly. CPPS brings together all information and report to plant protection department of MoA who predicts the occurrence of pest in every area with the concerned persons of CPPS and experts of AAS depending on the all pest information and weather forecasting information. The all concerned units received the predicted information of pest occurrence through the newspaper and national internal net. County Farm Management Board and plant protection substation inform the information to cooperated farms to manage pest in the field.

1.3 Development and usage of biological control agents in pest management. MoA has responsibility for the pest management in DPRK. MoA makes plan of production and import of chemical pesticides and biopesticides and supply them to cooperated farms. MoA has deep interest in biopesticide usage in pest management and supply the all materials for biopesticide production. The province and county plant protection substations produces Trichogramma in their established

Trichogramma production facilities under the direct interest of government and supply them to cooperated farms.

The entomopathogenic nematode facilities are producing the nematodes and managing the underground pests effectively by using the local developed species.

The plant protection institute of AAS developed the Bt to control pest such as diamondback moth in the cabbage fields.

The cooperated farms develop and produce the various biological pesticides and botanical pesticides to use the pest management.

2. Links to International IPM programmes

DPRK keeps in close links with the international organizations such as FAO and CABI to develop and adapt the advanced IPM programmes on the local status of country.

From 2004 to 2009 CABI, Swiss implemented successfully the technical and equipment support project for Trichogramma facilities in DPRK by the Europe Union Aids.

From 2011 CABI also implemented the support project for development and production of entomopathogenic nematodes to control under ground pests such as grub, cutworm and wireworm.

3. National IPM programmes

DPRK manages effectively crop pest depending on the national IPM programmes.

CPPS makes his effort to ensure the correctness of forecasting on the basis of well organized surveillance/forecasting system and scientific accuray.

AAS develops the new and effective biocontrol agents to manage pest in the fields.

County Plant Protection Substations and Farm management Boards organize the IPM training to farmers to recognize the pest and protect the natural enemies.

PART III: Impact assessment of IPM programmes

1. IPM impact assessment programmes

The correct forecasting information of pest makes the farmers to reduce the amount of pesticide.

The usage of biological pesticides reduces the damage to environment and human health and overcome the resistance by chemical pesticide to manage crop pest effectively.

PART IV: Challenges

It is important to introduce the advanced IPM techniques such as correct surveillance and forecasting of pest and development of effective and adaptable biological control agents to manage the crop pest.

References

- Integrated Pest Management(AAS, 2012)
- IPM of Main Crucifer Pest (MoA, 2010)
- Trichogramma production and usage (Video) (CPPS,2009)

STATUS OF INTEGRATED PEST MANAGEMENT(IPM) IN LAO PDR.

PART I: Historical perspective

1. Crop production

Rice is a main crop grown in Lao PDR accounting for 68% of the total cultivated area of 1.8 million ha. (MAF: Strategy for Agriculture Development 2011-2020). Total paddy rice production reached 3.1 million tons in 2009. Some twenty important crops produced in the country include coffee, cardamom, tea, castor bean, bulberry, maize, sweet corn, soybean, mungbean, peanut, blackbean, job's tear, tobacco, cotton, sesame, sugar cane, cassava, taro, vegetables, fruits (fruit tree, banana), legumes, rubber and jatropha, the latter for biodiesel production.

Major vegetable crops grown in Lao PDR include cabbages, Chinese kale, onions, garlic, lettuce, tomato, cucumbers, melon, yard long beans, mustards and chilies. In the wet season (June - September), most production areas are planted to rice and, hence, fewer vegetable crops are cultivated. Various kinds of fruit trees are grown scattered throughout the country, largely produced and marketed for domestic consumption.

Most commercial production of vegetables is centered around the larger urbanized areas of Vientiane, Savannakhet and Pakse. Vegetable production also takes place at higher elevation areas in Vientiane Province and on the Bolaven Plateau in Salavan and Champasack. The remaining vegetable production areas are located along the Mekong River and its tributaries from north to south. In general, pests and diseases of commercially-produced vegetables are managed with frequent applications of chemical pesticides.

2. Pest management

According to a March 2009 baseline survey, commercial production of other important crops also involve heavy use of chemical pesticides. Weed management of commercial production of maize in Northern Provinces, particularly in Vientiane and Sayabouly, mainly used herbicides including the now banned Paraquat and other chemicals, most notably Glyphosate and Atrazine. Commercial production of other important crops (e.g. black bean, sesame and job's tear) and vegetables for household consumption and local markets in these provinces also used chemical insecticides including Cypermethrin and Dicrotophos.

All practical plant protection matters are dealt with at the Plant Protection Center in Salakham whereas the DoA and its Regulatory Division in Vientiane plays a key role in pest and pesticide management policy reform and legislation review. A new pesticide regulation was adopted by MAF in 2010, with annexed a list of recently banned and restricted pesticides. The Plant Quarantine Division of DOA, in addition to the inspection of pests and diseases, carries out the inspection of pesticides import through the plant quarantine check point located at borders and airports. The plant protection infrastructure remains limited and under-staffed. Roles and functions of the Plant Protection Centre in Salakham (revised dated 07/02/2013, Ref. No. 0285/DOA) include (1) Survey, study/trial, identify and classify pests and natural enemies and have them recorded in database of pests in Lao PDR; (2) Set up an inventory of pests and diseases of each

crop grown in Lao PDR especially for prioritized crops and other crops with potential; periodically update the pest list for aiming to facilitate agriculture and agriculture product export negotiation with import countries; (3) Strengthen human resource development in plant protection field to be at standard level and capable to connect with/linkable with international and regional (4) Transfer plant protection techniques to society nation-wide; (5) Monitor, surveillance and report status of pests by timely issuing of notice and technical advice in according to locality specific/Strengthen Plant Pest Surveillance System (6) Test and analysis quality of imported chemical and bio pesticides and fertilizers including these products used in Lao PDR and also residue in crops, agriculture products and soil; (7) Participate in activity on monitoring, production checking, supply and use of seed, variety, pesticide and fertilizer; (8) Organize and participate in study tour, seminar, train technical staff about plant protection work domestic and international; (9) Coordinate, cooperate and source funding for support of plant protection work based on the existing capacity; (10) Participate in other activities as assigned by DG and Deputy DG.

In general, the tropical monsoon climate of Lao PDR is conducive to a variety of pests and diseases. Pest and disease incidence and severity may become more acute with the development of new export crops, off-season production, and the introduction of new high yielding crop varieties. Climate change and increased trade of agricultural materials along the major GMS economic corridors bring the risk of introduction of new pest and diseases. The coconut hispine beetle and cassava pink mealybug are recent examples of such invasive pests. List of pests and diseases encountered in Lao crop production is regularly updated by PPC.

3. IPM development

The Ministry of Agriculture and Forestry and its Department of Agriculture in particular- has proclaimed policies aimed at reduction of agro-chemicals in Lao agriculture. In recent years, MAF has attributed an important role to IPM in its clean agricultural production programme. For example, for implementation of the ‘Clean Agriculture’ initiative, the Provincial Agriculture and Forestry Service (PAFO) of Vientiane Capital makes extensive use of IPM trainers who were intensively trained by the FAO supported Lao National IPM Programme. The government is tasked to set up ‘safe vegetable’ production known as GAP- farmer groups. A number of organizations and projects are promoting organic production such as the Lao Farmer Association and the Promotion of Organic Farming and Marketing (PROFIL) project. This project mostly works with IPM-FFS farmer graduates who are interested and motivated ‘in taking the extra step’ in moving towards organic production. The government encourages this development and regards organic production as a way to find a niche on quality-oriented international markets for export of Lao high-quality produce.

PART II: Current status of IPM

1. Extension approaches in IPM

The Farmers Field School is the predominant extension and adult education method used for IPM promotion among smallholder farmers in the Lao PDR.

Link to international IPM programme

The Lao PDR joined the FAO Asia IPM Programme during the mid-1990s and has since been a key member country in this FAO Regional Programme. FAO continues to support the National

IPM Programme within the scope of a longer-term Regional Programme aimed at strengthening management of agricultural chemicals in the Greater Mekong Subregion. This Programme, in its current 2nd phase (September 2013-June 2018) is funded by the Swedish Government. Activities include training of trainers and farmer training on IPM and pesticide risk reduction. To date (September 2014), more than 4,900 farmers (including 1,611 women) in 149 villages of nine provinces (Vientiane Capital, Borkeo, Louang Prabang, Louang Namtha, Oudomxay, Phongsaly, Sayabouly, Xiengkhouang and Vientiane Province) participated in training and formulation of community action plans on pesticide risk reduction for implementing in their own communities. Lao PDR also participates in FAO's Regional Rice Initiative, which includes support for piloting Farmers Field Schools for Save and Grow-based Sustainable Intensification of Rice Production.

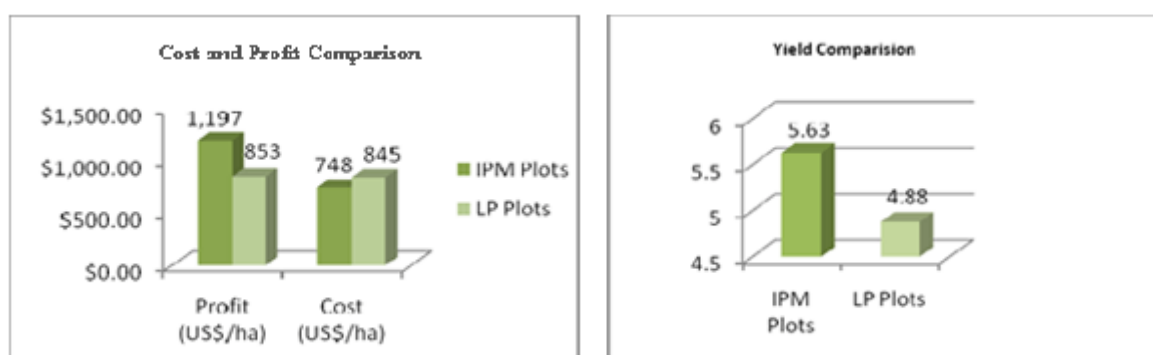
Links to other international projects currently ongoing include: CABI-Biosciences-Biocontrol in Rice project, ADB-Plant Quarantine, National IPM programme

National IPM programme

The National IPM Programme in Lao PDR is housed at the DOA-Plant Protection Center in Salakham and was established in 2001. The National Programme has supported IPM training for smallholder farmers in various crop commodities (rice, vegetables, fruits, cassava, coconut). For further details, see website: <http://www.vegetableipmasia.org/countries/view/laos>

PART III: Impact assessment of IPM programme.

Over the last decade, thousands of Lao farmers in 8 major rice and vegetable growing provinces have benefitted from participation in rice and vegetable Farmers Field School (FFS) conducted by the Lao National IPM Programme. IPM FFS graduate farmers typically reduce pesticide inputs, get higher yields and make better profits compared to conventional (LP) farmers. This is due to better crop management decisions as a result of regular field monitoring and expert agroecosystem analysis. The participatory and discovery-based learning processes employed in the FFS can be attributed to improved knowledge, skills and practice among IPM farmers. A comparison between IPM and local conventional (LP) practice in yard long bean production is given in the graphs below:



Source: 2008 Yard long beans FFS Report conducted in Hatpha-in Village, Saithany District, Vientiane Capital

Sustainability

With the assistance from FAO, the Lao National IPM Programme has implemented training of trainers and farmer IPM training, using the innovative and effective FFS approach. Thousands of

Lao rice and vegetable farmers have sustainably reduced inputs of agro-chemicals, obtained higher yields and better profits as a result of IPM adoption. The FFS approach has also been adapted by various local governments and NGOs (e.g. those involved in promotion of Good Agricultural Practices, Organic Agriculture Production and Plant Genetic Resource Management). All these projects make ample use of the skilled IPM farmers and extension workers trained by the Lao National IPM Programme. In recognition of the success of the programme and the importance of IPM and farmer education for human resource development in Lao PDR, the Lao Government provides co-funding for program implementation as part of the five year development plan and budget starting from 2006 onwards.

PART IV: Challenges

Current challenges with regards to successful up scaling of IPM and pesticide risk reduction training efforts include the limited human resources, including limited IPM trainers, at all government levels. The absence of a well-functioning and demand-driven agricultural extension system in Lao PDR also limits the up scaling of IPM training efforts. Climate change, low education level of farmers, change of consumer behavior/consumer demand, increasing of consumer demand on quality and food safety, barrier for accessing regional and international markets due to restriction of importing countries. Lack of market access for smallholder farmers in rural areas lead farmers to unfair treatment by suppliers for farmers in order to access to credit for agriculture inputs (seeds, pesticides, herbicides and fertilizer) and also lead farmers expose themselves and family to pesticides, in debt and even poorer. Most of smallholder farmers (as well as family members, spouse and young children) are affected by land concession and land leases. Farmers often end up becoming laborers/farm workers in concession farming resulted in young children lack of opportunity to go to school. Often, women and children handle pesticides and are thus highly exposed to pesticides being used in the farms. Awareness on food safety of majority of smallholder farmer and local consumers in rural areas is still relatively low whilst consumer behavior is general changed.

STATUS OF INTEGRATED PEST MANAGEMENT (IPM) IN MALAYSIA

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Summary

IPM programs in Malaysia were implemented on rice, fruits, vegetables and palm have been broadly based on three dimension. First is a solid IPM science basis including ecological interaction, plant physiology and soil-plant interactions. Second is policy for IPM, especially elimination of pesticide subsidies which cause over-use of pesticides and disrupt natural enemies leading to secondary pest outbreaks particularly on rice, fruits, vegetables and palm. Finally, the third dimension is farmer education through hands-on practical training. A case study on rice highlights broadened aspects of IPM activities through farmer empowerment.

Key words: *Department of Agriculture (DOA), Integrated Pest Management (IPM), Farmers Training*

Facts and figures of Country National IPM Programme :

Operational since: 2005

Implementing agency: Department of Agriculture Malaysia (DOA), Integrated Agriculture Development Area (IADA) Malaysia, MUDA Agriculture Development Authority (MADA), Sime Darby Plantation

Key partner institutions: Malaysian Agricultural Research And Development Institute (MARDI), University, CABI

Government funding and donors: Ministry of Agriculture and Agro-based Industry

FFS conducted: Department of Agriculture Malaysia

Farmers trained: 15 % female

Trainers active: government (30 % female); farmers (15% female)

Main crops in which IPM interventions are focused: Rice , Palm (Palm oil, coconut), Vegetables and Fruits

PART I : Historical perspectives

1. Crop production

The main crops in Malaysia are oil palm, rice, rubber and horticultural crop. Farmers in Malaysia produce variety of fruits and vegetables for the domestic market and export market, including bananas, coconuts, durian, pineapples, jackfruit, rambutan and others. Rice is a staple food in Malaysia, production of rice in the country in 2012 was 2.5 million metric tons. However, the overall production of rice does not fulfill the country's needs, and Malaysia have to imports rice from neighboring Thailand and Vietnam.

As one of the world's largest producers of oil palm industry, Malaysia produce 22 million metric tons. Malaysia also one of the world's leading suppliers of rubber, producing 1.3 million metric tons of rubber in 2014.

2. Pest management

Pest management is important because it can cause 55% yield losses if it is not managed properly (Saini et al., 2002). Chemical control is the most important control method in Malaysia prior to 1990's, however, Malaysia has moved to integrated pest management to reduce the usage of pesticide. Therefore, there is a need of a forecasting tool that can predict the level of pest activity so that early treatments can be applied to crops before the damage becomes worst.

3. IPM development

Pest management in Malaysia has been seriously dependent on pesticide, however since 1990's Malaysia has started to implement integrated pest management. First IPM projects in Malaysia is barn owl in rice field to control rats. This is one of the most successful stories of IPM in Malaysia. This project has reduced the incident of damage by rats. On vegetable, Malaysia has introduced *Diadegma semiclausum* to control *Plutella xylostella* (Diamondback Moth). This project also considered a success in controlling diamondback moth in cruciferous.

In 2000's, Malaysia has a problem with golden apple snail (*Pomacea* spp.), an invasive alien species in rice field. Malaysia has developed a program using goose and fish that feed on the eggs and adult of this IAS. This program was combined with other control methods like water management, chemical and physical methods.

The implementation of IPM principles and the practices in Malaysia was a gradual yet continual process. To date, the IPM approach has created measurable impacts in the various crops in Malaysia. IPM programmes already applied on paddy field, vegetables, fruit valley such as papaya, banana, mango, star fruit, guava, and jackfruit and also applied on coconut palm.

PART II : Current status of IPM

1. Extension approaches in IPM:

Department of Agriculture is the agency responsible for extension service in Malaysia. IPM approach is one of the main components in extension service. Extension agent is the frontline in implementing IPM at district level. Information on IPM is delivered by this extension agent. Technical staff from Plant Biosecurity Division will provide training and technical information to the extension agent. Besides this, a campaign programmed on IPM also done by DOA in cooperation with agencies and NGO's to increase the understanding and knowledge among officers and farmers.

2. Links to International IPM programmes:

Malaysia has conducted and participated in a few series of International seminar and workshop. For example, in 2013, Malaysia has conducted a workshop on eradication of golden apple snails and a symposium on IPM. In 2014, a workshop on pest information management were done to create link among ASEAN country for the updated pest management programme and to do reporting current progress on pest management from time to time.

Malaysia also has reactivated three national level committees namely committee on crop pest management, invasive alien species and biological control. These national level committees will support the implementation of IPM in Malaysia.

National committee on crop pest management functioned to control incursion of pest and to control spread of pest in the country while committee on biological control functioned to promote usage of biological agent to control important pest in Malaysia.

3. National IPM programmes:

Malaysian Good Agriculture Practices (MYGAP) is one of Malaysia IPM program. Usage of herbicide will be monitored in this scheme. Participant in this scheme have to record their pest incident, management and farm practices. All participants will be audited to before certify. Now there are nearly 300 farms in the process of accreditation, and some 60 farms with varying hectareage have been already been accredited and issued certificates.

In an effort to promote the use of IPM technologies in the various commodities, The Department of Agriculture has published several Technology Packages on major crops , including rice , fruits and vegetables. These packages incorporate various IPM component such as agronomic practices, cultural and biological control, as well as judicious use of pesticides. These packages are distributed to extension workers to extend and promote IPM practices to farmers.

For rice, Department of Agriculture provide barn owl house in all rice granary to promote control of rats. The Department also provides service for soil preparation for all rice fields outside the granary to reduce weed interference. Routine surveillance was also conducted in season and off season and the control program were initiated if incident above economic threshold level (ETL).

Malaysia also promotes the use of yellow sticker, pheromone traps, light trap, organic trap, Steiner trap to reduce pest population. Usage of trap plant in oil palm and rice field also part of IPM program in Malaysia.

On biological control, Malaysia have introduced *Asecodes hispinarum* to control *Brotispa longissima*. Research is being carried out on the potential use of biological control agent to control *Mikania micrantha* and *Parthenium hysterophorus*.

4. IPM policy for sustainable crop production intensification (SCPI) in support of practical Implementation of the FAO Save and Grow guidelines:

Malaysian Good Agriculture Practices (MYGAP), Malaysia Phytosanitary Certification Assurance Scheme (MPCA), Seed Certification Scheme, Reduction in Pesticide use, Organic Farming for production food crops, Zero burning policy during replanting of major crops.

PART III : Impact assessment of IPM programmes

1. Impact assessment of IPM programmes.

The practice of IPM in Malaysian agriculture has been increasingly adopted years by years. It involves the judicious selection and integration of all available methods for control pest and diseases implemented in a cost effective manner with consideration of environmental protection.

2. Impact on pesticide use

Malaysian farmers have various option to control pest with less dependence on pesticide. Even pesticide usage in the country showing increasing trend, the farmers have reduced the use of pesticide. The increase of pesticide in the country were caused by opening up land for agriculture use. Calendar spray practice were reduce and farmers knowledge on pesticide application technique increased. According to the trend, almost 70% of the farmers in Malaysia which is

participate in IPM Programmes already take an effective precaution and very careful to used chemical to control pest. They already find out the alternative for control pest without depending on the pesticide and also knows the correct pesticide application technique. For example, results of the IPM field trials showed with IPM programmers the used of herbicide could be reduced by as much as 50% with adoption of the alternative weed control strategies, and a no-insecticide option is viable to control paddy pest if biological controls are used (Hairuddin et al, 2012).

3. Economic impacts (cost benefits analysis)

IPM Practices in rice field under Muda Agriculture Development Authority in Kedah, Malaysia predicted cost savings per a season for 454 farmers was RM 891,681.00((Hairuddin et al, 2012). Otherelse there's no report and survey were done in Malaysia for the other crops.

4. Environmental impacts

The use of bio-pesticides, biological agent and IPM tool's will reduce environmental hazads. There is an increase of natural enemy population in the field that practice IPM. Chemical control were also used when the pest population exceed economic threshold level (ETL). Farm registered with the Department of Agriculture, Malaysia under Good Agriculture Practice Scheme were made compulsory for their product to be tested for maximum residue level. This is a way, promoting safe use of pesticide and protect the environment.

5. Social impacts

In a survey conducted on 454 farmers in Kedah, Malaysia showed that 88% of the respondents wore personal protective equipment when handling chemicals (Hairudin et al. 2012). The same study predict cost saving of RM 891,681.00, this will reduce the farmer's production cost burden. The farm that registered under MYGAP certification were also getting higher price for the produce. According to the survey from Department of Agriculture Malaysia also concluded that farmers which involved in IPM programs very happy and their view on pest management also change.

6. Policy impacts

The government's pest control policy changed from one which depended solely on pesticides to one which used a combination of control tactics, such as synchronized planting, crop rotation, the use of natural predators, and pesticides. More funding was given by the government to run the IPM Programmes and the focus to produce high quality and safe food is the main target for the agriculture sector in Malaysia nowadays. Besides this Malaysian government also empowering the quarantine rule and regulatores by enforcement at post entry-point to defend any invasive and endengerd pest entered to this country.

PART IV : Challenges

1. Scaling up of IPM to reach a larger number of smallholder farmers

Although IPM is an old concept judging from the inception, its implementation has been rather a challenging task at the moment. The experiences gained from the development and

implementation of IPM in rice, DBM/ crucifers, oil palm and fruits have shown that Malaysia has, by and large, succeeded in advocating the principles of IPM. However, the adoption rate which is currently low among the farmers and growers, need to be improved to realize the full impact of these IPM programs.

2. Building sustainable national IPM Programmes

The major drawback of IPM is that general recommendations are not possible for broad environments even within a single crop. The perception and utilization of IPM approaches should change from the 'package technology' to one of 'basket of tools and crop based technology' approach to be realistically acceptable to farmers with different problems and at different locations. There is also an unpredictable factor, ie., the constant changing of weather conditions especially in the tropical climate often affects the success rate of the IPM programs.

Experiences also indicated that IPM does not work well with *Bactocera spp* (fruit flies) in Malaysia. *Bactocera carambolae*, *B. Papayae*, is found to infest many species of fruits and in all eco-systems including orchard, village and forest areas. Moreover, fruits are produced throughout the year making it conducive for the breeding of fruit flies throughout the year too. Most IPM programs in reducing the fruit fly population were found to be not satisfactory at the moment. IPM approaches are also limited in a situation where bacteria and virus-vector complex exist. For example, in the case of Papaya Dieback, Papaya Ringspot Virus and Citrus Greening, the whole crop need to be destroyed once the bacteria or virus is detected on the plant and has potential to spread further and become epidemic.

3. Policy re-orientation to IPM for SCPI under the FAO Save and Grow guidelines

The IPM technology development programs are constantly faced with new challenges with the presence of new invasive pests. With the implementation of AFTA and World Trade Organisation (WTO), we anticipate very high volume of agriculture fresh produce coming into the country, that will further increase the chance of exotic pests slipping into the country without being detected. We have already experiencing new species of pest, for example, leaf miner being invading our ornamental crops. Once this pests established, new resources and personnel has to be exploited which further affects the IPM technology development programs. Whenever there is a shift in the focus, the 'IPM' gets weaken further.

4. Institutionalization of IPM

Although IPM field training in Malaysia is carried out regularly for farmers under various projects with immediate and medium term impact, long term sustained changes face significant challenges from advertisements for non-IPM applications. These IPM programmes is a long learning process to the DOA officers and farmers. It is a big challenges for Department of Agriculture to give supporting on IPM programmes in Malaysia. The development of IPM must include institutionalization support for internalizing IPM lessons and methods into policies, institutions and human resources responsible for pest management programmes. The same might be said for other emerging technologies that use ecosystem services and inherent biodiversity such as crop varieties, integrated farming systems, water management, soilhealth and pollinator management.

The successful adoption by farmers was due to proper organization, well co-coordinated research based data, hands-on training and strategic campaigns. The university's also need to do more

research on pest technology control for the alternative of pesticide used. More resources are needed to train farmers and plant protectionists at all levels including correct diagnosis of key pests and diseases and practical methods to determine economic threshold levels of pests for effective IPM. Effective IPM is supported by correct diagnosis, constant monitoring of pest and disease incidences and right timing of control.

References

- Saini, H. S., Kamal, R. & Sharma, A. N. (2002). Web Based Fuzzy Expert System for Integrated Pest Management in Soybean. *International Journal of Information Technology*. 8(1), pp. 54 – 73.
- Hairuddin M. A, M. Nasir Shamsudin, Zainal A. M, Md. Ariff H.& Alias R., (2012). *Journal of Economics and Sustainable Development*. ISSN 2222-1700 (Paper) ISSN 2222-2855 (Online). Vol.3, No.9, 2012. www.iiste.org

STATUS OF INTEGRATED PEST MANAGEMENT (IPM) IN MYANMAR

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Summary

Myanmar's economy relies on agriculture and integrated pest management has commenced since plant protection division has been established in 1979 provided financially and technically by FAO/UNDP and GIZ. In the pest management for every crop, Myanmar farmers rely on chemical pesticides. Farmers field schools have been started in Myanmar since 2000-2001 and now 6681 farmers has been trained about agricultural production including integrated pest management all over Myanmar. Farmers field schools have been commenced since 2000 and 6681 farmers have been trained till now. Among the farmers trained, about 35% are female farmers. The projects related to Integrated Pest Management have been conducted with financial and technical support by GIZ, EuropeAid and FAO. Policy makers, local authority concerned and plant protection staff are key persons to implement IPM strategy successfully.

Key words: *Farmers field school, Integrated Pest Management, female farmers, key persons*

Facts and figures of country National IPM-FFS Programme:

Plant Protection Division (PPD) is one of the divisions of Department of Agriculture (DOA) under Ministry of Agriculture and Irrigation (MOAI). PPD was established in 1979 with technical and financial assistance from FAO/UNDP and GIZ. Since then, Integrated Pest Management (IPM) section was established and carried out its function around Myanmar. IPM section has been collaborated and co-ordinated with other related sections of PPD. Moreover, in conduction experiments and research, it has carried out its functions with regional DOA office and staff. In 1999, steering committee of IPM was organized in PPD headquarters. The activities of IPM are:

- 1) Promotion of the importing environment friendly insecticides (e.g biocontrol agents),
- 2) Adoption of IPM approaches (rearing and release of predators, such as *Eocanthecona* spp., green lacewings, earwigs, *Trichogramma* spp. and entomophagus fungi such as *Metarhizium* spp),
- 3) Good Agriculture Practices (GAP) for fruits growers/public awareness. Government provides the required funds for travelling allowance for the trainers, materials required for farmers for Farmers Field School (FFS).

FFS has been commenced since 2000-2001 in Myanmar. In FFS, other divisions such as Land Use Division and Seed Division under DOA are also cooperated to train the farmers about agricultural production. Every year, FFS opens twice in every region and state. In each FFS, 30 farmers were selected whose education levels are middle school level at least. Now, among the farmers trained, 35% of woman farmers have been trained all over the country. Regarding with trainers from IPM, 75% are women as most of women are working in government organization in Myanmar. Main crops in which IPM interventions focused are rice, maize, vegetables, mango, green gram and black gram. Till now, 6681 farmers have been trained in FFS (Table). Other functions are conducting with IRRI to collect insects and their natural enemies in rice field.

Table: Number of Farmer Trainees trained by FFS organized by PPD

Sr	Year	No. of Region and state	Name of Crops	No. of Farmer Trainees
1.	2000-2001	3	Rice	212
2.	2001-2002	4	Rice	90
3.	2002-2003	2	Rice	64
4.	2003-2004	4	Rice, pulses	113
5.	2004-2005	4	Rice, pulses, winter crops	194
6.	2005-2006	3	Rice, pulses, oil-seed crops	135
7.	2006-2007	7	Rice, pulses, oil-seed crops, vegetables	298
8.	2007-2008	7	Rice, pulses, oil-seed crops, vegetables, horticultural crops	183
9.	2008-2009	11	Rice, pulses, vegetables, horticultural crops	400
10.	2009-2010	16	Rice, pulses, vegetables, horticultural crops	803
11.	2010-2011	17	Rice, pulses, vegetables, horticultural crops	948
12.	2011-2012	28	Rice	882
13.	2012-2013	18	Rice, pulses, monsoon sesame	862
14.	2013-2014	13	Monsoon rice, summer rice	679
15.	2014-2015	15	Rice, winter peanut, vegetables, monsoon sesame	818
Total				6681

Myanmar is an agro-based country and its economy relies on agriculture. The total area of Myanmar is 676,552 sq km. From north to south, Myanmar stretches about 2,085 km ; from east to west, the distance is about 930 km. The country has about 12,800 km of navigable rivers and canals. Staple food for Myanmar people is rice and rice is one of the main crops to export. Other major crops are pulses, maize and industrial crops (cotton, sugarcane, rubber, etc.). Last year, rice has grown 728397.48 ha and yielded 28602668.9 metric tons totally. Maize has grown 42985.84 ha and yielded 1586323.84 metric tons. Pulses were grown 44890.82 ha and produced 5804349.1 metric tons. Major exported commodities are cereals, pulses, oil crops, timbers and other crops. In 2013-2014, cereals can be exported 1219098 metric tons; pulses 1471965 metric tons; oil crops 186872 metric tons; maize 732909 metric tons; timbers 1088387 H. T; other crops 232092 metric tons. In Myanmar, farmers rely on chemical pesticides in the pest management. Moreover, they also use other control measures such as cultural control, mechanical and biological control methods. In spite of relying on pesticides to control pest in any crop, Myanmar has used lower pesticide when compared to neighbouring countries. Since ancient time, Myanmar farmers have known how to prevent the pest problem. For example, as soon as their crops were harvested they plowed these lands not only to destroy debris but also to disturb pests' life cycle, i.e. cultural control. They also cleared weeds around field not to hide any pests there. Whenever, they see the eggs on the crops, they destroyed by hand, i.e. mechanical control. Biological control began since 1980s in Myanmar. Also, biocontrol agents like neem azadirachtin, *Compoletis* spp. (larva parasites on American Bollworm of chickpeas), rotenone have been encouraged by the local plant protection staff to farmers. Every year, regional extension staff and plant protection staff have to

attend the training about IPM concept and knowledge. Then, they transfer their knowledge to local staff and farmers.

It is important to expand and improve IPM knowledge to farmers through local agricultural extension staff as those staff are key persons to communicate with farmers. IPM staff and extension staff demonstrated field trials to convince them how well the IPM strategy in pest management. IPM section linked with the international organizations like FAO, CABI, EuropeAid and GIZ. Rice IPM was funded by EuropeAid from 2011-2015, while maize IPM was funded by EuropeAid from 2012 to 2014. Regarding with nation IPM programs, rice, maize, pulses and cabbage crops were conducted for IPM strategy. Nowadays, MOAI laid down the policy to grow every crops IPM as a basic.

PART III: Impact Assessment of IPM programmes

Impact assessment of IPM programmes has been done since 1980s in Myanmar. As most farmers rely on chemical pesticides, it is rather difficult to practice IPM strategies, especially when using biological control method. Because of chemical pesticides, population of some natural enemies like spiders has been reducing. Moreover, population of fish in canals nearby rice fields has decreased year by year. As most of farmers could not use pesticides systematically, some health problems have been facing like acute toxin. When demonstrating IPM Vs farmers practices in the farmers practices fields, cost benefits analysis has also done. In first year, although the cost of IPM fields is higher than that of farmers practices fields, the number of natural enemies in IPM fields is higher than farmer practices fields. After two years of experiment, IPM fields showed more cost effective than farmer practices fields. Moreover, number of natural enemies becomes enriched. Environmental impacts, social impacts and political impacts of IPM have not been done yet partly because of insufficient funds and human resources. FFS is a media to reach IPM strategies to smallholder farmers. One of the main challenges to practice IPM is insufficient funds and human resource development. Local authority concerned, agricultural extension staff and regional plant protection staff are key persons to distribute the knowledge of IPM. Nowadays, farmers become to know the benefits of IPM gradually as more insects become more resistant to some chemical insecticides. Hence, plant protection division has laid down sustainable national programmes in which every crop grown all over Myanmar should be grown IPM based strategies. The objectives of the Plant Protection Division are; 1) To disseminate modernized plant protection strategies to reach farmers 2) To protect health of consumers and applicators by chemical pesticides used in crop production, environmental impacts 3) To implement crop production with IPM as a basis and to plant protection strategies for every single crop 4) To produce exportable crops in line with international plant protection convention guidelines 5) To produce and consume the crops not to be health hazard to human. Not only to produce more and less residue crop, related institutions have been cooperating and coordinating. Every year, regional plant protection staff and agricultural extension staff are trained to know the IPM strategies and then they share their knowledge local staff and farmers.

References

1. Myanmar Agriculture at a glance, Department of Agricultural Planning, Ministry of Agriculture and Irrigation.

2. Handbook of plant protection, Plant Protection Division, Department of Agriculture, Ministry of Agriculture and Irrigation.
3. Rice IPM. IPM Section, Plant Protection Division, Department of Agriculture, Ministry of Agriculture and Irrigation.
4. Maize IPM. IPM Section, Plant Protection Division, Department of Agriculture, Ministry of Agriculture and Irrigation.
5. Lecture notes related to plant protection methods for high-level training. Plant Protection Division, Department of Agriculture, Ministry of Agriculture and Irrigation.

STATUS OF INTEGRATED PEST MANAGEMENT (IPM) IN NEPAL

Dilli Ram Sharma, National Coordinator of NIPM Program of Nepal

Summary

Plant Protection Directorate (PPD) is one among the twelve Directorates of the Department of Agriculture (DoA). Its apex body is the Ministry of Agriculture development of the Government of Nepal. Major responsibility of this Directorate is to formulate the suitable policies of plant protection and implement through different organizations in the country.

Although Nepal has no longer history of Integrated Pest Management (IPM) in the country, however, it is the central strategy to crop protection. It was started only in the year 1997 through the Technical Cooperation Program of FAO, supporting financially and operating through the coordination of Plant Protection Directorate. IPM in Nepal has undergone some changes through its funding mechanisms and operational modality. After about a half decade of FAO supports, this program has been financially supported by Norwegian Government and been operated by PPD of the Government of Nepal. This has been one of the important programs of PPD and within DoA, where many farming communities and staffs have been involved in catering FFS for the effective implementation of IPM.

More than 200 cadres of officers. 369 JT/JTAs from ranges of disciplines are trained in and serving as in DoA. For the horizontal expansion more than 1100 farmers' level IPM facilitator is prepared. More than 55 thousand farmers are graduated in IPM FFS. The concept of FFS is expanded to cereals and now the program has more focus on vegetables, potato and recently to tea and coffee. Initially the FFS was begun with rice and later on in diverse crops. The outcomes of IPM program is highly promising on the area of reduction on pesticide use, empowerment of farmer, participation of female, institutionalization of IPM program.

Fact and Figures of Country National IPM-FFS Programme:

Operational Science of IPM through Farmer Field School

- Non formal education
- Adult learning
- Experiential learning cycle
- discovery learning
- Learning by doing
- Ecological based learnig

Implementation Agency

Implementing Agency			
Government	Local Government	INGO/NGo	Cooperative and Groups
MOAD, DoA, Plant	DDC	CARE Nepal	IPM Farmer Group

Protection Directorate	VDC/Municipality	World Education Caritas TITAN	
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Key Partner Institution

- FAO
- Nepal Agriculture Research Council
- Council For Technical Education & Vocational Training
- Institute of Agriculture and Animal Science
- INGO/NGO

Donor for NIPM

- Govt. of Nepal
- FAO
- Norway
- EU

FFS Conduction

Program and date	FFS conduction	Total Participant	Female %
TCP and Community IPM Program (1997-2002)	708	17850	52
Ist Phase(2003-2007)	845	22725	58
IInd Phase (2008-2014)			
Year long FFS	180	4603	63
Season long FFS	420	11397	60
Total	2153	56575	57

IPM Trainer

Program and Date	Level of Trainer	No of trainer/facilitator	Female%
TCP and Community IPM Program (1997-2002)	Officer	104	6
	JT/JTA	35 (organized by World Education)	43

	Farmer	381	25
Ist Phase(2003-2007)	Officer	35	0
	JT/JTA	42 +36 (Tea)	11+18
	Farmer	339	40
IInd Phase (2008-2014)	Officer	78	9
	JT/JTA	256	?
	Farmer	428	45
	CTEVT Instructor	60	8

Main crop in which IPM were focused

- Cereals: mainly rice few in maize and wheat
- Vegetable: Tomato, Potato, cauliflower and cabbage, Cucurbits, Chilli, Eggplant
- Fruits: Citrus, apple
- Others: Coffee, Tea, Ginger

PART I: Historical Perspective

1.Crop production

1.1 Land use pattern

The land use statistics further support to increase the area for agricultural activities with new dimension. As well forest and grass land also support to accelerate the livestock farming and other related enterprise (table 1).

Table.1. Land use pattern of Nepal

Type	Land in Ha. ('000)	Percentage
Agriculture land cultivated	3091	21
Agriculture land uncultivated	1030	6.99
Forest (Including shrub)	5828	39.59
Grass land and pasture	1766	11.99
Others	3003	20.4

Source: Statistical Information on Nepalese Agriculture 2012/13

Agriculture comprises of crop production, fruit and vegetable cultivation along with floriculture, livestock production, fisheries, agro-forestry and forestry (basically the domestication of NNTP's and aromatic and medicinal plants of forest origin).

1.2 Major crops and their production and productivity

Major crops of Nepal is paddy, maize and wheat, Oil seeds, potato, tobacco, sugarcane, various pulses, tea and vegetables (Table 2).

Table 2. Major crops of Nepal with area and production

S.N.	Crops	Area (ha.)	Production (mt.)	Yield (mt/ha)
Cereals				
1.	Paddy	1420570	4504503	3.171
2.	Maize	849635	1999010	2.353
3.	Wheat	754243	1727346	2.290
4.	Millet	274350	305588	1.114
5.	Barley	29598	33782	1.141
6	Buckwheat	10681	10056	0.941
Cash crops				
1	Oil seeds	215600	179000	0.830
2.	Potato	197234	2690421	13.641
3.	Tobacco	1800	2430	1.350
4.	Sugarcane	64483	2930000	45.438
5.	Jute	11300	15500	1.371
6	Cotton	175	150	0.857
7	Rubber	200	220	1.100
Others				
	Pulses (all)	333436	356743	1.070
	Vegetables (all)	266392	3301684	13.400
	Fruits (all)	101480	938731	9.250

	Cardamom		5753	
	Tea		20588	
	Coffee		366	
	Ginger		235033	
	Turmeric		35725	

Statistical Information on Nepalese Agriculture 20012/13 (MOAD. 2013)

2. Pest Management

2.1 History of plant protection in Nepal

Traditionally, farming in Nepal was organic in nature and was therefore, ecologically sound and sustainable for human beings and other living organisms. Until the 1950s, Nepalese farmers were unaware of agro-chemicals. They were dependent upon their rich traditional wisdom to control their agriculture pests. The use of agrochemicals such as fertilizers and pesticides started in early 1960s. Since then pesticide use trend is increasing day by day.

Entomology as a modern science entered Nepal around early fifties of the twentieth century. With the phasing out of Rana regime in 1951 and with it the break off of the self imposed isolation policy, a new era of changes was beckoned. Agriculture Entomology was introduced in the Department of Agriculture in 1953 as one of the several sections. In the meantime, the scion of Plant Pathology was also formed in Department of Agriculture but only as an office with a junior administrative staff. These sections involved in the study of entomology and pathology, related activities like training, demonstrations and services in plant protection. Ever since, these Sections meandered through various pathways to the present level. Plant protection entered in to a very formative phase in 1965 where fully function of Plant Pathology Section and Entomology Section were reformed. Plant Protection Units were established in major agriculture farms such as Tarhara, Janakpur, Parwanipur and Bhairahwa and Plant protection Junior Level Technicians (JTA) were also sent to 14 zones of Nepal in this decade.

Prior to the establishment of Nepal Agriculture Research Council (NARC) basic and applied research as well as regulatory activities (e.g. quarantine) were undertaken by Plant Pathology and Entomology Divisions at the national level. Prior to 1992, all district level plant protection services carried out as and when needed basis from these central divisions. Whenever pest outbreaks occurred, experts from these Divisions were mobilized to tackle such problems. Only few plant protection officers were also working in different agriculture farms and center as well.

After coming up of Parliamentary democracy in Nepal, agriculture sector was reorganized again in Nepal in 1989. Nepal Agricultural Research Center (NARC) a new organization autonomous where in lied the twin Divisions of Entomology and Plant Pathology, were solely devoted to research activities. Plant Protection service was recognized in the newly formed Directorate of Plant Protection and Industrial Entomology under the Department of Agriculture Development. Posts of plant protection officer were created in all the 75 districts. Five Regional Plant Protection Laboratories were formed to provide diagnostic services. Later on Directorate of Plant Protection

and Industrial Entomology were split to Plant Protection Directorate and Directorate of Industrial Entomology in 2000 AD.

2.2 Plant Protection Directorate (PPD)

PPD is designed as the Government agency responsible for the formulation of the plant protection policies and involve in the implementation of the Plant Protection activities through multi-pronged approach by involving various stakeholders. In addition to its representation at the national and international levels, it conducts several plant protection activities in the involvement of the Districts in various farming communities.

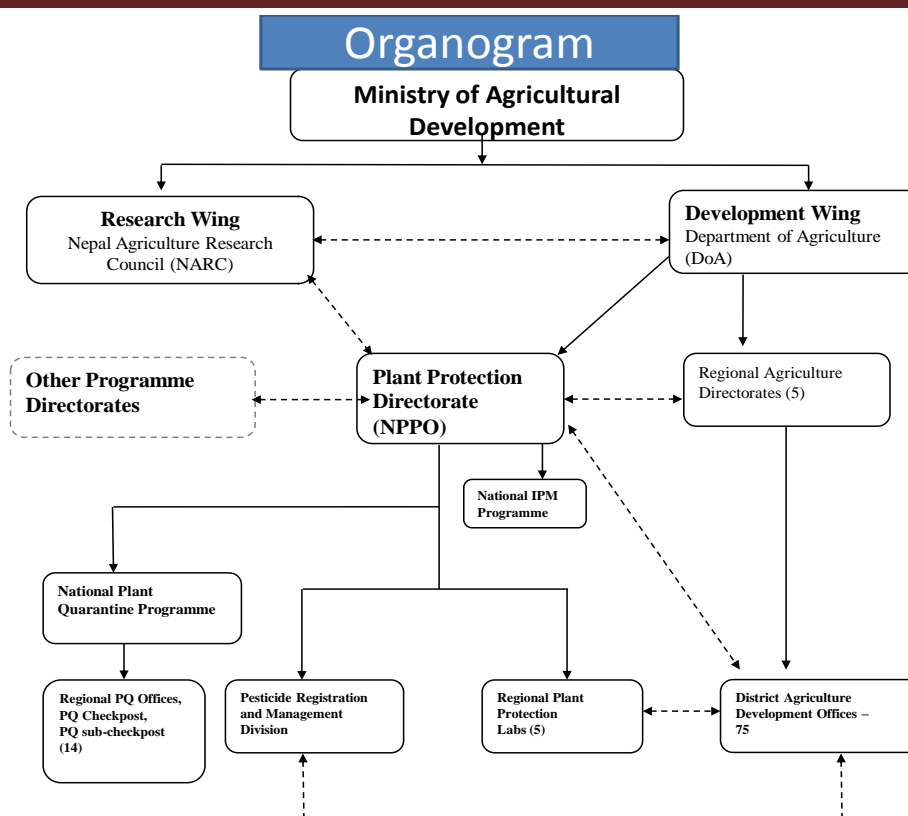
2.3 Mandate of PPD

Mandate of PPD are as follows:

- Work as official contact point for National Plant Protection Organization (NPPO) under IPPC.
 - To implement Plant Protection Act 2007 and Plant Protection Regulation 2009
 - To implement Pesticide Act 1991 and Pesticide Regulation 1994
 - To popularize adoption of IPM through training and demonstration in different crops.
- Survey & Surveillance of insect pest.
- To deal, advice & assist on all matters including international obligations related to plant protection.
 - Human Resource Development in Plant Protection.

2.4 Organizational set up

The Directorate is responsible for four national level programme – National IPM Programme, the Office of the Registrar of Pesticides, the Plant Quarantine Programme and Regional Plant Protection Laboratories for implementation of the programme. There are Five Regional Plant Protection Laboratories (RPPLs) in different Development Regions. National Plant Quarantine Program has fifteen different plant quarantine check-posts, sub-check posts and Regional Plant Quarantine Offices. All the Regional Plant Quarantine offices are located in the boarder side of India whereas three of the sub-check posts and check posts are located in chino-Nepal boarder and one plant quarantine check-post at Tribhuvan International Airport in Kathmandu. Plant Protection Directorate (PPD) is an apex body for coordinating these offices including Pesticide Registration and Management Unit.



2.5 Plant Protection programs under PPD

The PPD undertakes general pest control methods and new programs on pest management such as IPM. It also formulates national level plant protection policies and strategies to raise agriculture production and productivity with safeguarding human health and ecology. PPD also considers the introduction of safer and more specific chemical pesticides as well as development and use of local made botanical pesticide and biopesticides as a concurrent rational approach.

PPD is also responsible for pesticide management in Nepal. Pesticide Registration and Management Division under PPD is responsible to regulate Pesticide ACT 1991, and Pesticide Rules 1994 in Nepal. National Plant Quarantine Programme under PPD has mandate of regulating and implementing Plant Protection Act 2007 for quarantine purposes.

Five regional plant protection laboratories (RPPL) which maintain collections and preservations of specimens, biopesticide production, diagnose pest and act as technical backstop for the extension services.

Pest survey and surveillance is also integral part of Plant Protection programme which is done by District Agriculture Development Offices and RPPL. To provide efficient plant health services to poor to the farmers, Plant clinic is also one of the popular programs in Nepal.

3. IPM Development

One of the main constraints to increase agricultural production and value addition in the farm produce is the pest attack. Loss from crop pests is estimated to be around 35% annually. To reduce this loss farmers use synthetic pesticides, which are expensive, cause negative environmental consequences and are health hazardous to the growers and consumers. Integrated pest

management (IPM) is a priority activity in line with the government's policy for reducing pesticides and increasing food production, food security and sustainable agriculture.

3.1 Initial IPM Activities:

In Nepal, IPM had been the part of indigenous agriculture when pesticides were not used. After 1960 when pesticides entered into Nepalese agriculture, their use began rampantly increased. Extension systems are largely blamed as the technical messages for farmers still have the same old concepts. Before Nepal's participation in the Technical Cooperation Project (TCP) 1997 the program interventions were made with a concept of promoting the integrated use of different pest control methods to avoid or minimize pesticide use. These interventions made before 1997 makes it clear that pesticide reduction strategy, guided basically the Nepalese IPM Program rather than application of ecological principles.

3.2 Community IPM program

In 1996, an outbreak of brown planthopper in rice in two pockets of Chitwan district where pesticide used were indiscriminately caused an estimated loss value at almost NRs. 23.13 million. This created havoc in Nepalese agriculture because the case of BPH outbreaks in Nepal clearly a case of departure from secondary to major pest status. Realizing this fact Nepal joined Technical Cooperation Project within framework of FAO Global IPM Facility in 1997 to deal with pest problems through IPM in ecological principles.

It was the implementation of TCP project in rice in 1997 which brought Nepal into new paradigm of the discovery based, participatory and farmer based educational process found on the sound principle of agro-ecosystem analysis by farmers for decision making on pest management through season long FFS. In this project, major focus was given to human resource development i.e. to develop master IPM facilitators for IPM through IPM farmer field school to the farmers (Table 3).

The phase of Regional Community IPM Program (GCP/RAS/172/NOR) in support of Government of Norway by began in January 2000 as a part of continuity of TCP project. The beginning of new millennium was also the start of Community IPM in Nepal. Past two year's experience showed that the Rice IPM Farmers Field School was only the beginning, the entry point, for a longer term process while farmers develop the personal and organizational capacities necessary for sustaining agricultural and community development. Activities were focus on:

- Farmer as IPM Trainers (Farmer TOT, Farmer FFS)
- Farmer as planners
- Farmer as researchers
- Farmer as organizers
- Participatory planning and implementation
- Farmer to farmer FFS
- Farmer studies

Table 3. Different IPM activities during 1998-2002

S.N.	Training/workshop	No	Period	Participants
1	Season long RICE IPM training of trainers	1	April-July, 1998	30 APPOs
2	Rice FFS (as part of TOT)	5	-do-	150 farmers
3	Rice FFS	30	July- Nov	875 farmers
4	Strategy development workshop	1	Dec, 1998	MOA, DOA, PPD
5	Season long Rice IPM TOT	1	July-Oct, 1999	30 APPOS, 1 NARC, NGOs
6	Follow-up training on Participatory planning	2	March, 2000 and 2001	39 IPM trainers
7	Follow-up training on Science by farmers	2	May, 2000; May 2001	36 IPM trainers
8	Rice FFS	384	Mar. – Nov.2000; Mar-Nov. 2001	9600 farmers
9	Farmer to farmer FFS	176	July-Nov. 2000, Mar- Nov 2001	4400 farmers
10	Farmer TOT	5	2000	156 FT
11	Season long Rice IPM TOT	1	March-Jun.2001	17 JT/As (GO) and 17 JTs NGO
12	Vegetable curriculum workshop	1	March 2001	13 Participants of DOA and NARC
13	Vegetable IPM TOT	1	July-Oct 2001	30 GOs officer, 4 NGO officer
14	Policy workshop	1	Nov 2001	40 Policymakers and donor agencies

15	Vegetable FFS	23	Apr-Jul 2002	575 farmers
16	FTF FFS (Rice)	70	July 2002	1750
17	Farmer TOT	5	Mar-May 2002	150 FT
18	Farmer TOT	3	Oct-Nov, 2002	75 FT
19	FTF FS	14	July-Dec., 2002	350 farmers
20	FFS by trainers	20	July-Dec, 2002	500 farmers

Achievements:

Community IPM program significantly contributed towards the development of a pool of trained human resources (technicians and farmers) to support farmer IPM training initiatives. The Programme created awareness among the farmers on the concept, methods and principles of IPM and educated them on ecology-based crop production (mainly rice and some vegetables). The Programme also initiated a process of institutionalization and mainstreaming of IPM within the regular activities of DoA at different layers through the provision of various coordination committees at National, Regional and District levels. Furthermore, the Programme created a facilitating environment for other institutions from the non-government and academic sector to collaborate and promote IPM and FFS-based farmer training and action research.

Major achievements of this project were increased rice production about 15 to 25% and reductions pesticide about 40% by IPM trained farmers. The farmers who participated in FFS reported an increase in the understanding of agro-ecosystem. The ecological concept of pest management had been translated into practice. Farmers started making better decisions on crop and pest management after analyzing the actual field and crop conditions. The FFS process had shown to be able to bring together not only men and women in a common activity, but also different social classes. Farmers and local governments had shown high levels of enthusiasm for the adoption and implementation of the IPM program and the FFS approach. Involvement of NGO/INGO partners (such as World Education, CARITAS, MADE/Nepal, WINROCK international, Helvetas/Nepal) in programme implementation increased significantly over the years. Coordination of IPM activities features dominantly in the regular activities of the Ministry of Agriculture Development.

3.3 National IPM Program –Phase I

The first phase of the project began in 2003 when the Government of the Kingdom of Norway agreed to provide a grant totaling US\$ 1,284, 444 for the "Support to the National IPM Program in Nepal. The main objective of the program was "to contribute to sustainable broad based poverty reduction and food security while contributing to environment protection". The specific objectives were (i) to contribute to institutionalize a sustainable national IPM program in Nepal by strengthening the capacity of the PPD, and strengthening the capacity of National, Regional and District level training and extension institutions, and (ii) to empower farmers to increase production and productivity efficiently, while protecting the environment. To implement this

program, Government of Nepal signed an agreement with FAO to provide management and technical assistance services under UTF/NEP/055/NEP Project. The first phase of the National IPM program ended officially in December 2007 but was extended at no extra costs until the end of February 2008.

Achievements:

A. Training of Facilitators

In continuity of human resource training of past, following training of Facilitators (TOF) were conducted to support farmer IPM training initiatives.

- Officer level (2004) - Total Participants: 35, (PPO 20, Non PPO 15)
- Officer and JT/JTA-Total Participants:42, (JT 34, JTA 8)
- Tea IPM TOF-Total Participants: **36**, (JT-7, JTA-3, IPM Farmer Facilitators-9 , Tea Farmers-4, Tea & Coffee Technician – 9, Other Technicians/Leader -4)

B. TOF for farmer level

Altogether 339 farmers those who were graduated from FFS were got training of facilitators to conduct FFS on their locality. Among them 40% farmer facilitators were female.

C. Farmer Field School

Altogether 845 FFS (Rice:396 and vegetable:449) were conducted in this period from which altogether 22725 farmers were trained. Among total farmers 585 were female (Figure 1).

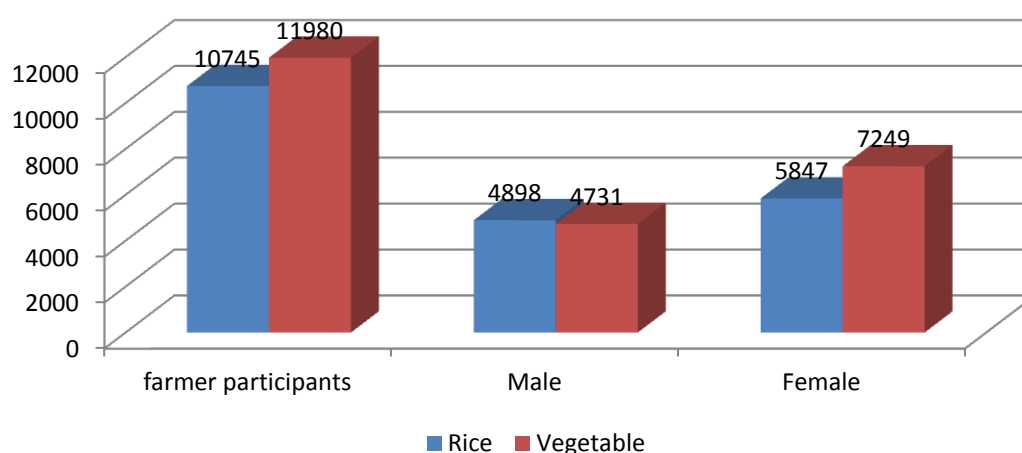


Figure 1: Genderwise FFS participants in Rice and Vegetable FFS during 2004-2007.

D. Post FFS activities

After FFS conduction some of the following follow up program were also conducted as per the need of farmers on the basis of existing local situation.

Farmer and Science

Total 82 farmers and science (Rice-19; vegetable-63) were conducted in this period to address their specific local problems.

Post harvest FFS

Grain loss in storage is 7-10% in Nepal. To address post harvest loss in storage, altogether seventy FFS on post harvest management were also conducted on rice, wheat and maize (Figure 2).

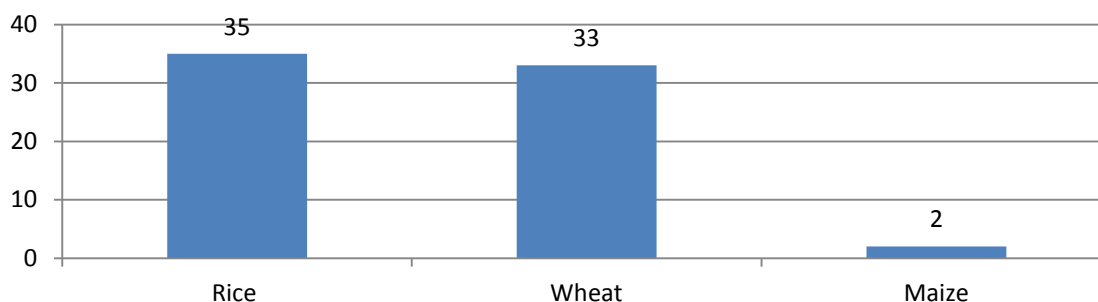


Figure 2: Number of postharvest FFS during 2005-2007.

E. Farmer congress

Farmer congress was conducted in 16 districts in this period for information exchange, lesson learnt and strengthening IPM groups. Altogether 1257 participants (male-858, female-399) were actively participated in which 934 participants were farmer facilitators.

F. Workshop, meetings and study tour

Various curriculum development workshop and Regional IPM review and coordination workshop were conducted periodically to facilitate IPM programme in Nepal. Coordination Committee Meetings and Project Tripartite Meeting were also conducted periodically to review and assess the IPM program.

Altogether twenty six personnel were visited other countries like India, China, Vietnam, Thailand and Bangladesh for international exposure in IPM programme..

3.4 Support to National IPM Programme in Nepal (Consolidation, Up-Scaling and Institutionalization, Phase II)

To continue the initiatives of IPM program, Support to National IPM Program-phase II (SNIPM-II) was prepared with the participation of the Government and FAO in 2008, taking into account lessons learned in earlier FAO and Royal Norwegian Government assisted IPM project (UTF/NEP/055/NEP) realizing that IPM is not just about pest control, but about a holistic and sustainable production management that can help achieve food security, reduce poverty and safeguard environment. As part of the contribution to the 13 million US Dollar project budget, the Royal Norwegian Government granted 27 million NOK valued at the equivalent of US\$ 5 million for the period of 27 October 2008 – 28 October 2013. Of this amount, US\$ 3400000 was given to FAO to assist in developing and testing the methodologies and procedures for intensification and institutionalization of IPM on pilot basis in 12 selected districts covering 5 development regions and 3 ecological zones. Emphasis was given to develop adequate trainer through both pre- and in-service training and follow-up capacities, establish permanent IPM –FFS groups, support them with services and back-up research, and finally set up a management information system. The agreement between Government of Nepal and FAO was signed in 27 October 2008 to implement

the project “Support to the National IPM Program in Nepal: Consolidation, Up-scaling and Institutionalization Phase II”. The programme became fully operational only in June 2009 onwards following the approval of the Inception report by the Ministry of Agriculture Development of the Government of Nepal and project ended officially in 31st January, 2014.

The overall goal of the project was to contribute to sustainable broad-based poverty reduction and food security while contributing to human health and environmental protection. Its purpose was to institutionalize a sustainable national IPM Programme in Nepal by strengthening the capacity of the PPD, collaborating national, regional and district level training and extension institutions in the government and non-government sectors to integrate IPM training and support programme for small holder farmers. The purpose was also to increase crop productivity in an environmentally sustainable way, avoiding health hazards for betterment of their livelihood and linking with markets, while enhancing the capacity of men and women to manage the development process.

It adopted the strategy to implement and gradually up-scale IPM technology through Farmer Field School (FFS) approach in selected 12 pilot districts across the country representing Terai (5 districts), Hills (5 districts) and Mountain (2 districts) ecology of Nepal. Project beneficiaries were small holder farmers including women farmers; where IPM could contribute to increase economic benefits, concomitant development of farmer empowerment and mobilization, as well as strengthening farmer groups/organizations together with activities to promote organized marketing of safer agriculture commodities. The related beneficiaries were all those engaged in agriculture, agriculture input dealers, agro-vets, facilitators, trainers, technicians, teaching and research professionals and policy makers.

The Programme implemented through two interrelated complementary to each other programme components, one through FAO management support and the other through internalizing into regular PPD programme. The focus of the PPD component was to maintain the existing training capacities in 63 districts as well as in coordinating and maintaining the linkages to all stakeholders and collaborating partners of the National IPM Programme. The intensive component supported by FAO to assist National IPM Programme in developing and testing methodologies and procedures for the intensification and institutionalization of IPM through pilot mode in 12 districts (Dadeldhura, Kailali, Banke, Surkhet, Jumla, Kapilvastu, Syangja, Mustang, Bara, Kavre, Jhapa and Ilam) across five development regions and 3 broader ecological zones as well as establishing a Monitoring and evaluation and Information system for the National IPM Programme.

Achievements

The project contributed considerably to the overall goal and objectives of the National IPM Program Phase II and two components remained intact in line with the agreed work plan. In terms of human resources development, the programme trained 1,029 including technical staff at various level and farmer facilitators. At the field level, more than 16,000 direct beneficiary farmers gained knowledge and skill on the ecological based agriculture technology. Out of this number, a total of 4,603 farmers also received post-FFS support ranging from 3 to 7 seasons for technology generation, certification, group strengthening, marketing and advocacy campaign. Farmers in project clusters adapted IPM technology with increased information on pesticide, its judicious use and reduction of hazardous chemical pesticides. There was sharp decline in amount and dose of pesticide application after project intervention among IPM farmers resulting in decreased mean

expenditure on pesticide by 30 percent. The impact assessment indicated that nitrogen application by participating farmers FFS decreased while application of FYM was increased by 69 percent particularly on major crops, like rice and vegetables. Increase in crop production contributed by enhanced productivity (7 to 66 percent mt/ha) and higher cropping intensity and net benefit (18 to 180 percent per hectare) with reduced production cost were persuading results of the IPM technology adopted by the farmers through project interventions.

Project emphasized participation of women and disadvantaged groups as their increasing role in agriculture and natural resources management and they represented 61 percent and 52 percent, respectively. Farmers were organized at hamlets/village/wards, Village Development Committee (VDC), district, regional and national level for advocacy and better access to market for healthy IPM products. Although in a pilot scale, production of bioagents as alternative to the chemical pesticides by the Community IPM Resource Centers was an innovative initiative of the project to sustain IPM program. Monitoring and reporting mechanism was developed and internalized at all level of project implementation to strengthen the process of institutionalization. The coordination mechanism developed and owned at various level helped to strengthen service delivery through improved collaboration and cooperation among service providers and the beneficiaries.

A. Capacity building

Capacity building was one of the most important components of the National IPM programme and its major thrust was to strengthen farmer capacity at individual as well as organizational level.

- **Farmer Facilitator Developed:** To develop quality human resource to facilitate the IPM-FFS, organize social mobilization and to provide basic technical services in groups, project organized ToF for 632 famer facilitators including former (204) and new (428) facilitators during the project period organizing 37 training events (Table 5).
- **Government Staff facilitators:** The project conducted 15 ToF events for 256 JT/JTAs to develop field level technician facilitators and 3 season long training of master facilitators (ToMF) course for 78 Officers including DoA, Academic and Training Institutes.
- **Training to Faculty Teachers and Instructors:** Season long student-teacher IPM Field School (IPM-FS) were conducted in the respective academic (IAAS, HICAST) and 6 CTEVT training centers. Selected graduates of the student-teacher IPM-FS further received a ToF organized for Master Facilitators. Total of 63 instructors and faculty members of university and training institutes graduated as Master Facilitators.
- **Specialized Training and Exposure Visit (abroad):** Project organized four training events for 2 Entomologist representing from NARC and DoA on specialized area of Fruit fly management in Viet Nam. Similarly, four Plant Protection Officers were provisioned to undergo training to perform Rapid Pesticide Residue Test (RPRT) through Rapid Bioassay for Pesticide Residue (RBPR) technique.

Table 5. Pre- and post-service training and beneficiaries trained

Type of training	Through FAO component		Through PPD component		Total No. Graduated
	No. of	Number of	No. of	Number of	

	Training events	Beneficiaries	Training events	Beneficiaries	
A. In-Service (Farmer and staff)					
1. ToF for new farmer facilitators	6	181	12	247	428
Refresher ToF for former Farmer Facilitators	16	156	3	48	204
JT/JTA ToF	8	143	7	113	256
TOF for new Officers	0	0	3	78	78
B. Pre-Service (Faculty members of academic and training institutes)					
ToF season long for Teachers	1	3	0	0	3
ToF season long for CTEVT Instructors	1	28	0	0	28
Teacher/Instructor ToF - general for Annex School of CTEVT	1	32	0	0	32
Total					1029

B. Development of Training Modules, Curriculum, Field guides, Process, Methodological tools and Policy documents

Project developed ToF curricula for JT/JTAs and farmer facilitators with corresponding FFS exercise manuals to conduct field trials and studies during conduction of the IPM-FFS on various crops (Table6).

Table 6. Curriculum developed for conduction of yearlong IPM-FFS

S.N.	IPM-FFS Curriculum Prepared	Remarks
1	ToF curriculum for farmer, JT/JTAs and officers	
2	Curriculum matrices to develop IPM-FFS curricula for various crops	9 vegetables, 2 field crops, oil seed (mustard), spice (Ginger), legume (lentil), 2 fruits (Apple and Citrus) and Tea.
3	First season IPM-FFS curriculum schedule for 11 crops	Okra, Cole crops, Chili, Cucurbits, Maize, Potato, Tomato, Spice, Cowpea/ Beans, Onion

		and Rice
4	Second season IPM-FFS curriculum schedule for IPM-FFS	
	Third season IPM-FFS curriculum schedule for IPM-FFS	
5	IPM-FFS Curriculum Schedule for Citrus	
6	IPM-FFS Curriculum Schedule for Apple	
7	IPM-FFS Curriculum Schedule for Tea	
8	Yearlong IPM-FFS Curriculum	Based on 5 crops (Vegetable, Cereals, Tea, Citrus and Apple)
9	IPM-Post FFS Curriculum Schedules	

Similarly, project also developed ToF curriculum of IPM FFS in fruits (citrus and apple) and corresponding guidelines for different exercises for implementing the FFS of citrus and apple. The existing IPM curriculum for refresher course was also revised to incorporate the content and approaches for implementing yearlong IPM-FFS.

C. Yearlong IPM Farmers' Field School Established

A total of 180 yearlong farmer field schools were established in 17 programme districts, where 420 seasonal (spring, rainy and winter seasons) FFS were conducted. Total of 1,734 number of IPM-PFFS trials were conducted covering 21 different crops (vegetables, cereals, spice, tea, citrus and apple) to test, verify and demonstrate IPM technologies in project districts. Through this trials and demonstrations, participating farmers compared IPM technologies with farmer practices (FP), and benefited with higher production and income from IPM over Farmer practice (FP) ranging from 18 percent to 180 percent.

Farmers realized that IPM FFS well addressed the issues of plant and soil health resulting in increased production efficiency of farmers while protecting human health and environment through IPM technology. Farmers conducted innovative experiments in all districts in various commodities through increasing use of bio-botanicals and minimizing use of chemical pesticides.

Total of 16,000 farmers involved directly as participants in the project implemented IPM-FFS field activities. Project prioritized inclusion of women and disadvantages groups (Figure 3 and table 7) to take advantages from the project interventions where participation of women farmers was higher (61%) compared to male farmers (39%) comprising higher number of participants of Brahmin/ Chhetris/ Sanyasi (48%) followed by Janjatis (29%), Madheshi (15%) and Dalit (8%).

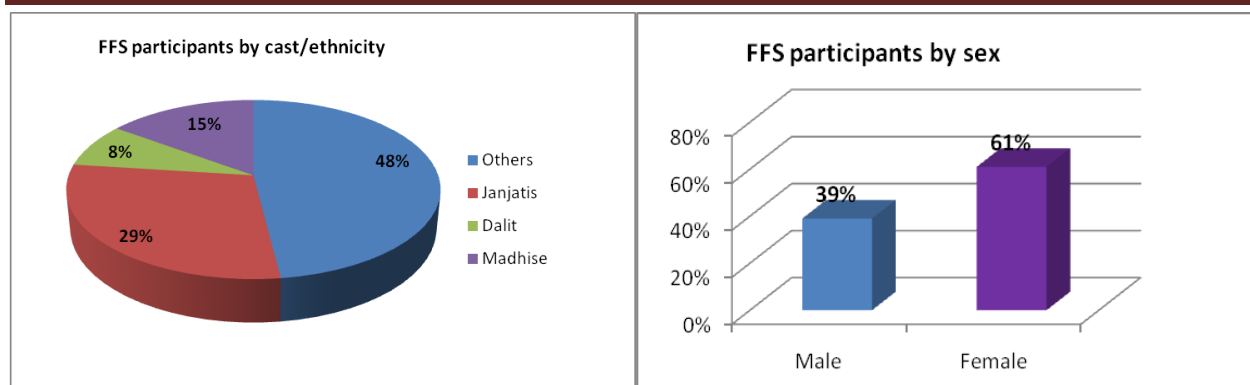


Figure 3. Farmer participation in IPM-FFS conducted in 17 project districts

Table 7. Farmer participation in the yearlong IPM-FFS

S N	District	Number of FFS	Total participants by group (Number / Percent) district						
			Male	Femal e	Tota l	B/C/S	Janjati	Dalit	Madhes i
			Number	Numb er					
FAO Intensive program									
1	Illam	9	134	111	245	135	108	2	
			(55%)	(45%)		(55%)	(44%)	(1%)	
2	Jhapa	7	97	80	177	144	26	7	
			(55%)	45%)		(81%)	(15%)	(4%)	
3	Bara	16	242	170	412	32	27	40	313
			(59%)	(41%)		(8%)	(7%)	(10%)	(76%)
4	Kavre	13	99	246	345	271	72	2	
			(29%)	(71%)		(79%)	(21%)	(1%)	
5	Kapilvastu	14	125	252	377	56	109	41	171
			(33%)	(67%)		(15%)	(29%)	(11%)	(45%)
6	Syangja	13	100	234	334	267	20	47	
			(30%)	(70%)		(80%)	(6%)	14%)	(0%)

S N	District	Number of FFS	Total participants by group (Number / Percent) district						
			Male	Femal e	Tota l	B/C/S	Janjati	Dalit	Madhes i
			Number	Numb er					
FAO Intensive program									
7	Mustang	3	35	25	60	0	50	10	0
			(58%)	(42%)		(0%)	(83%)	(17%)	(0%)
8	Banke	15	165	203	368	107	108	41	112
			(45%)	(55%)		(29.1%))	(29%)	(11%)	(30%)
9	Surkhet	16	74	335	409	320	66	23	0
			(18%)	(82%)		(78.2	(16.1)	(5.6)	(0.0)
10	Jumla	2	28	22	50	49	0	1	0
			(56%)	(44%)		(98%)	(0%)	(2%)	(0%)
11	Kailali	15	78	305	383	92	285	6	
			(20%)	(80%)		(24%)	(74%)	(2%)	(0%)
12	Dadeldhura	13	117	208	325	218	2	105	
			(36%)	(64%)		(67%)	(1%)	(32%)	(0%)
Total FAO Intensive Pilot Districts		136	1294	2191	348 5	1691	873	325	596
			(37%)	(63%)		(49%))	(25%))	(9%)	(17%)
Districts PPD Regular program									
1	Morang	9	86	149	235	97	48	1	89
			(37%)	(63%)		(41%)	(20%)	(0%)	(38%)
2	Dhading	9	102	129	231	123	100	8	0

S N	District	Number of FFS	Total participants by group (Number / Percent) district						
			Male	Femal e	Tota l	B/C/S	Janjati	Dalit	Madhes i
			Number	Numb er					
	FAO Intensive program								
			(44%)	(56%)		(53%)	(43%)	(3%)	(0%)
3	Chitwan	9	101	121	222	144	72	6	0
			(45%)	(55%)		(65%)	(32%)	(3%)	(0%)
4	Tanahu	8	44	158	202	119	60	23	0
			(22%)	(78%)		(59%)	(30%)	(11%)	(0%)
5	Bardiya	9	79	149	228	56	170	1	1
			(35%)	(65%)		(25%)	(75%)	(0%)	(0%)
Total PPD regular Districts		44	412	706	1118	539	450	39	90
			(37%)	(63%)		(48%)	(40%)	3%)	(8%)
Total yearlong FFS		180	1706	2897	4603	2230	1323	364	(686
			(37%)	(63%)	100%)	(48%)	(29%)	(8%)	(15%)
Total of Season long		420	4559	6838	11397				
			(40%)	(60%)	100%)				
Grand Total			6265	9735	16000				
			39%)	61%)	100%)				

D. Post FFS (PFFS) Activities and Follow up Programme :

Total of 777 PFFS supports were provided to farmer groups after completion of yearlong IPM-FFS to continue the PTD and other field based activities in the intensive pilot districts. It led foundation to motivate the farmers to design trial, resource sharing and conduction of problem based field trials and experimentation in each season by the groups on common issues and problems identified by the group. The PFFS support was also to carry out group strengthening, group planning, self-monitoring, technologies adoption and up scaling. PFFS support also provided opportunity to the farmers to adapt IPM technologies through organized production, inspection, monitoring and self realization of certification to a level of “Truthful labeling”.

E. Development of Training Materials

The project developed manuals, field guides, guideline, norms and standards required to streamline and manage the IPM program by stakeholders, service providers, IPM practitioners and beneficiaries at various steps during program implementation, product value chain, group mobilization and networking.

F. Development and Adoption of IPM Component Technologies

Selection of best adapted varieties in prevailing local agro-ecological condition in terms of pest resistance and stable yield was one of the strategies of IPM along with other aspects of growing healthy crop, such as management of soil nutrient, water, compost/FYM, jholmal, preparation and application of botanical based pesticides, improved crop management, postharvest practices, seed production, and improvements of cattle/livestock sheds were the major interventions.

Participating farmer groups identified and selected 21 new crop varieties of cereals and vegetable adapted to their local agro-ecological conditions and appropriate to apply IPM technologies.

Similarly, participants developed skill and knowledge on making biopesticides from plants of pesticide value available locally. Increased practice of livestock shed improvement to enhance use of urine and upgraded quality of compost. In the intensive pilot districts, 40 percent farmers used improved compost making technique and 35 percent farmer used urine collection and application in crop management.

G. Nepal IPM Standard

The Project developed a Nepal IPM standard within the framework of National GAP for 13 major crops included in the program. This IPM standard was the first of its kind as a guiding document to assure quality of the IPM product and its proper handling at various levels. It was a new initiative in Nepal for the standardization of IPM application within specified regulatory measures on quality control system (QCS), norms and code of conduct to be followed during crop production, post-harvest handling and storage till marketing of the produce in the value chain. It comprises guideline on IPM QCS during field production, handling and marketing, internal quality control code of conduct and crop specific standards.

H. Institutionalization Support:

Total of 60 instructors and faculty members of university and training institutes trained on IPM FFS. CTEVT has adopted and applied IPM-FFS curriculum of Technical school leaving certificate

(TSLC), Annex School (JTA course) and Intermediate in agriculture Science (I. Sc. Agriculture) course syllabus.

I. Formation of District Technical Team (DTT):

District technical teams (DTT) were operational in all project districts, as originally planned composed of DADO staff. DTT members effectively planned, coordinated and supported the implementation of project programs in the respective districts as per given ToR. The DTT was exclusively engaged in monitoring, technical backstopping and supervision of IPM-FFS.

J. Monitoring and Reporting

Plant Protection Directorate, a coordinating agency for implementing the IPM programme in the country lacked data and information, documentation, reporting and archiving of the IPM-FFS. This was also assessed and reported in the mid-term report in the first phase of programme. Owing to this situation, one of the major outputs of the 2nd phase of National IPM Programme is the establishment of monitoring and evaluation (M&E) system. Through strong M&E system, programme envisaged transparency, accountability at all level of programme implementation.

K. District Level Review and Planning Meeting

The objective of the review and planning meeting was to closely follow up the status of the implemented activities and to provide backstopping support to the farmer facilitators to efficiently plan and implement the seasonal and yearlong IPM-FFS activities.

L. Networking of IPM Farmer Groups:

The project organized a total number of 181 farmer groups, which then formed 30 IPM farmer network at VDC level and 10 IPM District network for institutionalizing the IPM and the marketing of healthy farm produce.

M. Self monitoring for Quality Control of IPM Products:

The guideline was specifically developed for the IPM Facilitators and DTT to support activities at group level. The farmer record book was extensively used to document information of crop production applying IPM practice by individual member farmers. This was one of the innovative practices developed by the project that helped monitor the standing crop in the field for quality standard and trace back the producer once it was out of the farm-gate.

N. IPM Resource Centre Established:

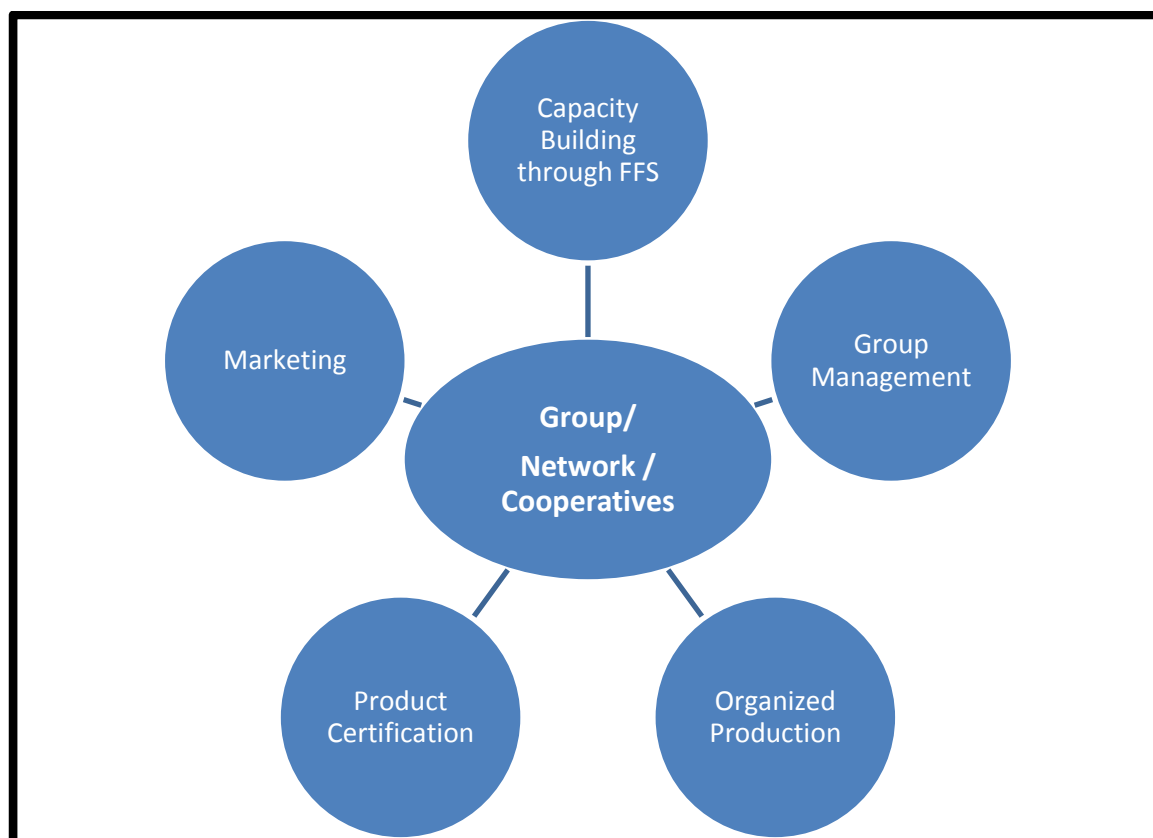
To provide support services to IPM farmers, the project established Community IPM Resource Centers in selected 3 potential districts as pilot initiatives for rearing and production of bioagents. With this objective, programme supported laboratory equipments and other necessary materials in cost sharing basis. The resource centres have been established within a framework of operating guidelines in Shreepur VDC of Kailali, Naubasta VDC of Banke district, Kusadevi VDC of Kavre district to increase access to and apply non chemical based pest control measures locally.

PART II: Current Status of IPM

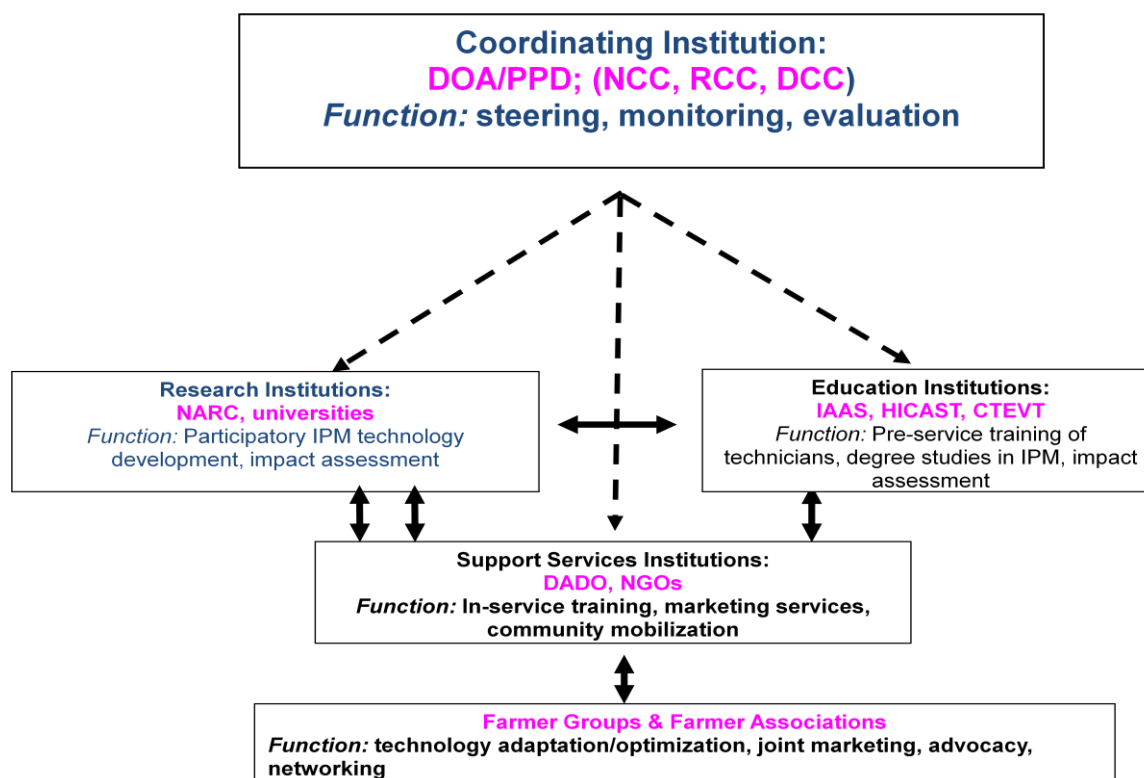
1 Extension Approach of IPM

Extension approaches of IPM mainly based on Farmer Field School and group approach. Season long FFS is major approach but in Phase II Year long IPM FFS introduced. officer, JT/JTA conduct FFS as vertical expansion. FFS graduated farmers trained as a FFS facilitators conduct FFS as horizontal expansion. Follow up program is conducted after the FFS like post harvest, participatory technology development (Farmer Science), participatory planning, group strengthening, farmer organization development in different level, IPM product marketing and area expansion

Approach of IPM intensification



Approach of IPM Coordination



2. Link with international IPM program

- Community IPM Program
- Vegetable IPM Asia
- International Exposure in IPM program: India, China, Vietnam, Thailand, Bangladesh etc.

3 IPM Policy for sustainable crop production intensification (SCPI) under the FAO save and grow guidelines

IPM policy has been already drafted and is in final stage of approval.

PART III: Assessment of IPM Program

1 Educational Impact

As an initiation of technical assistance and advisory support in developing the IPM and FFS curricula in academic institutes, student field schools were conducted in IAAS, HICAST and CTEVT. Conduction of IPM field schools also sensitized other faculty members, students and institute management as a whole about the importance of the subject and contents in their academic course curricula at all level including certificate, bachelor and master level courses.

Evaluation score of pre and post-test conducted before and after the conduction of yearlong IPM-FFSs indicated that the project interventions enhanced the capacity of participating farmers, which

ranged from lowest of 16% in Bara to higher of 65% in Jhapa district of intensive component with an overall average of 33% increment.

2. Impact in pesticide use

The impact assessment study revealed that the mean frequency of pesticide application by farmers was reduced more than baseline, especially with FFS and NFFS farmers. Maximum reduction in frequency was found with FFS (-77.24%) and NFFS (-51.93%) farmers under intensive program, followed by FFS (-36.86%) and NFFS (-29.26%) under regular program (Figure4). The result revealed that FFS and NFFS farmers were convinced to reduce the amount of pesticides by reducing the frequencies.

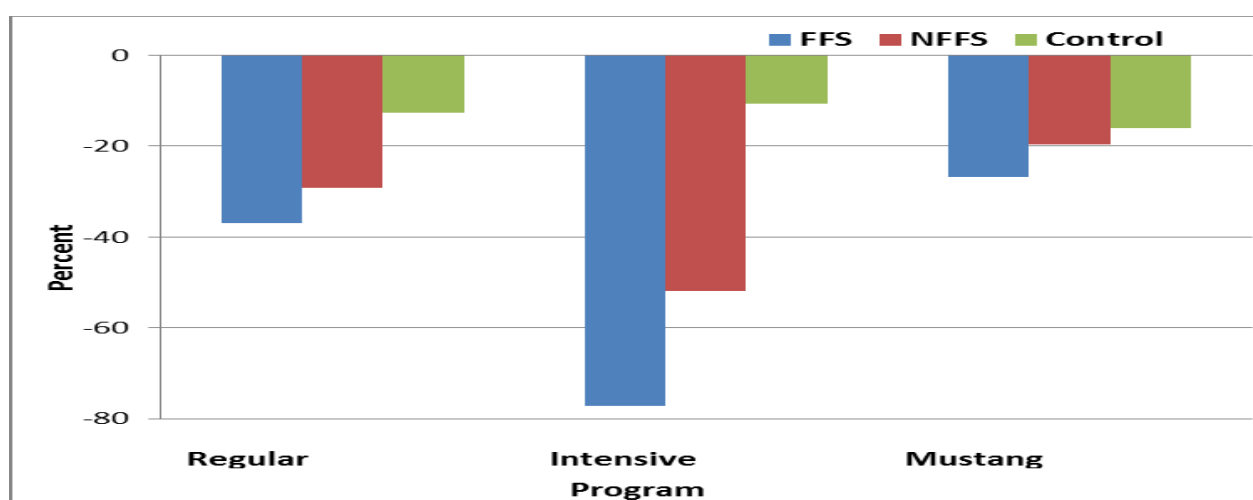


Figure4: Change in Frequency of Pesticide Application by Program and Household Type

Similarly, there was no use of class Ia pesticides and reduction was the highest (-97.38%) among all household types. Second highest area reduction was with regular, FFS farmers (-90.78%). NFFS farmers had (76.46%) and (-62.38%) reduction during regular and intensive programs, respectively. It appeared that FFS farmers were reducing area under class Ib pesticides considerably and there was also a good spillover effect (Figure 5). Spillover effect was also very high (-52.56%) under intensive, NFFS farmers.

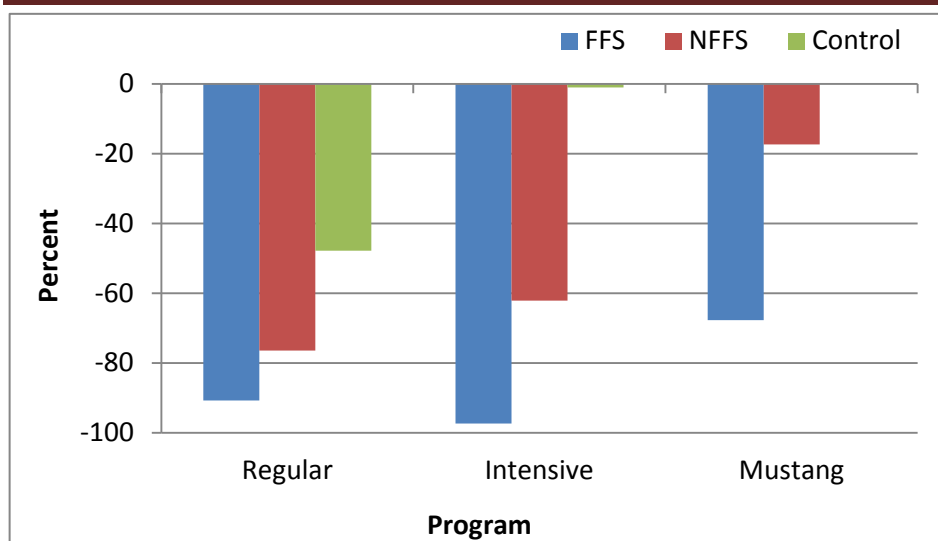


Figure 5: Change in Area Under Class Ib Pesticide by Program and Household Type

Total annual pesticide consumption was also decreased by -32.32%) during impact studies in the project districts. Among the household types, highest reduction in amount was found on intensive, FFS farmers, that was from 95.41 kg to 12.68 kg (Figure 7.7), with a decrease of -86.71 percent.. Dose of class Ib pesticides ranged from 0.08 to 50.00 kg or l/ha and 0.25 to 10.00 kg or l/ha, with a mean of 3.65 kg/ha (± 5.60) and 3 kg/ha (± 1.82) in Baseline and impact studies, respectively. Total cost on class Ib pesticides was reduced drastically in impact (32495.0 Rs.) than baseline (77201.0 Rs.). Cost reduction was highest (-96.60%) with intensive, FFS farmers.

3. Environment impact

Environmental Impact Quotient (EIQ) is one of the tools to assess the impact/risk of the pesticides on health and different environmental components. Mean field EIQ values of pesticides, especially with FFS and NFFS farmers were decreased in impact than baseline. There was a sharp reduction with intensive, FFS (below 20), followed by intensive, NFFS (below 40), and there was very slow decline in control type of households under intensive program (Figure 6).

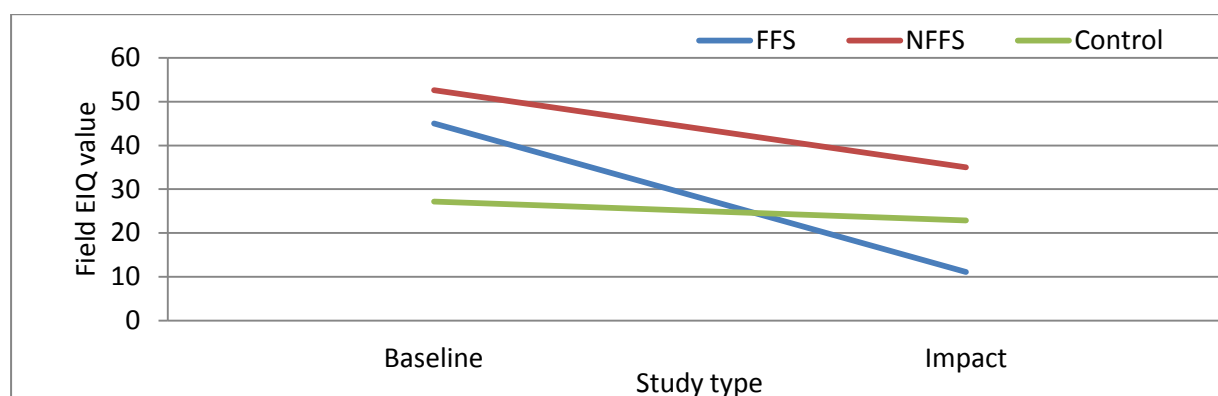


Figure 6: Mean field EIQ values for class Ib pesticide by program and household type

Mean field EIQ values in key crops were decreased in impact than in baseline, and were lowest with FFS than other types of farmers. Mean field EIQ values on potato under intensive program were reduced sharply to 41.31 and 18.90 of FFS, 39.48 and 23.49 of NFFS and 62.06 and 43.44 of

control farmers during baseline and impact, respectively. Other crops with high field EIQ values were tomato, followed by colecrops.

4. Economic impact:

There was remarkable yield increment and higher benefit from crop grown applying IPM technology over the FP in all project districts. In case of rice crop there was higher average production and income benefit by 40.5 and 76.1 percent, respectively over the farmers practice. Similarly, higher income benefits of 75%, 75%, 39%, 179%, 61.4%, 78.2%, 76.5%, 82%, 51.6% and 24% were observed in potato, bitter guard, beans, cabbage, cauliflower, cowpea, cucumber, okra, tomato and citrus, respectively applying IPM technology compared to farmer practice. However, there was no significant change in both production and income benefit in case of tea compared to existing farmer practice. Contributive factors to increased productivity was basically management of production inputs using improved planting materials (seed and saplings) with decreased seed rate and reduced synthetic fertilizers and pesticides while increased application of organic plant nutrients by the IPM farmers.

Figure 7 shows that nearly two folds increase in the income was observed under the intensive program compared to before the implementation of project. Hence the IPM FFS was found as the effective intervention. On a total average, annual household income increased significantly (Paired t value- 5.18, $P < 0.01$) compared to baseline study. Of the different sectors of economy income from crops in FFS household of intensive program increased remarkably (158%). Similarly, figure 8 indicates the highest gross margin of major crops in the intensive pilot districts.

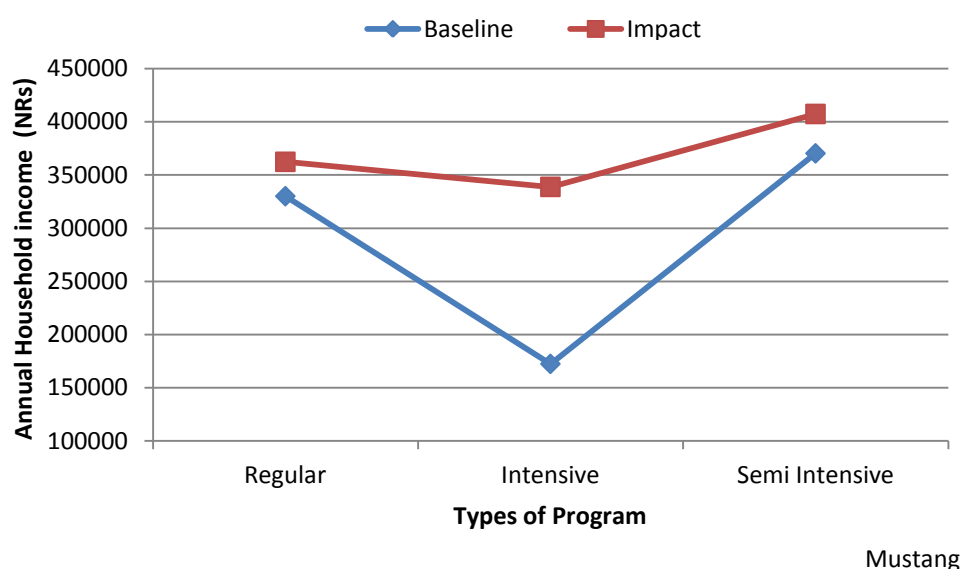


Figure 7: Annual Household Income by Program

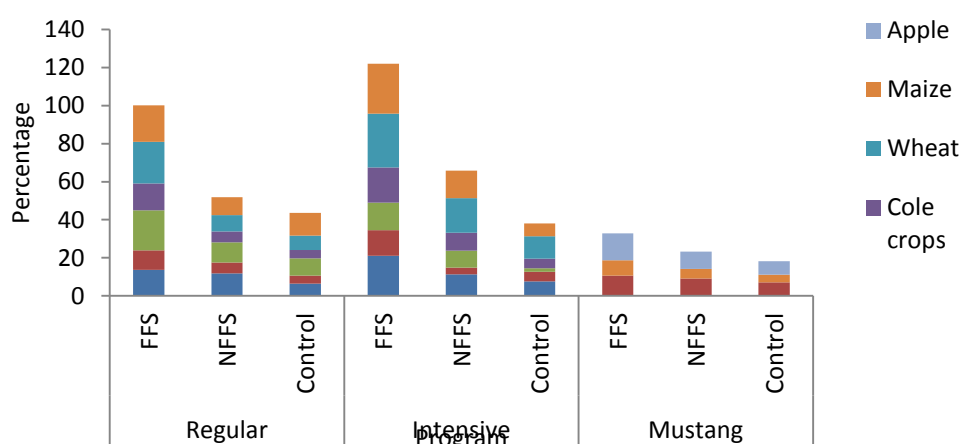


Figure 8: Change in Gross Margin of Major Crops by Program and Household Type

5. Impact on Up Scaling of IPM Approach

More than 8,500 non-participants farmers (neighbouring to participant farmers) practiced IPM technologies through farmer to farmer technology dissemination in the 9 pilot district sites covering 3,250 ha practicing some or whole component of IPM tools and technologies in vegetables, cereals and legumes.

6. Impact on sustainable farming

IPM groups have developed and established a participatory system for organized production, monitoring and certification. The group plan also includes resource mobilization, coordination, and market management for selling of healthy farm products. Farmers have developed crop management techniques: maintained crop calendar-wise cultural operations. So they have realized less infestation by insect pests in their crops.

Farmers organized in groups were able to grow healthy crops with increased cropping intensity. In addition, commercialization farming increased better opportunities for access to markets for selling the healthy farm products.

7. Social Impact:

The Programme adopted a policy of farmer selection including women and people from disadvantaged groups. Women constitute 63 percent of the IPM group member and 34 percent of the IPM-FFS facilitators. Likewise, women leader farmers constitute 40 percent to the total group chairpersons. However, this figure is higher in hills and among the privileged and indigenous nationalities. Women from Terai and Madhesi communities have lower participation in the group activities compared to the hills. 48 percent farmers are from the Brahmin, Chhetris and Sanyasi castes, 28 percent are Janajatis, 15 percent are Madhesi and 9 percent are Dalit.

8. Impact on Food Security and Livelihood

National IPM Programme has included high value crops, such as seasonal and off-seasonal vegetables, potatoes, ginger, citrus fruit, tea and apple in the IPM curricula for farmer's education. Farmers have also learnt applying the IPM practice in cereal crops, such as rice, maize and wheat. Thus, farmers have realized the essence of project interventions on food security, better nutrition

and livelihood promotion through the holistic way of crop production by practicing the IPM technologies.

9 Impact on policy

Agriculture Perspective Plan has recognized the IPM as national plant protection strategy. Agriculture policy 2005 and Agri entrepreneur promotion policy of Nepal have emphasized the IPM approach.

10. Lesson Learnt

- Yearlong IPM-FFS is more effective in educating the farmers on IPM for better management of crops on cropping pattern basis at individual as well as group level contributing to food security, food safety, human health and environment protection,
- Enhanced knowledge and skill with change in attitude of farmers imparted from IPM-FFS contributed to gradual reduction of hazardous chemical pesticides use,
- System of regular monitoring and backstopping support should be in place to maintain the quality of program interventions and finally the IPM product by the service providers,
- Inclusion of IPM curriculum in pre- and in-service training courses provided cost effective approach to develop human resource,
- Availability of substitutes for chemical pesticide is pre-requisite for the promotion of IPM technology and production of biopesticides in country would suffice the availability and its reliability,
- Formation of IPM farmer's and facilitators networks provided legal basis for exchange of information, planning, resource seeking with an effective approach in institutionalization,
- Linkage and cooperation is required among all the development actors working in agriculture and marketing
- FFS is found to be a good entry point to initiate other development interventions as it respects and promotes the human capital as change agent for overall development,
- Project developed an adaptive model of sustainable agriculture to integrate local capitals and resources efficiently and wisely to meet the development objectives.
- There is a need for consorted efforts from both government and development partners to out scale the module in the country for wider benefit.
- IPM FFS is more useful to small and middle farmers rather than large farmers

PART IV: Challenges

1. Program issues and challenges

- Implementation of IPM GAP Standard
- Sustainability of Field Activities
- Up-Scaling of IPM-FFS technologies
- Market and Marketing of IPM Products
- Area of cooperation between producers and line agencies
- Diversification of IPM product/commodities and increase scale of value addition and demand led production,
- Enabling environment for linking IPM products to market,

- Promotion and inclusion of climate-smart agriculture in IPM program to address the potential threats of crop failure due to pest insurgence/outbreak and climate vulnerability,
- Implementation of effective and resilient mechanisms for plant protection to support food security, food safety, poverty reduction and rural livelihood, and
- Continuity on engagement of farmer facilitator in IPM FFS conduction.
- Area and Farmer expansion
- Inclusion of commercial farmers in IPM Practices

STATUS OF THE INTEGRATED PEST MANAGEMENT (IPM) PAKISTAN

Dr. Muhammad Azeem Khan: Director General, National Agricultural Research Center, Islamabad Pakistan

Summary

Agriculture is the mainstay of economy of Pakistan. About 70 % population of the country depends on agriculture. Pakistan has a vast potential for increased agricultural production. However, in the past Pakistan was largely worried about feeding the increasing population and there was no concept of quality food production. In agriculture, pesticides have pivotal role to play. History of plant protection with pesticides in Pakistan started in 1947 with only 508 hand sprayers and 16 vehicles. Work on research and development, and IPM practice was initiated a long time ago. IPM technology comprising of cultural practices, resistant varieties, use of bio-control agents and selective use of pesticides has been developed for managing economically important pests in Pakistan. In Pakistan 70-80% of the pesticides imported in the country are utilized on cotton crop and the rest on vegetables, fruits, rice and other crops to manage pests especially insect pests. Government of Pakistan initiated a study on externalities of increased use of pesticides during 2000 which served as an eye opener at policy, research and extension levels to find that externalities of around US\$ 206 million for cotton crop only in Punjab Province.

National IPM Programme was established by the MINFAL in 2000 at National Agricultural Research Centre, Islamabad to develop integrated strategies for the management of economically important pests and to rationalize the use of pesticides through capacity building of agriculture stakeholders in farmer led IPM program. A number of plant protection related institutes in the National Agricultural Research System (NARS) are also involved in developing IPM technologies for major crops. The National Programme is implementing IPM in various crops through Farmer Field School (FFS) approach. The Program successfully completed various national/international projects resulting to the establishment of 107 Training of Facilitators (ToF/ToT), 6985 Farmer Field Schools (FFS), women open schools (WOS) and children ecological club (CEC) where 2824 facilitators and 155445 farmers have been trained throughout the country through FFS based IPM approach throughout the country till 2015. Experience has shown that FFS could be used an overall rural development tool or vehicle. It has proven to be a programme of capacity building, empowerment particularly of women, poverty reduction and pesticide policy reforms. Establishment of a network of community organizations at regional and national levels has paved the way to develop effective linkages between research, extension and development agencies. More than 30 district level IPM farmer organizations, Society of Facilitators and Trainers (SOFT) (2008) and FAO Alumni Association Network (AAN) established.

The impact of IPM FFS approach covered pesticides use, environment, economic and social aspects. Through FFS approach, there was reduction in pesticide use by 72.81% in all crops under FFS area & 58.06% in cotton crop, achieved 10.5% higher yield of cotton / acre, 25.54% more net profit, reduced input cost of pesticides by 73%, fertilizers by 11% and irrigation by 39%. Moreover, short term impact study revealed 23% increase uses of technical knowledge, recognition of pests/beneficial insects, decision making capacity and field experiments, 33% increase in number of farmers joining community organizations and 16% reduction in poverty of

the target farmers group. Key innovation is the linking of knowledge generation by farmers to academic research.

The major challenges of the program are the strengthening of FFS amongst academic researchers, Documentation of the FFS trials and refinement of Monitoring & Evaluation tools, Impact assessment of the FFS model. Though IPM has penetrated many agro-ecological regions of the country to which it has brought much needed relief from the burdensome over reliance on pesticides but its adoption and practical application are still restricted, varying considerably among geopolitical regions, the nature of the crop, and, mainly, with the commitment and support of governmental entities for programs dedicated to promote adoption of IPM.

Key words: *Pakistan, Agriculture, Integrated Pest Management, Pesticides, Insect Pests, Farmer Field School*

Facts and figures of Country National IPM Programme:

Operational since:	2000
Implementing agency:	Pakistan Agricultural Research Council, Government of Pakistan
Key partner institutions:	Provincial Research, Extension Departments and NGOs
Government funding and donors:	PSDP, FAO, EU, AGFUND, ADB, IDB, Aus aid, ICARDA
FFS conducted:	6985
Farmers trained:	155445 (15% females)
Trainers active:	NGOs/Farming communities 2824 (14% female)
Main crops in which IPM interventions are focused:	Cotton, Wheat, Rice, Sugarcane, Vegetables and Fruits

PART I: Historical perspectives

1. Crop Production

Agriculture is the mainstay of economy of Pakistan. About 70 % population of the country depends on agriculture; mainly rural families are mostly dependant on it. Pakistan has been growing agricultural commodities with fluctuating production quantities. However, on average production level has been maintained in many crops. Lower yields of different crops may be due to water logging, salinity, non-availability of good seed, small holdings, pest infestations and inefficient transfer of technologies.

Pakistan has a vast potential for increased agricultural production. The country has large areas of deep soil, favorable topography, suitable climatic conditions and water wealth developed in to the largest canal irrigation system in the world. There was wide gap of yield levels obtained by farmers using un approved traditional production technology. The various crops were grown in a number of cropping sequences under different agro ecological conditions.

A major part of the economy depended on farming, collection, storage, processing and the distribution of agricultural business to households. However, in the past Pakistan was largely worried about feeding the increasing population and there was no concept of quality food production. Therefore, the only way to protect the produce from pests and diseases keeping in mind the economy and environmental protection, IPM was the best option to be adopted by all farmers. In the long run the agricultural economy had to produce an increasing surplus without affecting ecology that may sustain the economic growth and also translate into a more market-oriented economy. This would also focus on quality of product, value addition and processing. In reality the agricultural economy (farming and agricultural business) is the dominant force, which drives the growth and development of national economy. No other sector is larger or more intimately related to individuals and the everyday consumption of necessities than agriculture. The historical data on cultivation and production is given in Table 1 & 2.

Table-1. Cultivated area ('000 'hectares) of crops by groups

Year	Food crops	Cash crops	Pulses	Edible oil
01-02	11999	4339	1380	570
02-03	11990	4069	1424	564
03-04	12657	4291	1447	698
04-05	12603	4343	1492	694
05-06	12896	4200	1405	729
06-07	13066	4320	1472	754
07-08	12117	4295	308.8	3904
08-09	22530	3849	278.2	3498
09-10	12950	4049	231.4	3677
10-11	12240	3677	188	3231
11-12	12308	3893	188	3503
12-13	12029	4008	178	3320
13-14	12945	3979	197	3174

Source: Agricultural Statistics of Pakistan, 2013-14, Govt. of Pakistan, MINFAL, Economic Trade & Investment Wing, Islamabad

Table-2. Production ('000'tonnes) of crops by groups

Year	Food crops	Cash crops	Pulses	Edible oil
01-02	24311	50400	594	4080
02-03	25890	54200	930	3948
03-04	26854	63946	871	4155
04-05	29906	50000	1094	5503
05-06	30395	47185	685	5063
06-07	32332	57236	1089	5106
07-08	30127	75575	209.6	3799
08-09	34578	61864	185.4	3747
09-10	33455	62287	140.3	3742
10-11	33744	66769	100.8	3899
11-12	33971	71992	115.5	3789
12-13	33967	76781	110.6	3800
13-14	36611	79238	112.4	4091

Source: Agricultural Statistics of Pakistan, 2013-14, Govt. of Pakistan, MINFAL, Economic Trade & Investment Wing, Islamabad

Farm size: Farm size is quite variable; however dominant farmers are of small holdings. There are 13% farmers which have under 0.5 ha; 14% with 0.5 to under 1.0; 20% with 1.0 under 2.0; 17% with 2.0 to under 3.0; 17% with 3.0 to under 5.0; 12% with 5.0 to under 10.0; 0.5% with 10.0 to under 20 and 2% with 20.0 to fewer than 60. Distribution of cropped area during 2006-2007 was 66.62% for food crops, 22.03% for cash crops, 7.50% for pulses and 3.84% for edible oil; (GOP, 2006-07).

Import and export of agricultural commodities: Imported commodities are oilseeds, wheat and pesticides. Rice, cotton and fruits are exported in sizable quantities. However, some of the exports may suffer in future when regulation of World Trade will be strictly enforced and proper measures are not implemented. Under these regulations marketing of agricultural commodities would be subjected to rigorous testing. The marketable commodities will have to be pest and pesticide free. The commodities may not be available pesticide free but at least pesticides residue level should be acceptable. Fruit export was in serious danger on the basis of presence of pests especially the quarantine pests and contamination with pesticides.

2. Pest Management

The history of agriculture is full of instances and examples, where man's interference with the natural balance has resulted into the multiplication of insect pests and diseases and their spread in larger areas; thus creating famine or near famine situations. For example introduction of delta pine cotton in Pakistan has resulted in changing the status of very minor pests e.g. *Heliothis* and

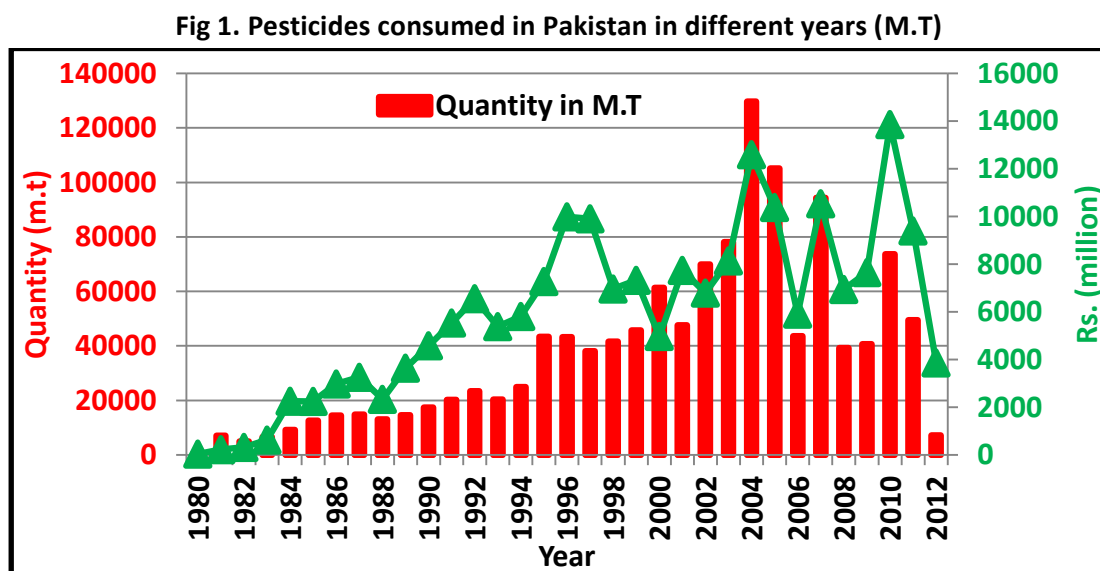
Spodoptera to serious pests of cotton, resulting in ban on delta pine cultivation. Similarly cultivation of IRRI 6 is responsible for introduction of rice hoppers. In agriculture, pesticides have pivotal role to play. History of plant protection with pesticides in Pakistan started in 1947 with only 508 hand sprayers and 16 vehicles. In 1951, locust problem became severe; hence aircrafts for aerial spraying were obtained and utilized. Later on, aerial spraying was done against *Pyrilla* infestations in sugarcane in KPK. After initial success, it was extended to cotton, rice and orchards in the whole country. Pesticides were provided free of cost to the farmers till June 1966. Later on, token payment of Rs. 0.25 per acre was charged from the farmers. In the same year it was decided to charge 25 % of the cost and subsequently the subsidy was further reduced.

In many cases, economic returns have only been possible by chemical control. It has been difficult, in the recent past, to grow agricultural crops economically without use of pesticides. However, their adverse effects are now well known (Irshad et al., 2002). Lesser use of pesticide has been discussed much earlier (Irshad, 1978). Unfortunately, the widespread use of chemical-based control programs in crops has probably increased pest problems (Ahmad et al, 2001). Excessive and inappropriate pesticide use disturbed the agro-ecosystem and killed non-target and environment friendly organisms including birds (Azeem 2000).

Pesticide use is governed by Pesticide ordinance 1971 which deals with their import, manufacturing, formulation, sale, distribution and use. It also contains organizational structure of Agriculture Pesticide Technical Advisory Committee and some other miscellaneous articles. In 1985, Pakistan adopted rules for pesticide registration as per FAO International Code of Conduct. The government also allowed pesticide import under generic names.

Rigorous campaigning along with provision of cheap pest management packages to the farmers were required to reduce the pesticide use in Pakistan. Due to importance and judicious use of pesticides in the concept of IPM a detail studies was undertaken which give recommendations for the use of pesticide in the future scenario (FAO- 2001).

The use of pesticide for pest management has been a continuous phenomena and the annual consumption of pesticide are given in the Fig 1.



3. IPM Development

Integrated Pest Management (IPM) in 1989 was considered as pest management system that in the, context of the associated environment and the population dynamics of the pest species utilizes all suitable techniques and methods in as compatible a manner as possible and maintain the pest populations at levels below those causing economically unacceptable damage or loss. In 2001 it was proposed that IPM means the careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimize risks to human health and the environment. However, in 2003 IPM was defined as economic use of available pest control techniques and subsequent integration of appropriate measures that discourages the development of pest populations and keeps pesticides and other interventions to cost effective level and reduce or minimize risk to human health and environment (Crop Life, 2003).

Government of Pakistan initiated a study on externalities of increased use of pesticides during 2000-01. The outcome of this study at policy, research and extension levels enabled to find that externalities of around US\$206 million were produced in just the major cotton growing areas of Punjab Province. Inclusion of this externality in the private cost of the cotton growers further reduced meager benefit cost ratio of 1:1.14 to 1: 0.43. These results were shared with policy makers and understood as great threat to human and animal health, degradation of natural resources, environment and biodiversity losses.

An analysis of pesticide policy through a UNDP-FAO Policy Reform Project paved the way for the establishment of a National IPM Programme in 2000 and provided instruments to scale up the Farmer-led IPM using Farmer Field School approach. FAO-EU Cotton IPM in Asia played a major role in supporting the National IPM Programme. Bringing together the international agencies FAO, CABI Bioscience, EU, ADB, Global IPM Facility, and the National Research and Extension organizations, the National IPM Programme has developed a strong initiative of large-scale implementation of IPM in Pakistan.

The Program has successfully completed various national/international projects entitled “*Policy and Strategy on Rational Use of Pesticides in Pakistan*” FAO/UNDP/Global IPM Facility project, “*FAO-EU IPM Programme for Cotton in Asia*”(1999-2004), “*ADB Cotton IPM TA for Pakistan*” and Arab Gulf Fund for UNDP project on “*Pesticide Risk Reduction in Women*” (2002-03), PSPD/MINFA project “*National Integrated Pest Management*” 2004-10 and FAO funded “*Community-based Livelihood Recovery Programme for Earthquake affected Areas of Azad Kashmir and KPK*” August 2008 June 2009. Currently two projects are being implemented i.e. “*Integrated Crop management practices to enhance value chain outcome for mango industry in Pakistan and Australia*” 2010-2015, ASLP project, “*Management of CLCuV disease through Integrated Pest Management (IPM)Techniques by adopting Farmers Field School (FFS) approach*” 2010-2015 ICARDA-USDA funded project.

Moreover, more than 30 district level IPM farmer organizations have been established as outcome of these projects which are generating their own resources with the support of public & private sectors. Further development resulted in establishment of Society of Facilitators and Trainers

(SOFT) since 2008 to enhance skill development and coordination among rural communities for sustainable and peaceful livelihood development strategies throughout the country. In 2012, Alumini Association Network (AAN) was formed by Food and Agriculture Organization (FAO) Pakistan & NARC where more than 75 farmer-based and community organizations of the country have been linked through AAN Share Mela for better coordination and sustainable actions.

The FFS based IPM initially experimented on cotton crop has now expanded to the cropping system (i.e. cotton-wheat) and to high value crops like fruits (apple, mango, citrus, peach, guava), vegetables (onion, tomato, cucumber, Pumpkin, okra). The FFS-IPM concept has also been upgraded to Integrated Crop Management, Best Agriculture Practices, Enterprise Development, Farm Service Centers and Livestock Management etc.

PART II: Current status of IPM

1. Extension approaches in IPM

Effectively organized extension services are key element in the process of agricultural development through transfer of improved technologies to the farmers. Due to increasing misuse/overuse of pesticides and their negative impacts on the society, a consultative process among potential stakeholders began in early 2000 and led to the establishment of a National Integrated Pest Management Programme for implementing of IPM activities through FFS approach. Initially FFS based IPM approach was experimented on cotton crop which was later expanded to other crops, fruits vegetables and has now been upgraded to Integrated Crop Management, Best Agriculture Practices, Enterprise Development, Farm Service Centers and Livestock Management etc.

Use of Training of Trainers/Facilitators (ToT/F) and Farmer Field Schools (FFS) has been demonstrated as an effective means of IPM dissemination. The approach is field-based and participatory. Each setting has its own problems and solutions, and farmers must be equipped to best address their problems. Under the TOT/FFS, 25 participants (mostly agricultural extension agents, but also representatives from research, NGOs, or others) are trained over a cropping season. The schedule is such a participatory one that all participants of the ToF work in the field with farmers. The world experience over the years has shown that the best way for the translation of knowledge is through training of facilitators (TOF) and Farmer Field School (FFS) activities.

2. Links to International IPM Programmes

The National IPM Programme is working in collaboration with international NGOs such as FAO, WWF, Plan Pakistan, Lead Pakistan, ICARDA, USDA, AusAid and UNDP for training of farmers in ToF and FFS approach under different commodity projects (Table 4).

3. National IPM Programme

Although, work on research and development, and IPM practice was initiated a long time ago in Pakistan, IPM was not institutionalized as in other countries. National IPM Programme was institutionalized in 2000 and since then programme implemented various IPM projects on different commodities as well as providing technical backstopping and support to all federal, Provincial Institutions, NGO's and farmer organizations in the implementation of IPM through

Farmer Field School (FFS) and Training of Facilitators (ToF) approach. It has proven to be a programme of capacity building, empowerment particularly of women, poverty alleviation and pesticide policy reform. Table 5a, and 5b shows that programme accomplishments which has so far trained; 155445 farmers including 24330 women through 6985 FFS/WOS/CEC, 2824 IPM Facilitators (provincial extension, research and NGOs) through 107 ToF/WToF/FToF.

Some of the farmers innovations are given in Annex I, Public and Private Organizations involved in IPM Activities in Pakistan in Annex II, farmers and Facilitators Organizations in Annex III and FFS based IPM activities (Pictorial) Annex IV. IPM based IPM Network in the country is given in Annex V and network of Farmer based organizations is given in Annex VI. In respect of different crops and organizations the detail of FFS based IPM training imparted to the facilitators and farmers, is given in Table 3.

Table-3. Various Public and Private organizations involved in Capacity Building of Facilitators & Farmers in IPM-FFS approach in Pakistan up to Dec-2014

Institute/Organization	ToF/ WToF/FToF	Facilitators Trained	FFS/WOS/ CEC/FFFS	Farmers Trained
Nat-IPM-FAO-EU =FFS	12	315	512	13940
Nat-IPM-FAO-EU =WOS	2	37	52	993
Nat-IPM Project	13	362	877	19097
Plan-Pak, Vehari	3	74	96	2087
KWA-WWF-Pak	-	-	90	1889
WWF-Pakistan	6	150	210	4734
KWA-FAO-Kashmir & Bahawalpur.	1	32	86	2330
KWA-UNICEF	-	-	20	1400
Lead-Pakistan, Sindh	-	-	14	260
CCRI-Sindh	-	-	12	300
CARITAS-Sindh	-	-	12	300
Dev-Con-UNDP	-	-	8	200
PRSP-Khanewal	5	141	475	10498
Agri. Extension, Punjab	32	800	2074	28818
Agri. Extension, KPK	-	-	128	3200
Agri. Extension, SOFWM,	6	158	335	9881
Agri. Ext.Punjab-Fruit &	2	50	200	5000
WADO-Sindh	-	-	10	150
Others	25	705	1774	50368
Grand Total	107	2824	6985	155445

Source: National IPM Programme, NARC Islamabad, Pakistan

Table-4.a: Capacity Building of Farmers & Facilitators in IPM-FFS approach in Pakistan upto Dec. 2014

Gender	ToF/ WToF/ FToF	Facilitators Trained	FFS/WOS/ CEC/FFFS	Farmers Trained
Female	10	302	954	24330
Male	97	2522	6031	131115
Total	107	2824	6985	1,55445

Table-4.b. Capacity Building of IPM Farmers

Crop season long IPM- FFS/WOS/CEC/ FFFS trainings		Nos. of Farmers Trained
FFS	5148	108918
WOS	125	3,494
CEC	34	770
FFFS	25	640
Others	1653	41623
Grand Total	6985	155445

*ToF= Training of Facilitators**WToF= Women Training of Facilitators,**FToF= Farmer Training of Facilitators**FFS= Farmer Field School,**WOS= Women Open School,**CEC= Children Ecological Club,**FFFS= Farm Family Field School*

4. IPM policy for sustainable crop production intensification (SCPI) in support of practical implementation of the FAO Save and Grow guidelines

The Pesticide Policy Analysis Project was launched in May 2000, the objectives were: to build up national capacity in pesticide policy analysis and pesticide policy reform; collect data regarding the extent of pesticides usage on various crops, quantification of the use of banned pesticides in Pakistan; estimate the impact of direct and indirect effects of pesticides on human health and environment (namely, pesticide residues in soil, groundwater, and food items, and effects on agricultural biodiversity) and analysis of pesticide registration and usage laws to identify the gaps/flaws which have resulted in environmental and economic deterioration, especially in cotton ecosystem. The procedure of the study was based on the methodology developed by the Hannover

University Pesticide Policy Project (HU-PPP), which had been tested before in several countries in Asia, Africa and Latin America. The HU-PPP concept for policy analysis in crop protection has been widely recognized and is now being used by international and bilateral donor agencies.

Based on Pesticide Policy Analysis Project, study on externalities of increased use of pesticides during 2000-01, the externalities of around US\$206 million were produced in just the major cotton growing areas of Punjab Province. These results were shared with policy makers and understood as great threat to human and animal health, degradation of natural resources, environment and biodiversity losses. The findings of the study were presented and discussed in the Policy Workshop held on 1-2 May 2001 at Bhurban, Pakistan. The stakeholders from different national institutions such as policy, planning and development, environment, research, extension, NGOs and industry participated in the deliberations. The resource persons from Global IPM Facility, FAO Regional Office Bangkok, Regional Cotton IPM Programme in Asia, European Union (EU), and Asian Development Bank (ADB) also participated. The recommendations were deliberated in sub-groups to prepare a list of actions, responsibilities and time frame for implementation.

The implementation of IPM activity was complemented with continuous liaison by the Programme Leadership with federal and provincial policy makers, awareness campaigns and advocacy at policy and political levels through meetings, workshops, seminars, Power Point presentations, field visits, publications, Newspaper articles and radio & TV programmes. The results of ToF/FFS/WOS were presented at various forums and conferences and shared with different stakeholders and communities including scientists of different disciplines. It was demonstrated that cotton can be grown without or with much less use of pesticides and other inputs and that input efficiency can be improved by the farmers if empowered and educated through the participatory methodology of IPM FFS.

The policy makers were also taken to witness field activities, speak to participating communities and then the charged policy makers and politicians were brought on TV/radio to speak about the programme. This helped a great deal in developing understanding and appreciation of the programme by various stakeholders. Advocacy among other farmers and big landowners was done through organizing IPM Farmer Field Days and IPM Musical Evenings, whereby participating farmers would convey the message about benefit of IPM and related developments to non-participating farmers. This also helped bring closer the big growers and the small landowners as well as tenant farmers thereby moving towards harmony between the haves and have-nots in rural areas.

Student theses on ecology/agro-ecosystem are encouraged which developed interest of university teachers and students. A number of students (BSc, MSc and Ph.D) have completed their degrees by working on various aspects of IPM. Revision of IPM curriculum in universities was initiated which brought the academic institutions and Higher Education Commission on board and to support of IPM.

A documentary film “Hands Picking Poison” was produced and shown over 300 times at various forums and levels to emphasize the policy impacts. A second Documentary on FFS “A Rising Revolution” is under preparation. IPM as a pest management alternative to pesticides was made a part of Pakistan’s Cotton Policy for 2003, which further secured policy support for the approach.

The National IPM Coordinator has been made member of various policy-making bodies including the Agricultural Pesticides Technical Advisory Committee (APTAC) and Pesticide Act Amendment Committee. The Ministry of Food, Agriculture and Livestock (MINFAL) took concrete steps by amending the rules vide SRO No. 21 dated 13-01-2004 for creating efficient regulatory framework by updating the law and rules. These developments have again been highlighted through various means and shared with media, policy makers and politicians; this cycle is promoted to continue in order to win the policy support.

PART III: Impact assessment of IPM Programmes

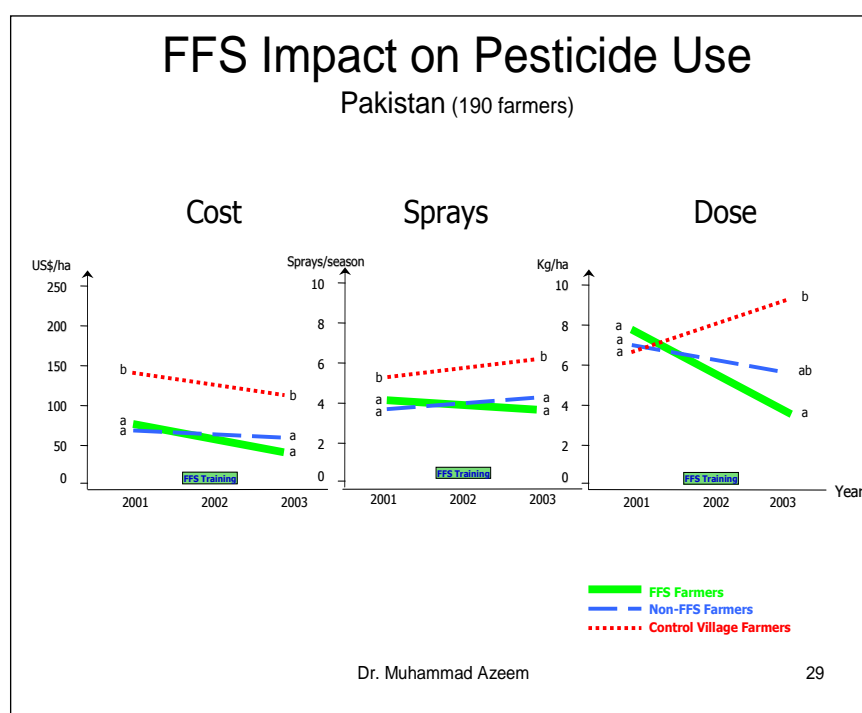
1. Impact assessment of IPM programmes

During year 2001, Training of Facilitators (TOF) and Farmers Field School (FFS) activities were implemented in the cotton growing areas of Sakrand and Khairpur areas of Sindh province of Pakistan which was expanded to other areas and provinces, i.e. Punjab and Balochistan. Khairpur district was selected for impact analysis for representing small size of holdings, growing pesticide use and poverty menace. Data used in this study comprises baseline and post FFS-impact surveys conducted during 2001 and 2003 respectively; and FFS data on yields, inputs, outputs during 2003. About 100 FFS-participating farmers (all 25 farmers per FFS), 60 Non-FFS (15 from each FFS village) from 4 IPM villages and 60 control farmers from 4 Non-IPM villages (15 farmers per village) were interviewed.

The programme impacts were estimated on economic, environmental, health, human capacity, organization, and institutional capacity building and policy reforms indicators. Methodologies applied includes gross margins, whole farm budgeting, Greer Thorbecke Index (GTX), Gini coefficients and income redistribution indices, Environmental Impact Quotients (EIQ), mean, T-test comparisons least square regression and probit models. Results show greater differences in the contribution of cotton towards net against gross household incomes. Significant increase in the net contribution (46%) of cotton on net household income at FFS farms helped reduce poverty profile. The poverty incidence at FFS farms reduced from 71% households below poverty line to 55% farms. The severity of poverty and income redistribution indexes improved from impossible to possible levels at FFS farms. Impacts on biodiversity and biosafety indicators shows that total doses of pesticide chemicals were largely reduced (43%) on FFS farms. Highly toxic class of pesticide use reduction was much higher (54%) which resulted into lowering the EIQ more than 100% as compared to a quantum jump at control farms. The FFS graduate farmers have shown resilience under panicking pest flare up situations. Impacts on human capital are estimated in the context of knowledge up-gradation, skills enhancement, decision-making, experimentation and community organization by the FFS participating communities. On FFS farms increase is estimated in the use of sources of technical knowledge (23%), significant increase at 1% level in the recognition of pests and predator, decision making capacities of the farmers and field experimentation (38%). Full attendance of FFS-sessions by farmers contributes towards learning skills and making independent decisions for additional economic gains. FFS farmers joined community organization in greater numbers (33%) during post FFS period. The poverty reduction attribute of FFS approach suggests its wider application to all system crops for the actualization of poverty reduction dreams of the rural poor.

2. Impact on pesticide use

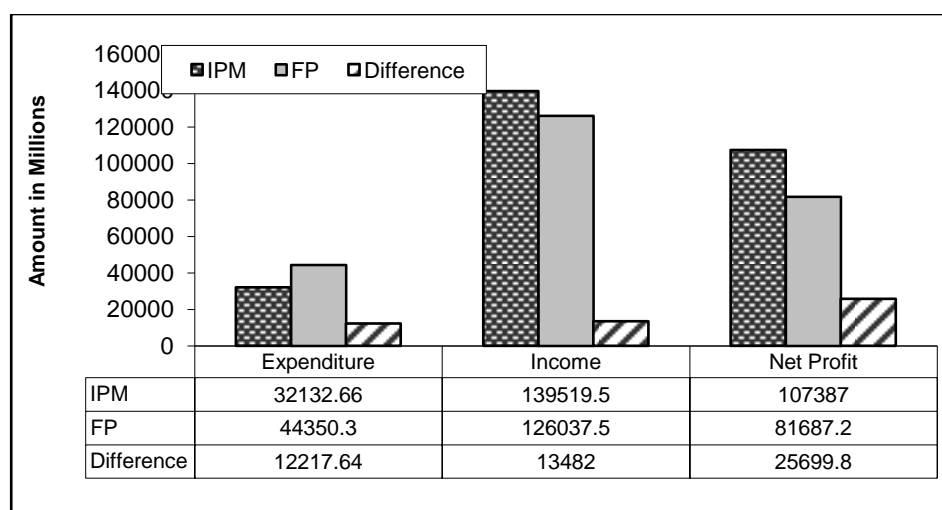
Information generated through CESA on pest and predator dynamics helps farmers to understand pest-predator interaction to allow nature to work with lesser or most appropriate interventions as an alternative to pesticides. Results show that total doses of pesticide chemicals were largely reduced (43%) on FFS farms. Highly toxic class of pesticide use reduction was much higher (54%) which resulted into lowering the EIQ more than 100% as compared to a quantum jump at control farms. The FFS graduate farmers have shown resilience under panicking pest flare up situations. Reduction in the use of highly toxic pesticides at FFS farms had significantly reduced number of poisoning incidences at household level (46%), total workdays lost (83%) and expenditure for poisoning treatment (74%).



Impacts on biodiversity and bio-safety indicators were estimated in the context of total pesticide use, toxicity class of pesticide use, environmental quotients, health hazards, attitude towards environment and pest-predator dynamics at IPM and farmers plots in Khairpur district of Sindh province. Data used in this analysis includes specific sections covered on knowledge and practices of farmers on plant protection measures and improvement in biodiversity, preservation of soil health and empowerment of farmers in decision-making on plant protection measures.

3. Economic impacts (cost benefits analysis)

Cost-benefit analysis for IPM and Farmer practices



4. Environmental impacts

Information collected through season long Cotton Eco-System Analysis (CESA) was specifically analyzed to determine field biodiversity and environmental gains. A list of statements was used to measure attitude towards environment and pesticide use precautions observed by farmers. The Environmental Impact Quotient (EIQ) method was used to estimate the total field EIQ of the farmer, ecology and consumer categories. Data on pest and predator population dynamics was analyzed to determine actions and counteraction at various crop growth stages.

Improvement in environmental impact quotients is an outcome of improvement in decision-making power of farmers, pesticide use reduction, positive attitude towards environment and strong belief on role of biodiversity in plant protection. The ratio of predators and pests indicates that less chemical use gives free hand to predators to flourish, fluctuate and counter the pest pressure, whereas on farmer practice plots, the pesticide aid reduces natural pest control processes; which enhances pesticide use dependencies.

5. Social impacts

The change in the FFS farmers' attitude and beliefs helped them to change pesticide use behaviors for better environment and health improvements. FFS-farmers attendance score and their age and education status are significantly associated with the pesticide applications, observed biodiversity and field EIQ. Old age decision makers' understanding on biodiversity and their attitude towards environment have shown negative association. Educated farmers were better in perceiving biodiversity roles, but education without proper FFS attendance, does not empower farmers to have better attitude towards environment and pesticide use reduction. A short study on social impact showed that 33% increase in number of farmers joining community organizations and 16% reduction in poverty of the target farmers group.

The community level initiatives are suggested to be taken to improve sanitation through recycling agricultural waste and its utilization to manage fertility for sustainable production. The community organizations and women schools can play a catalyst role in this important direction.

PART IV Nat-IPM Initiatives

The Nat-IPM Programme has experimented with many concepts to achieve the sustainability and social equity goals that include:

- a) Expanding IPM approach from commodity orientation to system focuses;
- b) Addressing gender involvement in season long trainings;
- c) Institutionalizing farmer to farmer knowledge/skills transfers;
- d) Integration of participatory experimentation and community development concepts;
- e) Sustainable use of services of IPM facilitators for promoting farmers science;
- f) Establishing a net work of FFS based community organizations
- g) Devising location specific technological packages for strengthening agriculture on business lines through enterprise development.
- h) The FFS-IPM concept has also been upgraded to Integrated Crop Management, Best Agriculture Practices, Enterprise Development, Farm Service Centers and Livestock Management etc.

Moreover, along with the above mentioned initiative Nat-IPM Programme has worked on the following areas to promote and upscale the FFS-Based IPM approach in Pakistan

- a) Advocacy of FFS based IPM among senior policy makers level;
- b) Development of capacity of mainstream extension in IPM on depressed cropping systems;
- c) Development of capacity of higher and secondary school education to realize health, environmental and ecosystem concepts;
- d) Development of capacity within rural women folk to protect communities and environment from pesticide hazards;
- e) Refinement of FFS training process for sustainability and technical backup in quality assurance; and
- f) Development of FFS based technological packages and refinement of facilitator's roles.

PART V: Institutionalization of FFS based IPM Initiatives

The world experience over the years has shown that the best way for the translation of the knowledge in practices is through Farmer Field School (FFS) Education approach. Where the decisions are not preplanned and are not dictated from a central command, but are based on the analysis of agro-ecosystem, site specific and made by the practicing farmers in the presence of a facilitator. Suitability of FFS in cotton, fruits, vegetables, Rice, wheat and other field crops has successfully been demonstrated throughout the Pakistan and has shown a visible impact on farmers' understanding of IPM. The Farmers who have gone through a crop season –long FFS training process, they became more organized, vigilant and realistic. If something is not clear to them, some short & very simple experiments (not too scientific) are set up by them to resolve some unclear issues. Thus, the farmers become well organized, learn to work in **community**, make their own day to day decisions and become experts so that they do not depend on the others for crop production and become able to resolve conflicts by themselves. In this way farmers were introduced with discovery based learning process, which empower the farmers for better utilization of available farm resources. The following are the some outcomes of the institutionalizations of the FFS-based IPM approach in Pakistan

Few FFS-Institutionalization outcomes:

- Development of a trained cadre for agriculture information dissemination

- Change in men and women Farmer's perception toward pesticides
- Children community awareness to pesticides and their ecosystem
- Awareness towards healthy food in term of kitchen gardening (KG's)
- Introduction of income generating schemes
- Enterprise development trainings
- Establishment of men and women Farmer's organizations
- Active participation of rural women in development processes

PART VI: Challenges

The National IPM Programme in Pakistan faces following challenges:

- Making participatory IPM training available to a larger number of farmers. With in these training programmes special attention needs to be paid to enabling and encouraging farmer initiative to continue experimenting after their Farmer Field Schools (FFS's) and spread IPM through their communities.
- Developing special programmes to ensure involvement of women in IPM activities at the grass root level.
- Improving the policy environment for IPM through reform of policies and practices that directly or indirectly provide irrational support to chemical pest control.
- Reforms in crop protection research and extension to be responsive to support farmer initiatives in IPM.
- Enhance coordination and cooperation among government, NGO's, donors and international organizations to achieve a high degree of coherence among different projects and initiative to optimize the benefits.
- Integrate participatory IPM into policies on sustainable agriculture and link the FFS approach to other development fields such as natural resource conservation, and community development etc.
- Strengthening the respect for FFS amongst academic researchers.
- Documentation of the FFS trials and refinement of Monitoring & Evaluation tools.
- Impact assessment of the FFS model.

Way Forward to Promote FFS-Based IPM

The following way forward is recommended by the stakeholders to further upscaling and refinement of FFS-Based IPM approach in Pakistan.

1. Centralized institution for project evaluation, implementation for quality assurance at regional and National level
2. Regular Training of Facilitators Programme, refresher Courses to develop a strong cadre of facilitators for FFS.
3. Awareness trainings workshops for policy makers
4. Curriculum developments for major crops and review of curriculum according to local situation
5. Incorporation of FFS curriculum for agricultural students
6. FFS approach should be extended to other fields wherever applicable
7. Facilitator certification process and hiring of certified facilitator
8. Implementation of FFS Approach through certified Facilitators'
9. Annual congresses for experience sharing and way forward for issues
10. Exchange visits through FFS net

References

- Ahmad, I., Poswal, M.A., Soomro, M.H., and Yasmin, T. (2001). Cotton IPM Implementation Strategies in Pakistan. Report of FAO-EU Cotton IPM Programme in Asia: Planning and Evaluation Meeting 11-15 September, Ho Chi Minh City, Veitnam.
- Azeem, M. (2000): Economic Evaluation of Pesticide Externalities in the Cotton Zones of Punjab Pakistan, Report for the UNDP study, FAO, Rome, Italy
- Crop Life, (2003). Plant science industry reaffirms commitments to approve rural livelihoods and environment through IPM 1-2 pp: Media Relaease. Brussels.
- FAO (2001). Policy and strategy for rational use of pesticides in Pakistan. Building consensus for action. 251 pp.
- GOP, (2006-07). Agricultural Statistics of Pakistan. Ministry of Food, Agriculture and Livestock, Islamabad. 280 pp.
- GOP, (2013-14). Agricultural Statistics of Pakistan. Ministry of Food, Agriculture and Livestock, Islamabad. 280 pp.
- Irshad, M. (1978). Possibilities of lesser use of pesticides. Agric. Pak. II: 7-8.
- Irshad, M. (2005). Insecticides-A cure or curse and rational use of Integrated Pest Management in Pakistan. Proc. Environmental sustainable development, COMSAT Institute of Information Technology, Abbottabad, 1399-1408.

STATUS OF INTEGRATED PEST MANAGEMENT (IPM) IN PHILIPPINES

WILMA R. CUATERNO, Bureau of Plant Industry, Department of Agriculture, Philippines

Summary

The Philippines is a country whose national IPM program started in 1993. It was called KASAGANAAN ng SAKAHAN at KALIKASAN in coordination with the Food and Agriculture Organization. It was implemented by its Department of Agriculture and the Local Government Units. When the funding support was withdrawn by FAO, the implementation was continued by the Local Government Units with little financial support by the Department of Agriculture which later implementation dwindled.

Later in mid 2000, a new program called Palay Check which is an enhancement of IPM implementation was launched. It was led by PhilRice unlike with IPM KASAKALIKASAN which was led and was coordinated by an office within the Department of Agriculture. Most of the trainings are usually conducted by the Agricultural Training Institute while some were conducted by DA Regional Field Office.

Now IPM is being applied especially in rice by some farmers throughout the country. IPM trainings for farmers are being conducted mostly in rice but later being applied in most agricultural crops. In the last four years, there were 976 FFS that were conducted for rice. According to most of the trainers, most of those who attended FFS were female though it is hard to get data to show it.

We know that IPM is an important strategy not just for pest management but as a way of life for our farmers to gain more from their labor. Healthy and happy farmers will contribute to sustainable agriculture and to our country's development.

Key words: KASAKALIKASAN, Palay Check, FFS

Facts and Figures of Country National IPM Programme

Operational since: 1993

Implementing Agency: Department of Agriculture

Key partner institutions : Local Government Units, Academes, Cooperatives, FAO

Government Funding and Donors: Department of Agriculture, Local Government Units

FFS conducted: 976 (in the last 4 years)

Farmers trained (% female): do not know the exact number but mostly female

Trainers active: government (% female) farmers (% female): no data

Main crops in which IPM interventions are focused: rice, corn, vegetable and some fruits

INTRODUCTION

The Philippines is an agricultural country with a population of about 100 million Filipinos. The ratio of male to female is almost 1:1. The Growth National Income as of last quarter 2014 is 6.3 while the Growth Domestic Product as of last Quarter of 2014 is 6.9. The growth rate of Agriculture and Fishery in the last Quarter of 2014 is 4.8. The major cereal crops are rice and corn while the first five Major non-cereal crops are coconut, sugarcane, banana, pineapple and coffee.

Rice has the largest share in the value of production in the crop sector amounting to 314,022.98 million pesos in 2013. It is the staple food of the 96% of the Filipinos and the driver of economy in the Philippines. It is planted to 2,467,164 hectares which are divided into 2,149,971 farmers. The Philippines is not yet self-sufficient in rice and we are importing from our ASEAN neighbors like Thailand, Vietnam and Indonesia.

The exports as of December 2014 is 4,379,000 while our import as of October 2014 is 4,869,000. The projected annual growth rate for export in 2015 is 1.64

PART I: Historical Perspective

1. Crop Production

Rice is considered the number one crop in the Philippines since it is the staple food of the Filipinos. Last year data shows that 18,967,826 MT was produced and harvested in 4,739,672 hectares averaging 4 MT per hectare. Seventy five percent of which were harvested from irrigated areas.

Corn is next to rice in the list of important crops. It is planted to 2,611,431 hectares last year and the volume of production was 7,770,602 metric tons. The average production per hectare is 2.97 metric tons.

Coconut is the first major non-cereal crop. It is one of the major export of the country also. In 2013, the country was able to produce 15,353 metric tons. It is planted to 3,550,491 hectares.

Sugarcane is the second major non-cereal crop. The 2013 production is 24,584,820 metric tons. It is planted to 437,068 hectares.

Banana is next to sugarcane. Our production last 2013 was 8,645,749 metric tons which was planted to 445,935 hectares. Some sugarcane areas are now becoming commercial especially in the major sugarcane production.

Pineapple is another important non-cereal crop. It is next to banana in terms of exports. The last year production was 2,458,422 metric tons. It is planted to 60,750 hectares.

Coffee is getting important now in the lives of the Filipinos. There is an increasing interest in coffee production. The 2013 production of coffee was 78,634 metric tons. It is planted to 116,459 hectares, short of 20,000 hectares compared in the 1990s.

2. Pest Management

In rice, the most use chemical is herbicide while there are few who use pyrethroid for insects. The problem on diseases are mostly by fungi so farmers are using inorganic fungicide. With most of

the Filipino farmers who cannot afford to buy pesticides, they are not used to apply it on their field.

The Asian Riceblackbug is now a regular concern of the rice farmer especially when full moon is approaching. To address the problem, they are applying a strain of *Metarhizium* which is an entomopathogenic fungus.

Tungro virus is occurring from time to time but its damage is not so significant. Farmers will just plowed down under or buried those hills of rice infected with the disease.

The Rice Stemborer is another problem in rice now but farmers can handle it by following what they call “moon calendar” and by using another species of *Trichogramma*.

Rodents are still problem in rice and farmers are still using rodenticide for its management. From their point of view, there is none yet to replace which is very practical to implement against rodents.

There still others like the Grain Bug and Rice Bug but they

The corn planthopper is still the most common insect pest of corn. They are using insecticide and cultural strategies to deal with it.

Farmers are planting different kinds of corn. For those organic corn and open pollinated varieties they are applying *Trichogramma evanescens*. These kind of corn are for food consumption. For corn use to feed livestock and poultry, they are planting genetically engineered corn. The most common GM corn being planted are those that are with Bt genes and herbicide ready. For herbicide ready corn, the farmers are obliged to use glyphosate.

For banana, they are more concerned on *Fusarium*. So in that area, they are using much fungicide. In the case of *Fusarium TR4*, they are now testing two varieties that are showing tolerance to the disease. They are also testing *Trichoderma harzianum* against *Fusarium*.

For mangoes, the problems are Cecid Fly and mango hoppers. They are becoming resistant to certain group of insecticides. So in managing the pest which is mostly by chemical method, they are considering the mode of action of pesticide to the insects before applying it.

3. IPM Development

Since the support fund of FAO was terminated, the conduct of IPM trainings landed in the hands of the Local Government Units. Though there is a little support from the Department of Agriculture, the conduct of different trainings in IPM is declining.

So it is up for the priority of Local Government Officials whether he will support a training or not. For officials who see the importance of having trained agricultural technicians, they will allot some funding but for those who have seen IPM as their less priority, then they will wait funding from the Department of Agriculture.

It is only when there is a pest outbreak when an IPM technician becomes important to most of the officials. Now, we have an ever changing climate. We do not know exactly what kind of weather

we are going to have every month. So some LGU officials who were trained in IPM before are seeing now its importance.

Most of them who were trained are getting old and they like to train younger generation IPM for pest management. Though the Philippines is not yet ready when farmers asked for the availability of biocon agents. Biocontrol is the based of Philippine IPM. We need to have more production and more kinds of BCA to address the needs of the farmers. What we are doing now to help in the availability of supply is to teach those who are interested in putting up a production laboratory. So for farmers or their associations or even to their Local Government Officials we are recommending the establishment of Village Type Biocon Laboratories. Not all biocon agent can be mass produced in that laboratory because some biocon needs some skilled worker for quality production.

For IPM Research, there are only few researches being conducted geared towards IPM. But with the implementation of GAP and the Food Safety Law, I think there will be more clamor for IPM.

PART II: Current Status of IPM

1. Extension Approaches in IPM

1. Training
 - funded by the Department of Agriculture, trained by Agricultural Training Institute or DA Regional Field Units
 - funded by Local Government Units, trained by previously trained IPM technicians
2. Links to International IPM Program
 - FAO
3. National IPM Program
 - none, but DA Regional Field Offices have designated Regional IPM Coordinators who are under the supervision of their respective Regional Executive Director
4. IPM Policy for sustainable crop production intensification in support of practical implementation of FAO Save and Grow Guideline
 - none yet but through the Office of the Department of Agriculture Undersecretary for Policy and Planning, 3 pilot regions have already conducted the Save and Grow Program of FAO and 8 more regions will be conducting the program soon.

STATUS OF INTEGRATED PEST MANAGEMENT(IPM) IN SRI LANKA

M.U.P.Jayasundara. Plant Protection Service, Department of Agriculture, Gannoruwa, Peradeniya, Sri Lanka

Summary

FAO inter-country IPM programme was introduced to Sri Lanka in 1984. During this period the programme mainly focused to train farmers on IPM concept. But from 1994 FFS was introduced and helped farmers to learn about ecology of their rice fields in order to enable them to make and implement crop management decisions which are safe, productive and sustainable. Later the Department of Agriculture (DOA) introduced a new concept called “White Revolution” to combat misuse of pesticides and reduce to a minimum the use of pesticides, as health sector claimed, one of the major reasons for Chronic Kidney Disease that is expanding in north central province.

Key words: *IPM, FFS, Sri Lanka,*

Introduction

Historically Sri Lanka has been an agricultural country. Country's generations old irrigation systems bears witness to the place agriculture has had in the distant past. The Department of Agriculture in Sri Lanka commenced working along IPM pathways since early 80's. Sri Lanka having been a participant of FAO inter- country programme for Rice Integrated Pest Management (IPM) since 1984. This programme has made significant impact through assisting research programmes, training officers as well as farmers in a big way by developing crop management and decision making expertise among farming communities.

During community IPM programme, commenced in 1994, 8 Season Long Training (TOT) programmes were conducted thus training 251 extension officers mainly in DOA and Mahaweli authority. Lesser number of extension officers from NGOS like CARE, Sarvodaya and Gami Seva Sevana were also trained.

During early stages, activities were limited to only farmer training. But later activities broadened with the commencement of the community IPM programme. As a follow-up to FFS, selected farmers were given ten day training and utilized them as Farmer Trainers to help extension officers. This was a novel approach to extension.

Identification of mosquito larvae

AESA at officer training



Towards the latter part of the IPM project it became evident that, rice being the major source of food and income that, rice cultivation also influence health in humans there by affecting livelihood situations of rural communities. The rice field proper, irrigation networks and seepage areas provide breeding habitats for mosquitoes, which includes vectors of Malaria and Japanese encephalitis, whereas the vector of dengue fever breeds around the peridomestic environments.

After 2002 no season long training of trainers (TOT) programmes were conducted due to lack of funds and low number of extension staff in district level. To overcome this situation IPM residential training system was reduced to 15 days instead of three months but continued throughout the season (seed to seed) for three months in the field. In this system, topics covered during three months are identification of natural enemies and pests, Agro eco-system analysis, rice plant anatomy and use of insect zoo. Under this programme 610 officers were trained up to now and it is in progress.

Now there is a big demand for IPM, due to expanding threat of chronic kidney disease (CKD) condition in north central province and some pockets of the island. Health department claim agrochemicals are one of the major reasons for this CKD condition.

Therefore Department of Agriculture is now taking necessary steps to combat this situation by introducing the “White Revolution” which aims to reduce pesticides usage in agriculture. In other words introduction of IPM. The main programme introduced in the latter part of 2014, based on “white revolution”, is Rice Yaya 2 programme. In this programme it is planned to train large number of farmers on good agriculture practices (GAP) like cultural methods, conservation of natural enemies, field observation, and as a last remedy chemical methods. This is actually scaling up of IPM to reach a large number of small holding farmers.

Plant Protection Service is planned to conduct large scale training programmes, in collaboration with several divisions of the Department of Agriculture like Rice Research and Development centre, provincial agriculture extension departments and some local NGOS who are conducting training programmes for extension officers, on IPM both rice and vegetables to help the “white revolution”.

STATUS OF INTEGRATED PEST MANAGEMENT(IPM) IN THAILAND

Areepan Upanisakorn, Biological Control Promotion Group, Plant Protection Promotion and Soil-fertilization Management Division, Department of Agricultural Extension. Ministry of Agriculture and Co-operative, Thailand.

Summary

DOAE adopted Integrated Pest Management (IPM) as the major pest control strategy for controlling pest ineconomic crops since 1982 with the collaboration of Thai-Germany Plant Protection Program (TGPPP) and Department of Agriculture (DOA). The collaboration has developed a pest surveillance system called “SEWS”. The main activities were carried out by the Department of Agricultural Extension (DOAE) staff of 31 Plant Protection Service Unit (PPSU) to do the survey for early warning system for the action control which use ETL (Economic Threshold Level) as the level of decision making for pesticides spraying, the project was terminated in 1989. In 1989, a major brown plant hopper (BPH) outbreak occurred in rice. The government spent big budget for purchasing pesticides and distributing to farmers free of charge. It has been observed that the more pesticides were sprayed, the pest situation worse, the high levels of pesticides leading to negative environmental effects and economic loss to the society and the various types of pesticides subsidies were effected to IPM adoption.

In the year 1992, with the supported of FAO, the first 4 Farmer Field School (FFS) were introduced and conducted as a pilot project in 4 provinces, in Central of Thailand. These FFS bring IPM to the farmers’ practice, the farmer survey the field and do the agro-eco system analysis (AESAs) for decision of action control. In 1999, the number of FFS increased widely in rice, vegetable and some other crops, named the “FFS under Royal Patronage” and IPM were widely accepted by farmers. The FFS farmers learned more about the ecological concept which is the basic of pest management, they recognize the benefit of predators, parasites and micro-organisms. They learned more on biological control, both augmentation and use of biological control agents to control pests and reduce the pesticides spraying. In 2008, the Community Pest Management Center (CPMC) were established as the small unit of pest management center located in the village. The activities done by farmers were monitoring, early warning, producing and used of biocontrol agents under the IPM concepts.

Since Thailand adapted Q-GAP as the standards of agricultural products to certified the qualified products, the IPM-FFS combined the GAP rule to the IPM-FFS curriculum for the farmer to practice to get the Q-GAP label. To date, the FFS concept is still mentioned in the DOAE policy procedures, such as this year the DOAE are conducting the project to promote the large scale areas of safe crop such as vegetable, rice, cassava. This project will conduct the FFS with the groups of farmer in the large area more than 160 ha. The DOAE organization that responsible to promote IPM for controlling the pests are Plant Protection Promotion and Soil-Fertilizer Management Division in Bangkok, the 9 Agricultural Technology Transfer (plant protection) Center (the former Pest Management Center) in the Region, the 77 Plant Protection Group in 77 provinces, 882 Districts and the 1500 Community Pest Management Center (CPMC) in the village.

Key words: *Integrated Pest Management (IPM) Farmer field school (FFS), Agro-ecosystem Analysis (AESA), Biological control, Plant Protection Promotion and Soil-Fertilizer Management Division, Agricultural Technology Transfer (plant protection) Center, Plant Protection Group, Community Pest Management Center (CPMC), Q-GAP certification.*

Facts and figures of Thailand National IPM Programe:

Operational since: 1999, with the establishment of the DOAE-Institute of Biological Control and Farmers Field Schools under Royal Patronage

Implementing agency: DOAE in close partnership with provincial governments.

Key Partners institution: DOA, DNFE, Royal Project Foundation, DANIDA IPM Project, Thai Education Foundation

Donors: Government funding, Provincial Governments and FAO, DANIDA, Norway, AusAID,

FFS conducted: 15,000 FFS

Farmers trained: 75,035 (55%female)

Trainers active: government staff 503 (20 % female)

Main crops in which IPM interventions are focused: Rice, Vegetable (crucifers), fruits, sugarcane, cassava.

Introduction

Thailand is predominantly an agricultural country with a land area of 513,115 sq.km and a population around 65.4 millions. The total land area of 51.36 million hectares, approximately 23.84 million ha (41%) was classified as arable land, 0.8 million ha as permanent pasture, 13.5 million ha (26%) as forest and woodland, and 15.989 million ha (31%) was unclassified land. The farm holding are broadly classified: 6 of major crop: Rice wet season 9.78 million ha, Rice dry season 2.74 million ha, corn 1.17 million ha, cassava 1.27 million ha, sugarcane 1.29 million ha. Para rubber 2.96 million ha, Oil palm 0.72 million ha and others 6.68 million ha.

Pest is one of the major problems of farmers and Thailand is a country under tropical conditions where agricultural pests flourish both in diversity and numbers which inflict untold damage. During the period of “Green Revolution”, the Thai Government’s policy on agriculture was to increase crop production, which also led to the increasing the use of fertilizers and pesticides. This situation induced the pests outbreak, it has been led to unfortunately believe that the only alternative to combat pests or otherwise effectively is only by using pesticides, which prompted farmers to increase their pesticide use, most believe that pesticides are like medicines. They consider that they kill pests selectively and are therefore less harmful to humans, animals and plants. That why the quantity and volume of imported pesticides were annually increasing. It has been observed that more pesticides were sprayed the pest situation worse, while the high levels of pesticides leading to negative environmental effects and economic loss to the society.

Thus, the concept of Integrated Pest Management (IPM) was introduced, mainly cope with pest problems, and intensive use of insecticides. The early IPM strategies focused on field scouting, pest forecasting and spraying decision based on the treatment thresholds of the key pests. Most of research was oriented towards the development of spraying thresholds and on integrated other control tactics. The government’s reaction was to allocated big budget for purchasing pesticides

and distributing them to farmers free of charge. Those various types of pesticide subsidies were effected to IPM adoption. The more-recent approach to IPM is to develop human resource capacities through season-long training for farmers in the so-called Farmer Field Schools (FFS). The IPM paradigm shifts from technology components to ecosystems.

Following, are the brief history of IPM with FFS in Thailand to overview of the development of pest management and the policy background for Integrated Pest Management (IPM) of agriculture in Thailand.

PART I: Historical perspectives

The crop protection in Thailand started in the 1950s with the establishment of the crop protection section at the Department of Agriculture (DOA) under the Ministry of Agriculture. The government was facilitated by the development of chemical pesticide, which were adopted in Thai agriculture rapidly. During that time the role of farmer in pest control basically was to carry out the instructions of the government pest control officers during the pest control campaigns. The DOA had been given the responsibility for pest control in all crop except rice which was under the responsibility of the Rice Department that had a rice protection section with the expertise on the control of rice pests.

In 1970 the Rice Department was merged with the DOA, which were responsible on agricultural research, while extension work were responsible by Department of Agricultural Extension. The responsibility of pest control actions was given to the Department of Agricultural Extension (DOAE). In rice, the “green revolution technology” was introduced since the 1970s with the cross breeding of Thai rice varieties. With the introduction of high yielding varieties, which increase the use of high levels of external input become profitable. The new varieties provided more favourable conditions for the development of pests. In 1972 and in 1977 two major outbreaks of the tungro virus which the vectors are green leafhopper, *Nephotettix spp.*, the control measures were chemical insecticides. Also the pesticides used had severe side effects on the beneficial organisms for natural control. Economic losses of pests outbreaks were perceived dramatically high, often without empirical evidence. Based on the perceived pest damage, the government introduced an emergency budget for storing pesticides to be managed by the 31 Plant Protection Service units (PPSU) of the DOAE throughout the country. This contributed to problem of resurgence of the green leafhopper and the development of new pests like brown plant hopper, *Nilaparvata lugens*.

The program of pest surveillance called “SEWS” established by the Thai government in 1982, which supported by the Government of Germany through a technical cooperation project of Department of Agriculture (DOA) and Department of Agricultural Extension (DOAE) named “Thai Germany Plant Protection Programme (TGPPP)” until 1989 aimed to strengthen the government role to put place an effective monitoring system for improving the government’s capability for pest control decision-making. Surveillance was effective in prolonging the control of government agencies in the field of pest control and thus preserver the weak position of the farmers. The example, in 1989 a major brown plant hopper outbreak occurred, which prompted farmers to increase their pesticide use thus causing resurgence of the brown plant hopper.

IPM-FFS Implementation

In 1992, the FAO supported the Government of Thailand (DOAE) to start Farmer Field Schools in Rice. Initially, a total of only four FFS were established in the provinces of Chachoengsao, Chainat, Singburi and Pitsanuloke using the FAO FFS manual. Consequently, implementation was slow and no up scaling of the program took place during these years. In 1998, the TV station produced a film featuring the farmers' activities in an IPM field school. The broadcast video impressively demonstrated to the general public the ability of farmers with low levels of formal education to prevent pest outbreaks with a minimum amount of pesticides without the help of the government. Another important message was that farmers who sprayed less pesticides even had higher yields than farmers who used higher levels of pesticides.

The key turning point for FFS in Thailand was the FFS film brought about by the attention of the King of Thailand. The King immediately recognized the larger implications of the FFS concept as a strategy of empowerment of the rural population in Thailand. His Majesty strongly recommended the FFS concept for implementation throughout the country.

In 1999, an Institute of Biological Agriculture and Farmer Field School (BAFFS) was established within DOAE central office together with 9 Biological Agriculture and Farmer Field School (BAFFS) centers across the country. The BAFFS was given the responsibility to coordinate the implementation of a nation-wide FFS program as recommended by the King of Thailand and produce the biological control agents to supported the farmers to control the pest in their fields instead of only use chemical pesticide., the number of FFS called “FFS Under The Royal Patronage” increased in rice, vegetables and some other crop such as cotton, sugarcane and fruit tree orchard. The IPM paradigm shifts from technology components to ecosystems.

However with the change in leadership at the DOAE priorities were again reversed towards a pesticide-based crop protection in Thai agriculture and the FFS programme declined, because actual support in terms of budget and programming is minimal.

Biological control-based IPM

The 9 Biological Agriculture and Farmer Field School (BAFFS) were also responsible to promote the utilization of the beneficials biocontrol agents as the key elements in pest management. DoAE brought the technology from researchers, modified, improved, and transferred to farmers. Mass production of biological control agents; predators, parasitoids and microbials, are produced and recommended to replaced and/or alternate with chemical pesticides. Successful application of biological control in IPM system has been achieved in various crops.

Since IPM-FFS were introduced to farmers practice, the FFS farmer learn more about the ecological concept which is the basic of pest management, they know the natural control by biological control agents. They recognized the benefit of predators parasites and micro-organisms. The biological control and IPM are widely accepted by farmers, the need of biocontrol agents are increasing the 9 Agricultural Technology Transfer (plant protection) Centers (the former Pest Management Centers) cannot produce enough biocontrol agents to the need of farmers. In 2009, the Community Pest Management Center (CPMC) were established as the smallest function of pest management system in Thailand. It should be the center of pest management where the farmer can learn, can work, share information, knowledge, technology and others about pest management together. The farmers will be empower for pest management in the community.

The activities in CPMC depend on the agricultural pests problem in community, the main activity are: Monitoring & forecasting, biocontrol agents producing. There are around 1,500 CPMC now, which 882 centers in 882 districts were fully supported by the government budget and the others more than 600 center were supported by other organizations: local government, private sectors, some foundations and NGOs or by the group of farmers themselves.

Good Agriculture Practice in the Extension System

Concerns over the WTO Agreement on the Application of Sanitary and Phytosanitary Measures and the Agreement on Technical Barriers to Trade, the Good Agricultural Practices (GAPs) for food crop was implemented as an approach to food safety and quality. GAPs guideline for cash crops have been developed and introduced to farmers.

The role of IPM in Good Agricultural Practices

In the extension system, GAPs approach has been launched nationwide through the Farmer Field Schools. The implementation approach emphasized on the producing safe agriculture products using IPM concept. A number of bio-agents are introduced to replace and/or to alternate with chemical pesticide. In addition, the before harvesting the products, especially vegetables, are tested for the chemical residue to ensure the safety for consumers.

DOAE has launched the project “Promotion of safety agricultural products” in 31 kinds of crops nationwide with the aim to assist farmers to understand the principle and the framework of GAP. To achieve this objective, the concept of IPM-FFS has been used as a tool to disseminate the knowledge.

However, the current pest control in Thailand do not focus only on IPM but to promote Good Agricultural Practices also. The recognition that farmers must practice IPM as part of GAP certification has resulted in renewed national interest and support for IPM-FFS training as part of GAP training programmes implemented by the DoAE. Meanwhile, provincial governments and various NGOs continue to support IPM-FFS farmer and follow the Q-GAP certification programmes.

To date, the FFS strategy is still mentioned in the DOAE policy procedures. In 2015, DOAE are conducting the promotion of growing safety products program in the large scale areas. This program will work with the group of farmers in more than 160 hectare to produce the qualified products for consumption and commercial. To achieve this project, the concept of IPM-FFS has been used as a tool to disseminate the knowledge. The objective is to get the certificate to guarantee the qualified production by Q-GAP label. The IPM-GAP-FFS curriculum are already developed to use for this specific area that needs the certificate for commercial reasons. The organization who responsible for the pest control in DOAE are Plant Protection Promotion and Soil-Fertilizer Management Division in Bangkok, the 9 Agricultural Technology Transfer (plant protection) Centers (the former Pest Management Centers) in the Region, the 77 Plant Protection Group in 77 provinces, 882 Districts and the 1500 Community Pest Management Center (CPMC) in the village.

References

- Anonymous, 1985. Proceedings of the “Seminar on Rural and Agricultural Development Management. Research Management Center of the University of the Philippines and Thai-Germany Plant Protection Program, May 1985.
- Agricultural Statistics of Thailand, 2014. Center for Agricultural Information, Office of Agricultural Economics: 170 pp.
- DOAE, FAO, 1993. Farmer practice guide in rice field.: paper distribute to participant in Global IPM meeting in Bangkok 1993.
- Rumakom, M., O. Prachuabmoh and L. Meenakanit, 1992. CABI, Proceeding of the Conference on Integrated Pest Management in the Asia Pacific Region, 23-27 September 1991. Kuala Lumpur. Malaysia. 211-236 pp.
- Sutham Areekul, 1967. Fundamental of Entomology, Entomology Division. Kasetsart University Bangkok Bangkok. 424 pp.
- Entomology and Zoology, 1990. Recommendation of and animal Pest Control. Department of Agriculture, Bangkok .303 pp.
- Napompeth, B. 1981. Thailand National profile on pest management and related problem. Special publication 4. National Biological Control research Center. Kasetsart University/ National Research Council. Bangkok : 150 p.
- Reissig W.H., E.A. Heinrichs. J.A. Litsinger, K. Moody, L. Fiedler, and A.T. Barrion, 1985. Illustrated Guide to Integrated Pest Management in Rice in Tropical Asia. IRRI. Manila.
- Tuenjit Satayavirut, 1997. Pest Management concept. Entomology and Zoology, Department of Agriculture, Bangkok .32p.
- Patchree Menakanit, 1997. Promotion of Biological control in IPM, Department of Agricultural Extension, Bangkok. 101p.

STATUS OF INTEGRATED PEST MANAGEMENT(IPM) IN TIMOR LESTE

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Abstract

Timor Leste situated in the eastern half of Timor Island and also neighbouring with two countries Indonesia and Australia. With the total area of 14,000 sq km, Timor Leste can be divided into 4 agro-climatic condition. About 83 % from 1,4 total population of Timor Leste relies on agriculture as main income. Maize and Rice are the major food crops that being planted by most of Timorese, however, other crops such as bean, potato, sweet potato, vegetables, and some fruit crops also being planted in order to support the family income. The production of main crops rice and maize are 84,871 and 102,473 tonnes respectively.

The integrated pest management activities which carry out has not significantly contributed to the total pest and disease control. Training, demonstration plots, Farmer field school (FFS) mainly focus on major crops and less activities at minor crops. The benefits also not significantly contributed to the development of IPM users in the country. Budget, lack of expertise, lack of understanding about IPM, and lack of willingness to learn are the main obstacle in the introduction of IPM.

Keywords: *Timor Leste, integrated pest management, farmer Field School, maize and rice*

Introduction

Timor Leste is Small Island which situated in the eastern half of Timor's Island. Gained independence from Indonesia in 1999 after long struggle for independence. With the total population of 1,4 million people (according to census 2010), about 83 % of its population relies on agriculture as main sector for income. Most of Timorese farmers is a subsistence farmers with small landholding and produce for his own consumption. Majority of farmers still relies and using traditional type of cultivation till today, moreover, this has not been change due to strong cultural tied to the type of cultivation.

Rice and Maize are the only major crops in Timor Leste, however, other crops such as beans, vegetable, potato, sweet potato, and some cereals crops also important for farmer in Timor Leste. The cultivated area for rice and maize crops is more than the minor crops, due to this, the production of these two crops increase dramatically. During growing season 2012/2013, the production of rice was 77,017 and at 2013/2014, the production was 84, 871 tonnes. On the other hand, the production of maize for 2012/2013 and 2013/2014 were 91,360 and 102, 473 tonnes respectively.

The integrated pest management program commence in the recent years. In 2008, the training that focusing on controlling pest and disease using integrated pest management was established to minor crops. This include potato, sweet potato and vegetable crops. In this program then continues to major crops such as rice. In 2009 until 2012, the integrated pest management program was focusing on major crops such as rice and maize. In this program, the government institute such as

Ministry of agriculture and fisheries, university and some international as well as national NGO's start to introduce the type of training to farmers related to IPM program.

Integrated pest management activities

There are number of integrated pest management activities which carry out by the government and other institute. This include training, field demonstration, and Farmer Field School. Various type of training related to control management strategies on insect pest in major crops. This training mainly focused on target farmer in the potential areas around Timor Leste. Bobonaro, Covalima, Baucau and Manufahi district are the potential area where maize and rice is being planted. The training often last for 2 days, and the training include the learning activities such as proper identification and field school, in which farmer are invited to the field to show and observe different insect pest which attack their crops.

Figure 1. Training on safe use of pesticides



The participation from the male and female in the integrated pest management activity has shown significantly increases. Female participation was recorded high in the horticulture areas, however in other areas, there is less women participation.

Table 1. Percentage male and female participation in the IPM activities

No	Name of activities	Year	Male	Female	Total
1	Training on pest and disease management of rice, maize and tomato	2009	360	180	540
2	Training on spray application and pesticides management	2010-2011	400	200	600
3	Demonstration plot for controlling diamond back moth on cabbage	2010-2014	200	100	300

4	Farmer field school on integrated pest vector management	2014	150	50	200
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Source: Department of Plant Protection, 2009-2014

The beneficiary not only from the farmer, however the extension officer, agriculture officers, agronomy also includes in the beneficiary part because when the training is carrying out in the field, the involvement of extension officer is necessary. In addition to that, the training also carry out in the 12 district all over Timor Leste.

The involvement of farmer in the integrated pest management activities in Timor Leste is quite small compare to other country due to lack of campaign about the benefit of this program, budget, lack of understanding and not commonly used by farmer due to over rely on traditional type of control.

Figure 2. Farmer that benefit from use of IPM on cabbage



Most of the activity carry out related to integrated pest management program is partially funded by the donors such as AusAID, FAO, GTZ, USAID and some by the ministry of agriculture and fisheries. It is important to expand the knowledge of integrated pest management, however lack of participation often become a challenge for implementer to continue and focus on this activity.

Impact assessment of IPM programmes

The impact of the integrated pest management program has not been done so far, however, there are already some changing in the behaviour of the farmer in some district. For example, in Ainaro district, where is the one of the horticulture areas has shown that most of the vegetable farmer

already use organic method of pest control such as cultural control, sanitation, use of bio insecticides such as neem, chromolaena weed, to control pest which attack their crops. In addition to that, some farmer already manage to control the use of pesticides and proper handling of pesticides.

Moreover, in some rice field, the implementation of integrated pest management has provide a bright change to the character of other farmers. For example, one of the farmers who learned from farmer field school about the integrated pest management of rice, and he is practicing the method of integrated pest management in his field, and his has contributed to the participation of the other farmer for sharing a knowledge he learned.

References

Department of Plant Protection, 2009. Final report for training of pest and disease of rice, tomato and maize in Manatuto, Suai and Oe-cusse district, Timor Leste

Department of plant protection, 2012. Final report on rice stem borer field trial conducted in Oecusse district, Timor Leste

Timor Leste Food Security bulletin, issue no. 8 July-September 2014

USAID, 2013. Modo fresku iha Timor Leste, Resultado peskisa Mercado, dili, Timor Leste

STATUS OF INTEGRATED PEST MANAGEMENT(IPM) IN VIETNAM



Summary

With the assistance of FAO, Vietnam has been implementing the Integrated Pest Management - IPM since 1992 to address the pest problem and abuse use of pesticides due to the lack knowledge of farmers on crop management. Since 1994, the Ministry of Agriculture and Rural Development established the National IPM Programme. The Department of Plant Protection is responsible for overall coordination of the implementation of IPM Programme. IPM has been implementing in all 63 provinces. At the provincial level, Plant Protection Sub Departments (PPSD) are in charge of managing the IPM programme and implementing FFSs and follow-up activities. In each province, there is a nucleus of IPM trainers that plays a central role. At commune level, the IPM-FFS alumna (especially woman) as the core force to mobilize IPM training activities and disseminate the IPM in their commune. The Support of Communal authority and participation of civil society organizations (CSO) play important role in sustainable development of IPM in communes.

The objective of the National IPM Programme is to increase small-scale farmers' knowledge and skills enabling them to make better-informed decisions in the management of their crop production systems which will lead to a more sustainable production and greater farm-level benefits including human health and environment protection.

IPM is still strongly associated with pests and is defined as a knowledge-intensive process of decision making that combines various strategies (biological, cultural, physical and chemical) to sustainably manage pests therefore minimize the risks causing by chemical pesticides as well as other chemicals to the environment and human health.

The training approach which is being used to help farmers learn about IPM is called the Farmers Field School (FFS). Participatory, non-formal adult education is the training approach being used to help farmers learn about IPM and is being implemented via the IPM Farmers Field School (FFS).

From year 1992 to 2013, there were 3,102 PPSP's technicians trained to become IPM trainers, and 5,855 farmers were trained to become Farmer trainers, 1,181,190 farmers (53% female) were trained through IPM FFS. IPM have been implementing on main crops such as Rice, Vegetables, Cotton, Maize, Tea, Citrus, Soybean, Cassava, Dragon fruit... In 2014 MARD has issued the

Scheme "Promoting the application of integrated pest management (IPM) on crop period from 2015 to 2020" to contribute to implementation of the Prime Minister' Scheme on "restructuring the agricultural sector towards increasing added value and sustainable development."

Facts and figures of Country National IPM Programme

Operational since: 1992

Implementing agency: Plant Protection Department

Key Partner institutions:

Government funding and Donors: Denmark, Norway, Australia, Netherlands, Europe Union (EU), World Bank

FFS conducted: 47,248

Farmers trained: 1,181,190 (30-50 % female)

Trainers active: 3,102 main trainers; 5,855 Farmer trainers

Main crops in which IPM-FFS interventions are focused : Rice, Vegetables, Cotton, Maize, Tea, Citrus, Soybean, Cassava, Dragon fruit...

Introduction

The misuse of pesticides is harmful to human health and is damaging to the environment. Far too many people are poisoned by pesticides every year, and pest problems are often made worse when the balance between beneficial and harmful insects is disturbed by applying toxic chemicals. Governments, international agencies and NGOs are working together to organize training which helps farmers to learn about the ecology of their fields and, as a result, enables them to make and implement decisions which are safe, productive and more sustainable. This ecological approach to plant protection is called Integrated Pest Management, or IPM. Not only does it involve minimizing the use of pesticides, it also involves a wide range of other cultivation practices aimed at growing a healthy crop as well as help farmer in strengthening their collaboration.

Under technical and financial support of FAO through the FAO Inter-country Programme for IPM in Rice in South and South East Asia Vietnam was launched the National IPM Programme in 1992 as a response to massive insect outbreaks (particularly the brown plant hopper and leaf folder) in rice resulting from misuse of broad-spectrum pesticides.. This has been followed up by several programmes including the FAO Community IPM, Vegetable, and Cotton IPM Programmes, Biodiversity Use and Conservation in Asia Programme (BUCAP) and the IPM Component under the DANIDA-funded Agricultural Sector Programme Support (ASPS) with additional initiatives from various NGOs including SEARICE, CIDSE, OXFAM America and research institutes such as Norwegian Crop Research Institute (NCRI), University of Western Sydney, World Bank. At central level the Plant Protection Department (PPD) of the Ministry of Agriculture and Rural Development (MARD) is responsible for co-ordination and management of the National IPM Programme. At provincial level the programme is implemented by the Plant Protection Sub-departments of Department of Agriculture and Rural Development (DARD).

The objective of the National IPM Programme is to increase small-scale farmers' knowledge and skills enabling them to make better-informed decisions in the management of their crop

production systems, which will lead to a more sustainable production and greater farm-level benefits including human health and environment protection.

During the past decade, the Government of Vietnam has emphasized a commodity-based agricultural approach aimed at securing domestic food security while maintaining a high level of export growth. Given the renewed attention to food security and current prominent driving forces for pesticide risk reduction related to food safety, international trade facilitation and enduring environmental and health concerns, the need for strong Integrated Pest Management (IPM) and Good Agricultural Practices (GAP) farmer training programmes is greater than ever. In tandem with such training efforts, there is a need to develop sustainable pest and pesticide management policies, to strengthen the regulatory framework to control the distribution and use of pesticides, and to enhance capacity for implementation of these policies and enforcement of pesticide legislation.

Efforts of IPM Programme since 2006 to the present, is a significant contribution for the implementation of the national programmes on food security, food safety, and sustainable use of natural resources. Useful support from FAO includes capacity development, technical advice, friendly technical initiatives, policy input, material provision, etc.

PART I: Historical perspectives

Vietnam has paddy land about 4 million hectares of rice, farmer grow 2-3 crops / year. Over 60% of the 15 million farmer households engaged in rice production. In 2013 rice yield was 55.8 tons / ha, production of paddy was 44 million tons / year. Rice contributed 30% of the crop production sector. Vietnam annual export about 7-8 million tonnes to 150 countries, including: China 38%; Philippines 9% , Malaysia 9%, Ivory coast 9%.

Other crops (in 2013); corn: 1,126,900 ha; vegetables: 900.000 ha; fruit crops: 832 thousand ha, production 930 thousand tons/year; sugarcane: area of 309.7 thousand ha, roduction of nearly 20 million tonnes; rubber: 800 thousand hectares, production was 1 millions tons/year; coffee: 630 thousand ha, production 1.25 million tons; tea: 130 thousand hectares, production 960 thousand tons of tea leaves; cashew: 310 thousand hectares, producing about 285 thousand tons; black pepper: 60 thousand ha, production 125 thousand tons/year.

In crop production, the misuse of chemical inputs (fertilizer, plant pesticide) is the primary factor causing pest outbreaks, difficult to control. Meanwhile, the habit of dependence on chemical pesticides to control pests of farmers tend to increase over the years due to a lack of understanding about the negative effects of chemicals, directly affecting the health of farmers and environment, as well as causing food safety problem, reduced production efficiency, and affect the product consumption.

With the assistance of FAO, Vietnam has been implementing the Integrated Pest Management - IPM since 1992 to address the pest problem and abuse use of pesticides due to the lack knowledge of farmers on crop management. In 1994, the Ministry of Agriculture and Rural Development established the National IPM Programme Steering Committee (MARD's Decision No: 549/NN/BVTV/QD dated 05/27/2004). The Department of Plant Protection is responsible for overall coordination of the implementation of IPM Programme.

The objective of the National IPM Programme is to increase small-scale farmers' knowledge and skills enabling them to make better-informed decisions in the management of their crop production systems which will lead to a more sustainable production and greater farm-level benefits including human health and environment protection.

Integrated Pest Management (IPM) is still strongly associated with pests and is defined as a knowledge-intensive process of decision making that combines various strategies (biological, cultural, physical and chemical) to sustainably manage pests therefore minimize the risks causing by chemical pesticides as well as other chemicals to the environment and human health.

Since 2007 the National IPM Programme has developed the a strategic direction for its activities on "Capacity building on pesticide risk reduction" to strengthen support for the implementation of the National's programmes on food food safety and environment protection. Key activities of the program from 2007 to 2015 are:

Training to raise awareness for the community about pesticide risks to humans and the environment, and to improve skills related to reducing the risks posed by pesticides when use or exposure to pesticides.

From the knowledge and skills acquired through training and education initiative to help farmers apply the protective equipment and the manipulation techniques when exposed to pesticides to curb pesticides enter the body, improve awareness and specific actions for environmental protection such as collect and place the empty containers at the prescribed place, make a best way of manipulating excess pesticide, rinsing the spraying equipment ensuring limited environmental contamination, arrangements in place for storing pesticides, spraying equipment make sure not affect people and pets ...

Training of farmers on the application of alternative chemicals such as the use of biological products, measures the mechanical, physical, farming ... in IPM.

Along with the training of farmers, the development of models to support local government strengthening pesticide management (sales and use) in parallel with the implementation of safe production in compliance with VietGAP at the commune were

In 2014, MARD issued the strategy on strengthening IPM utilization up to 2010, and IPM has been integrated in the MARD's Programme on reforming crop production.

PART II. Current status of IPM

1. Extension approach in IPM

1.1 IPM principles. IPM emphasizes the growth of a healthy crop with the least possible disruption of agro-ecosystem, thereby encouraging natural pest control mechanism. It is based upon four "IPM Principles" as follows:

- Grow a healthy crop
- Conserve natural enemies (beneficial insects)
- Conduct regular field observations

- Farmers become IPM experts

The first principle means that IPM trained farmers will need to be able to apply good agronomic practices and understand plant biology. This should help them to optimize their yield as well as grow plants that can withstand disease and pest infestation. The second principle implies that these IPM trained farmers will reduce their use of insecticides. To do this they need to understand insect population dynamics and rice field ecology. The third principle asserts that IPM requires of farmers the ability to regularly observe, analyze and take informed decisions based on their agro-ecosystems' conditions. The fourth principle posits that because of local specificity, IPM trained farmers are better positioned to take the informed decisions relevant to their fields than extension workers or technicians; they therefore should be able to apply IPM in their field and also help others do so.

1.2 The IPM Farmer Field School. Participatory, non-formal adult education is the training approach being used to help farmers learn about IPM and is being implemented via the Rice IPM Farmers Field School (FFS). Typically, a group of 25-30 farmers meet in their own fields half a day per week from the beginning of the cropping season until the crop is harvested. Through weekly observations of their crop they discover how the different parts of the agro-ecosystem interact, particularly the relationships between insect pests and predators (natural enemies). This helps farmers to understand insect population dynamics and field ecology. A FFS consists of two fields - an experimental field and a field grown according to conventional practices. Facilitated by trainers, the participants compare different crop management practices. Based on their own observations and analysis they then discuss and determine the best practices in each given situation. Following the four principles of IPM, some additional simple field experiments are also included. These can be defoliation studies to learn about plant physiological compensation after damage, or setting up of "insect zoos" to study predatory behavior and parasitism. These studies are decided and designed by FFS participants to help increase their understanding of ecological principles in their agro-ecosystems.

Each meeting includes a special topic related to the development stage of the crop and problems that emerge during that particular stage. As the season progresses the farmers will study and discuss most of the important issues in crop production - right from selecting a good variety, to cultivation practices, nutrient and water management, and of course also pest and disease management as well as economic input/output calculations. Field experimentation and observations followed by group discussions help farmers to optimize their yields and grow healthy plants that can withstand disease and pest infestations as well as unfavorable conditions.

Finally, group dynamics exercises focused on problem solving, communication, leadership, and team building are integrated into the FFS curriculum through games and discussions. FFS alumni are expected to be able to apply IPM in their own fields as well as help others to do so too. Field days and presentations in various media are organized for information dissemination and advocacy.

The FFS experience provides farmers with a basic educational foundation upon which they can further build to enhance their abilities to apply not only IPM, but also develop and improve other aspects of their farming systems.

2. Link to International IPM Programme

The IPM Programme's concept and approach was developed by FAO and has been implemented in Asia since 1980 as an Inter-country Programme funded initially by Australia and then the Netherlands. Since then the IPM programme has developed in each participating country to become their individualised National IPM Programme as they realised and experienced the benefits in risk reduction and increasing incomes as a result of utilizing agro-ecology concepts in crop management as well as farmer-ownership strengthening advocated under IPM. The first IPM Farmer Field School (FFS) training was initiated in 1989 in Indonesia, expanding to twelve Asian countries and gradually to over 30 countries worldwide. Since 1990 more than two million farmers have graduated from IPM FFS .

3. National IPM programme

3.1. Training of trainers and training of farmers. IPM program in Vietnam has trained about 3,102 main trainers and 5,855 Farmer trainers. The trainers are technicians of the Provincial and District Plant Protection Sub-Departments (PPSD). After attending TOTs, these technicians have been implementing farmer's field schools (FFSs) in rice and other crops (Rice, Vegetables, Cotton, Maize, Tea, Citrus, Soybean, Cassava, Dragon fruit...) in their own provinces and regions.

Furthermore in many locations, thousands of farmers have taken FFS upon themselves to organize and promote the practice of IPM in rice production within their communities.

3.2. IPM clubs. After finishing FFS training and wanting to do more IPM activities, some groups of farmers decided to maintain the momentum created in FFS by organizing themselves into IPM clubs or farmer groups with varying degrees of structure and organization, and with a wide range of activities (such as animal husbandry, credit, marketing, etc.) depending on the needs and ambitions of the respective groups. In these groups, the members work together and support each other in developing their farm enterprises. They also play a central role in organizing community IPM programmes as well as in the general district and commune agricultural planning. In addition, the farmers' groups link with other local organizations and the clubs coordinates with Extension Centres and the Youth Union for IPM related activities such as organizing and conducting farmer-to-farmer field school, monitoring field studies, etc.

3.3. Community IPM. The Community IPM model is designed specifically to nurture and sustain IPM learning after FFS through community ownership in planning, management and implementation of IPM activities. The model consists of a set of activities in the following sequence:

- i. Main IPM trainers initiate a FFS at the village level.
- ii. The most enthusiastic farmers participating in the FFS, who have also demonstrated good technical and communication skills, are identified and trained to become IPM farmer trainers.
- iii. Expansion of IPM throughout the farming community through the implementation of FFS and follow-up activities facilitated by farmer trainers.

To maintain and further develop the IPM programmes, and to continue to improve the knowledge and skills of farmers, various follow-up activities are organized. These may include:

- i. district and village IPM planning meeting for community action;

- ii. field studies addressing specific production constraints and opportunities in their locality, e.g. assessment of rice varieties, rice-fish studies, cultivation techniques, nutrient management, disease management, and
- iii. IPM for other crops, e.g. vegetables, soybeans, fruits or tea.

Cultural activities such as traditional songs, poems and theatre are popular tools used for disseminating IPM within the community and creating cohesiveness among farmers.

The goal of this strategy is to institutionalize IPM at the local level. Helping farmers to initiate and establish their own local IPM programmes will result in enriching the assets of rural communities and contribute to the promotion of sustainable rural livelihoods. Community IPM leads to farmer empowerment.

3.4. IPM link with local rice seed production (Biodiversity Use and Conservation in Asia Programme – BUCAP). Lack of rice genetic diversity in the fields remains one of the most vital reasons for agro-ecosystem imbalance that leads to pest outbreak. On the other hand, the current formal seed supply system meets only between 20% to 30% of farmers' demand on seed, leaving 70-80% to farmers' self-supply. The quality of seeds produced by farmers depends on their own capacity. The quality of rice seeds is directly related to pest resistance and yield—low quality seeds results in low resistance against pests and yield reduction.

It is essential to increase farmers' knowledge of seed and biodiversity to ensure the first principle of IPM - "Grow a healthy crop". Vietnam has participated in Biodiversity Use and Conservation in Asia Programme (BUCAP) since 2000 in order to support farmers in the intensive application of IPM.

The main objective of BUCAP Vietnam is to improve farmers' knowledge and methodology so that they can get involved in genetic conservation and development of tolerant varieties. BUCAP is being implemented under the administration of South-East Asia Regional Initiatives for Community Empowerment (SEARICE), and receives financial support from the Development Fund Norway. Main farmer-led activities are as follows:

- i. Participation in farmer field school (FFS) to obtain knowledge of biodiversity and variety selection skills;
- ii. Conducting variety selection studies including line segregation, and crossing;
- iii. Rehabilitating preferred traditional rice varieties that have deteriorated through poor seed conservation techniques or crossing with inferior varieties.
- iv. Comparing, evaluating new varieties in specific local land conditions to find out the adaptable ones; and
- v. Multiplying selected varieties to supply and exchange in community.



Hoa Binh Farmer is crossing the rice seed to develop new varieties

By the end of 2007, 5150 farmers from 185 communes out of the 13 provinces participating in the IPM programme had undergone FFS training. In 2003 SRD implemented a programme in Bac Kan province. Since its inception more than 900 farmers have been trained through the Plant Genetic Resource Conservation, Development and Uses FFS. Building-up on and moving forward on the success of this programme, SRD with Cordaid-Netherlands financial support has started a new project on Strengthening and Developing a Farmer's Rice Seed System in Bac Kan in 2008. This project based on IPM knowledge and principles aims at improving farmers' rice seed production capacity and also advocates for the role of farmers in rice seed production. The ability of farmers to produce their own good quality seeds will enable them not only to preserve more environmentally adaptable local varieties but also to be independent and in control and not fall into the trap of having no choice but to repeatedly buy expensive rice seeds from the Big Seed Companies.

Increase PGR diversity on-farm:

a) Conservation through collection and storage in the gene bank/community seed bank:

- Number of accessions of rice, other cereals, vegetables, etc: 534

Conservation through rehabilitation:

- Number of varieties of rice, maize, etc. rehabilitated/purified: 499

- Number of traditional rice: 35

- Number of improved rice varieties: 534

Conservation through development and use:

Number of varieties of rice, maize, vegetables, Soybean, etc. were selected through PVS or from stable materials: Total: 166 vars

(Rice: 151, Maize: 5, Vegetable: 8, Soybean: 2)

-stable rice materials were selected from segregating materials: 321

-stable rice materials were selected from farmer crosses: 52

b) Improvement in livelihoods through sustainable use of agricultural biodiversity

Increased income (on the average): 3.350.000 d/ha

Increase in yield per hectare: 400 kg/ha/crop season

70% of seed demand met by farmer's seed (10 Communes); 50 - 60% of seed demand met by farmer's seed (58 Communes); 30 - 40% of seed demand met by farmer's seed: (102 communes)

3.4 Empowerment of Farming Communities. Number of communities where PGR CDU is practiced: total of 188 communes of 68 districts in 12 provinces: Quang Nam, Hoa Binh, Ha Noi, Hue, Yen Bai, Bac Kan, Nghe An, Quang Binh, Ha Tinh, Phu Yen, Dien Bien, Lao Cai. (Not include 131 communes that funded by other sources). In additional there are 340 communities are practicing PGR CDU as multiplier effects

Number of farmers benefiting from the project: 89.950 Farmers

How many of direct beneficiaries: 21.735 farmers

Number of farmers directly trained through the project: 3.297 from 110 FFSs (Female: 1.830, Male: 1.467) (79 FFS funding by BUCAP)

-Number of farmer breeders: 2.045 (977 women, 1.068 men) learnt about breeding technique (but only about 341 are more active in breeding)

Number of farmer trainers: 646 (men: 194; women: 452)

Impact on gender equality:

The project help in improving their access to agricultural resources such as seeds: 3.297 from 110 FFSs (Female: 1.830, Male: 1.467)

- Improved the experimental skills: 8.712 women involved in field study.

- Strengthen linkage amongst women in sharing experience and help: 102 women group.

- Women are improved in the facilitation and negotiate skills that they can talk to the leaders; better cultivation technique that reduce exposure to pesticides; enhancing the decision-making capacity in terms of management of agricultural biodiversity; improved selection skills needed to have good vars, tolerant to pests and climate changes.

3.5 Strengthen local institutions to support on-farm PGR CDU. Key institutions involved in project implementation from the national: Department of Crop Production (DCP), National Center for Seed Testing Agricultural Genetic Institute, Can Tho University., Hue University

VASSI, NIPP, Televisions, Newspapers, Radios

Other Project funding BUCAP activities in the locality: SRD, EU, PARK, Helventax, SAM, Oxfam Belgium

Provinces: Department of Agriculture and Rural Development (DARD), Department of Science and Technology, Plant Protection Sub Department (PPSD), Extension Center.

Commune: Commune's People committee' Cooperatives, Mass Organizations (Farmer Union, Women Union...)

3.6 Influence policies & programs to be supportive of on-farm PGR CDU. Project influence the local government: Understand the PGR erosion and why, importance of Bio-diversity; recognized the capacity and role of farmers in PGR CDU; role of woman farmers; Role of farmers in production development.

Supports that local government provide on farmers' work on PGR CDU: Give fund for farmers with budgets, facilities, fields for study and multiply seeds, meeting room for FFS, organize the field day, introduce farmer's seed through the meetings, etc. Financial support from province and commune levels: 1.200.000 USD/year

Ministry of Agriculture and Rural Development (MARD)'s Decision on "On farm Seed production". This Decision aims to support farmers in PGR conservation, development including breeding, rehabilitation and exchange seeds in community.

3.7 System Rice Intensification (SRI). The practices of rice cultivation on the plain, hilly and mountainous areas in northern of Viet Nam are characterized by over application of nitrogen chemical fertilizer and high density in rice transplantation. Thus lead to reduce the disease resistance capacity of rice, rice is easier to infection, provides lower yield and economic return. Over-application of chemicals like fertilizers and pesticides in rice production also contaminates environment. To overcome these disadvantages, since 2003, the IPM program of PPD had learned and introduced SRI to rice farmers for adaption.

In two years 2003 and 2004, SRI adoption was tested in provinces of Hoa Binh, Ha Noi and Quang Nam. The withdrawn conclusions from practices showed that SRI adoption has mitigated the disadvantages in traditional rice cultivation method and farmers have capacity to adopt SRI.

In 2004, PPD developed SRI Adoption Technical Guideline for different rice cultivation conditions and disseminated to provinces for applying.

In 2005 - 2006, with assistance from IPM component of Agriculture Sector Support Program (ASPS) funded by DANIDA, demonstration model of SRI adoption was tested on larger area of 2-5 ha per model. The result of testing it from 12 provinces (Ha Noi, Hoa Binh, Nam Dinh, Ninh Binh, Thai Binh, Hai Duong, Hung Yen, Ha Nam, Ha Tay, Nghe An, Quang Binh, Quang Nam) during 2004-2005 courses has proved that SRI brings higher efficiency comparing traditional current rice practices: the amount of rice seed use reduced from 70 to 90 per cent, nitrogen fertilizer reduced by 20 to 25 per cent, but rice yield increased by 9-15 per cent in average. SRI adoption has improved micro ecological system in the field and prevented the development of plant diseases such as sheath blight, chocking disease of rice roots, and of pests including yellow snails. It also improves the disease resistant of rice.

In 2007, OXFAM of America had supported Viet Nam to develop Community-based SRI model successfully in commune level of 170 hectare in Dai Nghia commune, My Duc district, Ha Tay (Ha Noi recently) province. It was important evidence for MARD to issue decision No.3062/QD-BNN-KHCN on 15 October 2007 that officially announced SRI as technical progress at national level. Lesson learned from this model also were consolidated to prepare document of "Field SRI

Adoption Practical Guideline”. This document is used for helping community in following SRI practices, in SRI TOT and SRI Key Farmers training.

To enhance sustainability of SRI adoption in Viet Nam, since September of 2007, OXFAM of America has continued to support Viet Nam in realizing the initiative named “The System of Rice Intensification (SRI) - Advancing small rice farmers in Mekong region” then, and program “Farmer-Led Agricultural Innovation for Resilience (FLAIR) for period of 2010 – 2022.

In Summer rice crop season 2014, there were 1.813.201 farmers (69 per cent of whom is women) in 22 provinces had applied SRI (Ha Noi, Ha Tinh, Nghe An, Phu Tho, Thai Nguyen, Yen Bai, Bac Kan, Bac Giang, Dien Bien, Ha Nam, Hai Phong, Hoa Binh, Hung Yen, Lai Chau, Lao Cai, Nam Dinh, Ninh Binh, Quang Nam, Thai Binh, Tuyen Quang, Vinh Phuc, Lang Son) had adopted SRI on 394,894 ha, of which apply on direct seeding rice: 42,403; Area and apply on Transplanting rice 352,491.

3.8 Development of SRI in Vietnam. In two years 2003 and 2004, SRI adoption was tested in provinces of Hoa Binh, Ha Noi and Quang Nam.

In 2004, PPD developed SRI Adoption Technical Guideline for different rice cultivation conditions and disseminated to provinces for applying.

In 2005 - 2006, pilot model of SRI adoption was tested on larger area of 2-5 ha per model.

In 2007, MARD to issue decision No.3062/QĐ-BNN-KHCN on 15 October 2007 that officially announced SRI as technical progress at national level.

In 2011: Government enacts a “Scheme on reduction of greenhouse gas emissions in agriculture and rural areas by 2020” and promotes upscaling of SRI to reduce use of agro-chemical inputs and cut back on greenhouse gas emissions in rice cultivation.

In 2014 Irrigation Sector - MARD issued the plan by year 2020 with the goal of 30% of irrigated rice cultivation to adopt SRI and other environment friendly methods

SRI is integrated in the technical approach for sustainable rice intensification and response to climate change with in the schemes and projects on the restructure of rice production sector.

Vietnam has received assistance from other programs, international projects, from different national and international institutions as NGOs, research agencies on SRI promotion. For example: Program: the Biodiversity, Use and Conservation in Asia Program (BUCAP), IPM component of Agriculture Sector Support Program (ASPS) of DANIDA, IPM on Vegetables of FAO Asia office; Research Institute, University: Asia Institute of Technology (AIT), Thai Nguyen University, Agriculture University of Ha Noi; International and National NGOs: OXFAM America, GIZ, Oxfam Quebec, Oxfam Belgium, SRD, JVC, World Vision, Initiatives on Community Empowerment and Rural Development (ICERD).

3.9. Programme "Three reduction, three gains" - (3G3T). In 2005, the Minister of Agriculture and Rural Development has directed the provinces in Delta Mekong apply "Three reduction, three gains" - (3G3T) on rice. Those are technical measures to increase the efficiency planting high-yield rice Mekong delta.

The program "3G3T" to mobilize farmers to enhance the application of IPM to reduce input costs, gains production efficiency. "Three reduction, three gains" is applied mainly in fish c southern provinces, with the application area approximately 770,000-800,000 ha.

In recent years in the Mekong Delta to mobilize farmers to apply "A Must, Five Reduction" (1P5G). 1P5G is Built on the success of the campaign "Three reduction, three gains". "A Must, Five Reduction" is to promote the use of certified seeds (this is seen as a "must do"). Five reduction, including water, energy, post-harvest losses, fertilizers and pesticides. 1P5G "has been implemented in seven provinces of An Giang, Can Tho, Soc Trang, Bac Lieu, Binh Duong, Ninh Thuan and Lam Dong with the application area of 4,000 hectares

3.10 Mininum Tillage Potato IPM in Rice-based Cropping Systems. Today, elderly women in the northern Thai Binh province are growing potatoes using a labour-saving method and sell the farm produce to raise money to pay for their grandchildren's school! Between 2009 and 2012, incomes from growing potatoes increased by 19 to 31 percent using minimum tillage potato IPM compared with conventional potato growing methods. In 2008, the International Year of the Potato, FAO introduced Viet Nam to the concept of minimum tillage potato growing using integrated pest management (IPM) in lowland rice production systems. Soon after, Oxfam America joined FAO to support farmer field school training and field testing of this innovative potato growing method through Viet Nam's National IPM Programme managed by the Plant Protection Department of the Ministry of Agriculture and Rural Development (MARD). Rice fields are not ploughed, or tilled, after harvesting. Instead, the paddies are drained using drainage furrows that result in raised beds. The beds are ideal for growing potatoes without the usual need for labour intensive ploughing, or tilling. Using minimum tillage potato IPM, the potato seed tubers are simply placed on the beds created by the drainage furrows. After adding fertilizer to the soil around the tubers, the beds are covered with straw left over from the recent rice harvest. Twice during the growing season more fertilizer and rice straw must be added to the potato beds. Four hectares of rice produces enough straws to grow one hectare of potatoes. Using leftover rice straw for mulch has the added benefit of reducing the emission of greenhouse gases, because traditionally the rice straw was burnt. The straw mulch creates an important habitat for many of the potato's natural enemies. Also known as friends of farmers, these insects and micro-organisms are vital if the plant pest population is to be successfully regulated and in a natural organic way. Importantly, mulching with rice straw reduces the need for irrigation from 5 000 cubic metres of water to just 900 cubic metres per hectare. Using the IPM system to grow potatoes, farmers report a substantial reduction in the use of fertilizers and pesticides, and a dramatic reduction in labour. The method reduces the labour involved in land preparation, planting, irrigation, agrochemical application and harvesting by some 28 to 47 percent when compared to the conventional method of growing potatoes. In 2009, 23 women in the IPM Farmers' Group in Thai Giang village were able to buy television sets with the extra money they made growing potatoes. From their potato-farming income in 2010, they bought gas stoves while others said they were saving the money to send their children to university.

Initially, the initiative involved one province and 25 farmers. Today, 4 000 farmers have adopted minimum tillage potato using IPM in 22 provinces; about 70 percent of those farmers are women. As a result, minimum tillage potato IPM was recognized as a promising model and, in 2013, the ministry issued a directive calling for all potato-producing provinces in the country to apply the

practice. The potato is the fourth most important food crop in the world. The potato produces more nutritious food more quickly, on less land than any other major food crop. It has the potential to become an alternative source of carbohydrates in parts of the world where rice has long been king. In Viet Nam, the potato is an important winter-rotation food crop. It is used in food processing and has become a source of increasing income for small farmers. Favourable soil and climatic conditions – especially in the northern plains, the mountainous north and the north central and central highlands – make it possible to grow potatoes on at least 200 000 hectares of land each year. The practice of minimum tillage potato IPM may have come at just the right time, because potato productivity from traditional growing methods has been low in recent years. Areas planted to the crop have also been declining due to a lack of quality seeds and increasing labour costs. Urbanization and the migration of rural youth to nearby cities in search of better-paid employment opportunities have left farm activities mostly to women, especially the elderly. Because conventional potato production is labour-intensive, many families shifted to planting other crops. But, now minimum tillage potato IPM may be the potato's salvation in Viet Nam, helping to conserve resources and grow more food that can improve diets and increase farm incomes for families in many provinces across Viet Nam.

3.11 Pesticide risk reduction Programme. Vietnam is facing the issues of high demands of the community on food safety, environmental protection, and technical barriers to the international trade. The Government of Vietnam is highly concentrated to seek solutions to reduce chemical input in farming. Since 2007, FAO Regional Vegetable IPM Programme's Pesticide Risk Reduction Programme has supported the National IPM Programme to strengthen the training programme in PRR and in conjunction with better access/utilization of alternative pest management options.

After the first curriculum development workshop in Phnom Penh, Cambodia in 2007, Vietnam developed two training materials as Guide line to develop the curricular on PRR being integrated in IPM-FFS curricular, and to develop the Community Education Programmes on PRR and Safe Vegetable Production in compliance with VietGAP/GAP. At the same time, the Curricular for training farmer to conduct their own study on the hazardous pesticides handling and health effects that was developed by Helen H. Murphy also were applied in the training programme.

From year 2007 to 2010, five season-long TOTs were organized for 150 PPSD's technicians, 207 PPSD' IPM trainers have refreshed in technical skills, 1,761 FFS were organized for 51,757 farmers (53% female). 14 pilot models on Community Education Programmes on Pesticide Risk Reduction and Safe Vegetable Production in compliance with VietGAP/GAP were organised in Hanoi, Thai binh, Hai Duong, Ho Chi Minh. Model aims to demonstrate the partnership between GOs and NGOs, local groups and networks of small holder IPM farmers to address PRR and to implement safe vegetable production in compliance with GAP at the commune level and facilitate market access for farmer's products. PRR curricular also has been integrated in the training curricular of the Community Level Management of Plant Hoppers and Associated Virus Diseases in nine provinces (Nghe An, Ha Tinh, Nam Dinh, Thai Binh, Ninh Binh, Bac Giang, Quang Nam, Hai Duong and Hai Phong), with total participated farmers were 985 farmers. FFS alumna actively participating in the biological control of pests in order to minimize the chemical pesticide use, such as: Mass rearing and use of Earwig to control insect pest on coconut beetle in Quang Ngai province, on vegetable in Hung Yen, Hai Duong, Quang Ninh, Hanoi, Nghe An, Stem borer

and Mealybug on sugarcane in Nghe An province. In addition, Farmer alumna have created in minimum tillage production of potato that aims to improve soil ecology and protect environment from burning the rice crop residues (straw, stubble) as farmer practice. The National IPM programme has facilitated initiation of the linkage with private sector enterprises and farmer groups for promotion of the farmer's produces to the markets, such as Company Huong Canh and IPM farmer group of cooperative of Van Duc commune, Gia Lam District, Hanoi to produce vegetable in compliance with VietGAP; Hung Trung Viet Limited Liability Company farmer group in Dong Phu Commune, Chuong My, Hanoi province developed rice with VietGAP Certificate. The Impact assessment has carried out in Hanoi, Thai Binh, Hai Duong and Ho Chi Minh by Hanoi Agriculture University, the results of study provides lesson learn for the improvement of training programme. The training programme on PRR and alternative options to chemical pesticides has impacted on the Vietnam's policy reform on the management of the sale and use of pesticides, such as strengthening the state management of the people's committee in commune level on the pesticide management, review and reform and supplement some articles of Circular 38 to control entrance more closely and eliminate the outdated pesticides or at risk of harm to the environment, improve the labeling. Furthermore FAO has provided the comments on the Plant Protection Law drafting.

3.12 Application of Agro-biodiversity and reduction of pesticide risk for sustainable crop intensification. National IPM Programme facilitate the coordination between CSO Center for Initiatives on Community Empowerment on Rural Development (ICERD) and MOET, MARD/PPD at national level, DOET and PPSD at provincial level, district office of education and training and district plan protection station, continuing education centres and CLCs, PPCs at communal level to conduct the Swedish Chemicals Agency (KemI) REAL project, coordinated by The Thai Field Alliance (TFA). REAL project aims at i) Increased awareness and enhanced capacity in farming communities, schools, institutions and among consumers within provinces to reduce the risk associated with pesticide use and enhanced use of alternatives, and (ii) Enhanced national and local advocacy on sustainable pest management/agriculture. Following are some activities conducted within REAL project.

Application of conservation of fish and aquatic animals in rice field:



Based on the basic knowledge gained from training (ABD conservation and utilization, conservation of aquatic animal (Fish) in the rice field, pesticide risks, IPM, and " of Rice Intensification - SRI"), in 2014, there were 105 farmers with 55 woman (52%) from 4 communes of two provinces (Bac Giang: Quynh Son and Xuan Phu; Quang System Binh: Vinh Ninh and Loc

Thuy) applied the Model of “conservation of fish and aquatic animals in rice field”. Total applied area was over 34 ha. See picture bellow.

The overall advantages of “conservation of fish and aquatic animals in rice field” against traditional mono rice cultivation method are improved in practice as: increasing 551 – 211 % profits in comparison with mono rice cultivation practices. Increase income in conservation fields by 4 times in comparison with the rice fields do not conserve aquatic animals. Total production of conservation fields (rice, fishes, Aquatic animals) was 165,916,417 VND / ha, but production in the rice fields without conservation was only 40,495,417 VND / ha.

In average one farmer carried out conservation harvested (rice, fishes, aquatic animals) with 49,774,925 VND from 0.3 ha of conservation fields, but other famers who were not apply conservation harvested only 12,148,625 VND from the same of rice area of 0.3 ha.

3.13 Reason to support rice – fish culture. ICERD had a survey to Bac Giang and Quang Binh province to select project sites, the finding was that: In some areas, farmers culture fish that within the rice field areas, but their fish ponds have no connected to rice field. Question raised that, why not be integrated rice and fish cultivation?

The farmer's answer was: fishes cannot be alive in rice fields because pesticides could kill the fishes, (farmers apply 5 – 7 insecticides applications/crop, on top of that is herbicide). However, a confidence that there are some farmers have fish pond connected to rice field although fishes only be released from the pond to the rice fields after harvesting rice in order to protect fishes from pesticide contamination during rice crop season.

The agreement between ICERD, Plant Protection sub Department (PPSD), and commune have been made. Agreement relating to support farmers to improve rice field's ecosystem by reduction of chemical pesticide inputs, and apply IPM, SRI (wider spacing of rice transplanting/sowing), improve irrigation system. Improved rice field eco-system farmer can apply integrated rice fish cultivation.

Site selection: rice paddies with water conditions are favourable for the development of aquatic animals (fish, eel ...)

Owner households (priority for women) who have field adjoining each other within selected area have been invited to participate in the groups. Members of groups were trained on related technical issues, such as: rice fish culture techniques, training and practice of utilize alternatives to chemicals such as IPM, SRI, using of bio agent to control plant hoppers, ... participate in a review and evaluation, share experiences ...

Other farmers having fields within conservation area are also invited in technical training.

There are two main organized forms of conservation of fish in rice fields: All households have rice fields in the conservation area are directly rear fish in their rice fields; other form is only one of the households in conservation area to be in charge of rearing fish conservation area, however other households have committed on apply pesticide risk reduction methods to ensure not affect the fishes.

One more thing importance in this case is raising knowledge of indigenous on rear fish. It is supported to farmer how to plan for collecting species of fish for rice field.

3.14 Home vegetable garden. Training activities related to understanding of nutrient of indigenous vegetable, traditional medicine plants and food safety (pesticide risk) have encouraged farmers become more interested in growing of vegetables in home garden, but it also could be opportunity for market access afterwards.

Home gardens provide a ready, low – or no – cost supply of fresh, no chemical, nutritious vegetable for the whole family; create home-based employment, especially for women, through preserving, processing, or drying perishable vegetables; generate income for the household through the sale of surplus vegetables.

In 2014, there are 80 of woman in Bac Giang and Quang Binh improve home gardens with diversity of vegetables.

Through evaluation of the impact assessment team, in Bac Giang, income from grow vegetables, can increase the per capita income of about 135 million - 148,500,000dong / ha / year; Quang Binh estimated income from vegetable approximately 60,000,000 dong / ha / year. In average each woman saved 5,043,750 VND/year because farmers do not have to spend money to buy vegetables.

3.15 "Bio-mats" in raising pigs, chickens. Currently, there are still many farm families still maintain a good practices, that is raising pigs and chickens to serve the nutritional needs for the family and for sale, livestock manure to fertilize crops, buffaloes for ploughing and harrowing.

However, due to the narrow campus of house's garden, so where livestock are usually adjacent to resident, this situation caused the stench. To limit odour, many families have made investments in the cement floor to facilitate the rinse, cage wash water be poured into the sewer pit in the village, causing the stench and pollution rural environment.

ICERD has helped women to improve environmental knowledge, and skills of raising pigs and chickens on the Bio-mats in order to reduce environmental pollution caused by the production process and take advantage of source of organic fertilizer for plants.

3.16 GO-NGO collaboration on development of teaching curricular. ICERD in coordination with the Department of Continuing Education - Ministry of Education and Training (MoET), and the Department of Plant Protection (PPD) - MARD to develop teaching curricular on agro-biodiversity and pesticide risk reduction (PRR) to be integrated in teaching programme of the District Continuing Learning Centre (CLC).

In Vietnam, there is one Continuing Learning Centre (CLC) in each District throughout the country, CLC is under the management of Department of Continuing Education of (MoET). One of the activities of the CLC is organize education of the secondary school (grades 6 to 9), and high school (grades 10-12) for two types of trainees, they are: a) for whom are fail to join the basic secondary school, or high school. Age attendance at continuing education centers are (from 12-22 years old); b)for the adults, as the workers, officials, employees at commune and district levels. Currently, Department of Continuing Education - (MoET) working on revision of the content, curriculum for the subject of technical / technology (including the agricultural sector). ICERD in coordination with the Department of Continuing Education and PPD is developing teaching curriculum on the topics of agro-biodiversity and Pesticide Risk Reduction in order to be

integrated in the training programme of CLC. It will be approved in 2015 and to be the main materials for training on CLC in project site and going to expand to others in near future.

3.17 Overcome the outbreak of new pest resurgent. Support to develop Pilot Models for sustainable management of pests include:

Pilot model of Community Level Management of Plant Hoppers and Associated Virus Diseases” that have applied effectively in management of Brown Plant Hopper (BPH) and associated viruses in Rice crop in Mekong Delta;

Develop training curricular, develop Pilot models on community-wide management of sugarcane grassy shoot disease in Nghe An;

Building capacity for Spread Prevention and Management of Cassava Pink Mealybug including Identification and develop sustainable of Cassava Mealybug management for training technician and farmers.

Develop IPM on Fruit Flies (use protein bait) on Dragon Fruit, other fruit and vegetable: 2 Refresh TOT were organized to train the plant protection staff of the provinces on the sustainable management of fruit flies. And 3 FFS on area-wide management of fruit flies were organized by provincial Plant Protection Sub Department (PPSD) training a total of 90 farmers in the provinces of Binh Thuan, Tien Giang and Hanoi.

Community Biological Control Production and Utilization

Farmer groups do mass rearing and use of pathogen *Metharizum* for control Brown Plant Hopper (4 communes, 120 farmers)

Mass rearing and use of Earwig to control insect pests on sugarcane, coconut, vegetables

4. IPM policy for sustainable crop production intensification (SCPI) in support of practical implementation of the FAO Save and Grow guidelines

In 2011: Government enacts a “Scheme on reduction of greenhouse gas emissions in agriculture and rural areas by 2020” and promotes upscaling of SRI to reduce use of agro-chemical inputs and cut back on greenhouse gas emissions in rice cultivation.

In 2014 Irrigation Sector - MARD issued the plan by year 2020 with the goal of 30% of irrigated rice cultivation to adopt SRI and other environment friendly methods

SRI is integrated in the technical approach for sustainable rice intensification and response to climate change with in the schemes and projects on the restructure of rice production sector.

In 2014, MARD issued the Scheme on promotion application of IPM up to 2020 in order to implement the Government' Scheme on restructure the agricultural sector towards higher added value and sustainable development of the Prime Minister.

PART III. Impact assessment of IPM programme

One of the National IPM Programme's aims has been to develop a comprehensive participatory monitoring and impact evaluation system for the National IPM Programme in order to: i) improve monitoring and evaluation skills among farmers and IPM trainers; ii) provide leaders at all levels with information enabling them to make more effective decisions that can regularly develop the

activities that simultaneously boost productivity and decrease the use of chemical inputs; and iii) document impact. These internal impact studies which were carried out by the Plant Protection Sub-Departments (PPSDs) and IPM farmers in the DANIDA programme's areas, have been supplemented by external impact evaluations carried out by the Universities of the Hanoi Agriculture No1 and the Ho Chi Minh City's Agriculture with financial support from the DANIDA Agriculture Supporting Programme Sector (ASPS). All in all the studies have included more than 3,000 households.

The rice cropping systems of North and South Vietnam are distinctly different thus making comparisons between the two systems difficult. However extensive analysis of the impact studies for both regions done by the Agricultural University of Hanoi and the Agricultural University of Ho Chi Minh City from 2002 to 2006 in collaboration with other institutions and organizations mentioned in page 3, and published in a preliminary report (Email: ipmppd@fpt.vn, not available http adress) revealed the following results on the effectiveness of IPM training for farmers:

- Farmers have been able to reduce pesticide sprayings on an average by 38%. The percentage reduction is even higher by an average of 60% if only insecticide sprayings are considered. Overall, highest reductions have been achieved in insecticides, less in fungicides and no significant change in herbicides.

- The application of nitrogen has been reduced on an average by 15%. In the south (Mekong River Delta) overuse of nitrogen has generally been significantly reduced.

- Seed rates have been reduced by an average of 16%, and studies indicate that there is still potential for further reductions.

- In total, input costs have been reduced on an average by 8% whilst yields have increased on average by 8%. The combination of reduced input costs and increased yields has resulted in an increased income derived from rice production on average by 16%, representing VND 1.3 million (USD 80) per hectare for the winter-spring crop alone. Based on the above-mentioned studies, the increased income achieved during the first year after FFS training supported by the ASPS - IPM Component adds up to almost USD 23 million as compared to a total expenditure of USD 6.6 million.

Apart from the impact on agricultural practices and income, the studies made by the above-mentioned 2 agricultural universities in 2006 also indicate that participation in FFS improves farmers' analytical skills and critical thinking capacity, both of which have long-term effects. In addition, IPM farmers, working in collaboration with local IPM facilitators, local government extension workers cum IPM trainers and researchers, have tackled local agricultural problems and devised practical solutions based on experiments designed and carried out in their villages. Since 1999, the national average for women's participation in IPM activities has ranged from 38 – 50% at all levels: farmers, trainers and managers, varying by season, activity and region. Many farmers, including female farmers after having served as IPM trainers in their own communities for a certain period are then selected for local leadership positions.

Another important positive impact is that farmers having now gained a better understanding about pesticides' impact on human health and the environment are now paying more attention to safety precautions. This fact is supported by data collected that shows that compared to non FFS trained farmers, trained farmers reported less pesticides poisoning (exposure) related health symptoms

(e.g. headache, respiratory problems or vomiting) after spraying pesticides. The biggest impact of IPM on the environment is the significant reduction of pesticides use in the fields, not only at present but also in the future. Farmers have noticed that fish and shrimps in the fields have increased and natural enemies such as spiders, lady beetles, etc. are conserved. Now there are no pesticide poisoning cases as a result of limited pesticide use and proper handling. Minimal use of pesticides also means that rice grains are now less toxic, cleaner and safer for consumptions and therefore commanding better market price and hence higher income for farmers. Farmers are also taking advantage of the current healthier, less pesticides contaminated environment to apply integrated production models, such as rice – fish and rice – duck in their fields that brings about higher economic benefits. The environment of hamlets and fields is also cleaner.

To create a cleaner and healthier environment, the Pesticide Risk Reduction Programme (PRRP) has been developed under the National IPM Programme. The Programme aims to: i) assess the root causes of abuse and overuse of pesticides and risks associated with this and design field programmes in partnership with governmental and non-governmental organizations as well as local groups and networks of smallholder IPM farmers to address pesticide risk reduction and support ecologically-based agriculture in areas most affected by heavy pesticide abuse; ii) enhance the capacity of the Vietnam National IPM Programme by co-opting other government and non-government agencies, and farmer groups, to implement quality IPM training and action research activities with smallholder vegetable, rice, and fruit farmers, particularly in support of local governments' Safe Vegetable Programmes resulting in improved livelihoods, healthier and sustainable crop production and pesticide risk reduction; iii) develop, document and disseminate information on successful pilot models for community education for pesticide risk reduction to generate public sector and policy support from PPD, MARD and other sectors at all levels.

The model for the PRRP has been tried out in 2008 in three North provinces - Hanoi, Thai Binh and Bac Giang. After one season practice, a preliminary evaluation of the model conducted by the National IPM Programme, PPD, projected communes and PPSDs shows promising results. This model will be extended to all the other provinces throughout the country in year 2009.

PART IV. Challenges

- Lack of strategic at national scale for promotion of achievements and successes cases of IPM.
- Lack of integration of IPM in the crop production guidelines, therefore existing abuse of chemical fertilizers, narrow spaces of seeding, creating pest and disease outbreaks on a large scale difficult to control;
- Lack of coordination among agencies such as Extension, Plant Protection (PPD), cultivated in directing production plant, so it has limited capacity to promote IPM
- Lack of mechanisms and policies for promoting IPM
- Lack of IPM mainstreaming in programs, projects and other projects;
- Lack of IPM trainers because many people have retired, many people switch positions. These new technicians are not trained IPM because no budget.
- Lack of monitoring and evaluation activities at the local IPM

- There is no strong incentive policies for promotion of application of biological control, reduction of agricultural chemicals;
- Promotional activities, trade of pesticides and fertilizers in village-level community / villages / hamlets still inadequate, due to lack of control role of local government. Along with the ignorance of the people, leading to overuse of pesticides, fertilizers, increasing ecological imbalances, causing outbreaks;
- Absence of a core IPM farmers in the community, leading to situations where farmers depend on incorrect advice of pesticide seller./.