

National Agricultural Technology Project- Phase II

PEST MANAGEMENT PLAN (PMP) (VOL – II)

FOR PUBLIC RELEASE

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GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH**

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ACRONYMS/ABBREVIATIONS

AEO	Agriculture Extension Officer
BARC	Bangladesh Agriculture Research Council
BARI	Bangladesh Agriculture Research Institute
BINA	Bangladesh Institute of Nuclear Agriculture
BRRRI	Bangladesh Rice Research Institute
CEAL	Community Extension Agent for Livestock
CIG	Common Interest Group
DAE	Department of Agricultural Extension
DLS	Directorate of Livestock Services
DOF	Department of Fisheries
DPHE	Department of Public Health Engineering
EA	Environmental Assessment
EMF	Environmental Management Framework
EMP	Environmental Management Plan
ES	Environmental Screening
FAO	Food and Agriculture Organization
FIAC	Farmers' Information and Advice Centers
GOB	Government of Bangladesh
IEE	Initial Environmental Examination
IPM	Integrated Pest Management
LEA	Limited Environmental Assessment
LEAF	Local Extension Agent for Fisheries
MOA	Ministry of Agriculture
MoLF	Ministry of Livestock and Fisheries
NAP	National Agriculture Policy
NATP	National Agricultural Technology Project
NIPMP	National Integrated Pest Management Policy
NGO	Non-Government Organization
OP	Operational Policies (of the World Bank)
PMP	Pest Management Plan
SAAO	Sub-Assistant Agriculture Officer
SAPPO	Sub-Assistant Plant Protection Officer
STW	Shallow Tube Well
TOT	Training of Trainers
UFO	Upazila Fisheries Officer
UP	Union Parishad
UAO	Upazila Agricultural Officer
UZ	Upazila
WB	World Bank

PEST MANAGEMENT PLAN (PMP)

EXECUTIVE SUMMARY

ES 1: Introduction

The development of high yielding varieties has been associated with increased pest infestation requiring increased use of pesticides with all kinds of adverse impacts. Environmental pollution is increasing, soil productivity is declining, beneficial insects are getting wiped out, and water bodies are getting polluted endangering aquatic flora and fauna, the most important of which is the open water fisheries. Farmers' lack of information has led to widespread overuse of dangerous pesticides. In addition, farmers' lack of knowledge about precautions pertaining to handling of pesticides often creates health problems.

A wide range of pests attack the growing crops of the country and various kinds of pesticides are available in the markets which are used almost indiscriminately. Many of the registered pesticides are not only found highly ineffective but also causing destruction of crops. Pest management is also quite important for poultry and dairy farms as well as for fish ponds under controlled-conditions and also open waters. Indiscriminate use of inappropriate pesticides in over/ lower doses often results into loss of crop/ livestock/fish production causing huge financial losses to the farmers.

ES 2: Review and Evaluation of Pest Problems

Present Status and Need for the PMP: Pest management plan for the Bangladesh agriculture is of paramount importance because indiscriminate use of all types of pesticides is contaminating the bio-physical environment in addition to killing beneficial insects. As much as 16 percent damage in rice yield is occurring due to rice pests only and 25 percent yield damage in vegetables occurs due to pest attack. Pest infection is increasing producing costs of agricultural products. Agro-chemical dealers, especially retailers, handle agro-chemicals with their bare hands and the farmers are seen to applying and spraying pesticides without taking the necessary precautions. PMP is, therefore, of dire need for the farmers.

Goal of Preparing PMP: The NATP-2 subprojects to be implemented are expected to involve use of agrochemicals and farmers may expand the use of pesticides more than the recommended dosage in anticipation of higher yields of crops, fishes etc. Therefore, a Pest Management Plan (PMP) has been prepared. The goal of preparing the PMP is to promote the use of Integrated Pest Management (IPM) measures which is expected to reduce reliance on chemical pesticides.

The Aim and the Nature of the PMP: The PMP for the NATP-2 is prepared with the aim of standardizing a comprehensive plan for the management of pests without causing any harmful effect to the existing environmental conditions prevailing in the Project Area. Special efforts will be made to improve the current pest management practices to decrease harmful effects of agro-chemicals causing negative impacts due to subproject implementation. IPM system will be encouraged to decrease economic loss and to ensure environmental and health safety.

The farmers will be taught that pesticide application should be employed as a last resort following the four "R"s, e.g. (a) right pesticide, (b) right dose, (c) right time, and (d) right method of application.

Promotion of Safer Pesticides Management: For promoting safer pesticide management it is proposed to: (i) Create awareness among the farmers about the dangers related to pesticides and the necessity to learn about their potential harm. (ii) Impart training on appropriate methods of storage, handling and application procedures, (iii) Teach preventive measures as well as actions that might be necessary in case of accident (iv) Impart training on application of balanced fertilizers for various crops and fishes, (v) Provide easy-to-follow handbooks for following the above principles.

ES 3. Environmental Laws and Regulations Regarding Pest Management in NATP-2 Project

The Bangladesh Laws and Regulations include: Three Policies: (NAP, 1999), (NIPMP, 2002) & (NAEP, 2006 & 2012): These documents contain recommendations for using safer methodologies for utilizing pesticides, including use of IPM methods in one way or the other.

The **NAP, 1999 stipulated** that IPM will be the main policy for controlling pest and diseases.

The **NIPMP, 2002 advocated** growing healthy crops through not using pesticides but through:

- (1) Proper management of soil, water, fertilizers,
- (2) Augmentation of biological control agents and measures,
- (3) Use of pest tolerant varieties,
- (4) Useful cultivation practices,
- (5) Mechanical Control Measures,
- (6) Training of farmers in IPM and monitoring their fields for pest and diseases control, and
- (7) Use of pesticides not harmful to environment as a last resort

The **NAEP, 2006 and 2012 proposed** providing Integrated Environment support to the farmers in practicing IPM.

WHO Guidelines to Classification of Pesticides, 2009: No pesticides in the WHO Class-1A category will be used in the NATP-2 Project Pesticide brands based on the dirty dozen have been banned in Bangladesh. To ensure that none of the banned pesticides will be used in the sub-projects intentionally, suggestions have been made to train the farmers of NATP-2 on the names of pesticides which have been banned as well as on proper storage leveling and application processes. In addition, the sub-projects proponents will be instructed to observe this issue strictly. The project will promote IPM as much as possible throughout project activities especially through training activities which will be discussed and agreed during project implementation.

World Bank's Pest Management Safeguard Policy (OP 4.09): The purposes of OP 4.09 are: i) To ensure good practices that are applied in World Bank financed projects, ii) To avoid excessive use of pesticides, and iii) To promote environmentally sound and sustainable pest management.

OP 4.09 is triggered in the NATP-2 Project since:

- (i) The project is expected to introduce new pest management practices or expand or alter existing pest management practices, and/or
- (ii) The project may lead to substantially increased pesticide use and subsequent environmental and health risks because of the introduction of new crop varieties.

The policy OP 4.09 supports safe, effective, and environmentally sound pest management.

ES 4. Major Insect Pests and Diseases of Rice, Vegetables and Fruits as well as their Control Measures

Both primary and secondary information sources were used in preparing this section. The major insects and diseases of rice-the main staple crop, major vegetables and major fruits are listed in Table-1.

Table 1: Major Insect Pests and Diseases of Selected Vegetables, Fruits & Rice

Sl.	Name of the crop(s)	Major insect pests	Major Diseases
Vegetables			
1	Brinjal	i. Shoot and Fruit Borer, ii. Leaf Hopper, iii. Epilachna Beetle iv. Red Mite	i. Foot and Stem Rot/ Fruit Rot/ Fruit Blight ii. Bacterial Wilt iii. Root Knot Nematode
2	Tomato	i. Tomato Fruit Borer ii. White fly iii. Aphids iv. Leaf miner	i. Early Blight ii. Late Blight iii. Bacterial Wilt
3-4	Country Bean and Yard Long Bean	i. Aphids ii. Pod/Fruit Borer	i. Anthracnose ii. Common Bean Mosaic Virus
5-6	Cabbage and Cauliflower	i. Diamond Back Moth ii. Tobacco Caterpillar iii. Cutworm	i. Black Leaf Spot/Gray Leaf Spot
7-8	Radish and Carrot	i. Cutworm	i. Bacterial Soft Rot
9-17	Cucurbits	i. Fruit Fly ii. Red Pumpkin Beetle iii. Tobacco Caterpillar iv. Epilachna Beetle	i. Powdery Mildew ii. Mosaic Virus iii. Fruit Rot iv. Fusarium Wilt v. Alternaria Blight and
18	Okra	i. Fruit & Shoot Borer ii. Whitefly iii. Leaf Hopper	i. Yellow Vein Mosaic Virus
19	Aroids	i. Tobacco Caterpillar ii. Aphids iii. Mite	i. Leaf Blight
20	Green Papaya	i. Mealy Bug	i. Mosaic & Leaf Curl Virus ii. Damping Off iii. Anthracnose
Fruits			
1	Mango	i. Mango Hopper ii. Mango Weevil iii. Mango Fruit Fly iv. Leaf Cutting Weevil v. Mango Thrips vi. Mango Defoliator	i. Powdery Mildew ii. Anthracnose iii. Die-back iv. Leaf Blight v. Malformation vi. Rust
2	Litchi	i. Mite ii. Fruit Borer	i. Leaf Blight ii. Die Back
3	Guava	i. Mealy Bug ii. Fruit Fly iii. White Fly	i. Wilt ii. Anthracnose iii. Die Back
Rice			
1	Rice	i. Rice Stem Borer ii. Brown Plant Hopper (BPH) iii. White Back Plant Hopper (WBPH) iv. Leaf Folder	i. Brown Spot ii. Stem Rot/ Sheath Rot iii. Blast iv. Sheath Blight v. Bacterial Leaf Blight (BLB)

It should be mentioned that research and development on packages of IPM solutions for major insects, pests and diseases of rice, vegetables and fruits in Bangladesh are in very early stage. However, a good number of IPM procedures have been adopted by the farmers in many areas including those covered by the NATP: Phase-1. Still then, rampant use of chemical pesticides is being practiced by the farmers for controlling insects and diseases.

At present, the following IPM technologies are recommended for controlling different insect pests and diseases of various crops like rice, vegetables and fruits. However, use of all the technologies has not been practiced in the NATP-1 subproject areas visited.

ES 5. The Current Available IPM technologies for Crops, Vegetables and Fruits

The current IPM technologies for controlling insects of crops, vegetables and fruits differ according to the Commodities and the Types of Insects and Diseases. The details for specific insects and diseases relevant to specific crops, vegetables and fruits are provided in the EMF Report. The general IPM Technologies available now for controlling insects and diseases across crops, vegetables and fruits are summarized below.

Current General IPM Measures for Insect Control

- Use of tolerant/resistant varieties.
- Picking/catching by hand net or mosquito net and destruction of eggs, nymphs & adults.
- Use of light traps.
- Perching for attracting insect-eating birds.
- Burning or mixing the debris and left-over rice straw under soil.
- Delaying pesticide spray to help parasitic (friendly) insects in eating eggs of destructive insect pests.
- Removing water from the field and drying the soil temporarily.
- Increasing planting space of seedlings to allow increased light penetration through the canopy.
- Using balanced fertilizer.
- Pulling out of affected plants & burying under the soil.
- Use of sex Pheromone trap.
- Collection and destruction of infested leaf (with egg mass and grub).
- Application of ash on the plants.
- Practicing clean cultivation.
- Using yellow sticky trap.
- Cultivating trap crops like okra or mustard between rows and around the field.
- Spraying bio-pesticides.
- Destruction of infested flower pods and fruits regularly.
- Treating seeds with insecticides before planting in seedbed.
- Covering seedbeds with fine nylon net.
- Irrigation of field during infestation with very low quantity of kerosene oil.
- Use of poison bait (broken rice husk+ gur+ Carbarin insecticide).
- Using approved insecticide as a last resort.

Current general IPM Measures for Disease Control

- Using tolerant varieties
- Using height trap and hand net

- Using balanced fertilizer, urea application in three installments
- With-holding irrigation for 7-8 days & applying 5 kg potash fertilizer per bigha (0.33 areas) of land
- Collecting floating debris along the field borders and burying under soil
- Using crop rotation
- Using seed collected from healthy plants
- Using seed treatment measures
- Using organic manure
- Keeping standing water in the field (depending on the disease)
- Keeping the land dry for sometime in case of leaf scald attack
- Burning out the affected straw
- Keeping under control the grass-type weeds
- Not to use same land for seedbed be continuously
- Using purified seed by soaking in fungicide-mixed water
- Using soft seed bed and keeping it moist all the time (depending on the disease)
- Drying land immediately after disease appearance (depending on the disease)
- Throwing disease affected seedlings
- Burning out the disease affected plants
- Growing different varieties of rice at interval
- Using balanced fertilizer
- Mixing rice bran with seed bed soil (depending on the disease)
- Covering seedbed with polythene sheets during cold spells
- Prompt destruction of infested plant material to reduce initial inoculums
- Weed control (solanaceous weeds) such as nightshades
- Removal and destruction of the affected plant parts
- Application of *neem* cake at 250kg/ha
- Using yellow sticky traps
- Field sanitation by burning of crop debris
- Avoiding crowded planting of seedlings
- Maintaining field sanitation
- Using virus tolerant varieties
- Using of disease free seeds
- Use of high land and well drained soil (for vegetables & fruits)
- Use of fungicide as a last resort

ES 6. Implementation Strategies for the Pest Management Plan

(1) Training

- A series of training programs on various aspects of the PMP to the members of the CIGs have to be organized by the NATP-2 staff,
- Resource persons from relevant Departments (DAE, DLS, DOF) should be enlisted well ahead of time, contacted before hand and requested to prepare lecture notes keeping the educational and other qualifications of the trainee farmers in view.
- A modest amount of DSA has to be introduced for the CIG farmers in view of the fact that: (1) They are not aware of the benefits of attending the trainings initially,(2) They come to the Upazila Agriculture Office leaving behind their normal works as well as spending money on transport and lunch.

(2) Discussion Meetings

Discussion meetings of the CIG members among themselves regular basis on topics of trainings they received will help dissemination of the training matters among the members present as well as others who are not members.

(3) Demonstrations

Demonstration of the improved technologies proved to be the most effective strategy for dissemination of useful technologies to the CIG farmers present in the FGD.

(4) Personal Protection

Design of personal protective equipment, dresses, contraptions and other utensils should be collected from the IPM projects of DAE by NATP-2 personnel and:

- Delivered to the CIG members may be free of cost for the first time.
- The retailers of pesticides should be invited to discussion meetings and the protective equipment and dresses should be demonstrated in their shops.

(5) Dissemination of information about pest arrival

Arrangements should be made to disseminate information on arrival of pests that pose a threat to crops and public health especially at the beginning of the season. Additionally, information on control programs already in operation should also be made public in appropriate manner.

ES 7: Strategies for Subproject Screening

Environmental Assessment (EA) will be conducted as a tool for screening the subprojects involving the environmental issue of agrochemicals use. A proposed subproject will be selected for funding from the NATP-2 project only if the “expected nature of impact” is “positive” or “none”. Assessment will be conducted with regard to the component/activity involved, i.e. whether any banned pesticides or agrochemicals will be used, or increased amount of pesticides will be required or the potential extent of health hazards will increase due to subproject implementation.

ES 8: Environmental Assessment of EA of Subprojects

This involves a two-step process: (i) Environmental screening to identify the level of EA required and, (ii) EA to identify the required mitigation measures to be implemented on the basis of the Limited Environmental Assessment (LEA). **Details of these processes are provided in the EMF Section-5: Environment Management Process for Crop Development.**

ES 9: Environmental Monitoring Plan for Subprojects

1. Environmental monitoring in the PMP will involve information on baseline (before NATP-2) and change (at the end of each year). Possible indicators of monitoring: reduction of pesticide use (kg/liter per acre or no. of sprays); IPM used by CIG farmers (Pheromone trap= % farmers; light trap= % farmers; Braconet= % farmers).
2. Persons responsible for monitoring will be: SAAOs/UAOs/AEOs/SAPPOs. Notes/data will be collected mainly by the SAAOs and recorded in the crop production register and the data will be processed by the above mentioned officers at different stages upto arrival at the concluding state. The data will be collected before and at the end of each cropping season. **Environmental Monitoring Plan has been presented in Section-5.8 of the EMF report.**

PEST MANAGEMENT PLAN (PMP)

1. INTRODUCTION

1.1 Background

The development of high yielding varieties has been associated with increased pest infestation requiring increased use of pesticides with all kinds of adverse impacts. Environmental pollution is increasing, soil productivity is declining, beneficial insects are getting wiped out, and water bodies are getting polluted endangering aquatic flora and fauna, the most important of which is the open water fisheries. Among many factors, pollution of water bodies by pesticide wash outs is believed to be a major reason for the decline in fish production in Bangladesh. Many pesticides used in Bangladesh are banned or restricted under international agreements. In addition, several studies have shown that inadequate product labeling and farmers' lack of information have led to widespread overuse of dangerous pesticides. In fact, pesticide brands having adverse impacts have been banned in Bangladesh and these are shown in Annex1. In addition, farmers' lack of knowledge about precautions pertaining to handling of pesticides often creates health problems.

Integrated Pest Management (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. IPM emphasizes the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms.

1.2 Prologue

The main yield contributing factors for increasing production of a crop variety include inputs and good crop management practices. Good crop management practices, among others, include control of pests and diseases. A wide range of pests attack the growing crops of the country and various kinds of pesticides are available in the markets which are used almost indiscriminately¹. The lists of registered and banned pesticides have been published by the Plant Protection Wing of the Department of Agriculture Extension in 2008. The list is updated at some intervals. Each of the new pesticide is adequately tested both in the laboratories and in the field. The results are evaluated by a National Committee before permission for registration is given. But many of these pesticides are not only found highly ineffective but also causing destruction of crops. Some unscrupulous companies sell unregistered pesticides under the cover of the registered ones.

¹ Ali, M.M 2012. Management of Insects and Diseases of Rice and Vegetable Crops (In Bangla), Integrated Pest Management Project: Phase-II, Dept. of Agriculture Extension, Khamarbari, Dhaka-1215

Pest management is also quite important for poultry and dairy farms as well as for fish ponds under controlled conditions and also open waters. Indiscriminate use of inappropriate pesticides in over/ lower doses often results into loss of crop/ livestock/fish production causing huge financial losses to the farmers. In addition, improper utilization/application methods/procedures occasionally cause environmental pollution in the surrounding areas resulting in various kinds of problems through:

- 1) Extermination of useful flora and fauna, contamination of common waterways containing indigenous fishes and common grass lands grazed by cows and goats.
- 2) Contamination of food crops, vegetables, meat, milk and eggs through systemic pesticides as well as through residual effects have been causing myriads of problems and unknown damages to human health.

Pesticides use has been increasing fast in Bangladesh. In 1997, pesticide use in the country was 8000 tons. It doubled to 16000 tons in 2000. The figure again increased to 20000 tons in 2005-2006. The import cost for pesticides is estimated to be about US dollars 712 million in a year². The National Agriculture Policy (NAP) 1999³ proposed discouraging the use of pesticides and banning of chemical pesticides directly or indirectly harmful to human, animal and aquatic health. In its place, the policy document emphasized Integrated Pest Management (IPM), mechanical and biological control of pests. The Draft NAP 2010⁴ is silent on pest management. In view of the prevailing pollution problems in the country, the NAP 1999 strategies for pest management need to be reinforced⁵.

2. REVIEW AND EVALUATION OF PEST PROBLEMS

2.1 Present Status and Need for the PMP

Indiscriminate use of all types of pesticides is contaminating the bio-physical environment in addition to killing beneficial insects. Wash out of pesticides is finding their way into the wetlands and water bodies, thus adversely impacting the aquatic flora and fauna. From an environmental perspective, chemically-polluted runoff from fields has contaminated surface and ground waters, damaged fisheries, destroyed freshwater ecosystems and created growing "dead zones" in ocean areas proximate to the mouths of rivers that drain agricultural regions.

² [http://news.agropages.comNews/News Detail---3862.htm](http://news.agropages.comNews/News%20Detail---3862.htm) : Pesticide use in Bangladesh triples in 10 years.

³NAP 1999.Ministry of Agriculture, Government of the People's Republic of Bangladesh, Dhaka.

⁴NAP (Draft) 2010. . Ministry of Agriculture, Government of the People's Republic of Bangladesh, Dhaka.

⁵Shaikh, M.A.Q. 2012. Farmers' Access to Agricultural Inputs (Seeds, Fertilizers, Pesticides, Irrigation, Technologies and Subsidies) Vis-à-vis the Implementation of Agricultural Extension Services: Policy Limitations and Recommendations, WAVE FOUNDATION/ASIA FOUNDATION, Dhaka.

Pest management plan for the Bangladesh agriculture is of paramount importance because annual yield loss due to insect pests 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 crops⁶.

Some insects and diseases are increasing due to change in climatic conditions. Many less abundant pests are becoming highly abundant and attaining predominant positions and rising to destructive levels. All these changes are destroying ecological balance as well as increasing producing costs of agricultural products.

Agro-chemical dealers, especially retailers, are observed to handle agro-chemicals with their bare hands ignoring the danger of contamination. Also the farmers are seen to applying and spraying pesticides without taking the necessary precautions. Direct contact with pesticides during weighing by the dealers/ retailers and applications by the farmers leads to skin diseases while inhaling pesticides during spraying may lead not only to respiratory problems, but also to all types of infections as well.

2.2 Goal of Preparing the PMP

The NATP-2 subprojects to be implemented under the DAE are expected to involve use of agrochemicals and farmers may expand the use of pesticides more than the recommended dosage in anticipation of higher yields. Therefore, as a matter of precaution to address any potential and unforeseen issues of pest and pesticide management, a Pest Management Plan (PMP) is being prepared. The goal of preparing the PMP is to promote the use of Integrated Pest Management (IPM) measures which is expected to reduce reliance on chemical pesticides.

2.3 The Aim and the Nature of the PMP

The PMP for the NATP-2 is prepared with the aim of standardizing a comprehensive plan for the management of pests without causing any harmful effect to the existing environmental conditions prevailing in the Project Area. Special efforts will be made to improve the current pest management practices in vogue to decrease harmful effects of agricultural chemicals causing negative impacts due to subproject implementation. Integrated Pest Management (IPM) System will be encouraged in the pest and disease prevention measures of agricultural commodities to decrease economic loss and to ensure environmental and health safety for the surrounding populations. The nature of actions will be:

- Prevention and control of pests and diseases below the level of economic loss instead of removing them totally,
- Dependence on non-chemical measures to maintain the amount of harm caused by pests and diseases at a low level,

⁶MOA, 2002, National Integrated Pest Management Policy Ministry of Agriculture, Government of the People's Republic of Bangladesh Dhaka.

- If pesticide use is imperative, special care will be suggested to select appropriate pesticides having the least harmful effects as well as the appropriate application methodologies with relatively small negative impact on the biological environment, flora and fauna as well as the health of the person employing the pesticide in the field and in the store room, and finally,
- The farmers in the subprojects will be taught that pesticide application should be employed as a last resort following the four “R”s:
 - (a) right pesticide,
 - (b) right dose,
 - (c) right time, and
 - (d) right method of application.

2.4 Promotion of Safer Pesticides Management

For promoting safer pesticide and fertilizer management it is proposed to: (i) Create awareness among the farmers about the dangers related to pesticides and the necessity to learn about their potential harm. (ii) Impart training on appropriate methods of storage, handling and application procedures, (iii) To teach preventive measures as well as actions that might be necessary in case of accident (iv) Impart training on application of balanced fertilizers for various crops and fish, (v) Provide easy-to-follow handbooks for following the above principles

2.5 Methodology followed in Preparing the PMP

The specific tasks carried out in the preparation of PMP are:

- Reviewed and evaluated the pest problems, disease and pest attack in major crops and vegetables, and reviewed various methods and techniques currently in use for pest control in Bangladesh;
- Reviewed legislation related to crop protection or use of pesticides in Bangladesh and reviewed the rules and regulations of WHO, World Bank and other Development Agencies on pest management;
- Determined to what extent the project activities involve pesticide use, and describing what the nature of the usage would be (high, low, moderate) as caused by the project and the kinds of pesticides that would be used;
- Reviewed the Integrated Pest Management (IPM) measures and determined of (a) the extent to which current practices are consistent with Integrated Pest Management (IPM), including the policy framework and incentive structure; (b) problems and opportunities for improvement;
- Developed a strategy for implementation of IPM for various crops and vegetables at the NATP-2 project sites.

3. REGULATORY FRAMEWORK FOR PEST MANAGEMENT

3.1 Bangladesh Laws and Regulations

Laws/ Regulations relevant to environmental issues with respect to Pesticide Management in Bangladesh include-

- National Agriculture Extension Policy 1996 and 2012
- National Agriculture Policy, 1999
- National Integrated Pest Management Policy, 2002

All these documents contain recommendations for using safer methodologies for utilizing pesticides, including use of IPM methods in one way or the other. The components of the IPM policy include:

1. Maintenance of ecological balance,
2. Executing appropriate actions on pesticides,
3. Operating an effective system for implementing IPM program.
4. Developing human resources as the core of IPM
5. Conducting research on IPM

The National Agricultural Policy (NAP), 1999 stipulated that IPM will be the main policy for controlling pest and diseases. The NAP has given importance to the following activities for the pest control.

- Farmers will be motivated to use more pest resistant varieties of crop.
- Modern cultivation practices will be followed to reduce incidence of pest infestation
- Use of mechanical control measures such as light trap, hand net etc will be increased and popularized. Biological control measures will be used to destroy harmful insects and preserve the useful ones.
- Regular training and discussion programs on IPM will be conducted among the farmers under the supervision of Union Agricultural Development Committee for successful introduction and popularization of the method at the farmers' level.
- Pest surveillance and monitoring system will be strengthened.

The Integrated Pest Management Policy advocated, among others

- Growing a healthy crop through proper management of soil, water, fertilizers, pests, etc:
- Conservation of biological control agents by avoiding or reducing the use of toxic pesticides:
- Augmentation of biological control agents;
- Use of pest tolerant crop varieties;
- Use of cultivation practices that can minimize pest populations;
- Mechanical control of pests;
- Monitoring of field by the farmer on a regular basis;
- Build up farmers as experts in their own fields in taking Pest Management decisions;
- Income generated activities such as growing of 'ail' (border) crops, fish culture in the rice field, etc;
- Use of pesticides that are not harmful to the environment as a last resort;

The National Integrated Pest Management Policy (NIPMP) includes the following number of specific actions regarding the use of pesticides in addition to some others

- New proposal for registration of any pesticide will be declined if it falls under WHO class 1A and 1B pesticide compounds.
- Experimental toxicity data on beneficially insects, fish and other aquatic animals in Bangladesh must be taken into consideration before registering any pesticide.
- GOB will provide support and incentives to the private sectors for producing bio-control agents (parasitoids, predators and insect pathogens such as fungi, bacteria and viruses) and botanical pesticides locally.
- GOB will monitor any misleading advertisement toward using pesticides and will initiate appropriate legal actions against such malpractice.

3.2 WHO Classification of Pesticide by Hazard and the Guidelines to Classification, 2009

From the Classification guidelines point of view, no pesticide in the WHO Class-1A category will be used in the NATP-2 Project. In fact, pesticide brands based on the dirty dozen have been banned in Bangladesh and these are given Annex-1. To ensure that none of the banned pesticides will be used in the sub-projects intentionally, there will be need for training of farmers on which pesticides are banned as well as proper storage, labeling and application processes. In addition, the sub-projects proponents will be instructed to observe this issue strictly.

3.3 FAO Definition of Pesticide

The definition of Pesticide as coined by FAO, in addition to other points, includes:

Any substance or mixture of substances:

- intended for preventing, destroying or controlling any pest, including a) vectors of human and animal disease, b) unwanted species of plants or animals causing harm during, or otherwise interfering with: production, processing, storage, transport or marketing of food, agricultural commodities, wood and wood products or animal feedstuffs;
- that may be administered to animals for the control of insects, arachnids or other pests in or on their body;
- Substances applied to crops either before or after harvest to protect the commodity from deterioration during storage and transport.

The project will promote IPM as much as possible throughout project activities especially through training activities which will be discussed and agreed during project implementation. Some project activities will already support IPM through research or technology dissemination.

3.4 World Bank's Pest Management Safeguard Policy (OP 4.09)

The purposes of OP 4.09 are:

- To ensure good practices that are applied in World Bank financed projects,
- To avoid excessive use of pesticides, and
- To promote environmentally sound and sustainable pest management.

Its objectives relevant to the NATP-2 Project include:

- (i) To minimize the environmental and health hazards related to pesticide usage, and
- (ii) To ensure that pest management activities follow an Integrated Pest Management (IPM) approach.

The overall pest management approach is based on the capacity of the country's regulatory framework and institutions to promote and support safe, effective and environmentally sound pest management. OP 4.09 is triggered in the NATP-2 Project as:

- the project is expected to introduce new pest management practices or expand or alter existing pest management practices, and/or
- the project may lead to substantially increased pesticide use and subsequent environmental and health risks because of the introduction of new crop varieties. In addition, use of pesticides and other agro-chemicals may increase as a result of the enhanced agriculture extension services activities by the DAE including supply of inputs like seeds of improved varieties, fertilizers etc.

The policy OP 4.09 supports safe, effective, and environmentally sound pest management.

4. MAJOR INSECTS PESTS & DISEASES OF MAJOR CROPS, VEGETABLES AND FRUITS AS WELL AS THEIR CONTROL MEASURES

4.1 Pest Problems in the Past and Present

Both primary and secondary information sources were used in preparing this Section. The major insects and diseases of rice, the main crop, major vegetables and major fruits are listed in Table-2.

Visits were made to Belabo of Narsingdi District and Kapasia of Gazipur District, two Subproject Areas of the NATP-1 (Annex-15 of EMF Report). Discussions were held on various aspects of project implementation including major pests and diseases of major crops and vegetables as well as their control measures before and during NATP-1. Integrated pest management (IPM) issues were also dealt with (Fig. 1) and (also Figs. 2-3 in Annex 15 of EMF Report).

Visits were also made to the Bangladesh Agricultural Research Institute (BARI) and the Bangladesh Rice Research Institute (BRRI) and held discussions with the Administrative Heads of the institutes (Director General and Director Research) and the Heads of Divisions as well as relevant scientists of Entomology and Plant Pathology Divisions of both the Agricultural Research Institutes. Discussions were also held with officers of the Plant Protection Wing of the Department of Agriculture.

4.2 Insects Pests and Diseases

The FGDs with the farmers of the subproject areas and KIIs with other stakeholders and Consultants as well as literature surveys yielded valuable information with regard to major pests and diseases of rice, vegetables and fruits (Table-1) and the current methods and techniques of pest control in use in the NATP-1 subprojects and Bangladesh in general.

Table 1: Major Insect Pests and Diseases of Selected Vegetables, Fruits & Rice⁷

Sl #	Name of the crop(s)	Major insect pests	Major Diseases
Vegetables			
1.	Brinjal	<ul style="list-style-type: none">• Brinjal Shoot and Fruit Borer,• Leaf Hopper,• Epilachna Beetle• Red Mite	<ul style="list-style-type: none">• Foot and Stem Rot/ Fruit Rot/ Fruit Blight• Bacterial Wilt• Root Knot Nematode
2.	Tomato	<ul style="list-style-type: none">• Tomato Fruit Borer	<ul style="list-style-type: none">• Early Blight

⁷ Rabbani, M.G. et al.2014. Major Pest Identification and IPM Solution: Mainly for Vegetable Products in Bangladesh, KATALYST, Baridhara, Dhaka-1212

Sl #	Name of the crop(s)	Major insect pests	Major Diseases
		<ul style="list-style-type: none"> • White fly • Aphids • Leaf miner 	<ul style="list-style-type: none"> • Late Blight • Bacterial Wilt
3-4.	Country Bean and Yard Long Bean	<ul style="list-style-type: none"> • Aphids • Pod/Fruit Borer 	<ul style="list-style-type: none"> • Anthracnose • Common Bean Mosaic Virus
5-6	Cabbage and Cauliflower	<ul style="list-style-type: none"> • Diamond Back Moth • Tobacco Caterpillar • Cutworm 	<ul style="list-style-type: none"> • Black Leaf Spot/Gray Leaf Spot
7-8.	Radish and Carrot	<ul style="list-style-type: none"> • Cutworm 	<ul style="list-style-type: none"> • Bacterial Soft Rot
9-17.	Cucurbits	<ul style="list-style-type: none"> • Fruit Fly • Red Pumpkin Beetle • Tobacco Caterpillar • Epilachna Beetle 	<ul style="list-style-type: none"> • Powdery Mildew • Mosaic Virus • Fruit Rot • Fusarium Wilt • Alternaria Blight and Fruit Rot
18.	Okra	<ul style="list-style-type: none"> • Fruit & Shoot Borer • Whitefly • Leaf Hopper 	<ul style="list-style-type: none"> • Yellow Vein Mosaic Virus
19.	Aroids	<ul style="list-style-type: none"> • Tobacco Caterpillar • Aphids • Mite 	<ul style="list-style-type: none"> • Leaf Blight
20.	Green Papaya	<ul style="list-style-type: none"> • Mealy Bug 	<ul style="list-style-type: none"> • Papaya Mosaic & Leaf Curl Virus • Damping Off • Anthracnose
Fruits			
1.	Mango	<ul style="list-style-type: none"> • Mango Hopper • Mango Weevil • Mango Fruit Fly • Leaf Cutting Weevil • Mango Thrips • Mango Defoliator 	<ul style="list-style-type: none"> • Powdery Mildew • Anthracnose • Die-back • Leaf Blight • Malformation • Rust
2.	Litchi	<ul style="list-style-type: none"> • Mite • Fruit Borer 	<ul style="list-style-type: none"> • Leaf Blight • Die Back
3.	Guava	<ul style="list-style-type: none"> • Mealy Bug • Fruit Fly • White Fly 	<ul style="list-style-type: none"> • Wilt • Anthracnose • Die Back
Rice			
1.	Rice	<ul style="list-style-type: none"> • Rice Stem Borer • Brown Plant Hopper (BPH) • White Back Plant Hopper (WBPH) • Leaf Folder 	<ul style="list-style-type: none"> • Brown Spot • Stem Rot/ Sheath Rot • Blast • Sheath Blight • Bacterial Leaf Blight (BLB)

It is pertinent to mention here that indiscriminate use of chemical pesticides continued till 1990. In view of the multifarious problems arising out of such use of the agro-chemicals, integrated pest management (IPM) system was introduced in Bangladesh from 1991. As a carry over to this process, a few IPM techniques for controlling insect pests and diseases started being used. Lately, under the MOA, DAE has been implementing the IPM Project: Phase-2 since the year 2010, in 270 Upazilas of 64 Districts of the country. This indicates that research and development on packages of IPM solutions for major insects pests and diseases of rice, vegetables and fruits in Bangladesh are in very early stage.

As a result of the above – mentioned endeavors, a good number of IPM procedures have been adopted by the farmers in many areas including those covered by the NATP: Phase-1. Still then, rampant use of chemical pesticides is being practiced by the farmers for controlling insects and diseases.

However, some packages of IPM solutions for controlling various insects and diseases of different crops, vegetables and fruits are provided below (Tables 3-7) which were developed on the basis of KIIs conducted at the Agricultural Research Institutes (ARI) (Annex-2) and published materials by the ARI scientists, DAE Project Staff as well as other Consultants of the country^{9,10}.

4.3 Currently Available IPM Technologies for Crops, Vegetables and Fruits

The Current IPM Technologies for controlling insects of rice, vegetables and fruits differ according to the Commodities and the Types of Insects and Diseases. The details for specific crops, vegetables and fruits relevant to specific insects and diseases are provided in Tables 3-7. The general IPM Technologies available now for controlling insects and diseases across crops, vegetables and fruits are summarized below.

4.3.1 Current General IPM Measures for Insect Control

- Perching for attracting insect-eating birds.
- Use of sex Pheromone trap.
- Use of light traps.
- Use of tolerant/resistant varieties.
- Picking/catching by hand net or mosquito net and destruction of eggs, nymphs& adults.
- Burning or mixing the debris and left-over rice straw under soil.
- Delaying pesticide spray to help parasitic (friendly) insects in eating eggs of destructive insect pests.

⁹Ali, M. Mobarak. 2012. Management of Insects and Diseases of Rice and Vegetable Crops (In Bangla), Integrated Pest Management Project: Phase-2, Dept. of Agriculture Extension, Khamarbari, Dhaka-1215

¹⁰ Rabbani, M.G. et al.2014. Major Pest Identification and IPM Solution: Mainly for Vegetable Products in Bangladesh, KATALYST, House-20, Road-6, Baridhara, Dhaka-1212

- Removing water from the field and drying the soil temporarily.
- Increasing planting space of seedlings to allow increased light penetration through the canopy.
- Using balanced fertilizer.
- Pulling out of affected plants & burying under the soil.
- Collection and destruction of infested leaf (with egg mass and grub).
- Application of ash on the plants.
- Practicing clean cultivation.
- Using yellow sticky trap.
- Cultivating trap crops like okra or mustard between rows and around the field.
- Spraying bio-pesticides.
- Destruction of infested flowerpods and fruits regularly.
- Treating seeds with insecticides before planting in seedbed.
- Covering seedbeds with fine nylon net.
- Irrigation of field during infestation with very low quantity of kerosene oil.
- Use of poison bait (broken rice husk+gur+Carbarin insecticide).
- Using approved insecticide as a last resort.



Fig.1: Perching (top) and Pheromone Trap (bottom) used in the rice and vegetable field as measures of IPM

4.3.2 Current General IPM Measures for Disease Control

- Using tolerant varieties
- Using Light trap and hand net
- Using balanced fertilizer, urea application in three installments
- With-holding irrigation for 7-8 days & applying 5 kg potash fertilizer per bigha (0.33 areas) of land
- Collecting floating debris along the field borders and burying under soil
- Using crop rotation
- Using seed collected from healthy plants
- Using seed treatment measures
- Using organic manure
- Keeping standing water in the field (depending on the disease)
- Keeping the land dry for some time in case of leaf scald attack
- Burning out the affected straw
- Keeping under control the grass-type weeds
- Not to use same land for seedbed be continuously
- Using purified seed by soaking in fungicide-mixed water
- Using soft seed bed and keeping it moist all the time (depending on the disease)
- Drying land immediately after disease appearance (depending on the disease)
- Throwing disease affected seedlings
- Burning out the disease affected plants
- Growing different varieties of rice at interval
- Using balanced fertilizer
- Mixing rice bran with seed bed soil (depending on the disease)
- Covering seedbed with polythene sheets during cold spells
- Prompt destruction of infested plant material to reduce initial inoculums
- Weed control (solanaceous weeds) such as nightshades
- Removal and destruction of the affected plant parts
- Application of neem cake at 250kg/ha
- Using yellow sticky traps
- Field sanitation by burning of crop debris
- Avoiding crowded planting of seedlings
- Maintaining field sanitation
- Using virus tolerant varieties
- Using of disease free seeds
- Use of high land and well-drained soil (for vegetables & fruits)
- Use of fungicide as a last resort

4.4 MAJOR INSECT PESTS, VEGETABLES AND FRUITS AS WELL AS THEIR CONTROL MEASURES USING IPM

As mention earlier, research and development on packages of IPM solutions for major insect pests are in very early stage in the country. But due to strong efforts by the research and extension staff a good number of IPM packages for insect control have been developed and are being practiced by farmers.

4.4.1 Controlling Insect Pests of Rice Using IPM

The climatic conditions of the country are favorable for sustaining various types of rice hybrids as well as monoculture practice of producing rice after rice encourage insect infestation in rice fields. As many as 12 species of insects are seen to infest rice and IPM measures are available now (Table 2).

Table 2: Major Insect Pests of Rice and their Control Measures Using IPM

Sl. no.	Name of Insect Pest	Control Measures Using IPM
1.	Stem Borer	<ul style="list-style-type: none"> • Using tolerant variety (BR-1, BR-10, BR-11, BR-22) • Collection of insect's eggs and destruction • Collection & killing of moths using light traps • Perching for attracting insect-eating birds • Delaying pesticide spray to help parasitic (friendly) insect to eat stem borer eggs • Applying approved insecticide when about 5% white spike is observed • Burning or mixing the debris and left-over stalk after harvesting the Aman rice
2.	Gall Midge	<ul style="list-style-type: none"> • Using light traps to control grown up flies • Using approved insecticide when 5 percent leaves show 'onion leaf' symptom
3.	Rice Hispa	<ul style="list-style-type: none"> • Catching insects by hand net or mosquito net & killing • Using approved insecticide when 35% leaves are spoilt or four fully grown insects are present in every tillered plant
4.	Insect Leaf Roller	<ul style="list-style-type: none"> • Using light traps • Perching for attracting insect-eating birds • Applying approved insecticide when 25% leaves are damaged
5.	Rice Caseworn	<ul style="list-style-type: none"> • Using light traps • Collecting larvae by hand net & killing • Removing water from the field & drying the soil • Applying approved insecticide when 25% leaves are damaged
6.	Swarming Caterpillar	<ul style="list-style-type: none"> • Burning the left-over straw or ploughing down with soil after harvesting paddy • Controlling the moths by light traps • Perching for attracting insect-eating birds • Applying approved insecticide when 25% leaves are damaged
7.	Brown Plant Hopper	<ul style="list-style-type: none"> • Planting rice seedlings at 25x15 or 20x20 cm distance to allow lot of air and light around the plants • Using limited/regulated amount of urea, stopping top-dressing of urea in infested field

Sl. no.	Name of Insect Pest	Control Measures Using IPM
		<ul style="list-style-type: none"> • Removing the standing water from the field and keeping dry for a few days if the insect is visible at the base of the plant • Spraying Abamectin 1.8 EC@ 1 litre/ha if 2-4 adults or 8-10 nymphs are found per plant • Using approved insecticide if most of the plants are seen to have four adult female insects, with full belly eggs in each
8.	White-backed Plant Hopper	<ul style="list-style-type: none"> • Same control measures as are used for Brown plant hopper (sl.7)
9.	Mealy Bug	<ul style="list-style-type: none"> • Pulling up of affected plants & burying under the soil • Using approved insecticide only in the area of infestation
10.	Thrips	<ul style="list-style-type: none"> • Top dressing of urea after irrigating the seed plot /field • Using approved insecticide if attack is severe
11.	Rice Bug	<ul style="list-style-type: none"> • Using light-traps • Applying insecticide when, on average, one rice bug is observed in 2-3 bunches of rice plants • It is more effective to apply insecticide in the afternoon
12.	Earcutting Caterpillar	<ul style="list-style-type: none"> • Burning out the leftover straw • Perching to attract insect-eating birds • Irrigating the land few days before harvesting

4.4.2 Controlling Insects Pests of Vegetables Using IPM

All the 19 vegetables grown in the country are infected with 34 species of vegetables. IPM measures for controlling many of these are available now for use (Table-3).

Table 3: Major Insect Pests of Vegetables and Their Control Measures Using IPM

Sl. No.	Name of Insect	Control Measures Using IPM
BRINJAL		
1	Shoot and Fruit Borer	<ul style="list-style-type: none"> • Using resistant varieties like Jhumka, Shingnath, Noyontara etc. • Borer infested shoot and destroyed at least once in a week • Sex pheromone trap is to be established in the field within 2-3 weeks of planting seeding • If infestation is very high , approved insecticide is to be sprayed 4-5 times at 10-12 days interval (Bacillus thuringiensis formulation (1%) at weekly interval) • Using organic pesticide spinosad- 45 EC (4ml/10 litre water)
2	Epilachna Beetle	<ul style="list-style-type: none"> • Collection and destruction of infested leaf (with egg mass and grab) by hand picking • In case of high infection, approved insecticide is to be sprayed at recommended doses • Application of ash on the plants

Sl. No.	Name of Insect	Control Measures Using IPM
		<ul style="list-style-type: none"> • Practicing clean cultivation
3	Red Mite	<ul style="list-style-type: none"> • Applying sulphur group of fungicides (Cumlax, Theovit etc.) • Spraying Ebamectin 1.8 EC, 15ml in 10 litre water • Spraying water on the lower surface of leaves during dry season
4	Leaf Hopper	<ul style="list-style-type: none"> • Cultivating tolerant variety (BARI brinjal-6) • Using yellow sticky trap • Cultivating trap crop such as Okra around the field • Spraying of 5ml liquid soap in 1 litre water • Spraying of neem oil+ Tricks (at 5 ml+ 5ml per litre of water) on the lower surface of the leaves • Spraying of Bioneem 0.3EC@ 3 ml/l of water or Phytomax 3 EC@ 2ml/l of water for 3-4 times at 10-12 days interval

TOMATO

1	Tomato Fruit Borer	<ul style="list-style-type: none"> • Using sex pheromone traps (115 pheromone traps/ha) • Spraying biopesticide HNPV@ 0.1 g/l of water for 2-3 times at 10-12 days interval • Use of perching • Destruction of infested fruits • Spraying neem seed extract (1 kg broken neem seed soaked in 20 litre of water, sieving the extract before spraying) three times at 10 days interval after flowering starts • Use of bio-pesticide i.e. Spinosad -45EC (4ml per 10 liter of water) • In case of severe infestation, use systemic insecticide such as imidocloroprid 20SL@ 125ml/ha or phepronil 50EC@ ml/ha. Fruits can not be eaten within two weeks of spraying
2	White Fly	<ul style="list-style-type: none"> • Using of resistant varieties such as TLB 111, 130 & 182 • Spraying neem seed extract (1 kg broken neem soaked in 20 litre of water, sieving the extract before spraying) • Treating seed with insecticides • Cover seed beds eith fine nylon net • Using of yellow sticky trap • For severe infestation, spraying Admire 200L (2.5ml/10 litre water)
3	Leaf Miner	<ul style="list-style-type: none"> • Collection and destruction of infested leaves • Using of yellow sticky trap • Spraying neem seed extract (1 kg broken neem soaked in 20 litre of water, sieving the extract before spraying) • In case of severe infestation using recommended systemic insecticide. Fruits can not be eaten within two weeks of spraying

COUNTRY BEAN AND YARD LONG BEAN

1	Aphids	<ul style="list-style-type: none"> • Destructing aphids from infested leaves and twigs • Using neem solution (1kg broken seed soaked in 20 litre water in 12 hours • Spraying insecticide, malathion 57 EC 20 ml/10 litre water
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Sl. No.	Name of Insect	Control Measures Using IPM
2	Fruit Borer	<ul style="list-style-type: none"> Collecting and destroying infested flowers and pods regularly Clean cultivation and destruction of dropped out flowers and pods Spraying of organic pesticide i.e. MNPV (0.2 gm per litre of water, 2-3 times and 10-12 days interval) Spraying of bio-pesticide i.e. Spinosad-45EC (4ml per 10 litre of water) at 2 weeks interval in case of severe infestation

CABBAGE AND CAULI FLOWER (CRUCIFEROUS VEGETABLES)

1	Diamond Back Moth	<ul style="list-style-type: none"> Clean cultivation and burning of crop residues followed by ploughing Collection and destruction of egg masses and caterpillar Using trap crop such as Mustard cultivation in between rows of cabbage Spray <i>Bacilusthuringiensis</i> formulation (1%) at weekly interval
2	Tobacco Caterpillar	<ul style="list-style-type: none"> Collection and destruction of caterpillars at early stage of infestation Use of pheromone traps within 1 week of planting seedlings in the field Use of bio-pesticide SNPV @0.2g/l at 10 to 12 days for 2-3 times Use of neem seed solution (1kg broken seed/20 litre water in 12hrs)
3	Cutworm	<ul style="list-style-type: none"> Collection and killing of caterpillar by hand picking in early morning or during night using torch as it is nocturnal pest Irrigation to the field during infestation with very low amount of kerosine oil Perching Use of poison bait (broken rice husk+ gur+ Carbarin insecticide) in infested portion or in a hole In severe infestation, spraying Chloropyriphos 20EC e.g. Dursban or Pyriphus 5 ml/litre near the seedling base during evening

CARROT AND RADISH

1	Cutworm	<ul style="list-style-type: none"> Collection and killing of caterpillar by hand picking in early morning or during night using torch as it is nocturnal pest Irrigation to the field during infestation with very low amount of kerosine oil Perching Use of poison bait (broken rice husk+ gur+ Carbarin insecticide) in infested portion or in a hole In case of sever infestation, spray Chloropyriphos 20 EC viz. Dursban, Pyriphos 5 ml/1 near the base of the seedlings during evening
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CUCURBITS (Bottle gourd, Pointed gourd, White gourd, Sweet gourd, Ridge gourd, Bitter gourd, Teasel gourd, snake gourd and Cucumber)

Most insects of Cucurbits are common. Therefore, names of the insects and their IPM control measures are shown together here

1	Fruit Fly	<ul style="list-style-type: none"> Clean cultivation Collection of infested fruit from plant as well as from the soil and burying it under soil Covering of young fruit by net or poly bag Joint of use of sex pheromone trap and poison bait In case of severe infestation, spray Carbaryl 50WP@ 3gm/l or Indoxacarb 0.5
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Sl. No.	Name of Insect	Control Measures Using IPM
		ml/l
2	Red Pumpkin Beetle	<ul style="list-style-type: none"> Collecting and destroying the adult insects through hand picking Clean cultivation, keeping the field free from any debris Application of dry ash in plant Destruction of alternative host Covering the plant with net (for 20-25 days) in seedling stage, use any recommended granular insecticide such as Carbofuran 5G 2-5 g/pit followed by watering
3	Tobacco Caterpillar/ Fruit Borer	<ul style="list-style-type: none"> Collecting and destructing of catepillar during early stage of infestation Use of bio-pesticide SNPV @0.2g/l at 10-12 days for 2-3 times Use of sex pheromone traps from the early stage of the crop In case of severe infestation, use contact poisons belonging to the Cypermmthrin group such as Perthrin, Cymbush, Basathrinetc @ 10ml/l at 2 weeks interval for 2-3 times
4	Epilachna Beetle	<ul style="list-style-type: none"> Application of ash in plant Destruction of egg mass and grub Practicing clean cultivation
OKRA		
1	Fruit & Shoot Borer	<ul style="list-style-type: none"> Regular destruction of infested shoot and fruit at least once in a week Clean cultivation Cultivation of alternating host such as cotton should be avoided Use of bio-pesticide i.e. Spinosad-45 (4ml per litre of water) In case of severe infestation using recommended systemic insecticides. Fruits can not be eaten within 2 weeks of spraying
2	White Fly	<ul style="list-style-type: none"> Spraying of neem seed extract (1 kg broken neem seed to soaked in 20 litre of water, sieving the extract before spray) Treating seed with insecticides Cover the seed beds with fine nylon net Using yellow sticking traps Spraying Admire 200 SL (2.5 ml/10 litre of water) in case of severe infestation
GREEN PAPAYA		
1	Mealybug	<ul style="list-style-type: none"> Destruction of insects from infested leaves and twigs Use of neem seed solution (1 kg broken seed per 20 litre water in 12 hours)

4.4.3 Controlling Insects Pests of Fruits Using IPM

Fruits like mango, litchi and guava are attacked with insects but, fortunately, IPM methods for controlling them are available and the farmers are using many of those (Table 4).

Table 4: Major Insect /Pests of Fruits and their Control Measures Using IPM

Sl. No.	Name of Insects	Control Measures Using IPM
MANGO		
1	Mango Hopper	<ul style="list-style-type: none"> • Avoiding dense planting, maintaining open canopy; overcrowd and overlapping branches at the end of rainy season • Keep orchard clean by regular ploughing and removal of weeds • Spraying of 0.2% Nimbicidin or Azadirachtin 3000 ppm@2ml/l at initial stage of hopper population • Spraying permethrin 10 EC @ 1 ml/l 10 days before panicle initiation. If hopper population is more than 5-10/ panicle, second (at pea size) should be done • Chemical spray is to be minimized and should be need based • A rational of insecticide is desirable to counteract the tendency of pest to develop field resistance
2	Mango Weevil	<ul style="list-style-type: none"> • After harvesting of mango, weed and parasitic plant should be removed • Digging of soil in 4m radius of mango plant in January- February • Removing waste and weed under the plant
3	Fruit Fly	<ul style="list-style-type: none"> • Prior to harvest (30-40 days) collecting and destroying off infested and fallen fruits to prevent further, multiplication and carry over of population • Ploughing of orchard during November- December for exposing pupae to sun's heat, which kills them • Hanging of methyl eugenol wooden block traps soaked in rthanol, methyl eugenol and malathion (6:4:1) during fruiting period from April to August @10traps/ha tying them tightly at 3-5 feet above ground level • To control adult flies during severe infestation placing poison bait viz Protein hydrolysate +malathion 50ml+ 200ml molasses in litres of water be sprayed adding an additional 18 liters of water to bait poison. Commencing at preoviposition period and repeating at 15 days interval. Addition of 10ml methyl eugenol in place of malasses is also recommended • Three weeks before harvesting, spraying Deltamethrin 2.8EC @ 0.5ml/l+ Azadiractin (3000 ppm) or 2ml/l
4	Leaf Cutting Weevil	<ul style="list-style-type: none"> • Destructing of infested leaves as early as possible to kill the insect at immature stages • Covering with net of the newly born leaves in nursery.
5	Mango Defoliator	<ul style="list-style-type: none"> • Killing of caterpillar with the leaves • Collecting and destroying pupal cocoon
		<ul style="list-style-type: none"> • Pruning • Release of lady bird beetle as beneficial insect • Spraying with 0.5% soap water and or extraction of neem leaves • Spraying with Spinosad-45 EC or Tracer-0.4ml per litre • Avoid excessive use of nitrogenous fertilizer • Infested and dropped fruits should be destroyed in the month of March-April
LITCHI		
1	Mite	<ul style="list-style-type: none"> • After harvesting, infested portion should be broken and brunt • Painting trunk with coal tar or lime

Sl. No.	Name of Insects	Control Measures Using IPM
		<ul style="list-style-type: none"> spraying water or shampoo-water in the infested plant
2	Fruit Borer	<ul style="list-style-type: none"> Cultivation of resistant variety such as China-3 Burning the dropped and dried leaves to kill the caterpillar

GUAVA

1	Mealy Bug	<ul style="list-style-type: none"> Breaking and destroying infested leaves and twigs Destruction of egg masses should be practiced Covering by transparent polythene from the root portion soil to 15-20cm, so that mealy bug will not be able to climb
2	White fly	<ul style="list-style-type: none"> Spraying of mixture (1kg broken neem seed per 20 litre water and kept in 12 hours) in the backward portion of leaves Using yellow colored sticky traps
3	Fruit fly	<ul style="list-style-type: none"> Practicing clean cultivation Collection of dropped as well as infested fruit from plant and burying under soil Covering of young fruit by net or poly bag Use of sex pheromone trap to kill male insect Use of poison bait (ripped fruit of pumpkin-100gm+ Mipcin 0.25gm + 0.5gm Secufon + 100 ml water)

4.5 MAJOR DISEASES OF RICE, VEGETABLES AND FRUITS AS WELL AS THEIR CONTROL MEASURES USING IPM

As mentioned in case of insects pests, diseases of rice have also increased due to favourable climate, introduction of hybrid rice and continuous cultivation of rice throughout the year. The farmers have been fighting hard throughout the ‘green revolution’.

4.5.1 Controlling Diseases of Rice Using IPM

A good number of IPM measures are now available for IPM measures for controlling diseases of rice and the farmers including those under NATP-1 project are using these measures (Table-5).

Table 5: Major Diseases of Rice and Their Control Measures Using IPM

Sl. no.	Name of Disease	Control Measures Using IPM
1.	Rice Tungro	<ul style="list-style-type: none"> • Using tolerant varieties • Burning or burying down the Arali grass • Using right trap and hand net
2.	Bacterial Blight	<ul style="list-style-type: none"> • Using tolerant variety • Using balanced fertilizer, urea application in three installments • With holding irrigation for 7-8 days for drying the soil and applying 5 Kg potash fertilizer/bigha (0.33 acre)
3.	Sheath Blight	<ul style="list-style-type: none"> • Collecting floating debris along the borders and burying under soil • Using resistant varieties (BR-22, BR-23, BRRIdhan 34 & BRRIdhan 41) • Planting seedlings at a space of 25 x 20 or 25 x 15 cm and 3 seedlings together in one place. • Burning out the dead plants • Using crop rotation • Using appropriate dose of urea • Using approved fungicide
4.	Blast	<ul style="list-style-type: none"> • Using tolerant variety (BR-12, 15, 16, 24, BRRIdhan-33) • Using seed collected from healthy plants • Using balanced fertilizer, seed treatment • Using organic manure in the field • Keeping standing water in the field • It needed, applying approved fungicide at initial stage of infection
5.	Leaf Scald	<ul style="list-style-type: none"> • Using tolerant variety • Using balanced fertilizer and not to apply excessive urea • Keeping the land dry for some days when the disease appear • Collecting seed from healthy plants • If needed using fungicide containing 80% sulphur

Sl. no.	Name of Disease	Control Measures Using IPM
6.	Sheath Rot	<ul style="list-style-type: none"> • Burning out the affected straw • Using healthy seed and seed treatment • Using tolerant variety (BR-2, BR-3, BR-5, BR-10, BR-16, BR-25, BRRIdhan-26, BRRIdhan-32, BRRIdhan-33) • Using balanced fertilizer • Keeping the land dry for some days when the disease appears • If needed, using approved fungicide
7.	Ufra	<ul style="list-style-type: none"> • Using the tolerant variety, Raida and Bajail, for a few years • Burning out the left over straw after harvest of paddy • Keeping under control the grass type weeds • Using worm/larvae killing agent like Furadan 5G (2.5 kg/bigha) during early stages of the crop. • Purifying seedlings by submerging them for one night in water mixed with Furadan 5G (15 gm in one litre of water) • Cutting the top parts of rice leaves at the initial stage of attack
8	Foot rot & Bakanae	<ul style="list-style-type: none"> • Using resistant variety • Using disease-free seeds • Not using same land for seed bed continuously. • Using seed purified by soaking in fungicide mixed water. • Using soft seed-bed and keeping it moist all the time. • Drying land immediately after disease identification. • Throwing the disease affected seedlings. • Burning out the disease affected plants. • Using different varieties of rice at intervals or using crop rotation • Using balanced fertilizer.
9	Brown Spot	<ul style="list-style-type: none"> • Using resistant variety. • Using healthy seeds. Hot water (53-54°C) or cold water soaking • Planting seeds purified by fungicide (Thiram, Captan, Bavistin) • Keeping seedbed moist • Using large quantities of organic fertilizer • Using balanced chemical fertilizer
10	Bacterial Leaf streak	<ul style="list-style-type: none"> • Using resistant variety. • Killing insects so that leaf is not attacked by bacteria in the spots. • Drying the land by removing water. • Using balanced fertilizer, less amount urea is desirable
11	Seedling Blight	<ul style="list-style-type: none"> • Purifying seed by using Vitabrex or Thirum before sowing • Mixing rice bran with seedbed soil. • Avoiding times with excessive cold for sowing seeds in seedbeds • Keeping seedbed/land under standing water for some days
12	Seedling Damping off	<ul style="list-style-type: none"> • Not keeping seedbed under water during germination of seed • Not to sow seeds in seedbed during heavy colds. • Covering seedbed with polythene sheets during cold spells • Purifying seed before sowing (4 gm Captan / 2 gm Copper oxychloride per kg of seed)

4.5.2 Controlling Diseases of Vegetables Using IPM

All the 19 vegetables grown in the country are infected with 20 diseases of vegetables. IPM measures for controlling many of these are available now (Table-6) and many of these measures are used by the farmers including those under the NATP-1 project.

Table 6: Major Diseases of Vegetables and Their Control Measures Using IPM

Sl. No.	Diseases	Control Measures Using IPM
BRINJAL		
1	Fruit & stem rot/ Fruit rot/ Fruit blight/ Blight & fruit rot	<ul style="list-style-type: none"> • Avoiding collection of seeds from diseased fruits and using pathogen-free seeds • Adopting a crop rotation cycle of three or four years • Prompt destruction of infested plant material to reduce initial inoculum • Weed control (solanaceous weeds) such as nightshades • Using resistance varieties e.g. Jessore local, Kata begun, Isharwardi-1 • Mulching and furrow irrigation to reduce infection caused by water and soil splashing • Spraying of BAU-Biofungicide (3%) • Spraying bavistin @ 2g/l as a protective fungicide
2	Bacterial Wilt	<ul style="list-style-type: none"> • Removal and destruction of the affected plant parts • Using diseases resistant varieties to reduce the diseases incidence • Crop rotation with okra, tomato, potato, should be avoided • Dipping seeds in a solution of Streptomycin (1g/40 litres of water) for 30 minutes before sowing
3	Root Knot Nematode	<ul style="list-style-type: none"> • Removal and destruction of weeds hosts and other host plants in and around the field • Soil solarisation can control nematodes • Leaving the field fallow in the summer after two or three deep ploughings • Application of neem cake at 250kg/ha • Application of carbofuran 3G @1 kg a.i./ha
TOMATO		
1	Early blight/ Alternaria leaf blight	<ul style="list-style-type: none"> • Seed treatment with tricho-solution or garlic tablet • Field sanitation • Spraying tricho-solution (3%) at 7 days interval • Spraying of Dithane M-45 at 7 days interval
2	Late blight of tomato	<ul style="list-style-type: none"> • Using diseases free seed • Spraying BAU-Biofungicide (3%) • Spraying of Mancozeb @ 7 days interval

Sl. No.	Diseases	Control Measures Using IPM
3	Bacterial wilt	<ul style="list-style-type: none"> Using diseases free seeds Use of seedlings from diseases free seed bed Crop rotation with cereals for at least 3 years if field becomes contaminated
4	Leaf curl of tomato caused by virus (transmitted by white fly)	<ul style="list-style-type: none"> Growing seedlings under net Using of barrier crops in the field Using yellow sticky traps Uprooting of infested plants and weeds Spraying Dimethoate at 10 days intervals

COUNTRY BEAN AND YARD LONG BEAN

1	Anthraxnose	<ul style="list-style-type: none"> Seed should be always collected from healthy pods and disease-free area Seeds must be treated with Carbendazim@ 0.25% Field sanitation by burning of crop debris Grow crop on bower system to avoid soil contact Foliar spray of Carbendazim @ 0.1% or Chlorothalonil @0.2% but spray must be started soon after infection
2	Common bean mosaic virus	<ul style="list-style-type: none"> Use of diseases free healthy seeds Spray Dimethoate or Admire (0.05%) to control aphids and vectors

CABBAGE AND CAULIFLOWER

1	Black Leaf Spot/ Gray Leaf Spot	<ul style="list-style-type: none"> Crop rotation, avoiding overhead irrigation Remove and destroy all crop debris immediately after harvest, since this diseases overwinters on plant residue Hot water treatment of seeds at 50°C for 30 minutes Avoid overhead irrigation Seed treatment with BAU-biofungicide (3% of seed weight) Spraying BAU-biofungicide (3%) Use fungicides when necessary. First foliar spraying with Calixin 75EC @0.1% followed by spraying with Mancozeb 0.25% a month interval
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CARROT AND RADISH

1	Bacterial soft rot	<ul style="list-style-type: none"> Seed treatment with Bavistin/ Captan/ Vitavex (0.4% fo seed weight) Crop rotation Application of Mustard oil cake (250kg/ha)
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Sl. No.	Diseases	Control Measures Using IPM
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CUCURBITS

Most of the diseases of cucurbits (Bottle Gourd, Pointed Gourd, White Gourd, Sweet Gourd, Ridge Gourd, Bitter Gourd, Teasel Gourd, Snake Gourd and Cucumber) are common and their names and control measures with furnished together as below:

1	Powdery Mildew	<ul style="list-style-type: none"> • Avoiding crowded planting of seedlings • Maintaining field sanitation • Applying wettable sulphur @ 0.2% or dusting finely powdered sulphur to cover the foliage, once or twice during plant growth season • Spraying of BAU-Biofungicide (3%) • Spraying Thiovit (2g/L) at weekly intervals
2	Mosaic Virus	<ul style="list-style-type: none"> • Using virus tolerant varieties • Destructing diseases host including weeds • Spraying insecticide (Metasystox @ 0.1%) to suppress the insects vectors
3	Fruit Rot	<ul style="list-style-type: none"> • Soil drenching with BAU-Biofungicide (3%) • Fruits should be kept away from soil • Rotation with non-host crops like pepper, tomato, eggplant • Spraying of BAU-Biofungicide (3%)
4	Fusarium	<ul style="list-style-type: none"> • Planting resistant cultivars is the only reliable way to keep infested field in production • Treating seeds with hot water at 55°C for 15 minutes and by drenching soil with Carbendazim • Treating seed with BAU-Biofungicide (3% of seed weight) • Drenching soil with BAU-Biofungicide (3%)
5	Alternaria Blight & Fruit Rot	<ul style="list-style-type: none"> • Using of diseases free seeds, clean cultivation and crop rotation are effective controls • Spraying 0.25% Indifil M-45 at 10-15 days interval is effective in diseases control

OKRA

1	Yellow Vein Mosaic or Vein Clearing Disease	<ul style="list-style-type: none"> • Using of disease free seeds • Uprooting and burning the infested plants as soon as they are noticed is the best method to check the spread of this disease • Use of tolerant variety like PusaSawani • Controlling insect vector by spraying with Dimethoate (Rogor-30EC) or Monocrotopho (Monocil) @ 1 ml/ litre of water
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GREEN PAPAYA

1	Papaya Mosaic & Leaf curl Virus	<ul style="list-style-type: none"> • Uprooting and destroying the infected plants • Regular spraying of insecticides to control aphids and other vectors
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Sl. No.	Diseases	Control Measures Using IPM
2	Damping off	<ul style="list-style-type: none"> Seed treatment with BAU-Biofungicide (3% of seed weight) Use of high land and well drained soil Use of tricho-compost as soil amendment
3	Anthracnose	<ul style="list-style-type: none"> Clean cultivation Applying Mancozeb or Carbendazim (g/litre)

4.5.3 Controlling Diseases of Fruits Using IPM

For the three major fruits of the country, there are eight major diseases. Losses due to these diseases are highly significant. Previous control measures using pesticides were either ineffective or less effective. On the other hand, the residual chemicals posed lot of health problems for the consumers. IPM measures have decreased such problems considerably. The IPM measures available now are shown in Table-7.

Table 7: Major Diseases of Fruits and Their Control Measures using IPM

Sl. No.	Diseases	Control Measures Using IPM
MANGO		
1	Powdery Mildew	<ul style="list-style-type: none"> Clean cultivation Spraying thiovit @0.2% at 10-15days interval Spray BAU-Biofungicide @3% at 12 days interval
2	Anthracnose	<ul style="list-style-type: none"> Clean cultivation (diseased leaves. Twigs and gall midge infected leaves and fruits, should be collected and burnt) Pre-harvest sprays of hexaconazole (0.01%) or Canbendazim (0.1%) at 15 days interval. Last spray should fall 15 days prior to harvest Spraying cupravit @ 0.03% on infected plant at 15 days interval Spray BAU-Biofungicide @3% at 12 days interval Covering the fruits on tree, 15 days prior to harvest with news or brown paper bags
3	Die-back	<ul style="list-style-type: none"> Clean cultivation Scion wood selected for propagation should be free from infection Pruning the diseased terminals along with the basal 15-20cm healthy portion and painting cut end Spraying cupravit @ 0.03% on infected plant at 15 days interval
LITCHI		
1	Leaf blight	<ul style="list-style-type: none"> Spray gentamycin or kenamycin @ 0.05% at 15 days interval
2	Die-back	<ul style="list-style-type: none"> Prune the malformed terminal alongs with the basal 15-20cm health portion and paint cut end Spray curpavit @ 0.03% on infected plant at 15 days interval

		<ul style="list-style-type: none"> • Spray BAU-Biofungicide @ 3% at 12 days interval
GUAVA		
1	Wilt	<ul style="list-style-type: none"> • Wilted trees should be uprooted and burnt • Before transplanting, pits need to be treated with formalin and covered for 3 days • Apply organic manure, oil cake and lime • Spray BAU-Biofungicide @ 3% at 12 days interval
2	Anthraco-nose	<ul style="list-style-type: none"> • Spray curpavit @ 0.03% on infected plant at 15 days interval • Spray BAU-Biofungicide @ 3% at 12 days interval
3	Die-back	<ul style="list-style-type: none"> • Avoid alkaline soil for orchard • Prune the malformed terminal alongs with the basal 15-20cm health portion and paint cut end with any fungicide • Spray curpavit @ 0.03% on infected plant at 15 days interval • Spray BAU-Biofungicide @ 3% at 12 days interval

5. STRATEGIES FOR IMPLEMENTATION OF PEST MANAGEMENT PLAN

The pesticide management measures that will be promoted in the project include: (1) Reduce pesticide application amount through project activities, (2) Forbid using unregistered pesticide in project activities, (3) Forbid using the type I pesticide of the World Health Organization in project activities, and (4) Promote IPM techniques.

The strategies to be followed for implementation of PMP are as follows:

- Assessment ,monitoring and reporting
- Training or capacity building
- Awareness building

5.1 Assessment, Monitoring and Reporting

The NATP-2 financed crop demonstrations by CIG farmers will be carefully assessed and monitored with a purpose to improve the quality of the NATP-2 crop production activities and enhance overall environmental sustainability. Crop development Component will monitor safe use of pesticides and implementation of proposed Integrated Pest Management Plan for Rice and different vegetables.

While the NATP-2 staff uses Limited Environmental Assessment (LEA) form for selection of CIG farmers for crop demonstrations, they will make an effort to learn whether the selected farmer is currently using any hazardous pesticides impacting human and environmental health or the current use of pesticide is unsafe or overdosed. Based on that, during the assessment period, an Environmental Management Plan (EMP) indicating application of IPM will be suggested for crop CIG farmers. Annex 4 of the EMF has provided the LEA format for crop demonstrations.

Environmental monitoring format prescribed for Crop Development of NATP-2 will incorporate parameters to measure changes or improvement due to the implementation of IPM by the CIG farmers. Annex –7-11 of EMF will be used for IPM application monitoring.

The Project Management Unit of NATP-2 will recruit an Environmental Safeguard Specialist who would ensure implementation of pest management plan. The Environmental Specialist on the quarterly visits would need to visit selected demonstration sites to observe the application of IPM measures. At the field, IPM and pesticides application management will be monitored by the SAAOs. The Upazila Agriculture Officer (UAO) will be given the local Authority to review the monitoring program of PMP. The Upazila Livestock Officer (ULO) and the Upazila Fisheries Officer (UFO) will be assisting the UAO in organizing the monitoring activities.

Monitoring Schedules and Participants

- a) Implementation of IPM by the CIGs to be monitored by the SAAOs once in a crop season.
- b) Half Yearly Review and Planning Workshop, lasting two days to review progress of implementation of CIG activities of last six months and planning for CIG activities in the next season. The SAAOs, LEAFs and CEALs will be called for the workshop and given the opportunity to discuss any problems encountered during the implementation of the CIG activities.
- c) Leaders of CIG will be called for reporting achievements, difficulties, shortcomings on the part of SAAOs, LEAFs and CEAL and further opportunities for improvement.

5.2 Training

Training programs on various aspects of the pest and disease management and judicious use of chemical pesticides have to be organized by the NATP-2 for the members of the Crop CIGs, pesticides dealers and retailers. It would be the responsibility of the Safeguard Specialist to train the relevant staff in the NATP-2. Resource persons from relevant projects of DAE, DLS and DOF should be enlisted well ahead of time, contacted beforehand and requested to prepare lecture notes keeping the educational and other qualifications of the trainee farmers in view. Training modules for pest management in rice, vegetables, and fruits should be developed. Following training programs will be provided under NATP-2:

1. CIG farmers' training
2. Pesticides dealers' training
3. NATP staff training

5.2.1 CIG Farmers' Training

The goal of farmers' training is to strengthen safety of farmers and let them master skill on biological control of ordinary pest, strengthen the ability for economically and effectively controlling pest, including: how to identify pest, how to adopt correct prevention and control measures and how to adopt appropriate prevention and control measures, etc. Training in dormitories is a more formal avenue of training which is often not popular with smallholder farmers who have various family and community obligations. It may be more appropriate for training of trainers (TOT).

Each CIG crop farmer will receive training during pest control period. Training on IPM would be conducted through "farmer to farmer" approach. For this, a group of core trainers among the crop CIGs will be developed.

5.2.2 Pesticide Dealers' Training

A rigorous training program will be organized for the dealers / retailers of pesticides to make them aware about toxicity of pesticides and rules of pesticides use so that they can disseminate this information to the farmers. This is needed because, in practice, the dealers/ retailers while selling pesticides help the farmers in selecting the appropriate pesticide for specific insect or disease, give guidance to dose determination, dilution ratio, frequency of application etc. Their training curricula may be prepared by actual experts in the fields of disease and insect control for crops, livestock and fisheries. The best practice, of course, would have been to give dealership/retailership license to only those candidates having diplomas in crops, livestock and fisheries.

5.2.3 Training for NATP Crop Development Staff

Training programs for the SAAOs, and other categories of grass root-level workers should be organized to improve their knowledge on PMP. The contents of training include:

- Features of pests
- Harm of all kinds of pests
- The natural enemies of all kinds of pests
- Method of field investigation
- Prevention and control index
- Control measures including IPM method; safely store, manage, and process pesticide wastes and packaging containers.
- Using method and protection requirement of chemical pesticide

At the end of the training programs, a field day should be organized at the crop and vegetable field to create awareness about IPM activities among non-CIG farmers.

Some other issues pertaining to training

The most important activities of pest management training, when practiced by the trained farmers of CIGs, will also be utilized by other farmers through both personal contacts and visual observations if announcement about the training courses are made in market places beforehand. The non-CIG farmers will get encouraged to ask questions to the CIG farmers.

- A modest amount of DSA has to be introduced for the farmers in view of the fact that:
- They are not aware of the benefits of attending the trainings initially,
- They come to the Upazila Agriculture Office leaving behind own works, spend money on transport and lunch.

5.3 Awareness building

To initiate the promotion of IPM and sound pesticide use, NATP-2 will organize awareness program involving CIG, non-CIG farmers and different stakeholders. Awareness will be raised through demonstrations, discussion meeting, dissemination of information about pest arrival, etc.

Discussion meetings

Discussion meetings of the CIG members among themselves on regular basis will help dissemination of the IPM techniques and their benefits and aware all CIG and non-CIG farmers.

Demonstrations

Demonstration of the improved technologies has become one of the most effective strategies for dissemination of useful technologies to the farmers. Therefore, extreme care should be taken from the beginning to the end of conducting demonstration on various IPM techniques.

Dissemination information about pest arrival

Arrangements should be made to disseminate information on pests that pose a threat to crops and public health especially at the beginning of the season. Additionally, information on control programs already in operation should also be made public in appropriate manner.

5.4 Personal Protection

- Design of personal protective equipment, dresses, other utensils should be collected from the IPM projects of DAE by NATP-2 personnel and:
- Delivered to the CIG members may be free of cost for the first time.
- The retailers of pesticides should be invited to discussion meetings and the protective equipment and dresses should be demonstrated in their shops.
- Pamphlets should be printed by NATP-2 and given to the shopkeepers for distribution by them among the farmers coming to buy pesticides.



5.5 Budget

The pest management work of the project should be listed into the daily management of each level of project office, and needed fund will be listed into the fund budget of the project office. NATP-2 will allocate fund for purchasing protective gear for pesticides spray and budget for the training of CIG farmers, NATP staffs and pesticides dealers and retailers.

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ANNEXES

ANNEX 1: List of Banned Pesticides in Bangladesh (Updated Up to December 2012)

Name of pesticide	Registration Number	Name of Company
1. Diazinon	14G AP-08	Shetu Corporation Ltd.
2. Bizaguard	2P AP-09	Ciba-Geigy (Bangladesh) Ltd.
3. Roxion	40EC AP-11	International Services (Bangladesh) Ltd
4. Dankavapon	100 AP-13	Shetu Corporation Ltd.
5. Damphin	2P AP-19	Ciba-Geigy (Bangladesh) Ltd.
6. Diazinon	90L AP-20	Ciba-Geigy (Bangladesh) Ltd.
7. Damphin 950EC	AP-25	Ciba-Geigy (Bangladesh) Ltd.
8. Dichlorovos	AP-27	Bayer (Bangladesh) Ltd.
9. Cureterr 3G	AP-30	Bayer (Bangladesh) Ltd.
10. 2,4-D Na Salf	AP-34	Bayer (Bangladesh) Ltd.
11. Folithion ULVC 98	AP-36	Bayer (Bangladesh) Ltd.
12. Methybron	AP-38	Excell trading Co.
13. Heptachlor 40WP	AP-39	KrishiBanijjyaProtishthan
14. Chlordane 40 WP	AP-40	KrishiBanijjyaProtishthan
15. Aerovap 100 EC	AP-41	Liza Enterprise Ltd.
16. Aerodriel 20EC	AP-42	Liza Enterprise Ltd.
17. Aeromal 57% EC	AP-44	Liza Enterprise Ltd.
18. Padan 10G	AP-52	Data Enterprise Ltd.
19. Fenitrothin 98	AP-53	Farm Chemical corporation Ltd.
20. Carbin 85 WP	AP-54	Farm Chemical corporation Ltd.
21. Diamal 57EC	AP-55	Farm Chemical corporation Ltd.
22. Detia Gas EXT	AP-56	Farm Chemical corporation Ltd.
23. Dichlovos 100	AP-57	Farm Chemical corporation Ltd.
24. Methyl Bromide 98	AP-58	Farm Chemical corporation Ltd.
25. Malathion 57EC	AP-68	BPI Ltd.
26. Cureterr 3G	AP-69	Bayer (Bangladesh) Ltd.
27. Dieldrin 20EC	AP-73	Shell Company of Bangladesh Ltd.
28. Bidrin 24WSC	AP-74	Shell Company of Bangladesh Ltd.
29. Malathion 57EC	AP-78	Burma Eastern Ltd.
30. Vapona	AP-79	Shell Company of Bangladesh Ltd.
31. Bidrin 85WSC	AP-80	Shell Company of Bangladesh Ltd.
32. Diealdrin 50WP	AP-82	Shell Company of Bangladesh Ltd.
33. Dieldrin 40WP	AP-83	Shell Company of Bangladesh Ltd.
34. Furadan 3G	AP-85	FMC International S. A.
35. Actellic 2% Dust	AP-99	Bangladesh Manufacturers Ltd.
36. Quickphos	AP-102	Agrani Traders
37. Torque 550g/l	AP-115	International Service Bangladesh Ltd.
38. Ridan 3G	AP-131	RupaliSangstha Ltd.
39. Bkzne 14G	AP-135	B. K. Traders Ltd.
40 Aerocypermethrin	AP-137	Liza Enterprise Ltd.
41. Karmex	AP-145	BEXIMCO Agrochemicals Ltd.
42. Carbaryl 85Wp	AP-147	Shetu Corporation Ltd.
43. Agridhan 3G	AP-154	Shetu Corporation Ltd.
44. Tecto 2% Dust	AP-157	Alco Pharma Ltd.

Name of pesticide	Registration Number	Name of Company
45. Manex II	AP-163	Shetu Corporation Ltd.
46. Phytos MZ-80	AP-164	Liza Enterprise
47. Uniflow TM Sulphur	AP-167	Shetu Corporation
48. Fenkil 20EC	AP-169	Agrani Traders
49. Sunfuran 3G	AP-171	Shetu Corporation Ltd.
50. Hekthion 57EC	AP-178	Farm Chemicals Corporation Ltd.
51. Poligor 40EC	AP-180	Farm Chemicals Corporation Ltd.
52. Melbromid 98	AP-185	Horizon Trade Ltd.
53. Mebrom	AP-186	Bengal Wings Trade Ltd.
54. Agrine 85WP	AP-187	Edgro (Pvt) Ltd.
55. Drawizon 60EC	AP-190	Keeco Pesticides Ltd.
56. Gastoxin	AP-195	Bright Corporation
57. Cekomethrin 10EC	AP-219	Premier Traders
58. Cythrin	AP-220	Bari and company Ltd.
59. Cekuthoate 40EC	AP-225	Premier Traders
60. Arifos 20EC	AP-229	Bari and company Ltd.
61. Malathion 57EC	AP-230	Sabrina Trading Corporation.
62. Cardan 5G	AP-234	Bari and Company Ltd.
63. Diazinon 14G	AP-236	Liza Enterprise Ltd.
64. Rizinon 60EC	AP-239	Bari and Company Ltd.
65. Zincphosphide	AP-258	Liza Enterprise Ltd.
66. Davison Glyphosate	AP-266	Shetu Pesticides Ltd.
67. Morestan 25WP	AP-269	BEXIMCO Agrochemicals Ltd.
68. Manzate 200	AP-22 & 277	Auto Equipment Ltd.
69. Dimecron 100SL	AP-301	Novratis (Bangladesh) Ltd.
70. Pillarcron 100SL	AP-148	Shetu Pesticides Ltd.
71. Benicron 100WSC	AP-06	Sabrina Trading Corporation.
72. DDVP 100W/V	AP-03	ACI Formulations Ltd.
73. ChemoDDVP 100EC	AP-245	Chemfil Bangladesh Ltd.
74. DDVP 100EC	AP-151	McDonald Bangladesh (Pvt) Ltd.
75. Nogos 100EC	AP-26&274	Novertis (BD) Ltd.
76. Phosvit 100EC	AP-46	Data enterprises Ltd.
77. Daman 100EC	AP-325	Petrochem (B) Ltd.
78. Azodrin 40WSC	AP-336	BASF Bangladesh Ltd.
79. Nuvacron 40SL	AP-18&275	Novratis (Bangladesh) Ltd.
80. Megaphos 40SL	AP-175	McDonald Bangladesh (Pvt) Ltd.
81. Phoskil 40SL	AP-339	United Phosphorous (Bangladesh) Ltd.
82. Kadette 40WSC	AP-284	BISCO Pesticides & Chemical Corporation
83. Monophos 40WSC	AP-328	Alpha Agro Ltd.
84. Monodrin 40WSC	AP-07	Sabrina Trading Corporation
85. Corophos 40SL	AP-342	Corbel International Ltd.
86. Luphos 40SL	AP-388	ACI Formulations LTD.
87. Amcordin 40SL	AP-340	Atherton Imbros Co. Ltd
88. Vitacron 40SL	AP-341	ShetuMarketing Co.
89. Monotaf 40WSL	AP-331	Auto Equipment Ltd

Name of pesticide	Registration Number	Name of Company
90. Tamaron 40SL	AP-188	Haychem (B) Ltd.
91. Folythion 50EC	AP-32	Haychem (B) Ltd.
92. Macuprex 65%	AP-65	Bayer Crop Science
93. Zithiol 57EC	AP-126	RohnPolenk Bangladesh.
94. Delapon Na-84	AP-66	RohnPolenk Bangladesh.
95. Anthio 25EC	AP-64	RohnPolenk Bangladesh.
96. Zolone 35EC	AP-67	RohnPolenk Bangladesh.
97. Rentokill CC Type 75%	AP-221	Getco Limited
98. Paramount CC Type	AP-300	B. D. Associate and Company.
99. Darsbun 20EC	PHP-5	Auto Equipment Ltd.
100. Darsbun 20EC	PHP-85	Auto Equipment Ltd.
101. Basudin 10G	AP-23	Syngenta Bangladesh Ltd.
102. Diazinon 60EC	AP-24	Syngenta Bangladesh Ltd.
103. Mortin King Mosquito Coil	PHP-54	Reckit and Benckiser Bangladesh Ltd.
104. Mortin Mosquito Coil	PHP-101	Reckit and Benckiser Bangladesh Ltd.
105. Sarfium 56%	AP-689	Sar Trade
106. Sicofen 20 EC	AP-624	Genetica
107. Pesnon 57 EC	AP-189	Sea Trade Fertilizer Ltd.
108. Sicofen 20 EC	AP-624	Genetica

Internationally banned chemicals in 122 countries including Bangladesh:

- (1) The internationally banned chemicals are known as Persistent Organic Pollutants (POP).
- (2) POPs include nine pesticides (Aldrin, Chlordane, DDT, Dieldrin, Endrin, Heptachlor, Hexachlorobenzene, Mirex and Toxaphene). Mirex and toxaphene never entered into Bangladesh.
- (3) Two other chemicals (Furans and dioxins) which are by-products of other chemical processes are also banned.

ANNEX-2: Visit to the Research Institutes BRRI and BARI: 9 October, 2014

Persons contacted, held discussions & collected published materials from:

Bangladesh Rice Research Institute (BRRI)

Sl. No.	Name	Designation
1.	Dr. Jibon Krishna Biswas	Director general
2.	Dr. Ansar Ali	Director (Research)
3.	Dr. Sheikh ShamiulHaque	P.S.O. & Head, Entomology Division
4.	Dr. Nur Ahmed	P.S.O., Entomology Division
5.	Dr. Mohammad Hussain	SSO, Plant Pathology Division

Bangladesh Agricultural Research Institute (BARI)

Sl. No.	Name	Designation
1.	Dr. M.A. Rahman	CSO &Head, Plant Pathology Division
2.	Dr. M. Mominul Islam	SSO, Plant Pathology Devision
3.	Dr. SayedNurulAlam	CSO & Head, Entomology Division
4.	Dr. DebashishSankar	SSO, Entomology Division