

**DRAFT FINAL REPORT**

**BANGLADESH WATER DEVELOPMENT BOARD (BWDB)  
DEPARTMENT OF AGRICULTURAL EXTENSION**

**INTEGRATED PEST MANAGEMENT PLAN  
(IPMP)**

**December 2017**

**Climate Smart Agricultural Water Management Project  
(CSAWMP)**

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## **ABBREVIATIONS**

<b>AESA</b>	<i>Agro-ecosystem analysis</i>
<b>AI</b>	<i>Active Ingredient</i>
<b>BAU</b>	<i>Bangladesh Agricultural University</i>
<b>BRRRI</b>	<i>Bangladesh Rice Research Institute</i>
<b>BWDB</b>	<i>Bangladesh Water Development Board</i>
<b>CIG</b>	<i>Common Interest Group</i>
<b>CSAWMP</b>	<i>Climate Smart Agricultural Water Management Project</i>
<b>DAE</b>	<i>Department of Agricultural Extension</i>
<b>EC</b>	<i>Emulsifiable concentrates</i>
<b>EPA</b>	
<b>FFS</b>	<i>Farmer Field School</i>
<b>FGDs</b>	<i>Focus Group Discussions</i>
<b>G</b>	<i>Granular</i>
<b>GAP</b>	<i>Good Agricultural Practice</i>
<b>IEE</b>	<i>Initial Environmental Examination</i>
<b>IPM</b>	<i>Integrated Pest Management</i>
<b>LEA</b>	<i>Limited Environmental Assessment</i>
<b>LEAFs</b>	<i>Local Extension Agent for Fisheries</i>
<b>M&amp;E</b>	<i>Monitoring, Record-Keeping and Evaluation</i>
<b>NAP</b>	<i>The National Agricultural Policy</i>
<b>NIPMP</b>	<i>The National Integrated Pest Management Policy</i>
<b>OP</b>	<i>Operating Procedure</i>
<b>PMPs</b>	<i>Pest Management Plans</i>
<b>PPE</b>	<i>Personnel Protective Equipment</i>
<b>SAPPO</b>	<i>Sub-Assistant Plant Protection Officer</i>
<b>SL</b>	<i>Soluble Liquid</i>
<b>UAO</b>	<i>Upazila Agriculture Officer</i>
<b>UFO</b>	<i>Upazila Fisheries Officer</i>
<b>USAID</b>	<i>United States Agency for International Development</i>
<b>USD</b>	<i>United States Dollar</i>
<b>USEPA</b>	<i>US Environmental Protection Agency</i>
<b>WHO</b>	<i>World Health Organization</i>
<b>WMIP</b>	<i>Water Management Improvement Project</i>
<b>WMOs</b>	<i>Water Management Organizations</i>
<b>WP</b>	<i>Wettable Power</i>

## EXECUTIVE SUMMARY

1. The Government of Bangladesh is now preparing the Climate Smart Agricultural Water Management Project (CSAWMP) for climate resilient agricultural water management introducing new activities related to on-farm water use efficiency and climate smart irrigation and water management technologies. The proposed project will scale up the pilot reforms program initiated under recently completed WMIP to deepen the participatory scheme management approach and institutionalize within BWDB structure.
2. The project is expected to bring positive environmental benefits to the project areas through the introduction and expansion of modern technologies that promotes sustainable practices and applications that can improve current cropping patterns and farming methods, increase efficiency in the management of water resources, protect agriculture soils, and roll out the integrated pest management. The diversification and intensification of agricultural activities under the project could lead to change in the application of pesticides for pest and disease controls. As per the World Bank safeguard policy Pest Management (OP 4.09, this standalone Pest Management Plans (PMP) has been prepared for the project based on Integrated Pest Management (IPM) principles.
3. The Project will assist and train farmers to be able to develop their IPM approaches to the management of pests and diseases. This will be holistically approach from seed selection, land preparation, planting and farm maintenance to harvesting and post harvesting issues. Farmers will be trained enough and encouraged to make detailed observations in their fields regularly so that they can detect early infestations and make the appropriate management decisions using agro-ecosystem analysis (AESA).
4. The PMP proposes that a detailed assessment of the pest management practices that are currently practicing at farmers level. The results of this assessment are then to be used in the preparation of an action plan to be implemented via the SCPPC focusing on the following actions. The action plan should outline and recommend measures with regard to the following areas.
  - Strengthening pest forecasting
  - Promoting the Agronomic Control
  - Promoting the Physical Control
  - Promoting the Biological Controls and
  - Discouraged or reducing the Chemical Control to rid from pest infestation.
5. The general norm of the action plan should be once pest or disease occurs in cultivation areas, agricultural mechanical control measure should be firstly considered, physical and biological measures secondly considered. Chemical drugs shall be lastly adopted only when all other control measures have failed and the pest/disease damage exceeds the economic threshold. When chemical drugs are applied, attention shall be made to select pollution-free drugs to reduce the drug resistance of the pests and avoid pollution to the environment.
6. Although farmers are likely using numerous IPM tactics, without really calling them that, IPM philosophy or planning is not generally an active part of crop production in Bangladesh plots; thus, a basic understanding of the steps or elements needed in an IPM program are addressed below:
  - Step 1: Learn and value farmers' indigenous IPM tactics.
  - Step 2: Identify key pests for each target crop
  - Step 3: Evaluate all management options.
  - Step 4: Choose IPM methods, identify Needs and Establish Priorities.
  - Step 5: Do effective activities and training to promote IPM.
  - Step 6: Partner successfully with other IPM implementers.
  - Step 7: Monitor the fields regularly:
  - Step 8: Select an appropriate blend of IPM tools:
  - Step 9: Develop education, training, and demonstration programs for extension workers:
  - Step 10: Monitoring, Record-Keeping and Evaluation (M&E)

# 1 INTRODUCTION

## 1.1 Project Background

7. The Government of Bangladesh is now preparing the Climate Smart Agricultural Water Management Project (CSAWMP) for climate resilient agricultural water management introducing new activities related to on-farm water use efficiency and climate smart irrigation and water management technologies. The proposed project will scale up the pilot reforms program initiated under recently completed WMIP to deepen the participatory scheme management approach and institutionalize within BWDB structure. The proposed follow on project will also strengthen WMOs formed under WMIP and include lessons from the pilot phase in formation of new WMOs. The project will be implemented by the Bangladesh Water Development Board (BWDB) under the Ministry of Water Resources.
8. Introducing climate smart agriculture and aquaculture is one of the components of Climate Smart Agricultural Water Management Project (CSAWMP). This Component includes interventions that promote and facilitate increased agricultural productivity, enhanced resilience (adaptation), and reduced GHG emissions (mitigation), as well as improved market access. The component aims to strengthen institutional capacity and increase farmers' adoption of climate-smart practices in selected rural landscapes associated with specific schemes being rehabilitated under sub-component. In addition, this component will also support capacity building of DAE officials for delivering improved extension serviced that focus on integrated agricultural water management.
9. The CSAWMP will include agricultural water management by not only improving irrigation infrastructure, but also introducing activities related to on-farm water use efficiency, as well as climate smart and climate resilient agriculture practices and technologies. The CSAWMP will scale up the participatory reforms initiated under the predecessor project.

## 1.2 Background of IPM based PMP

10. While the project is expected to bring positive environmental benefits to the project areas through the introduction and expansion of modern technologies that promotes sustainable practices and applications for improvement of current cropping patterns and farming methods, increase efficiency in the management of water resources, protect agriculture soils, and introducing integrated pest management plan. The diversification and intensification of agricultural activities under the project could lead to changes the application of pesticides for pest and disease controls. *As per the World Bank safeguard policy Pest Management (OP 4.09, this standalone Pest Management Plans (PMP) has been prepared for the project based on Integrated Pest Management (IPM) principles.* The PMP describes the relevant national regulatory framework, current status of pest and disease control, monitoring and supervision

mechanism, major experience and problems, and lessons learnt from past projects. It specifies a means of assessing and documenting the range of nonchemical methods used for pest management in the form of IPM across the country, the preparation of a detailed action plan and training and monitoring program to facilitate implementation. A list of all chemicals needed for the project that meet Bank requirements, which also comply with the World Health Organization's recommended categories, have been included in the PMP. The project will not partake in the procurement of pesticides or pesticide application devices.

11. The following IPM based Pest Management Plan (PMP) has been prepared in order to address the concerns related to the risks associated with the envisioned possible increase in the use of pesticides that will result from project as a whole and roll out Integrated Pest Management within the project in a strategic manner, while meeting safeguards requirements. IPM is not a single pest control method but rather involves integrating multiple control methods based on site information obtained through, inspection; monitoring; and reports. Consequently, every IPM program is designed based on the pest prevention goals and eradication needs of the situation. Successful IPM programs use this four-tiered implementation approach.
12. 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 Appendix 1. In addition, farmers' lack of knowledge about precautions pertaining to handling of pesticides often creates health problems.
13. The project investments may increase the use of higher pesticides and other chemical inputs by promoting improved management practices in agriculture and horticulture as well as through increasing crop intensification due to improved access to water resources and area under irrigation. While such improvements on one hand will augment the production and income of the farmers, on the other hand due to its excessive and inappropriate use it would affect the natural resources, environmental services and food systems. In order to protect the environment and its services the project will promote the adoption of Integrated Pest Management approach. As part of the ethical practices, the project will not recommend or use pesticides which are banned, refused registration and restricted in use.

### 1.3 Objective of the PMP

14. The objective of the Pest Management Plan is to promote the use of a combination of environmentally and socially friendly practices (hygienic, cultural, biological or natural control mechanisms and the judicious use of chemicals) and reduce reliance on synthetic chemical pesticides and ensure that health, social and environmental hazards associated with pesticides are minimized under the Project and within acceptable limit requirements of key stakeholders (i.e. primary users among farmers and their immediate dependents/families).
15. The specific objectives of the PMP are to:
- Ensure appropriate pest management techniques in to technologies supported under the Project
  - Effectively monitor pesticide use and pest issues amongst participating farmers
  - Provide for implementation of an IPM action plan in the event that serious pest management issues are encountered, and/or the introduction of technologies is seen to lead to a significant decrease in the application of pesticides
  - Assess the capacity of the country's regulatory framework and institutions to promote and support safe, effective, socially and environmentally sound pest management and to provide for appropriate institutional capacity support recommendations
  - Ensure compliance with regional standards, laws and regulations
  - Ensure compliance with World Bank safeguard policy OP 4.09 and
  - Ensure compliance with USAID requirements on pesticides procedures.

## 2. REVIEW OF POLICY, REGULATORY AND INSTITUTIONAL FRAMEWORKS

### 2.1 Bangladesh Laws and Regulations

16. 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:
  - Maintenance of ecological balance,
  - Executing appropriate actions on pesticides,
  - Operating an effective system for implementing IPM program.
  - Developing human resources as the core of IPM
  - Conducting research on IPM

17. 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.

## **2.2 WHO Classification of Pesticide by Hazard and the Guidelines to Classification, 2009**

18. No pesticide of WHO Class-1A category will be used in the CSAWMP Project. Pesticide brands based on the dirty dozen have been banned in Bangladesh and these are attached in the *Annexure-1*. To ensure that none of the banned pesticides will be used in the scheme intentionally, there will be needed 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.

## **2.3 World Bank Pest Management Safeguard Policy (OP 4.09)**

19. 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
- To promote environmentally sound and sustainable pest management. Its objectives relevant to the CSAWMP Project include
- To minimize the environmental and health hazards related to pesticide usage and
- To ensure that pest management activities follow an Integrated Pest Management (IPM)

approach.

20. 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 CSAWMP Project as:

- The project is expected to introduce new pest management practices or expand or alternate 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.

### 3. MAJOR INSECTS PESTS & DISEASES OF MAJOR CROPS, VEGETABLES AND FRUITS AND CONTROLLING METHOD

#### 3.1 Insects and Diseases

21. The major pests and diseases of rice, vegetables and fruits and the current methods and techniques of pest control in use in the CSAWMP schemes is following as

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

Name of the	Major insect pests	Major Diseases
<b>Vegetables</b>		
Brinjal	<ul style="list-style-type: none"> <li>• Brinjal Shoot and Fruit Borer,</li> <li>• Leaf Hopper,</li> <li>• Epilachna Beetle</li> <li>• Red Mite</li> </ul>	<ul style="list-style-type: none"> <li>• Foot and Stem Rot/ Fruit Rot/ Fruit Blight</li> <li>• Bacterial Wilt</li> <li>• Root Knot Nematode</li> </ul>
Tomato	<ul style="list-style-type: none"> <li>• Tomato Fruit Borer</li> <li>• White fly</li> </ul>	<ul style="list-style-type: none"> <li>• Early Blight</li> <li>• Late Blight</li> </ul>
Country Bean and Yard Long Bean	<ul style="list-style-type: none"> <li>• Aphids</li> <li>• Pod/Fruit Borer</li> </ul>	<ul style="list-style-type: none"> <li>• Anthracnose</li> <li>• Common Bean Mosaic Virus</li> </ul>
Cabbage and Cauliflower	<ul style="list-style-type: none"> <li>• Diamond Back Moth</li> <li>• Tobacco Caterpillar</li> <li>• Cutworm</li> </ul>	<ul style="list-style-type: none"> <li>• Black Leaf Spot/Gray Leaf Spot</li> </ul>
Radish and Carrot	<ul style="list-style-type: none"> <li>• Cutworm</li> </ul>	<ul style="list-style-type: none"> <li>• Bacterial Soft Rot</li> </ul>
Cucurbits	<ul style="list-style-type: none"> <li>• Fruit Fly</li> </ul>	<ul style="list-style-type: none"> <li>• Powdery Mildew</li> </ul>
	<ul style="list-style-type: none"> <li>• Red Pumpkin Beetle</li> </ul>	<ul style="list-style-type: none"> <li>• Mosaic Virus</li> </ul>
	<ul style="list-style-type: none"> <li>• Tobacco Caterpillar</li> </ul>	<ul style="list-style-type: none"> <li>• Fruit Rot</li> </ul>
	<ul style="list-style-type: none"> <li>• Epilachna Beetle</li> </ul>	<ul style="list-style-type: none"> <li>• Fusarium Wilt</li> <li>• Alternaria Blight and Fruit Rot</li> </ul>
Okra	<ul style="list-style-type: none"> <li>• Fruit &amp; Shoot Borer</li> <li>• Whitefly</li> <li>• Leaf Hopper</li> </ul>	<ul style="list-style-type: none"> <li>• Yellow Vein Mosaic Virus</li> </ul>
Aroids	<ul style="list-style-type: none"> <li>• Tobacco Caterpillar</li> <li>• Aphids</li> <li>• Mite</li> </ul>	<ul style="list-style-type: none"> <li>• Leaf Blight</li> </ul>
Green Papaya	<ul style="list-style-type: none"> <li>• Mealy Bug</li> </ul>	<ul style="list-style-type: none"> <li>• Papaya Mosaic &amp; Leaf Curl Virus</li> <li>• Damping Off</li> <li>• Anthracnose</li> </ul>

#### ➤ *Fruits*

1.	Mango	<ul style="list-style-type: none"> <li>• Mango Hopper</li> <li>• Mango Weevil</li> <li>• Mango Fruit Fly</li> <li>• Leaf Cutting Weevil</li> <li>• Mango Thrips</li> <li>• Mango Defoliator</li> </ul>	<ul style="list-style-type: none"> <li>• Powdery Mildew</li> <li>• Anthracnose</li> <li>• Die-back</li> <li>• Leaf Blight</li> <li>• Malformation</li> <li>• Rust</li> </ul>
2.	Litchi	<ul style="list-style-type: none"> <li>• Mite</li> <li>• Fruit Borer</li> </ul>	<ul style="list-style-type: none"> <li>• Leaf Blight</li> <li>• Die Back</li> </ul>
3.	Guava	<ul style="list-style-type: none"> <li>• Mealy Bug</li> <li>• Fruit Fly</li> <li>• White Fly</li> </ul>	<ul style="list-style-type: none"> <li>• Wilt</li> <li>• Anthracnose</li> <li>• Die Back</li> </ul>

➤ **Rice**

1.	Rice	<ul style="list-style-type: none"> <li>• Rice Stem Borer</li> <li>• Brown Plant Hopper (BPH)</li> <li>• White Back Plant Hopper (WBPH)</li> <li>• Leaf Folder</li> </ul>	<ul style="list-style-type: none"> <li>• Brown Spot</li> <li>• Stem Rot/ Sheath Rot</li> <li>• Blast</li> <li>• Sheath Blight</li> <li>• Bacterial Leaf Blight (BLB)</li> </ul>
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### 3.2 Controlling Insect of Rice Using IPM

22. 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.

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"> <li>• Using tolerant variety</li> <li>• Collection of insect's eggs and destruction</li> <li>• Collection &amp; killing of moths using light traps</li> <li>• Perching for attracting insect-eating birds</li> <li>• Delaying pesticide spray to help parasitic (friendly) insect to eat stem borer eggs</li> <li>• Burning or mixing the debris and left-over stalk after harvesting the Aman rice</li> <li>• Applying approved insecticide when about 5% white spike is observed</li> </ul>
2.	Gall Midge	<ul style="list-style-type: none"> <li>• Using light traps to control grown up flies</li> <li>• Using approved insecticide when 5 percent leaves show 'onion leaf' symptom</li> </ul>
3.	Rice Hispa	<ul style="list-style-type: none"> <li>• Catching insects by hand net or mosquito net &amp; killing</li> <li>• Using approved insecticide when 35% leaves are spoilt or four fully grown insects are present in every tillered plant</li> </ul>
4.	Insect Leaf Roller	<ul style="list-style-type: none"> <li>• Using light traps</li> <li>• Perching for attracting insect-eating birds</li> <li>• Applying approved insecticide when 25% leaves are damaged</li> </ul>

<b>Sl. no.</b>	<b>Name of Insect Pest</b>	<b>Control Measures Using IPM</b>
5.	Rice Case worm	<ul style="list-style-type: none"> <li>• Using light traps</li> <li>• Collecting larvae by hand net &amp; killing</li> <li>• Removing water from the field &amp; drying the soil</li> <li>• Applying approved insecticide when 25% leaves are damaged</li> </ul>
6.	Swarming Caterpillar	<ul style="list-style-type: none"> <li>• Burning the left-over straw or ploughing down with soil after harvesting paddy</li> <li>• Controlling the moths by light traps</li> <li>• Perching for attracting insect-eating birds</li> <li>• Applying approved insecticide when 25% leaves are damaged</li> </ul>
7.	Brown Plant Hopper	<ul style="list-style-type: none"> <li>• Planting rice seedlings at 25x15 or 20x20 cm distance to allow lot of air and light around the plants</li> <li>• Using limited/regulated amount of urea, stopping top-dressing of urea in infested field</li> <li>• 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</li> <li>• Using approved insecticide if most of the plants are seen to have four adult female insects, with full belly eggs in each</li> <li>• Spraying Abamectin 1.8 EC@ 1 litre/ha if 2-4 adults or 8-10 nymphs are found per plant</li> </ul>
8.	White- backed Plant	<ul style="list-style-type: none"> <li>• Same control measures as are used for Brown plant hopper (sl.7)</li> </ul>
9.	Mealy Bug	<ul style="list-style-type: none"> <li>• Pulling up of affected plants &amp; burying under the soil</li> <li>• Using approved insecticide only in the area of infestation</li> </ul>
10.	Thrips	<ul style="list-style-type: none"> <li>• Top dressing of urea after irrigating the seed plot /field</li> <li>• Using approved insecticide if attack is severe</li> </ul>
11.	Rice Bug	<ul style="list-style-type: none"> <li>• Using light-traps</li> <li>• Applying insecticide when, on average, one rice bug is observed in 2-3 bunches of rice plants</li> <li>• It is more effective to apply insecticide in the afternoon</li> </ul>
12.	Ear cutting Caterpillar	<ul style="list-style-type: none"> <li>• Burning out the leftover straw</li> <li>• Perching to attract insect-eating birds</li> <li>• Irrigating the land few days before harvesting</li> </ul>

### 3.3 Controlling Insects of Vegetables Using IPM

23. 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: Major Insect Pests of Vegetables and Their Control Measures Using IPM

Sl. No.	Name of Insect	Control Measures Using IPM
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➤ **BRINJAL**

1	Shoot and Fruit Borer	<ul style="list-style-type: none"> <li>Using resistant varieties like Jhumka, Shingnath, Noyontara etc.</li> <li>Borer infested shoot and destroyed at least once in a week</li> <li>Sex pheromone trap is to be established in the field within 2-3 weeks of planting seeding</li> <li>Using organic pesticide spinosad- 45 EC (4ml/10 litre water)</li> <li>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)</li> </ul>
2	Epilachna Beetle	<ul style="list-style-type: none"> <li>Collection and destruction of infested leaf (with egg mass and grab) by hand picking</li> <li>In case of high infection, approved insecticide is to be sprayed at recommended doses</li> <li>Application of ash on the plants</li> </ul>
3	Red Mite	<ul style="list-style-type: none"> <li>Practicing clean cultivation</li> <li>Applying sulphur group of fungicides (Cumlax, Theovit etc.)</li> <li>Spraying Ebamectin 1.8 EC, 15ml in 10 litre water</li> </ul>
4	Leaf Hopper	<ul style="list-style-type: none"> <li>Cultivating tolerant variety ( BARI brinjal-6)</li> <li>Using yellow sticky trap</li> <li>Cultivating trap crop such as Okra around the field</li> <li>Spraying of 5ml liquid soap in 1 litre water</li> <li>Spraying of neem oil+ Tricks ( at 5 ml+ 5ml per litre of water) on the lower surface of the leaves</li> <li>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</li> </ul>

➤ **TOMATO**

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

➤ **COUNTRY BEAN AND YARD LONG BEAN**

1	Aphids	<ul style="list-style-type: none"> <li>• Destructing aphids from infested leaves and twigs</li> <li>• Using <i>neem</i> solution ( 1kg broken seed soaked in 20 litre water in 12 hours</li> <li>• Spraying insecticide, malathion 57 EC 20 ml/10 litre water</li> </ul>
2	Fruit Borer	<ul style="list-style-type: none"> <li>• Collecting and destroying infested flowers and pods regularly</li> <li>• Clean cultivation and destruction of dropped out flowers and pods</li> <li>• Spraying of organic pesticide i.e. MNPV (0.2 gm per litre of water, 2-3 times and 10-12 days interval)</li> <li>• Spraying of bio-pesticide i.e. Spinosad-45EC ( 4ml per 10 litre of water) at 2 weeks interval in case of severe infestation</li> </ul>

➤ **CABBAGE AND CAULI FLOWER ( CRUCIFEROUS VEGETABLES)**

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

➤ **CARROT AND RADISH**

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

Sl. No.	Name of Insect	Control Measures Using IPM
1	Fruit fly	<ul style="list-style-type: none"> <li>• Clean cultivation</li> <li>• Collection of infested fruit from plant as well as from the soil and burying it ml/l under soil</li> <li>• Covering of young fruit by net or poly bag</li> <li>• Joint of use of sex pheromone trap and bait trap (poison bait)</li> <li>• In case of severe infestation, spray Carbaryl 50WP@ 3gm/l or Indoxacarb 0.5</li> </ul>
2	Red Pumpkin Beetle	<ul style="list-style-type: none"> <li>• Collecting and destroying the adult insects through hand picking</li> <li>• Clean cultivation, keeping the field free from any debris</li> <li>• Application of dry ash in plant</li> <li>• Destruction of alternative host</li> <li>• Covering the plant with net (for 20-25 days) in seedling stage</li> <li>• Use any recommended granular insecticide such as Carbofuran 5G 2-5 g/pit followed by watering</li> </ul>
3	Tobacco Caterpillar/ Fruit Borer	<ul style="list-style-type: none"> <li>• Collecting and destructing of caterpillar during early stage of infestation</li> <li>• Use of bio-pesticide SNPV @0.2g/l at 10-12 days for 2-3 times</li> <li>• Use of sex pheromone traps from the early stage of the crop</li> <li>• In case of severe infestation, use contact poisons belonging to the Cyper methrin group such as Pyrethrin, Cymbush, Basathrin etc @ 10ml/l at 2 weeks interval for 2-3 times</li> </ul>
4	Epilachna Beetle	<ul style="list-style-type: none"> <li>• Application of ash in plant</li> <li>• Destruction of egg mass and grub</li> <li>• Practicing clean cultivation</li> </ul>

➤ **OKRA**

1	Fruit & Shoot Borer	<ul style="list-style-type: none"> <li>• Regular destruction of infested shoot and fruit at least once in a week</li> <li>• Clean cultivation</li> <li>• Cultivation of alternating host such as cotton should be avoided</li> <li>• Use of bio-pesticide i.e. Spinosad-45 (4ml per litre of water)</li> <li>• In case of severe infestation using recommended systemic insecticides. Fruits cannot be eaten within 2 weeks of spraying</li> </ul>
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2	White Fly	<ul style="list-style-type: none"> <li>• Spraying of neem seed extract (1 kg broken neem seed to soaked in 20 litre of water, sieving the extract before spray)</li> <li>• Treating seed with insecticides</li> <li>• Cover the seed beds with fine nylon net</li> <li>• Using yellow sticking traps</li> <li>• Spraying Admire 200 SL (2.5 ml/10 litre of water) in case of severe infestation</li> </ul>
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➤ **GREEN PAPAYA**

1	Mealy bug	<ul style="list-style-type: none"> <li>• Destruction of insects from infested leaves and twigs</li> <li>• Use of <i>neem</i> seed solution (1 kg broken seed per 20 litre water in 12 hours)</li> </ul>
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### 3.4 Controlling Insects of Fruits Using IPM

24. 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 are shown in the following table:

**Table-4: Major Insect Pests of Vegetables and Their Control Measures Using IPM**

Sl. No.	Name of Insects	Control Measures Using IPM
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➤ **MANGO**

1	Mango Hopper	<ul style="list-style-type: none"> <li>• Avoiding dense planting, maintaining open canopy; overcrowd and overlapping branches at the end of rainy season</li> <li>• Keep orchard clean by regular ploughing and removal of weeds</li> <li>• Spraying of 0.2% Nimbicidin or Azadirachtin 3000 ppm@2m/l at initial stage of hopper population</li> <li>• 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</li> <li>• Chemical spray is to be minimized and should be need based</li> <li>• A rational of insecticide is desirable to counteract the tendency of pest to develop field resistance</li> </ul>
2	Mango Weevil	<ul style="list-style-type: none"> <li>• After harvesting of mango, weed and parasitic plant should be removed</li> <li>• Digging of soil in 4m radius of mango plant in January- February`</li> <li>• Removing waste and weed under the plant</li> </ul>

	Fruit Fly	<ul style="list-style-type: none"> <li>• Prior to harvest (30-40 days) collecting and destroying off infested and fallen fruits to prevent further, multiplication and carryover of population</li> <li>• Ploughing of orchard during November- December for exposing pupae to sun's heat, which kills them</li> <li>• 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</li> <li>• 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 molasses is also recommended</li> <li>• Three weeks before harvesting, spraying Deltamethrin 2.8EC @ 0.5ml/l+ Azadiractin (3000 ppm) <sup>or 2ml/l</sup></li> <li>• Three weeks before harvesting, spraying Deltamethrin 2.8EC @ 0.5ml/l+ Azadiractin (3000 ppm) <sup>or 2ml/l</sup></li> </ul>
4	Leaf Cutting Weevil	<ul style="list-style-type: none"> <li>• Destructing of infested leaves as early as possible to kill the insect at immature stages</li> <li>• Covering with net of the newly born leaves in nursery.</li> </ul>
5	Mango Defoliator	<ul style="list-style-type: none"> <li>• Killing of caterpillar with the leaves</li> <li>• Collecting and destroying pupal cocoon</li> <li>• Pruning</li> <li>• Release of lady bird beetle as beneficial insect</li> <li>• Spraying with 0.5% soap water and or extraction of neem leaves</li> <li>• Avoid excessive use of nitrogenous <b>fertilizer</b></li> <li>• Infested and dropped fruits should be destroyed in the month of March-April</li> <li>• Spraying with Spinosad-45 EC or Tracer-0.4ml per litre</li> </ul>

➤ **LITCHI**

1	Mite	<ul style="list-style-type: none"> <li>• After harvesting, infested portion should be broken and brunt</li> <li>• Painting trunk with coal tar or lime</li> <li>• spraying water or shampoo-water in the infested plant</li> </ul>
	Fruit Borer	<ul style="list-style-type: none"> <li>• Cultivation of resistant variety such as China-3</li> <li>• Burning the dropped and dried leaves to kill the caterpillar</li> </ul>

➤ **GUAVA**

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

### 3.6 Controlling Diseases of Rice Using IPM

25. A good number of IPM measures are now applied for controlling diseases of rice under NATP-1 project and that could be followed by CSAWMP also as follows as

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"> <li>• Using tolerant varieties</li> <li>• Burning or burying down the Arali grass</li> <li>• Using right trap and hand net</li> </ul>
2.	Bacterial Blight	<ul style="list-style-type: none"> <li>• Using tolerant variety</li> <li>• Using balanced fertilizer, urea application in three installments</li> <li>• With holding irrigation for 7-8 days for drying the soil and applying 5 Kg potash fertilizer/bigha (0.33 acre)</li> </ul>
3.	Sheath Blight	<ul style="list-style-type: none"> <li>• Collecting floating debris along the borders and burying under soil</li> <li>• Using resistant varieties (BR-22, BR-23, BRRIdhan 34 &amp; BRRIdhan 41)</li> <li>• Planting seedlings at a space of 25 x 20 or 25 x 15 cm and 3 seedlings together in one place.</li> <li>• Burning out the dead plants</li> <li>• Using crop rotation</li> <li>• Using appropriate dose of urea</li> <li>• Using approved fungicide</li> </ul>
4.	Blast	<ul style="list-style-type: none"> <li>• Using tolerant variety ( BR-12, 15, 16, 24, BRRIdhan-33)</li> <li>• Using seed collected from healthy plants</li> <li>• Using balanced fertilizer, seed treatment</li> <li>• Using organic manure in the field</li> <li>• Keeping standing water in the field</li> <li>• It needed, applying approved fungicide at initial stage of infection</li> </ul>
5.	Leaf Scald	<ul style="list-style-type: none"> <li>• Using tolerant variety</li> <li>• Using balanced fertilizer and not to apply excessive urea</li> <li>• Keeping the land dry for some days when the disease appear</li> <li>• Collecting seed from healthy plants</li> <li>• If needed using fungicide containing 80% sulphur</li> </ul>

6.	Sheath Rot	<ul style="list-style-type: none"> <li>• Burning out the affected straw</li> <li>• Using healthy seed and seed treatment</li> <li>• Using tolerant variety (BR-2, BR-3, BR-5, BR-10, BR-16, BR-25, BRRIdhan-26, BRRIdhan-32, BRRIdhan-33)</li> <li>• Using balanced fertilizer</li> <li>• Keeping the land dry for some days when the disease appears</li> <li>• If needed, using approved fungicide</li> </ul>
7.	Ufra	<ul style="list-style-type: none"> <li>• Using the tolerant variety, Raida and Bajail, for a few years</li> <li>• Burning out the left over straw after harvest of paddy</li> <li>• Keeping under control the grass type weeds</li> <li>• Using worm/larvae killing agent like Furadan 5G (2.5 kg/bigha) during early stages of the crop.</li> <li>• Purifying seedlings by submerging them for one night in water mixed with Furadan 5G (15 gm in one litre of water)</li> <li>• Cutting the top parts of rice leaves at the initial stage of attack</li> </ul>
8	Foot rot & Bakanae	<ul style="list-style-type: none"> <li>• Using resistant variety</li> <li>• Using disease-free seeds</li> <li>• Not using same land for seed bed continuously.</li> <li>• Using seed purified by soaking in fungicide mixed water.</li> <li>• Using soft seed-bed and keeping it moist all the time.</li> <li>• Drying land immediately after disease identification.</li> <li>• Throwing the disease affected seedlings.</li> <li>• Burning out the disease affected plants.</li> <li>• Using different varieties of rice at intervals or using crop rotation</li> <li>• Using balanced fertilizer.</li> </ul>
9	Brown Spot	<ul style="list-style-type: none"> <li>• Using resistant variety.</li> <li>• Using healthy seeds. Hot water (53-54°C) or cold water soaking</li> <li>• Planting seeds purified by fungicide ( Thiram, Captan, Bavistin)</li> <li>• Keeping seedbed moist</li> <li>• Using large quantities of organic fertilizer</li> <li>• Using balanced chemical fertilizer</li> </ul>
10	Bacterial Leaf streak	<ul style="list-style-type: none"> <li>• Using resistant variety.</li> <li>• Killing insects so that leaf is not attacked by bacteria in the spots.</li> <li>• Drying the land by removing water.</li> <li>• Using balanced fertilizer, less amount urea is desirable</li> </ul>
11	Seedling Blight	<ul style="list-style-type: none"> <li>• Purifying seed by using Vitabrex or Thirum before sowing</li> <li>• Mixing rice bran with seedbed soil.</li> <li>• Avoiding times with excessive cold for sowing seeds in seedbeds</li> <li>• Keeping seedbed/land under standing water for some days</li> </ul>
12	Seedling Damping off	<ul style="list-style-type: none"> <li>• Not keeping seedbed under water during germination of seed</li> <li>• Not to sow seeds in seedbed during heavy colds.</li> <li>• Covering seedbed with polythene sheets during cold spells</li> <li>• Purifying seed before sowing (4 gm Captan / 2 gm Copper oxychloride per kg of seed)</li> </ul>

### 3.7 Controlling Diseases of Vegetables Using IPM

26. The common 19 vegetables widely infected by 20 different types of diseases. IPM techniques could be used for controlling these types of diseases as follows as

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

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

➤ **TOMATO**

1	Early blight/ Alternaria leaf blight	<ul style="list-style-type: none"> <li>• Seed treatment with tricho-solution or garlic tablet</li> <li>• Field sanitation</li> <li>• Spraying tricho-solution (3%) at 7 days interval</li> <li>• Spraying of Dithane M-45 at 7 days interval</li> </ul>
2	Late blight of tomato	<ul style="list-style-type: none"> <li>• Using diseases free seed</li> <li>• Spraying BAU-Biofungicide (3%)</li> <li>• Spraying of Mancozeb @ 7 days interval</li> </ul>
3	Bacterial wilt	<ul style="list-style-type: none"> <li>• Using diseases free seeds</li> <li>• Use of seedlings from diseases free seed bed</li> <li>• Crop rotation with cereals for at least 3 years if field becomes contaminated</li> </ul>
4	Leaf curl of tomato caused by virus (transmitted by white fly)	<ul style="list-style-type: none"> <li>• Growing seedlings under net</li> <li>• Using of barrier crops in the field</li> <li>• Using yellow sticky traps</li> <li>• Uprooting of infested plants and weeds</li> <li>• Spraying Dimethoate at 10 days intervals</li> </ul>

➤ **COUNTRY BEAN AND YARD LONG BEAN**

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

➤ **CABBAGE AND CAULIFLOWER**

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

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

27. 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:

Sl. No.	Diseases	Control Measures Using IPM
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1	Powdery Mildew	<ul style="list-style-type: none"> <li>• Avoiding crowded planting of seedlings</li> <li>• Maintaining field sanitation</li> <li>• Applying wettable sulphur @ 0.2% or dusting finely powdered sulphur to cover the foliage, once or twice during plant growth season</li> <li>• Spraying of BAU-Biofungicide (3%)</li> <li>• Spraying Thiovit (2g/L) at weekly intervals</li> </ul>
2	Mosaic Virus	<ul style="list-style-type: none"> <li>• Using virus tolerant varieties</li> <li>• Destructing diseases host including weeds</li> <li>• Spraying insecticide (Metasystox @ 0.1%) to suppress the insects vectors</li> </ul>
3	Fruit Rot	<ul style="list-style-type: none"> <li>• Soil drenching with BAU-Biofungicide (3%)</li> <li>• Fruits should be kept away from soil</li> <li>• Rotation with non-host crops like pepper, tomato, eggplant</li> <li>• Spraying of BAU-Biofungicide (3%)</li> </ul>
4	Fusarium	<ul style="list-style-type: none"> <li>• Planting resistant cultivars is the only reliable way to keep infested field in production</li> <li>• Treating seeds with hot water at 55°C for 15 minutes and by drenching soil with Carbendazim</li> <li>• Treating seed with BAU-Biofungicide (3% of seed weight)</li> <li>• Drenching soil with BAU-Biofungicide (3%)</li> </ul>
5	Alternaria Blight & Fruit Rot	<ul style="list-style-type: none"> <li>• Using of diseases free seeds, clean cultivation and crop rotation are effective controls</li> <li>• Spraying 0.25% Indifil M-45 at 10-15 days interval is effective in diseases control</li> </ul>

➤ **OKRA**

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

1	Papaya Mosaic & Leaf curl Virus	<ul style="list-style-type: none"> <li>• Uprooting and destroying the infected plants</li> <li>• Regular spraying of insecticides to control aphids and other vectors</li> </ul>
2	Damping off	<ul style="list-style-type: none"> <li>• Seed treatment with BAU-Biofungicide (3% of seed weight)</li> <li>• Use of high land and well-drained soil</li> <li>• Use of Tricho-compost as soil amendment</li> </ul>
3	Anthracnose	<ul style="list-style-type: none"> <li>• Clean cultivation</li> <li>• Applying Mancozeb or Carbendazim ( g/litre)</li> </ul>

### 3.8 Controlling Diseases of Fruits Using IPM

28. For the three major fruits of the country are infected by eight major diseases that could lead to loss 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 these problems considerably. The IPM measures could be applied by CSAWMP as follows as

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

Sl. No.	Diseases	Control Measures Using IPM
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➤ **MANGO**

1	Powdery Mildew	<ul style="list-style-type: none"> <li>• Clean cultivation</li> <li>• Spraying thiovit @0.2% at 10-15days interval</li> <li>• Spray BAU-Biofungicide @3% at 12 days interval</li> </ul>
2	Anthraco nose	<ul style="list-style-type: none"> <li>• Clean cultivation (diseased leaves. Twigs and gall midge infected leaves and fruits, should be collected and burnt)</li> <li>• Covering the fruits on tree, 15 days prior to harvest with news or brown paper bags</li> <li>• Pre-harvest sprays of hexaconazole (0.01%) or Canbendazim (0.1%) at 15 days interval. Last spray should fall 15 days prior to harvest</li> <li>• Spraying cupravit @ 0.03% on infected plant at 15 days interval</li> <li>• Spray BAU-Biofungicide @3% at 12 days interval</li> </ul>
3	Die-back	<ul style="list-style-type: none"> <li>• Clean cultivation</li> <li>• Scion wood selected for propagation should be free from infection</li> <li>• Pruning the diseased terminals along with the basal 15-20cm healthy portion and painting cut end</li> <li>• Spraying Cupravit @ 0.03% on infected plant at 15 days interval</li> </ul>

➤ **LITCHI**

1	Leaf blight	<ul style="list-style-type: none"> <li>• Spray gentamycin or kenamycin @ 0.05% at 15 days interval</li> </ul>
2	Die-back	<ul style="list-style-type: none"> <li>• Prune the malformed terminal alongs with the basal 15-20 cm health portion and paint cut end</li> <li>• Spray BAU-Biofungicide @ 3% at 12 days interval</li> <li>• Spray Curpavit @ 0.03% on infected plant at 15 days interval</li> </ul>

➤ **GUAVA**

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

## 4. POTENTIAL IMPACTS AND POSSIBLE MITIGATION MEASURES

### 4.1 Potential Impacts

29. The use of various agro-chemicals especially pesticides would have substantial impacts on the environment during the implementation stage of the CSAWMP irrigation and storage interventions. The major impacts are

- Health problems &
- Environmental hazards

#### ➤ *Health Problems*

30. There are acute and chronic health effects may manifest as local or systemic effects. They include

- skin irritations, such as itching, rashes, blisters, burns, wounds etc.
- irritation of throat leading to cough or difficulty in breathing with or without wheezing or choking etc.
- chest pain, burning mouth and throat with pain on swallowing etc.
- runny nose, sore throat, head ache, dizziness, sudden collapse with or without unconsciousness.
- eye irritation, blurred vision, lots of tears or saliva or mucus secretion and sweating, nausea, vomiting, chest infections due to aspiration of vomits, fever, abdominal pain or discomfort, diarrhea, uncontrolled urination and defecation, slowing of heart beat or rapid heartbeat, weakness including muscles for breathing, muscle twitching or pains, tremors, convulsion, coma, hallucinations, pain and numbness in legs, allergic reactions.
- Others are problems with liver, kidney, or nerves functions, improper functioning of the heart etc.

#### ➤ *Environmental Hazards*

31. The major environmental hazards lead by pesticides effects are as follows

- Contamination of drinking water and ground water
- Soil contamination
- Wildlife and domestic animals can be killed by spray drift or drinking contaminated water
- Exposure may also cause infertility and behavioral disruption
- Destroy or disrupts the food chain
- Loss of biodiversity and agricultural environments
- Reduce the plant resistance etc.

## **4.2 Possible Mitigation Measures**

### **4.2.1 Field Demonstrations**

32. Field demonstrations are the practical way of convincing farmers on IPM practices, establishment of a Farmer Field School (FFS). FSSs can actually show farmers the successful crop yields that can be expected by IPM implementation and demonstrate user friendly mechanisms. This will assist in changing set mindsets and educate farmers on the programs, driving them to implement them as well.

33. 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.

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

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

### **4.2.2 Awareness Creation**

35. Awareness creation on the ill effects of pesticides will be conducted to the targeting communities. The programs will include along with project beneficiaries, various stakeholders residing in the project area, including the community, government officers, project staff and local politicians. Awareness materials would be but not limited, posters, flyers, brochures, etc. These will be made available via the Agriculture extension offices. The following materials would be covered as

- Integrated Crop Management
- Integrated diseases management
- Integrated weed management
- Health issues of pesticide application
- Safe use of agrochemicals
- Steps in integrated pest management

### **4.2.3 Building technical capacity via training**

36. Training of beneficiaries and relevant stakeholders on IPM based pesticide management and safe use of pesticides will be conducted with the following areas as

- Detrimental effects of pesticide use to human health/environment

- Decision making in use pesticides
- Transport, storage ,handling and distribution of pesticides
- Safe application of pesticides
- Risks on handling and use of pesticides
- Managing risks and pesticide poisoning via green mechanisms
- Intergraded Pest Management

37. Training programs will first be conducted among the project beneficiaries, successful applicants of the MGP, project/field staff and will also target local DOA officers, stationed in the project area. It is proposed that this program be conducted by reputed pest management specialists with experience working in Sri Lanka. This will thus provide the existing project staff with the capacity to conduct training programs in the field. Training material will be prepared comprehensively and cover the key areas highlighted prior, fashioned as a guidance book for long term use and support post training.

Table-8: Training plan for execution of IPM based Pest Management Plan

No	Area	Indicators
1.0	Training and awareness creation	<ul style="list-style-type: none"> <li>• Types and number of participatory learning modules (PLM) delivered;</li> <li>• Category and number of extension agents and farmers trained and reached with each PLM;</li> <li>• Category and number of participants reached beyond baseline figures;</li> <li>• Practical skills/techniques most frequently demanded by extension agents and farmers; and Crop management practices preferred by farmers.</li> </ul>
2.0	Technology acceptance/ application field	<ul style="list-style-type: none"> <li>• Category and number of farmers who correctly apply the skills they had learnt; New management practices adopted most by farmers;</li> <li>• Category and number of other farmers trained by project trained farmers; Types of farmer-innovations implemented;</li> <li>• Level of pest damage and losses;</li> <li>• Rate of adoption of IPM practices;</li> <li>• Impact of the adoption of IPM on production performance of farmers</li> </ul>
3.0	Project benefits direct	<ul style="list-style-type: none"> <li>• Increase in crop production;</li> <li>• Increase in farm revenue;</li> <li>• Low incidence of pests and diseases</li> <li>• Social benefits: e.g., improvement in the health status of farmers;</li> <li>• Level of reduction of pesticide purchase and use; and</li> <li>• Number of project co families using preventive mechanisms against diseases.</li> </ul>

## 4.2.4 Safer Use Actions/Mitigation

38. Where a project has direct control over pesticide use, assure the following. Where a project is supporting or recommending pesticide use but has less than complete control, take all practicable measures to assure the following:

- **Hydrology.** Do not spray or rinse pesticide equipment in or within 30 meters of ponds, irrigation and drainage ditches, and other surface waters.

Do not spray pesticides with high toxicities to aquatic organisms before an impending rainstorm, as they can be washed into waterways before breaking down.

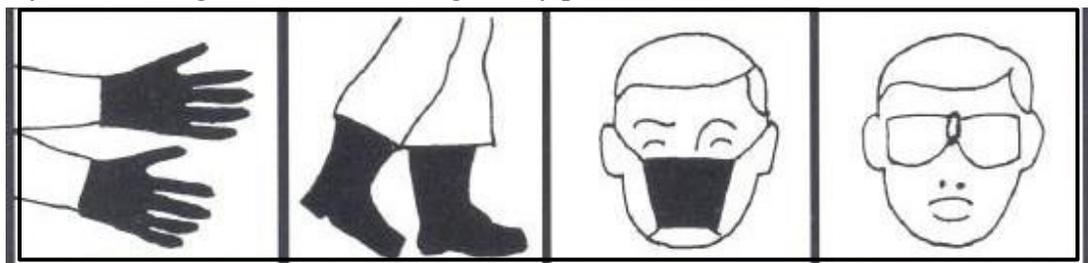
- **Soils:** Do not use or recommend for use herbicides or other pesticides with high leaching and groundwater pollution potential near drinking water sources, on highly sandy soils or soils with water tables close (2-3 meters) to the surface.
- **Soils:** Since transport of soil particles with pesticides adsorbed to them is a likely transportation route to waterways, employ techniques to reduce farm soil erosion whenever erosion is likely. Such techniques include vegetated buffer strips, green manure, mulching, terracing, employing wind breaks, employing ground covers between rows, planting rows perpendicular to the slope, using drip irrigation, and so on).

## 4.2.5 Safer use Plan

39. As appropriate, the CSAWMP will promote low-risk preventive and natural chemical pest controls that are attached in the *Annexure-3* and incorporating these controls in the pest management plans (PMPs) developed under this CSAWMP.

## 4.2.6 Personal Protection

- Design of personal protective equipment, dresses, other utensils should be collected from the IPM projects of DAE by CSAWMP personnel and:
- 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 CSAWMP and given to the shopkeepers for distribution by them among the farmers coming to buy pesticides.



## 5. Institutional Arrangement, Monitoring and Reporting and Budget

40. The CSAWMP financed crop demonstrations by WMG farmers will be carefully assessed and monitored with a purpose to improve the quality of the CSAWMP 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.
41. The CSAWMP uses Limited Environmental Assessment (LEA) form for selection of WMG farmers for crop demonstrations, it 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 WMG farmers.
42. The Project Management Unit of CSAWMP under DAE part will recruit an Environmental Safeguard Specialist/Climate Change and Adaptation Specialist who would ensure implementation of pest management plan. The Environmental Specialist on the quarterly visits the selected demonstration sites to observe the application of IPM measures. At the field, IPM and pesticides application management will be monitored by the SAAOs, SAPPOs. The Upazila Agriculture Officer (UAO) will be given the local Authority to review the monitoring program of PMP. The Upazila Fisheries Officer (UFO) will be assisting the UAO in organizing the monitoring activities.

### 5.1 Monitoring Schedules and Participants

- Implementation of IPM by the WMGs to be monitored by the SAAOs and SAPPOs once in a crop season.
- Half Yearly Review and Planning Workshop, lasting two days to review progress of implementation of WMG activities of last six months and planning for WMG activities in the next season. The SAAOs and LEAFs will be participated in the workshop and given the opportunity to discuss any problems encountered during the implementation of the CIG activities.
- Leaders of WMG will be participated for reporting achievements, difficulties, shortcomings on the part of SAAOs, SAPPOs and LEAFs and further opportunities for improvement.
- All these issues and challenges will or may arise with the implementation of the

Project. Appropriate mitigation measures and implementation tools as well as monitoring indicators are therefore required to be instituted to contain any adverse occurrence. The key actors to be involved in the implementation of the mitigation and management need to be identified as well.

## **5.2 Institutional Arrangement**

43. The DAE will form a Safeguard Team to oversee and ensure that the project complies with relevant safeguard policy documents prepared for the Project including this PMP and report to PCU.
44. The CSAWMP Project coordinators or PIU will communicate the content of the Pest Management Plan to all upstream project actors or participants such as the DAE at the national and relevant regional levels (i.e. within project beneficiary regions). It will establish on-going communication with both the national and relevant regional level pest and pesticide management representatives.
45. The CSAWMP will also organize an orientation workshop on IPM techniques as well as the PMP for relevant primary communities, which will in fact be at the forefront in terms of use of pesticides and are likely to be exposed to its various and gradual risks.
46. The PMP implementers will coordinate the pest management process with all relevant water resource regulators/users and other major land users in the project areas. Any activities that may have an impact on pest management will be identified and included in the pest management planning process. Contacts will be established with significant neighboring land owners and consult with them when appropriate and co-ordinate management activities with representatives of the identified government agencies and other land users when appropriate.
47. The purpose of the capacity building of farmers in particular is to help farmers develop their IPM approaches to the management of pests and diseases under the Project. The success of IPM depends largely on developing and sustaining institutional and human capacity to facilitate informed decision making by farmers and farm assistants, and empowering them to integrate scientific and traditional knowledge to solve location-specific problems, and respond to market opportunities. Poor communication between farmers/farm assistants, extension agents and researchers has often led to poorly-targeted research or to poor adoption of promising options generated by research. The full benefits of investments in agricultural research thereby remain untapped under these circumstances.

### **5.2.1 Dissemination Information About Pest Arrival**

48. 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.

49. The DAE (Regional/District Officers) will collaborate with the FFS farmers of WMGs to identify and organize farmers groups for training (i.e. use of farmer field school to teach farmers on the efficient and responsible use of pesticides); prepare, organize and supervise training implementation plan; verify reports of persisting pest problems and farmers training needs; monitor performance of farmer trainers and post-training assignments; and prepare training progress reports.

### 5.3 IMPLEMENTATION BUDGET

50. A budget estimate of USD is required to implement the PMP during a 3- year period, and this will be an annual estimated cost of USD and Details are provided in the table below. At the time of the preparation of this document the budget breakdown of items were not available from DAE. This information will be updated when the budget component breakdown for the IPMP is available from DAE.

Table-9: Budget Estimates

	Activity/Programme	Budget, USD				
		Year 1	Year 2	Year 3	Total	Cost/yr
<b>1.0</b>	<b>Capacity Building</b>					
1.1	Orientation workshops (on PMP, IPM, and					
1.2	Training of trainers					
1.3	Farmer group training					
1.4	Study visits					
	<i>Sub total</i>					
<b>2.0</b>	<b>Support/Advisory services</b>					
2.1	Registration of pesticide suppliers					
2.2	IPM problem diagnosis					
2.3	Field guides/ IPM materials					
2.4	Public awareness/ sensitization					
2.5	Pest/ vector surveillance					
2.6	Laboratory analysis support-MRLs					
2.7	Emergency response support					
	<i>Sub total</i>					
<b>3.0</b>	<b>Environmental management</b>					
3.1	Pesticide monitoring in surface water					
3.2	Equipment, bed nets, chemicals					
3.4	Support to IPM R&D					
	<i>Sub total</i>					
<b>4.0</b>	<b>Project management</b>					
4.1	PMP coordination					
4.2	Monitoring and evaluation					

4.3	Reviews and reporting					
	<i>Sub total</i>					
	<b>GRAND TOTAL/USD</b>				<b>318,000</b>	<b>106,000</b>

Source: Consultant's estimate

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*Annexure-1: Possible Impacts and Mitigation Measures under IPM based Pest Management Plan*

Impact issue / Pest & pesticide threat/	Mitigation Measures	Implementation tool	Expected result	Monitoring indicators	Responsibility/ Key
Pollution of water resources and aquatic life	Control and supervise pesticide use by farmers	Adoption of IPM approaches/ techniques	Farmers trained in IPM techniques	Number of farmers trained, Training records	DAE
	Proper disposal of pesticide containers by resellers/farmers	Pesticide container collection and disposal plan	Pesticide container disposal plan developed and implemented	Number of farmers/ resellers aware of pesticide container disposal plan	DAE & DoF
	Monitor pesticides in water resources	Environmental quality monitoring plan (linkage with Project ESMP)	Pesticide concentration in water resources	Levels of pesticides in water resources	DoF
Public health concerns from water-borne or water related diseases in project areas under irrigation	Design appropriate irrigation systems and ensure functional operation system (removing aquatic vegetation, lining canals with cement or plastic, regularly fluctuating water levels, periodic rapid drying of irrigation canals)	<ul style="list-style-type: none"> <li>Adoption of environmentally friendly irrigation system designs</li> <li>Selection of experienced and proven contractors and consultants for project designs and construction</li> <li>Effective operational maintenance system</li> </ul>	Well-functioning and environmentally friendly irrigation system;	Number of times system breakdown in a given year	Department of health

Mycotoxin poisoning from poor maize drying	Ensure adequate and timely drying of maize	Mycotoxin Elimination Plan (Education, equipment/facilities, international standards etc.)	Mycotoxin levels in maize produced meets international standards	Number of farmers trained and educated in the proper way of maize	DAE
	Provide proper maize drying facilities			Number and condition of maize drying facilities available	DAE
	Ensure maize storage facilities are adequate and meet acceptable standards				
	Monitor mycotoxin levels in maize produced under the project			Mycotoxin levels	DAE
Improper use of pesticides by farmers and farm assistants	Educate farmers and farm assistants on proper use of pesticides and pesticide use hazards	Pesticide hazards and use guide manual or leaflet for the project (include simple pictorial presentations)	Proper use of pesticides by farmers and farm assistants	Number of cases of pesticide poisoning occurring under the project	DAE, Pesticide companies
	Control and supervise pesticide use on farms	Adoption of IPM approaches/ techniques	Farmers trained in IPM techniques	Number of farmers trained, Training records	DAE
	Monitor pesticide residue in crops	Random sampling procedure for crops and storage products	Pesticide residue in crops within acceptable limit/MRL	<ul style="list-style-type: none"> <li>Levels and trend of pesticide residue in sampled crops</li> <li>Number of times exported crops are rejected due to pesticide residues</li> </ul>	DAE ,SRDI

Poisoning from improper disposal of pesticide containers	Educate farmers, farm assistants and local communities on health hazards associated with use of pesticide containers	Pesticide hazards and use guide manual or leaflet for the project	Farmers, farm assistants, FBOs, local communities educated on pesticide health hazards	Number of cases of pesticide poisoning through use of pesticide containers; Number of farmers returning empty pesticide containers at collection points; Number of farmers, retailers trained in proper cleaning of pesticide containers	DAE, Department of health
	Properly dispose pesticide containers	Pesticide container cleaning and disposal plan	Pesticide container cleaning and disposal plan developed and implemented		DAE, Department of health
Production and market losses from fruit fly pest and armyworm outbreaks	Educated farmers to agricultural (GAP) and train adopt good practices	Adoption of IPM techniques/ approaches	Farmers trained in IPM techniques and GAP	<ul style="list-style-type: none"> <li>• Number of farmers trained, Training records</li> <li>• Number of times exported crops rejected due to fruit fly pest</li> <li>• Production losses from crop pests</li> </ul>	DAE
	Establish pest surveillance system	Early detection and warning system in place	Zero or minimal fruit fly/ armyworm cases	Incidence of fruit fly /armyworm cases recorded	DAE
	Apply EPA approved and PPRSD recommended pesticide if necessary	Inspection of pesticides at farm/storage gate prior to use (Project Policy)	Applied pesticides registered and approved by key stakeholders and in conformity with IPM	Records of pesticides applied at each farm	DAE

Threat crop diseases from pests other and	Educated farmers to agricultural (GAP) and train adopt good practices	Adoption of approaches IPM techniques/ approaches	Farmers trained in IPM techniques and GAP	<ul style="list-style-type: none"> <li>• Number of farmers trained, Training records</li> <li>• Incidence of crop pests</li> <li>• Production losses from crop pests</li> </ul>	DAE
	Apply EPA approved and PPRSD recommended pesticide if necessary	Inspection of pesticides at farm/storage gate prior to use (Project Policy)	Applied pesticides registered and approved by key stakeholders and in conformity with IPM	Records of pesticides applied at each farm	DAE
Impact on post-harvest losses due to pests	1. Provide adequate and proper storage facilities	Post-harvest loss reduction plan based on IPM techniques in place	<ul style="list-style-type: none"> <li>• Post-harvest losses avoided or minimized</li> <li>• Applied pesticides registered and approved by key stakeholders and in conformity</li> </ul>	Number of farmers trained in IPM techniques for post-harvest storage; Number and condition of storage facilities in use	DAE
	Monitor incidence of post-harvest pests			Number of cases of post-harvest pests	DAE
	Confirm status and integrity of pesticides at storage gate prior to use	Inspection of pesticides at farm /storage gate prior to use (Project Policy)		Records of pesticides applied at storage sites/ rooms	DAE

Abuses in pesticide supply and sales	Identify all pesticide distributors and resellers interested in providing services and products to farmers under the Project	Registration policy for all interested distributors and resellers under project	Only approved and licensed dealers and resellers supply pesticides under project	<ul style="list-style-type: none"> <li>• Company registration documents</li> <li>• Evidence of license/permit to operate in pesticides</li> <li>• Evidence of location and contacts of suppliers/resellers</li> </ul>	DAE
	Confirm status and integrity of pesticides supplied under project	<ul style="list-style-type: none"> <li>• All pesticides are to be in the original well labeled pesticide containers prior to use</li> <li>• No decanting of pesticides under this project</li> <li>• Inspection of pesticides at farm gate prior to use</li> </ul>	<ul style="list-style-type: none"> <li>• Only approved and registered pesticides used under project</li> <li>• Banned pesticides avoided</li> <li>• Fake and expired pesticides avoided Integrity of pesticide guaranteed at farm gate level</li> </ul>	<ul style="list-style-type: none"> <li>• List of pesticides supplied and used in line with EPA and USE list of registered and approved pesticides</li> <li>• Cases of pesticides found in non-original containers</li> <li>• inspection records for pesticides at farm gate prior to use</li> </ul>	DAE, Upazila Administration
	Ban big pesticide containers to minimize decanting cases	Decanting policy (No decanting of pesticides under project)	All pesticides delivered for use are in the original containers	Cases of pesticides found in non-original containers	DAE

General health safety farmers/ crops environmental hazards	Educate farmers to adopt GAP based upon IPM techniques; and do not use chemical pesticides unless advised by DAE	IPM techniques with emphasis on cultural and biological forms of pest control	Compliance with national IPM policy and WB policy on Pest/ pesticide management	Number of farmers trained in IPM techniques; Number of farmers implementing IPM on their farms Frequency of chemical pesticides usage	DAE
	Provide PPEs to farmers/farm assistants for pesticide use in the fields	Health and safety policy for farm workers	Farmers and accompanying dependents(children ) protected against pesticide exposure in the fields	PPEs supplied or made available under the project	DAE, Health department, Upazila Administration
	Educate farmers/ farm assistants in the proper use of pesticides	Pesticide hazards and use guide manual or leaflet for the project (include simple pictorial presentations)	Farmers know and use pesticides properly; pesticide hazards and use guide leaflet or flyers produced	Number of farmers trained in pesticide use; Number of farmers having copies of the pesticide hazard and use guide flyers;	DAE
	Properly dispose obsolete and unused pesticides	Obsolete and unused pesticide disposal plan	Obsolete and unused pesticide disposal plan prepared and implemented	Relationship between pesticide supply and usage	DAE, Upazila administration

<p>Educate farmers to obtain or purchase quantities of pesticides required at a given time and to avoid long term storage of pesticide</p>	<p>Pesticide use policy/plan</p>	<p>Only pesticides needed are purchased; long term storage of pesticides by farmers avoided</p>	<p>Relationship between pesticide supply and usage</p>	<p>DAE</p>
<p>Provide emergency response to pesticide accidents and poisoning</p>	<p>Emergency response plan</p>	<p>Pesticide accidents and emergencies managed under the project</p>	<p>Number of pesticide accidents and emergencies</p>	<p>DAE, Health department</p>

**Annexure-2: List of Banned Pesticide in Bangladesh**

SL	Trade name of Products	Registration Number	Name of Company	SL	Trade name of Products	Registration Number	Name of Company
1	Diazinon 14G	AP-08	Shetu Coporation Limited	30	Vapona	AP-79	Shell Company of Bangladesh Limited
2	Bizguard 2P	AP-09	Ciba-Geigy (Bangladesh) Limited	31	Bidrin 85 WSC	AP-80	Shell Company of Bangladesh Limited
3	Roxion 40 EC	AP-11	International Services (BD) Limited	32	Dieldrin 50 WP	AP-82	Shell Company of Bangladesh Limited
4	Dankavapon 100 EC	AP-13	Shetu Corporation Limited	33	Dieldrin 40 WP	AP-83	Shell Company of Bangladesh Limited
5	Damfin 2P	AP-19	Ciba-Geigy (Bangladesh) Limited	34	Furadan 3G	AP-85	FMC International S.A.
6	Diazinon 90L	AP-20	Ciba-Geigy (Bangladesh) Limited	35	Actellic 2% Dust	AP-99	Bangladesh Manufacturers Limited
7	Danmfin 950 EC	AP-25	Ciba-Geigy (Bangladesh) Limited	36	Quickphos	AP-102	Agrani Traders
8	Dichlorvos	AP-27	Bayer (Bangladesh) Limited	37	Torque 550g/I	AP-115	International Services (BD) Limited
9	Curaterr 3G	AP-30	Bayer (Bangladesh) Limited	38	Ridan 3G	AP-131	Rupali Sangstha Limited
10	2,4-D Na Salt	AP-34	Bayer (Bangladesh) Limited	39	Bkzne 14G	AP-135	B. K. Traders
11	Folthion ULVC 98	AP-36	Bayer (Bangladesh) Limited	40	Aerocypermethrin 10 EC	AP-137	Liza Enterprise Limited
12	Methybron	AP-38	Excell Trading Company	41	Karmex	AP-145	Beximco Agrochemicals Limited
13	Heptachlor 40 WP	AP-39	Krishi Banijya Protisthan	42	Carbaryl 85 WP	AP-147	Shetu Corporation Limited
14	Chlordane 40 WP	AP-40	Krishi Banijya Protisthan	43	Agridan 3G	AP-154	Shetu Pesticides Limited
15	Aerovap 100 EC	AP-41	Liza Enterprise Limited	44	Tecto 2% Dust	AP-157	Alco Pharma Limited
16	Aerodriel 20 EC	AP-42	Liza Enterprise Limited	45	Manex-II	AP-163	Shetu Corporation Limited
17	Aeromal 57 EC	AP-44	Liza Enterprise Limited	46	Phytox MZ 80	AP-164	Liza Enterprise Limited
18	Padan 10G	AP-52	Data Enterprises Limited	47	Uniflow TM Sulphur	AP-167	Shetu Corporation Limited
19	Fenitrothion 98	AP-53	Farm Chemical Corporation Limited	48	Fenkil 20 EC	AP-169	Agrani Traders
20	Carbin 85 WP	AP-54	Farm Chemical Corporation Limited	49	Sunfuran 3G	AP-171	Shetu Corporation Limited
21	Diamal 57 EC	AP-55	Farm Chemical Corporation Limited	50	Hekthion 57 EC	AP-178	Farm Chemical Corporation Limited
22	Detia Gas EXT	AP-56	Farm Chemical Corporation Limited	51	Poligor 40 EC	AP-180	Farm Chemical Corporation Limited
23	Dichlorvos 100 EC	AP-57	Farm Chemical Corporation Limited	52	Melbromid 98	AP-185	Horizon Trade Limited
24	Methyl Bromide 98	AP-57	Farm Chemical Corporation Limited	53	Mebrom	AP-186	Bengal Wings Trade Limited
25	Malathion 57 EC	AP-68	BPI Limited	54	Agrine 85 WP	AP-187	Edgro (Private) Limited
26	Curaterr 3G	AP-69	Bayer (Bangladesh) Limited	55	Drawizon 60 EC	AP-190	Keeco Pesticides Limited
27	Dieldrin 20 EC	AP-73	Shell Company of Bangladesh Limited	56	Gastoxin	AP-195	Bright Corporation
28	Bidrin 24 WSC	AP-74	Shell Company of Bangladesh Limited	57	Cekomethrin 10 EC	AP-219	Premier Traders
29	Malathion 57 EC	AP-78	Burmah Eastern Limited	58	Cythrin	AP-220	Bari & Company Limited
SL	Trade name of Products	Registratio	Name of Company	SL	Trade name of Products	Registration	Name of Company

59	Cekuthoate 40 EC	AP-225	Premier Traders	88	Vitacron 40 SL	AP-341	Shetu Marketing Company
60	Arifos 20 EC	AP-229	Bari & Company Limited	89	Monotaf 40 WSC	AP-331	Auto Equipment Limited
61	Malathion 57 EC	AP-230	Sabrina Trading Corporation	90	Tamaron 40 SL	AP-188	Haychem (Bangladesh) Limited
62	Cardan 5G	AP-234	Bari & Company Limited	91	Folithion 50 EC	AP-32	Haychem (Bangladesh) Limited
63	Diazinon 14G	AP-236	Liza Enterprise Limited	92	Macuprax 65%	AP-65	Bayer CropScience Limited
64	Rizinon 60 EC	AP-239	Bari & Company Limited	93	Zithiol 57 EC	AP-126	Rhone Poulenc Bangladesh
65	Zincphosphide	AP-258	Liza Enterprise Limited	94	Delapon Na-84	AP-66	Rhone Poulenc Bangladesh
66	Davison Glyphosate	AP-266	Shete Pesticides Limited	95	Anthio 25 EC	AP-64	Rhone Poulenc Bangladesh
67	Morestan 25 WP	AP-269	Beximco Agrochemicals Limited	96	Zolone 35 EC	AP-67	Rhone Poulenc Bangladesh
68	Manzate 200	AP-301	Auto Equipment Limited	97	Rentokill CC Type 75%	AP-221	Getco Limited
69	Dimecron 100 SL	AP-	Novartis (Bangladesh) Limited	98	Paramount CC Type	AP-300	BD Associate and Company
70	Pillarcron 100 SL	AP-148	Shetu Pesticides Limited	99	Darsban 20 EC	PHP-5	Auto Equipment Limited
71	Benicron 100 WSC	AP-06	Sabrina Trading Corporation	100	Darsban 20 EC	PHP-85	Auto Equipment Limited
72	DDVP 100 W/V	AP-03	ACI Formulations Limited	101	Basudin 10G	AP-23	Syngenta Bangladesh Limited
73	Chemo DDVP 100 EC	AP-245	Chemsfil Bangladesh Limited	102	Diazinon 60 EC	AP-24	Syngenta Bangladesh Limited
74	DDVP 100 EC	AP-151	McDonald Bangladesh (Pvt) Limited	103	Mortin King Mosquito	PHP-54	Reckitt Benckiser Bangladesh Limited
75	Nogos 100 EC	AP-	Novartis (Bangladesh) Limited	104	Mortin Mosquito Coil	PHP-101	Reckitt Benckiser Bangladesh Limited
76	Phosvit 100 EC	AP-56	Data Enterprises Limited	105	Sarfium 56%	AP-689	Sar Trade Fertilizer Limited
77	Daman 100 EC	AP-325	Petrochem (Bangladesh) Limited	106	Sicofen 20 EC	AP-624	Genetica
78	Azodrin 40 WSC	AP-336	BASF Bangladesh Limited	107	Cythrane 10 EC	AP-310	ACI Formulations Limited
79	Nuvacron 40 SL	AP-	Novartis (Bangladesh) Limited	108	Diazonyl T-60	AP-283	ACI Formulations Limited
80	Megaphos 40 SL	AP-175	McDonald Bangladesh (Pvt) Limited	109	Salmathion 57 EC	AP-1066	Agrimax Bangladesh Limited
81	Phoskil 40 SL	AP-339	United Phosphorus (Bangladesh) Ltd	110	Basamid Granular	AP-205	BASF Bangladesh Limited
82	Kadette 40 WSC	AP-284	Bisco Pesticide & Chemical	111	Ducord 17 EC	AP-793	BASF Bangladesh Limited
83	Monophos 40 WSC	AP-328	Alpha Agro Limited	112	Argold 10 EC	AP-409	BASF Bangladesh Limited
84	Monodrin 40 WSC	AP-07	Sabrina Trading Corporation	113	Dicofol 18.5 EC	AP-359	McDonald Bangladesh (Pvt) Limited
85	Corophos 40 SL	AP-342	Corbel International Limited	114	Carbaryl 85 WP	AP-150	McDonald Bangladesh (Pvt) Limited
86	Luphos 40 SL	AP-388	ACI Formulations Limited	115	Amitage 20 EC	AP-476	McDonald Bangladesh (Pvt) Limited
87	Amcodrin 40 SL	AP-340	Atherton Imbros Company Limited	116	Neoron 500 EC	AP-551	Syngenta Bangladesh Limited
117	Anvil 5 SC	AP-472	Syngenta Bangladesh Limited	160	Crack down	PHP-193	Bayer CropScience Limited
118	Ridomil Gold MZ 68 WG	AP-377	Syngenta Bangladesh Limited	161	Resigen 50 E	PHP-194	Bayer CropScience Limited
119	Folio Gold 440 SC	AP-1133	Syngenta Bangladesh Limited	162	Resigned OS	PHP-196	Bayer CropScience Limited
120	Dolma 5G	AP-1226	Syngenta Bangladesh Limited	163	Bilshot M 46.5 EC	AP-586	Pharma & Farm
121	Sonnet 50 SP	AP-1488	Syngenta Bangladesh Limited	164	Pharzeb 80 WP	AP-784	Pharma & Farm
122	Basudin 10GR	AP-532	Syngenta Bangladesh Limited	165	Phartap 50 SP	AP-605	Pharma & Farm

123	Ricon 60 EC	AP-533	Syngenta Bangladesh Limited	166	Cypercid 10 EC	AP-523	Pharma & Farm
124	Paprika 50 EC	AP-1250	Syngenta Bangladesh Limited	167	Glyphar 41 SL	AP-896	Pharma & Farm
125	Touchdown	AP-404	Syngenta Bangladesh Limited	168	Topsin M 70 WP	AP-193	Data Enterprises Limited
126	Touchdown HiTech 500SL	AP-873	Syngenta Bangladesh Limited	169	Homai 80 WP	AP-179	Data Enterprises Limited
127	Dual Gold 960 EC	AP-1111	Syngenta Bangladesh Limited	170	Padan 50 SP	AP-555	Data Enterprises Limited
128	Lintur 70 WG	AP-633	Syngenta Bangladesh Limited	171	Diazinon 14G	AP-554	Data Enterprises Limited
129	Koranda	AP-794	Auto Crop Care Limited	172	Diazinon 60 EC	AP-557	Data Enterprises Limited
130	Seda 50 SP	AP-420	Auto Crop Care Limited	173	Diazinon 90 ULVC	AP-560	Data Enterprises Limited
131	Lorsban 15G	AP-371	Auto Crop Care Limited	174	Trebon 10 EC	AP-161	Data Enterprises Limited
132	Autoguard 25 EC	AP-1147	Auto Crop Care Limited	175	Bassa 50 EC	AP-142	Data Enterprises Limited
133	Focus 50 SC	AP-828	Auto Crop Care Limited	176	Elsan 50 EC	AP-556	Data Enterprises Limited
134	Alert 50 EC	AP-648	Auto Crop Care Limited	177	Elsan 92 ULVC	AP-558	Data Enterprises Limited
135	Quinguard 25 EC	AP-1106	Auto Crop Care Limited	178	Vitavax 200B	AP-559	Pioneer Equipment & Chemical Co.
136	Fendror 5G	AP-279	Auto Crop Care Limited	179	Pyriban 20 EC	AP-381	Agro Development Services Co. (Pvt) Ltd
137	Edfen 50 EC	AP-191	Sea Trade Fertilizer Limited	180	Aimal 57 EC	AP-1136	Agro Development Services Co. (Pvt) Ltd
138	Malatox 57 EC	AP-286	Sea Trade Fertilizer Limited	181	Asset	AP-364	Agrodev United
139	Edthoate 50 EC	AP-307	Sea Trade Fertilizer Limited	182	Padan 4 G	AP-372	Krishi Kallyan Limited
140	Metasystox R 25 EC	AP-493	United Phosphorus (Bangladesh) Ltd	183	Diazinon 10GR	AP-385	Krishi Kallyan Limited
141	Sumithion 3% Dust	AP-156	Shetu Corporation Limited	184	Limithion 57 EC	AP-264	ACI Formulations Limited
142	Sumibas 75 EC	AP-255	Shetu Corporation Limited	185	Knockout Liquid Insect Sprya	PHP-28	Shetu Pesticides Limited
143	Arozin 30 EC	AP-383	Bayer CropScience Limited	186	Victor 1G	PHP-340	Shetu Pesticides Limited
144	Basta SL 15	AP-265	Bayer CropScience Limited	187	Night Queen Mosquito Coil	PHP-46	Shetu Pesticides Limited
145	Baycarb EC 500	AP-488	Bayer CropScience Limited	188	Sovathion 50 EC	AP-240	Shetu Pesticides Limited
146	Curaterr 5G	AP-490	Bayer CropScience Limited	189	Pillartex 50 EC	AP-414	Shetu Pesticides Limited
147	Cupravit 50 WP	AP-489	Bayer CropScience Limited	190	Kap 50 EC	AP-216	Shetu Pesticides Limited
148	Hinosan EC 50	AP-491	Bayer CropScience Limited	191	Dipterex 80 SP	AP-561	United Phosphorus (Bangladesh) Ltd
149	Labaycid 50 EC	AP-492	Bayer CropScience Limited	192	Cekufon 80 SP	AP-257	Shetu Pesticides Limited
150	Sunrice Super 315 EC	AP-1777	Bayer CropScience Limited	193	Palash 57 EC	AP-312	Petrochem (Bangladesh) Limited
151	Benefiter 315 SC	AP-2105	Bayer CropScience Limited	194	Pounce 1.5G	AP-419	FMC Chemical International AG
152	Thiodan 35 EC	AP-1147	Bayer CropScience Limited	195	Acecro 20 EC	AP-318	McDonald Bangladesh (Pvt) Limited
153	Fantush 300 EC	AP-2569	Asia Trade International				
154	Ultima 40 WG	AP-2560	Mimpex Agrochemicals Limited				
155	Abate 15 G	PHP-118	BASF Bangladesh Limited				
156	Fendona 1.5 SC	PHP-84	BASF Bangladesh Limited				
157	Edfen 50 EC	PHP-40	Sea Trade Fertilizer Limited				
158	Coopex 25 WP	PHP-191	Bayer CropScience Limited				
159	Sislin 2.5 EC	PHP-192	Bayer CropScience Limited				

*Annexure-3: Botanical Active Ingredients in Pesticides, Repellents, and Baits*

Name	Other Names	Use	Toxicity
1-Octen-3-ol	From clover,	Trap bait: mosquitoes	Low
Orange		Repels vertebrates	Low
Swietenia Mahagoni	Mahogany Fruit	Pesticide	Low
p-Methane-3,8 diol	Eucalyptus sp.	Repels biting flies, mosquitoes	Low
2-Phenylethyl-propionate	From peanuts	Kills insects, ticks, mites & spiders	Low
Pyrethrum	Chrysanthemu	Stored products use	III
Red pepper	Chilli	Repels insects	Low
Rosemary	Herb		Low
Rotenone	Derris sp.,	Controls ticks	III
Ryania	Ryania speciosa	Kills thrips, codling moth, corn borers	
Sabadilla	Schoenocaulon		III
Sesame Oil	Sesamum	Pyrethroid synergist	Low
Soybean Oil	Soja	Kills insects, mites	Low
Thyme	Herb	Controls aphids	Low
1,2,4 Trimethoxy-benzene	From squash	Trap bait: corn rootworm, cucumber beetles	Low
Verbenone	From pine trees	Repels bark beetles	Low

*Annexure-4: Field Monitoring Form for Farmer Best Practices including GAP and IPM options*

Date of site visit:				
Name of the Demonstration Farmer :				
Name of planted Crop:				
<b>District / Upazila :</b>				
<b>Village/ Union:</b>				
<b>Location: Lat----- Long-----</b>				
Environmental Screening Checklist		Check (✓)		Comments
		Yes	No	
Environmentally conscious design				
1. What are the major pests encountered by the farmer?				
2. Which of the attached Preventive and Curative GAP and IPM tools and tactics are used by farmer?				
3. Are pesticides used by demo farmer?				
4. How are pesticides applied? ( <i>backpack sprayer or others</i> )				
5. What are the pesticides used?				
6. Does PPE have and use?				
7. If yes, name of PPE used during spray?				
8. Had the farmer received IPM and Safe Pesticide Use training				
9. Are there any empty pesticide containers scattered in the field?				
10. Are there signs that the backpack sprayer has leaks?				
11. Does the farmer understand the pesticide label information?				
12. Is the pesticide stored safely out of the house or away from kids?				

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13. Does the farmer use gloves for mixing the pesticide with water?				
14. What times of the day are the pesticides applied?				
15. Are pesticides applied during rain or windy conditions?				
16. Are women or children permitted to apply pesticides?				
17. Are empty pesticide containers are used to store water?				
18. Does the farmer rinse equipment away from streams and open water?				
19. Does the farmer wash clothes after applying pesticides?				
20. How does the farmer dispose of empty pesticide containers?				<b>puncture/bury</b>
21. Is there any evidence that pesticides are becoming less effective?				
Name of Evaluator:		Signature:		



*Annexure-5: Control Card for Pesticides Use-This card will stay with farmer, to keep a record on the use of pesticide by crop.*

**CONTROL FORM FOR THE USE OF PESTICIDES**

<b>GENERAL DATA</b>			
<b>FARMERS NAME</b>			
<b>Community:</b>	<b>Municipality:</b>	<b>Province:</b>	<b>Altitude:</b>
<b>USE OF PESTICIDES - 1st TREATMENT</b>			
<b>CROP:</b>		<b>SURFACE:</b>	
Pest to be treated	Name of material	Date and time of application	Quantity used
Environmental conditions:			
Justification for use			
Other recommended control measures			
Result of application			
<b>NAME AND SIGNATURE OF IG AND NRM SUPERVISOR:</b>			
<b>USE OF PESTICIDES - 2nd TREATMENT</b>			
<b>CROP:</b>		<b>SURFACE:</b>	
Pest to be treated	Name of material	Date and time of application	Quantity used
Environmental conditions:			
Justification for use			
Other recommended control measures			
Result of application			
<b>NAME AND SIGNATURE OF IG AND NRM SUPERVISOR:</b>			

### ***Annexure-6: BASELINE INFORMATION ON THE ENVIRONMENT, AGRICULTURE AND PESTICIDE USE***

1. The BWDB has identified 43 potential schemes for financing under the CSAWMP. Detailed plans will be prepared for at least 20 selected schemes where interventions by each entity can be started in the first year of project implementation. It was agreed that BWDB will work with DAE and DOF teams to identify the nature of agriculture and fisheries/aquaculture activities that will be carried out in these priority schemes, including needed actions to facilitate farmers' access to markets.
2. For systematic recording of data, baseline environment is usually classified into physical environment, biological environment, and socio-economic environment; and important features/parameters under each category are identified and measured/ recorded during feasibility study. Each scheme specific IEE should provide an updated overview of baseline conditions for the whole program area (reflecting any changes on the ground since this preliminary baseline for the full program area was established at the time of preparation of this document), as well as a detailed analysis specific to the influence area of that phase. The following screening will be used for each scheme.

**Table 1 Environmental Screening**

	<b>Adverse Ecological Zone</b>	<b>Flood Plain</b>	<b>Monsoon Flooding</b>	<b>Land Classification Based on Flooding</b>	<b>Erosion Zone</b>	<b>Hazard Type and Class</b>	<b>Soil Texture Type</b>	<b>Environmental Sensitive Area</b>	<b>Salinity</b>
<b>Scheme</b>	Yes/No	Yes/No	Severity of Flooding	Land Classification Type	Erosion Zone	Hazard Type and Class	Soil Texture Type	Yes/No Identify wetland, beel, forest	Yes/No

3. Team of Consultants along with the BWDB officials visited three BWDB zones, i.e., Central zone Dhaka, Mid-Western zone Faridpur, South Eastern zone Chittagong . Meeting were held with the official of local BWDB offices, Union Chairman and local representatives of the concerned schemes for some of the visited schemes and with the Upzilla Officials (DA and DoF) of the respective schemes.

During field visits, discussions were held with the different stakeholders on different issues; discussions on; proposed schemes to be implemented under CSAWMP; and capacity and institutional arrangement for environmental management of the proposed schemes . Focus Group Discussions (FGDs) were held during these field visits to identify issues and problems to enable the institution to corrective measures and to identify lessons and opportunities to enhance project implementation mechanism. Discussions also have been held with the BWDB officials on different aspects of project implementation and management, particularly focusing on existing capacity and institutional arrangement for environmental management of the proposed schemes.

4. The following information were obtained during the focused

- The type of crop, vegetable and fruit produced
- Current pest management practices
- Pesticide use
- Availability of labour and labour out migration
- Availability of inputs
- Cost of production
- Market facilities
- Current market price of produce

*Cost of Pesticide Use*

5. Presents costs of inputs as percentages of cash and full costs per hectare, and Table shows costs of inputs as total and percentages of cash costs per hectare for irrigated *boro* paddy cultivation. Full costs include imputed land rent and imputed cost of family labor, but cash costs exclude these items

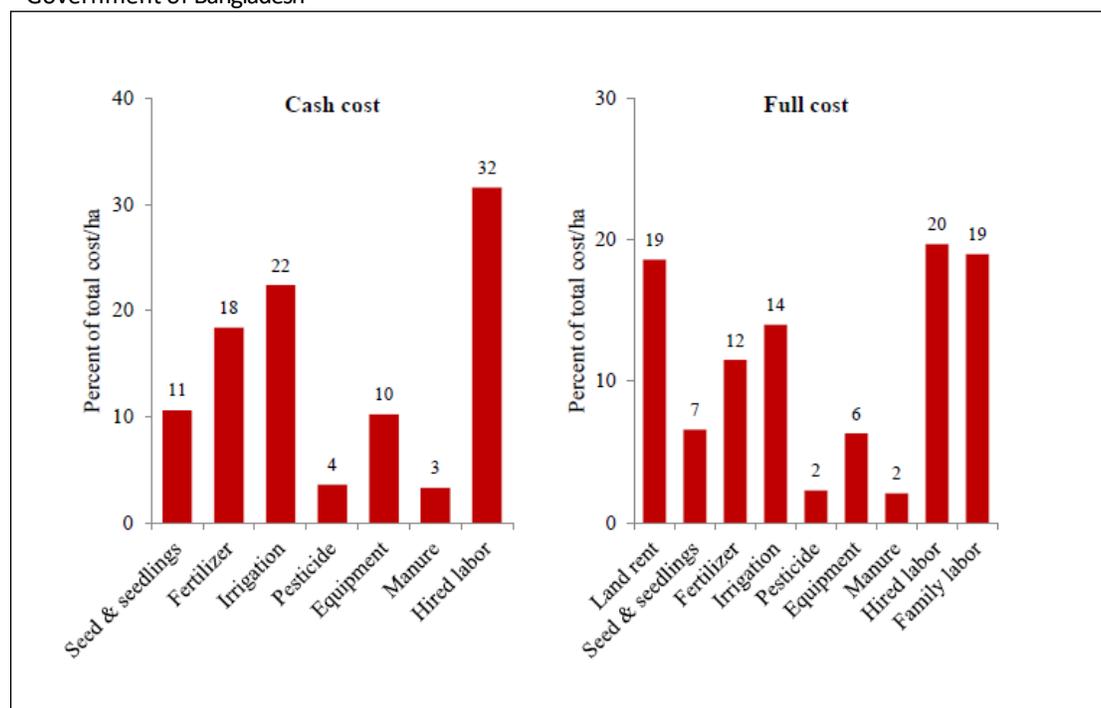


Figure 1 Percent Cost of Pesticide

Table 2 Per Hectare Cost of Pesticide

Input	Division								Bangladesh
	FTF zone	Barisal	Chittagong	Dhaka	Khulna	Rajshahi	Rangpur	Sylhet	
					(taka)				
Seed/seedling	4,757	3,957	6,902	6,049	4,549	6,710	3,769	4,159	5,549
Mechanical irrigation	13,453	8,648	11,386	12,079	13,641	11,332	10,380	6,864	11,431
Manual irrigation	477	842	333	217	854	315	64	575	327
Land rent	14,565	10,763	12,973	14,434	15,110	18,854	16,892	14,414	15,623
Urea	3,696	3,647	3,464	3,489	4,031	3,494	3,419	2,398	3,487
TSP	3,445	4,581	4,182	2,494	3,889	2,463	2,532	2,041	2,858
DAP	771	-	185	1,147	849	1,193	848	25	885
MP	1,528	663	1,401	1,509	1,832	1,312	1,374	563	1,416
Zinc	700	449	351	277	1,217	417	196	85	408
Ammonia	16	-	-	3	21	5	27	-	9
Gypsum	1,048	-	66	165	1,005	372	408	77	338
NPKS	23	-	9	36	6	8	9	17	17
Calcium	225	470	173	357	307	148	104	111	232
Manure	1,382	252	1,760	1,402	634	1,930	3,395	516	1,751
Pesticides	2,112	3,263	2,187	1,373	2,010	2,864	1,835	761	1,907

Table 3 Percent Cost of Pesticide

Region	Seed	Irrigation	Land rent	Fertilizer	Manure	Pesticide	Equipment	Family labor	Hired labor	Total
(percent)										
FTF zone	5.7	16.6	17.4	13.7	1.6	2.5	6.7	19.1	16.7	100.0
Barisal	5.4	12.9	14.6	13.3	0.3	4.4	14.2	16.2	18.7	100.0
Chittagong	7.3	12.4	13.7	10.4	1.9	2.3	6.3	15.1	30.7	100.0
Dhaka	7.0	14.3	16.8	11.0	1.6	1.6	6.4	20.1	21.1	100.0
Khulna	5.2	16.6	17.3	15.1	0.7	2.3	6.4	20.0	16.3	100.0
Rajshahi	7.7	13.4	21.8	10.9	2.2	3.3	5.7	18.7	16.2	100.0
Rangpur	5.0	13.8	22.3	11.8	4.5	2.4	6.3	20.0	14.0	100.0
Sylhet	6.3	11.3	21.9	8.1	0.8	1.2	7.8	17.7	25.0	100.0
Bangladesh	6.6	14.0	18.6	11.5	2.1	2.3	6.3	19.0	19.7	100.0

Source: IFPRI Bangladesh Integrated Household Survey, 2011-2012. The survey represents rural areas only.

Note: Equipment include drought animal, power tiller and other agricultural machineries

**Annexure-7: Acute Toxicity of Pesticides: EPA and WHO Classifications.***General Toxicity*

1. Pesticides, by necessity, are poisons, but the toxicity and hazards of different compounds vary greatly. Toxicity refers to the inherent intoxicating ability of a compound whereas hazard refers to the risk or danger of poisoning when the pesticide is used or applied. Pesticide hazard depends not only on toxicity but also on the chance of exposure to toxic amounts of the pesticide. Pesticides can enter the body through oral ingestion, through the skin or through inhalation. Once inside the body, they may produce poisoning symptoms, which are either acute (from a single exposure) or chronic (from repeated exposures or absorption of smaller amounts of toxicant).

*US Environmental Protection Agency (USEPA) and World Health Organization (WHO) Toxicity Classifications*

2. Basically, there are two systems of pesticide toxicity classification. These are the USEPA and the WHO systems of classification. It is important to note that the WHO classification is based on the active ingredient only, whereas USEPA uses product formulations to determine the toxicity class of pesticides. So, WHO classification shows relative toxicities of all pesticide active (or technical) ingredients, whereas EPA classification shows actual toxicity of the formulated products, which can be more or less toxic than the active ingredient alone and are more representative of actual dangers encountered in the field. The tables below show classification of pesticides according to the two systems.
3. *USEPA classification (based on formulated product = active ingredient plus inert and other ingredients)*

Class	Descriptive term	Mammalian LD50		Mammalian Inhalation LC50	Irritation		Aquatic invert/fish (LC50 or EC50) <sup>2</sup>	Honey bee acute oral (LD50)
		Oral	Dermal		Eye <sup>1</sup>	Skin		
I	Extremely toxic	≤50	≤200	≤0.2	Corrosive	Corrosive	< 0.1	
II	Highly toxic	50-500	200-2000	0.2-2.0	Severe	Severe	0.11-1.0	< 2 µg/bee
III	Moderately toxic	500-5000	2000-20000	2.0-20	No corneal opacity	Moderate	1.1-10.0	2.1-11 µg/bee
IV	Slightly toxic	≥5000	≥20000	≥20	None	Moderate or slight	10.1-100	
	Relatively non-toxic						101-1000	
	Practically non-toxic						1001-10,000	> 11 µg/bee
	Non-toxic						> 10,000	

4. Corneal opacity not reversible within 7 days for Class I pesticides; corneal opacity reversible within 7 days but irritation persists during that period for Class II pesticides; no corneal opacity and irritation is reversible within 7 days for Class III pesticides; and Class IV pesticides cause no irritation Expressed in ppm or mg/l of water.

*WHO classification (based only on active or 'technical' ingredient)*

Class	Descriptive term	Oral LD50 for the rat (mg/kg body wt)		Dermal LD50 for the rat (mg/kg body wt)	
		Solids	Liquids	Solids	Liquids
Ia	Extremely hazardous	≤5	≤20	≤10	≤40
Ib	Highly hazardous	5-50	20-200	10-100	40-400
II	Moderately hazardous	50-500	20-2000	100-1000	400-4000
III	Slightly hazardous	≥501	≥2001	≥1001	≥4001
U	Unlikely to present acute hazard in normal use	≥2000	≥3000	-	-