GOVERNMENT OF KARNATAKA
Department of Horticulture

The World Bank Assisted
Karnataka Watershed Development Project-II
(Sujala-III)

Additional Environmental Assessment and Revising and Updating Environmental Management Framework

Final Report
June 2012

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Table of Contents

1 Approach and Methodology

1.1 Background

An Environmental Management Framework was prepared for the World Bank assisted Karnataka Watershed Development Project – II (Sujala-III). As the project preparation progressed, Horticulture component of this project has gained prominence in terms of scope and funding. Due to this change of project scope and investments, an Additional Environmental Assessment of the horticulture component was undertaken. The revised Horticulture component has the following sub-components:

- Extension and demos for productivity Improvement
- Farmer horticulture soil and crop monitoring
- Horticulture post harvest management value chain
- Horticulture services support
- Horticulture (Proposed Investments)

The present effort of conducting an environmental assessment of the horticulture component is completed and updating the existing EMF is in progress.

1.2 Scope of Work

This additional Environmental Assessment and the Environmental Management Framework is prepared to supplement the already existing and approved EA and EMF.. The scope of the additional work includes:

1. Data on climate and meteorology of the micro watersheds involving the horticultural crops grown in the area
2. Water sources, ground water table, water quality, soil, air and biodiversity aspects
3. Sensitive areas with respect to above aspects
4. Cropping pattern in the micro watersheds with special reference to horticulture crops of small/ marginal farmers.
5. Usage of fertilizers, pesticides etc.,
6. Water harvesting and water saving techniques under practice
7. Sustainable agricultural practices including bio-control measures
8. Waste management practices
9. Infrastructure likely to be developed due to the direct impact of the project and because of the project, impact of these infrastructures on environment.
10. Analysis of the GOI, GOK and WB Laws, Acts, Regulations and Policies
11. Identification of Good Agricultural Practices in the micro watersheds.
12. Identification of the positive and negative impact due to the project activities and post project follow up activities.

13. Categorization of these impacts into permanent and temporary and severe, moderate and negligible nature
14. Preparation of Environmental Management Plan (EMP) duly specifying enhancement measures for good practices and mitigation measures to the negative impacts.
15. Prescribing environmental monitoring and audit plan with monitorable indicators.
16. Capacity building and training for implementing EMP.
17. Interaction with officers of the Department of Horticulture and other related departments
18. Any other necessary information

1.3 Approach and Methodology

The study is conducted using participatory approaches throughout. The approach to study is to complete the assignment in two phases covering five distinct stages of work as explained below:

1.4 Assignment Phases

The five stages covering the two phases of the assignment and the activities to be taken up during each stage are given below:

Stage	Activities
Inception Stage	▪ Finalization of Approach and Methodology ▪ Identification of data requirements and mode of data collection ▪ Preparation of study tools ▪ Preparation and Submission of Inception Report
Field Surveys Stage	▪ Data Collection from Secondary Sources ▪ Field Surveys in micro watersheds selected by Horticulture Department for getting information on the nature and severity of environmental issues ▪ Discussions with stakeholders in these micro watersheds ▪ Data collection from secondary sources ▪ Preliminary assessment of environmental issues, based on secondary sources of information, field surveys and consultations
Analysis and Assessment Stage	▪ Analysis of baseline environmental issues, policies, legislations and institutions ▪ Firming up recommendations regarding mitigation measures, monitoring and evaluation strategies and institutional responsibilities ▪ Preparation of the Environment Management Monitoring Plan and Performance Indicators
Draft Reporting Stage	▪ Review of EMF and Updation ▪ Submission of Draft Updated EMF Report
Final Reporting Stage	▪ Comments from Horticulture Department/ WB ▪ Incorporation of comments ▪ Submission of Updated Final EMF Report

1.5 Data Collection

The study will depend mainly on primary and secondary sources of information. The primary data was obtained through Personal Discussions and Focus Group Discussions with the officials of Horticulture Department and grass roots stakeholders at the sampled micro-watersheds during field visits; information on the perceived environmental issues was collected. Basic PRA methods, viz., observation and transact walk were applied during field visits.

The checklists used for data collection are given in Annexure 1.

1.6 Sampling

These study was taken up in the below mentioned micro watersheds.

District	Taluk	Micro water shed
Koppal	Kushtagi	Vittalapura
	Koppal	Hyder Nagar
Chamarajanagar	Chamarajanagar	Harve
	Kollegal	Bandally

1.6.1 Consultations

These consultations were organized with the support of the client and local resourceful organizations. One consultation was held in each sampled micro-watershed after the data collection and the information on project was disseminated to the stakeholders. These Consultations were held in the field for proper feedback. These were recorded including the details of the participants and matters discussed.

1.6.2 Environmental Indicators

The following indicators were considered during the environmental assessment:

- Water
  - Surface Water
    - Quality
    - Quantity
  - Ground Water
    - Quality
    - Quantity
- Soil
  - Quality
  - Erosion
  - Salinization
- Horticultural Productivity

  - Fertilizers
  - Pesticides

- Bio-Diversity
  - Vegetation
  - Flora and Fauna

The detailed parameters are given in Annexure 1.

1.6.3 Anticipated Environmental Impacts

Anticipated positive and negative impacts are listed below.

A. Positive Impacts:

The expected positive impacts of the project are:

- Soil and water conservation
- Raise in groundwater table
- Increase in yield from groundwater sources
- Retention of soil moisture for longer period in a year
- Change in cropping pattern; shifting from agriculture to agro-horticulture and agro-forestry
- Increase in crop yield
- Overcoming drinking water scarcity in the villages
- Improvement in fodder and fuel wood dependency
- Significant improvement in local employment generation
- Reduction in off-season migration of the people out of village

B. Negative Impacts:

Even though there are many positive benefits there are few negative impacts are also likely to occur due to the project activities. Some of them are:

- Possible contamination of surface and ground water due to poor sanitation condition prevailing in the project area
- Increased dependency on the chemical fertilizer and pesticides will cause the soil to lose the moisture holding capacity
- Loss of soil fertility
- Increase in resistance among pests and insects
- Possibility of reduction in water potential for the people in the downstream area of the sub-watershed of the project area
- Conflicts between landholders and landless

1.7 Regulatory Requirements, Operational Policies and Directives

The EA study was conducted in accordance with laws, regulations, and any other requirements of the State of Karnataka and Government of India. The study also addressed environmental requirements of the World Bank as outlined in relevant operational policies and directives. In the approved EA, only one safeguard policy, namely, Environmental Assessment (OP 4.01) was triggered, whereas this additional EA has triggered the safeguard policy on Pest Management (OP 4.09).

1.8 Present Final Report

The present Final Report comprises the baseline data collected from the sample micro-water sheds and the observed good practices and an Environmental Management Framework. As a part of mitigation management a Pest Management Plan is also presented.

2 Baseline Data of Sample Micro-watersheds

2.1 Introduction

The basic baseline information was collected during the field trips from officers of Horticulture Department and from farmers. During Field Visits, Transect Walks were conducted through villages, catchment areas, tanks, canals, check dams, etc. and data was collected through observation and FGDs with the farmers using PRA approaches.

2.2 Baseline information

Parameter	Micro-watersheds			
District	Chamarajanagar	Chamarajanagar	Koppal	Koppal
Taluk	Kollegal	Chamarajanagar	Kushtagi	Koppal
Micro-Watershed	Bandally	Harve	Vittalanagara	Hydernagar
Rainfall, mm	781	781	562	590
Temp, Deg C	Max:32 Min: 16	Max: 37 Min.: 23	Max: 42 Min.: 12	Max.: 44 Min.: 15
Soils	Red Soils, Sandy Loam	Red Soils, Sandy Loam, Gravelly	Red Soils, Sandy Loam,	Red soils
Water Quality	Fluoride	Nil	Nil	Nil
Groundwater Availability	Depleting	Depleting	Depleting	Depleting
Natural Disasters	Drought since 2 years	Drought since 2 years	Drought during 2001-2004	None
Sensitive Areas within 1 Km	Nil	Nil	Nil	Nil
Wildlife	Peacocks, Elephants, Deer, Wild Boar, Occasional Leopard, etc.	Deer, Elephants, Wild Pigs, etc.	Bear, Peacock, Wild Pig, etc.	None
Livestock	Local Cow, Buffalo, HF, Goat, Sheep, etc.	Local Cow, Buffalo, Goat, Sheep, etc.	Local Cow, Buffalo, HF, Goat, Sheep, etc.	Local Cow, Buffalo, Goat, Sheep, etc.
Horticulture Crops	Turmeric, Coconut, Mango, Banana Chrysanthemum, marigold, Beans, Tomato, Carrot, Cabbage, Chilies, Onions, etc.	Coconut, Coconut, Mango, Banana Chrysanthemum, marigold, Beans, Tomato, Carrot, Cabbage, Chilies, etc.	Papaya, Kinno, Mango, Banana, Pomegranate, Neem, Sapota, etc.,	Brinjal, Bitter gourd, Onion, Cucumber, Tomato, Chilies, Ladies Fingers, Pomegranate, Water melon Oil Palm, etc.
Major Weeds	Parthenium, Bhoki, Jake, Congress Weed, BJP Weed, etc.	Parthenium, Bhoki, Jake, Congress Weed, BJP Weed, etc.	Parthenium, Bhoki, Jake, Congress Weed, BJP Weed, etc.	Parthenium, Bhoki, Jake, Congress Weed, BJP Weed, etc.
Potential Markets	Local, Tamil Nadu	Local, Tamil Nadu	Local, Maharashtra	Local, Maharashtra
Storage Facilities	Nil	Nil	Cold Storage	Nil

			Plant	
Processing Facilities	Nil	Coconut Processing	Oil Palm Processing	Nil
Pesticides Used	Acephate, Chloropyriphos, Endosulphan, Roger, Bavistin, DM-45, DZ-78, COC, Azadiraktin, Organic Fertilizers, etc.	Acephate, Chloropyriphos, Endosulphan, Roger, Bavistin, DM-45, DZ-78, COC, Azadiraktin, Organic Fertilizers, etc.	Acephate, Chloropyriphos, Endosulphan, Roger, Bavistin, DM-45, DZ-78, COC, Azadiraktin, Organic Fertilizers, etc.	Acephate, Chloropyriphos, Endosulphan, Roger, Bavistin, DM-45, DZ-78, COC, Azadiraktin, Organic Fertilizers, etc.
Fertilizers Used	Compost, Cow dung, NPK, Etc.	Compost, Cow dung, NPK, Etc.	Compost, Cow dung, NPK, Etc.	Compost, Cow dung, NPK, Etc.

2.3 Good Practices Identified

2.3.1 Integrated Horticulture and Water Resource Sustainability

Mr. Shivaswamy's Uma Maheshwari Krushi Farm is at Nanjedevarapura near Harave Village. He owns a 15 acre plot in Nanjadevarapura and is implementing integrated horticulture with drip system. A small check dam and a farm pond were constructed with assistance from watershed department and these help maintain moisture and recharge groundwater. Since the construction of these, the groundwater level has increased, even though the land is undulating and in slopy. He has taken up different activities like diary, epiculture (Chitta and Thuduve), goatery, sericulture, vermi-compost, etc. He is growing a mix of horticulture crops such as Mulberry (V1 and M1), Turmeric, Ginger, Areca Nut, Banana, Papaya, Guava, Pomegranate, Jackfruit, etc. Presently he is planning to introduce a couple of fish ponds and gober gas plants as well. He draws energy from solar panels.

2.3.2 Integrated Horticulture and Soil Conservation

Mr Gadigi's farm, which is nearly 30 acres in two plots, is in Malligera village of Kushtagi taluk. He is practicing Zero Cultivation technique. He is growing several varieties of Horticulture crops; the latest one being grafted Jambulina (nila nerala). This has a very good market and fetches a good rate as well; he got first crop last year and had good returns. His other crops are Lemon, Papaya, Coconut, Mango, Sapota, Orange, Kinno, etc. He procured the Kinno from Rajasthan, for which he visited Rajasthan to understand the Kinno cultivation. He has also planted Neem wood, Sandal Wood, Teak, etc. He practices zero cultivation in dry land. He uses no chemicals, but only bio-organic pesticides and fertilizers, drip irrigation.

2.4 Issues Identified During FGDs

The following issues were identified during the Focus Group Discussions:

- Scarcity of quality seeds is a major problem that the farmers face. There is a need for intervention in this area. Easy and timely availability of quality seeds is sought by all farmers. The farmers want the Horticulture Department to introduce high yielding varieties.
- Marketing of produce is a major problem. Involvement of Middlemen/ commission agents in marketing is resulting in reduced margins to farmers. The involvement of middlemen needs to be reduced through Horticulture Department promoted and organized Marketing Chains like HOPCOMS.
- There are no proper processing units in the production area; there is a need to promote processing units based on the horticulture products in the area.
- Presently weighing of produce is a problem that is being faced by all most all the horticulture farmers, as a lot of cheating takes place while weighing. This need to be curbed through establishment of electronic automatic scales.
- Most famers feel that storage of produce is a problem. They would like to have sufficient cold storage facilities as well ripening chambers for fruits.
- Support Price is an another issue that the farmers bring up quite often.
  Smell is observed in coconut processing units. This need to be reduced by installing chimneys and by distributing masks to workforce. Wastage of coconut water is a matter of concern. This need to be collected, processed and sold. Slippery floors too are an issue in these units. The floors need to be of non-slippery tiles.
- Farmers mention that there are lakes in the area, but the infiltration into ground is low due to high silt levels. While discussing water scarcity and groundwater depletion, the farmers complain that the bills are claimed without desilting of tanks. They suggest that involvement of NGOs in watershed works improves quality of implementation. They also mention that the farmers are not digging recharge pits near bore wells.
- Soil nutrients are decreasing on a regular basis and the crop yields are also decreasing with this.
- Exclusive training and exposure trips, for both farmers and Horticulture Department officers, is required for quality production and produce of horticulture crops. Further the Horticulture Department should take up demonstration of certain crops and varieties.

2.5 Environmental Management Framework

Under the horticulture component various projects which could be taken up; which would probably have adverse impacts on environment are:

- Cultivation of fruits and vegetables
- Floriculture
- Cultivation of medicinal plants

As result of the above activities and due to the increased profitability of horticulture the following activities would probably be taken up by private parties.

- Harvesting and storage of horticulture produce
- Transportation and processing of produce
- Packaging and marketing of produce including establishing market and linkages

The adverse impact of horticultural on environment is largely due to crops from introduction of high yielding varieties in the area and increased cropping area. Due to this there could be increased pressure on the soil, water and natural resources. Higher amount of pesticides and fertilizers inputs on the same land, results in related impacts on the existing gene pool of pest, pollution of soil and groundwater and the related ecosystem. Horticulture is one area wherein the shelf life of the produce being very short, results in large waste generation due to inefficient packaging, storage, transport, etc.

In order to mitigate these adverse impacts, the following Environmental Management Framework is proposed:

2.5.1 Environment Management Framework Highlighting Project Activities, Impacts, Mitigation Measures with Responsibilities

ACTIVITIES	IMPACTS (POSITIVE and NEGATIVE)	ENHANCEMENT/ MITIGATION MEASURES	RESPONSIBILITY
HORTICULTURE COMPONENT • Extension and demos for productivity Improvement • Farmer horticulture soil and crop monitoring • Horticulture post harvest management value chain • Horticulture services support • Horticulture (Proposed Investments)	Positive Impacts • Increased production base, biomass production & perennial cover • Direct economic benefits • Reduced soil erosion due to increased vegetative cover • Retention of soil moisture due to vegetative cover	Enhancement Measures • Higher use of bio-fertilizers (bio-Compost, vermin compost, microbial inoculants, etc.) and bio pesticides will reduce chances of soil contamination and water pollution. • Live hedge fencing should be encouraged • Use of farm yard manure or mulching practices should be encouraged • Valuable plantation crops, medicinal crops and aromatic crops should be encouraged. • Build awareness among farmers on medicinal crops, bio-fertilizers, bio-pesticides, etc.	• Horticulture Dept. • DDH • SADH • Farmers/ Beneficiaries • Consultants

ACTIVITIES	IMPACTS (POSITIVE and NEGATIVE)	ENHANCEMENT/ MITIGATION MEASURES	RESPONSIBILITY
Horticulture farm production • Cultivation of Fruits & Vegetables • Floriculture • Cultivation of Medicinal plants	Negative Impacts • Biodiversity • Food vs non-food crops (Horticulture on agricultural fields) • Occupational hazards • Loss of forest land if carried out in forest areas. • Horticulture production replacing food crops - Loss of agriculture land for cultivation if carried out on agriculture lands. • New varieties of pests and related problems • Soil fertility loss due to withdrawal of excess nutrients from soil • Soil and ground water contamination due to excess use of pesticides especially on fruits & vegetables and some ornamental plants. • Health related impacts due to increased use of fertilizers, herbicides and pesticides • Non point water pollution due to surface run off containing high pesticides, herbicides and fertilizer levels. • Pressure on water resources • Risks of bio-piracy in case of medicinal plants	• Cultivations of plants shall be taken up with prior assessment of surrounding bio diversity and its suitability with other plants. • Lessons learnt from National Horticulture Mission, especially on environmental and social issues, to be incorporated in designing sub-projects. • Ensure that horticulture supplements and does not completely replace local agricultural practices and food crops. First priority should be to use land not suited for agriculture. • Promote integrated pest management techniques and practices, use of biological pesticides and new generation pesticides and herbicides. • Encourage use of personal protective equipment while handling, using and storage of fertilizers and pesticides. • Ensure bunding to check surface run-off of fertilizers and pesticides. • Ensure disposal of hazardous waste like pesticides with containers, as per the Hazardous Waste (Management and Handling) Rules, 1989, amended 2003. • Promote rainwater harvesting to augment water resources. • Organic waste should be segregated and used for composting. • Develop codes of practice for growing medicinal plants. • Consult local people about cultural practices related to medicinal plants. • Include benefit sharing strategies with the local community for traditional medicinal plants, especially in tribal areas.	• Horticulture Dept. • DDH • SADH • Farmers/ Beneficiaries • Consultants

ACTIVITIES	IMPACTS (POSITIVE and NEGATIVE)	ENHANCEMENT/ MITIGATION MEASURES	RESPONSIBILITY
Harvesting & Storage of Horticulture Produce (Fruits, vegetables, herbs, medicinal plants, flowers etc.) • Harvesting activities • Development of Storage facilities	Negative Impacts • Horticulture wastes • Pressure on land for storage facilities • Wastage of horticulture produce • Use of pesticide on stored material • Disposal of horticulture plant wastes after harvesting, especially with vegetable and aromatic (for perfume) plants • Loss of cultivable land for construction of storage facilities • Damaged horticulture product due to pests attack etc will lead to large amount of solid organic wastes, disposal of which will be an issue • Greater use of pesticides to protect the stored horticulture produce may lead to product contamination • Cold Storages from its normal operation may generate rotten fruits and vegetables and other material, which will be required to be disposed.	• Fruits, vegetables and other horticulture plant wastes residue shall not be dried and burnt in the field. These wastes may be mixed with fodder and given to animals as fodder. • Fruits and vegetables residue shall be collected and decomposed in pits for bio-manure development • Storage facilities shall be built on waste/ non-cultivable land to avoid any acquisition of agriculture land • No over use of pesticides on stored material. • Bio-pesticides or low harmful chemical base pesticides shall be promoted if possible • Cold storage and other storage facilities shall be developed as per standard criteria for vegetables and other horticulture produce respectively to minimize damage.	• Horticulture Dept. • DDH • SADH • Farmers/ Beneficiaries • Consultants

ACTIVITIES	IMPACTS (POSITIVE and NEGATIVE)	ENHANCEMENT/ MITIGATION MEASURES	RESPONSIBILITY
Transportation & Processing of Produce • Construction & Operation of Transportation facilities • Setting & Operation of agricultural processing units	Negative Impacts • Land requirement • Aspects related to construction related activities for both Transportation and Processing facilities Local Water Drainage Waste generation and disposal • Water requirement • Wastewater from product (medicine, perfume, etc.) extraction from plants Solid wastes from extraction units • Construction of road, processing units, or markets for agricultural produce will change land use and if it is horticulture land/forest land then loss of cultivable land/felling of trees respectively. • Solid organic wastes (like, leaves, branches, peel off material, vegetable and fruit pulp etc.) from the processing of vegetables, fruits, medicinal products etc. which may create nuisance of disposal • Increased pressure on water resource due to large amount of water requirement in some processes. • Wastewater from extraction and other processes, which generate liquid wastes at different stages of the process. • Obstruction of drainage pattern in the road construction area. This can lead to problems of flooding, erosion etc. • Construction of these facilities would result in temporary air, water and noise pollution • Increased transportation would lead to air pollution and will have associated impacts. • Increased safety risks due to handling of machinery like cutters, threshers and vibrators. • Health and safety hazards due to use of chemicals to protect raw material and finished products from pests.	• Prior site assessment for suitability and development of Environment Management Plan for setting up processing units in the area. • If possible, processing units shall be established on waste or non cultivable land. • Disposal of fruit or vegetable pulp and refuse from extraction of medicine etc. shall be used as animals feed or as fuel (especially medicine extract wastes) • Water conservation measures shall be taken up. • Water recycling possibilities shall be explored in the processing facilities. • Wastewater laden with organic loads shall be treated as per the prescribed standard and treated wastewater may be used for irrigation purpose (the organic load can work as nutrients) • Disposal of pesticide/chemical empty containers as per Hazardous Waste (Management and Handling) Rules, 1989, amended 2003. • Develop rain water harvesting for groundwater recharging. • Adequate drainage mechanisms shall be provided during design & construction of roads/pathways • Provision of safety guards on the moving, revolving parts of the processing machinery. • Improve road infrastructure for better connectivity • Proper maintenance and upkeep of markets for cleanliness and hygiene • Use of personal protective equipment for use and handling of hazardous chemicals.	• Horticulture Dept. • DDH • SADH • Farmers/ Beneficiaries • Consultants

ACTIVITIES	IMPACTS (POSITIVE and NEGATIVE)	ENHANCEMENT/ MITIGATION MEASURES	RESPONSIBILITY
Packaging and Marketing including establishing market facilities and linkages. • Packaging Units • Market Facilities and Linkages	• Use of plastic, paper and wood for packaging (both primary & secondary packaging) • Packaging wastes • Mechanization and Construction of market facilities • Pressure on natural resources (wood from forest etc.) for packaging material for primary and secondary packaging. • Increased use of plastics would lead to disposal problems, especially in hilly areas. • Packaging in informal sectors and associated risks of poor working conditions and high exploitation. • Health risks due to use of preservatives and printing ink for labelling etc. • Land acquisition for setting up markets etc. • Construction of these facilities would result in temporary air, water and noise pollution • Increase man power and influx of people to the markets would add pressure on existing infrastructure like sewage disposal and drainage system. • High solid waste generation leading to disposal problems, especially in small towns and rural areas.	• Prior site assessment for suitability and development of Environment Management Plan for setting up of packaging units (if stand alone) and market centers/facilities in the area. • Explore opportunities to use multi usable/recyclable material for packaging. • Ensure that material used is coming from commercial sources rather than being accessed from forest areas. • Marketing cooperative/committee of farmers or local people shall be developed that can procure material from farmers and sell into the markets. This may reduce the influx of people and associated impacts. • Proper maintenance and upkeep of markets for cleanliness and hygiene • Reuse organic waste from the markets for composting. • Use the opportunity of the project to improve basic local infrastructure like small drains, sewage system etc. in and around the market facilities	• Horticulture Dept. • DDH • SADH • Farmers/ Beneficiaries • Consultants

2.5.2 Monitoring Plan

Given in the table below are indicators for project investments to be taken up by Horticulture Department.

Project Components/ Issues	Monitoring Indicators	Frequency	Agency
Horticulture • Extension and demos for productivity Improvement • Farmer horticulture soil and crop monitoring • Horticulture post harvest management value chain • Horticulture services support • Horticulture (Proposed Investments)	• Increase in production of fruits and other plants products. • Quality of production (taste, odour, color, perishability etc.) • Increase in economic benefits per unit land • Reduction in damage of crops against diseases, drought, etc. • Increase in the use of non chemical applications e.g., bio pesticides, green manure, etc.	• Annually	• Horticulture Dept. • DDH • SADH • Farmers/ Beneficiaries • Consultants
Production • Biodiversity • Food vs non- food crops (Horticulture on agricultural fields) • Occupational hazards • Use of pesticides • Harvesting and Storage: • Horticulture wastes • Pressure on land for storage facilities • Wastage of horticulture produce • Use of pesticide on stored material	• Bio diversity Assessment • Percentage (%) increase in area of agriculture land used for horticulture • Amount of water required for Horticulture • Increase in amount of pesticide in use • Percentage (%) of harvesting wastes composted or used as fuel • Amount of pesticides used / Horticulture storage centre • Amount of bio pesticides used	• Annually/ Quarterly	• Horticulture Dept. • DDH • SADH • Farmers/ Beneficiaries • Consultants
Transportation and Processing • Land requirement • Aspects related to construction related activities for both Transportation and Processing facilities • Local Water Drainage • Waste generation and disposal • Water requirement • Wastewater from product (medicine, perfume, etc.) extraction from plants	• Clearance acquired for applicable projects • Amount of freshwater required (KL) • Wastewater discharge from processing unit (KL) • Amount of organic wastes composted or reused (Tons) •	• Annual/ Half-yearly/ Quarterly	• Horticulture Dept. • DDH • SADH • Farmers/ Beneficiaries • Consultants
Solid wastes from extraction units Packaging & Marketing • Use of plastic, paper and wood for packaging (both primary & secondary packaging) • Packaging wastes Mechanization and construction of market facilities	• Amount of non bio degradable packaging material per unit of product • Amount (%) of recyclable/bio degradable packaging material per unit of product • Amount of waste fruit, vegetable etc. material	• Quarterly	• Horticulture Dept. • DDH • SADH • Farmers/ Beneficiaries • Consultants

2.5.3 Pest Management Plan

In addition to the above a Pest Management Plan has been prepared as a part of this EMF. This is given in the of guidance section. The concerned line departments, i.e. Horticulture Department need to ensure that this plan is implemented at the field level.

The NGO partner will have a major role in mobilizing the farmers to implement the provisions of this plan.

Along with this Pest Management Plan, a guidance on proper storage, handling and disposal of pesticides too is given.

2.6 Training for Horticulture Personnel and Farmers

While the above mentioned training is for all stakeholders of the project, the following programs are proposed for the horticulture farmers and officials:

H1 - Awareness programs on using pesticides for farmers: The will involve one day awareness creation programs at the district level. There will also be one day refresher programs organized annually. In each district 5 main programs in the first year and 3 refresher programs per year during subsequent years will be conducted. Including the main and refresher programs, the total these awareness programs will be about 120 for the project duration.

H2 - Exposure trips to model farmers: Every year about 100 farmers, in batches of 25 will be taken for exposure visits to farms/ demonstration plots/ research stations for a 5 day visit. This will amount to about 4 exposure visits per year totaling to 20 for the project duration.

H3 - Special training to horticulture department officials: The training will include an initial orientation workshop, a main and annual refresher training workshops on environmental assessment. The main and refresher training programs will be for duration of 2-3 days each, whereas the initial orientation workshop will be of one day duration. 10 Training programs will be conducted during the first year and 5 refresher programs per year will be conducted for the next 4 years. This will total to 30 programs.

H4 - Exposure trips to horticulture department officials: Every year about 50 officials, in batches of 10 will be taken for exposure visits to farms/ demonstration plots/ research stations for a 5 day visit. This will amount to about 5 exposure visits per year totaling to 25 for the project duration.

The following institutions are identified for the above training:

- University of Horticultural Sciences , Bagalkot
- Indian Institute of Horticulture Research, Bangalore
- MANAGE, Hyderabad
- IIHR - Indian Institute of Horticulture Research, Hesarghatta, Bangalore.
- Central Institute for Medicinal and Aromatic Crops, Bangalore.
- Spice Research Institute, Trivendrum.
- Biocentre, Department of Horticulture, Hulimavu, Bangalore.
- Central tuber crops research Institute, Trivendrum.

- University of Agricultural sciences, Bangalore / Dharwad.
- University of Agricultural Sciences, Coimbatore.
- International Crop Research Institute for Semi Arid Tropics (ICRISAT), Hyderabad.
- Directorate of Oil Palm Research, Pedaragi, Andhra Pradesh.

2.6.1 Budget

The total estimated cost of training/ awareness programs for horticulture department officials and farmers, including studies proposed to be conducted works out to Rs. 6.30 crore. The details are presented in the table below:

S. No.	Training	No. of Programs	Estimated Unit Cost in Rs.	Total Cost In Rs.
1	H1	120	50,000	60,00,000
2	H2	20	4,00,000	80,00,000
3	H3	30	1,00,000	30,00,000
4	H4	25	5,00,000	1,25,00,000
5	Environmental Impact Assessment of Horticulture Dept Supported Storage/ Processing/ Packaging Units	10	15,00,000	1,50,00,000
6	Studies on marketing potential of horticulture crops/ products	5	20,00,000	1,00,00,000
7	Studies on Bio-diversity	1	25,00,000	
8	Unforeseen Items			25,00,000
9	Sub-Total			5,70,00,000
10	Contingencies 10%			57,00,000
	TOTAL			**6,27,00,000**

3 Pest Management Plan – Guidance

Introduction

Horticultural productivity has made a quantum leap with the introduction of hybrid seeds/saplings, chemical fertilizers and chemical pesticides. However, the field visits reveal that many of the farmers are poor and are not in a position to invest much in Horticulture. Whatever resources the poor farmer has are going into buying the hybrid seeds, chemical fertilizers and chemical pesticides. The resource poor farmers are hit by disasters like drought, new pests, new diseases and changing nutrient quality of the soils, thus rendering the crops less productive. Coupled with fewer inputs, the productivity is further affected by the impact of diseases and insect pests. However, realization has dawned now that excessive use of chemicals in agriculture/ horticulture has not only increased the cost of cultivation, but has also damaged the very soil, water and air on which crop production is dependant. The environmental impact of widespread and intense use of chemical pesticides, poisons of varying lethality, is the poisoning of the ecosystem which not only affects humans and farm animals through the food cycle, but also the destruction of numerous predatory organisms which in nature check and maintain the growth of crop pests. Thus, ironically, repeated and continuous use of chemical pesticides not only increases the resistance of the pest to the chemical but also regularly wipes out population of predators thereby providing an enemy free environment for the growth of the very pests that one wants to control. Specifically, excessive use of chemicals in horticulture has led to the following impacts:

- Development of resistance in target insects/pests and they are no longer eliminated with recommended doses.
- Resurgence of pests, as they are not wiped out and reappear time and again.
- Destruction of useful insects that were natural predators of problem insects due to continuous use of chemical insecticides.
- Pollution of soil and water resources resulting in reduced soil productivity.
- Deposition of pesticide residues in the environment that ultimately enters the human food chain leading to health hazards in the form of severe disorders such as, cancer, miscarriage, infertility, birth-defects, kidney problems, etc.
- Outbreak of secondary pests due to loss of natural enemies.

Given the obvious importance of chemical pesticides in controlling pests and thereby managing higher productivity and also given the clearly adverse impacts of its excessive use, the KWDP-II has adopted Integrated Pest Management (IPM) as the key strategy to combat pests and diseases in the project. IPM is a key component of the Integrated Crop Management strategy based on green and sustainable horticulture principles that KWDP-II is seeking to promote in the project. Thus, IPM has been mainstreamed in the KWDP-II for implementation.

Integrated Pest Management Plan

What are the Pests?

- Insects
- Diseases
- Nematodes
- Harmful animals
- Harmful birds
- Weeds

Factors increasing pest population

- High humidity and temperature
- Excessive and untimely use of irrigation water
- High use of fertilizer
- High use of pesticides
- Dense plant population
- Mono cropping
- In appropriate cropping system
  (For immediate profit motives)

Why IPM?

Pest management is an ecological matter and has much relevance in the context of drought ridden project area. The World over, in general, over dependence on the use of synthetic pesticides in crop protection programs has resulted in disturbances to the environment, pest resurgence, pest resistance to pesticides, and lethal and sub-lethal effects on non-target organisms, including human's world over. These side effects have raised public concern about the routine use and safety of pesticides. Therefore the farmers are required to manage their land with greater attention to direct and indirect off-farm impacts of various farming practices on water, soil, and flora and fauna. Thus, reducing dependence on chemical pesticides in favor of ecosystem manipulations is a better strategy for farmers of the region. Successful IPM is based on sound farmer's knowledge of the ongoing agro-ecological processes of the farming environment; such farmers should therefore be technically sound to make decisions on the most appropriate management strategies to apply at the specific period of crop development.

Objectives of Integrated Pest Management Plan

- The purpose of this document is to describe a Plan by which the project can promote and support safe, effective, and environmentally sound pest management in horticultural interventions undertaken under KWDP-II. The plan further presents components to strengthen such capacity.
- The Plan promotes the use of biological and environmental control methods and the reduction in reliance on synthetic chemical pesticides.

Integrated Pest Management is the approach now being adopted worldwide to address the issue of excessive use of chemical pesticides in horticulture and agriculture. The World Bank's Operational Policy 4.09 defines integrated pest management as a mix of farmer-driven, ecologically based pest control practices that seeks to reduce reliance on synthetic chemical pesticides. It involves;

- Managing pests (keeping them below economically damaging levels) rather than seeking to eradicate them
- Relying, to the extent possible, on non-chemical measures to keep pest populations low; and
- Selecting and applying pesticides, when they have to be used, in a way that minimizes adverse effects on beneficial organisms, humans, and the environment.

The revised International Code of Conduct on the Distribution and Use of Pesticides, FAO (2002) defines IPM as follows:

"IPM means the careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimize risks to human health and the environment. IPM emphasizes the growth of a healthy crop with the least possible disruption of agro-ecosystems and encourages natural pest control mechanisms."

IPM is a broad ecological approach of pest control (insects, diseases, weeds, rodents, etc) employing all methods and techniques viz. cultural, mechanical, genetic, regulatory, biological and chemical in a compatible manner to keep pest population below economic threshold level (ETL).

Currently, the major thrust areas of plant protection in India are promotion of Integrated Pest Management (IPM), ensuring availability of safe and quality pesticides, streamlining the quarantine measures and for human resource development including empowerment of women in plant protection skills. In India, IPM related activities are being implemented through 26 Central Integrated Pest Management Centers (CIPMCs) located in 23 states and Union Territories. The major activities under IPM approach include undertaking sample roving surveys for monitoring pest/disease situation on major crops, production and release of Bio-control agents and conducting Farmers' Field Schools (FFSs).

IPM Tools

IPM involves a range of methods to control pests:

a) Reactive options: Such as—physical and mechanical methods, biological and chemical control. A sudden withdrawal of pesticides will invariably bring down the yields drastically which the farmer can ill afford. IPM recommends a gradual withdrawal of pesticides allowing time for both the plants (and the farmers) to adjust and build up internal strength, reserves and resilience.
b) Proactive Options: However the long term goal should be to promote proactive options to grow perfectly good crops without the help of chemical pesticides. Crop rotations and creation of habitat for beneficial organisms

permanently lower the carrying capacity of the farm for the pest. Cultural controls are also considered as proactive strategies, which includes maintaining healthy, biologically active soil (increasing below ground diversity), maintaining habitat for beneficial organisms (increasing above ground diversity) and using appropriate plant cultivars. Some of the ways that can be used to maintain biodiversity of the farm would include, increasing genetic diversity, species diversity, crop rotations, multiple cropping, inter cropping, use of disease free seed and planting material, use of resistant varieties, sanitation, plant spacing, altered planting dates, optimum growing conditions, use of mulch material, etc.

The main tools of IPM are:

Key Components of IPM

- Identification of major pests & diseases for the crop in the area
- Identification of the minor pests & diseases for the crop in the area
- Assessment of ETL for major pests /diseases
- Pest monitoring based on Agro Ecosystem Analysis (AESA) and conjunctive use of pheromone traps, sticky traps, etc.
- IPM in action
  - Identification of pest & disease tolerant/resistant varieties
  - Cultural methods
  - Physical / mechanical methods
  - Biological methods
  - Bio-pesticides
  - Chemical methods (preferably use chemicals that are less toxic and have a shorter life after application

Monitoring

Crop monitoring, that keeps track of the pests and their potential damage, is the foundation of IPM. This provides knowledge about the current pests and crop situation and is helpful in selecting the best possible combinations of the pest management methods. Pheromone traps have an advantage over other monitoring tools such as light and sticky traps; being selective to specific pests, they have proven their usefulness in large scale IPM validations.

Pest Resistant Varieties

Breeding for pest resistance is a continuous process. At the same time the pests also, particularly the plant pathogens, co-evolve with their hosts. Thus, gene transfer technology is useful in developing cultivars resistant to insects, plant pathogens and herbicides. An example of this is the incorporation of genetic material from Bacillus Thuringensis (Bt), a naturally occurring bacterium, in cotton, corn, and potatoes, which makes the plant tissues toxic to the insect pests. Scientific community is impressed by its huge potential in managing the pests, but is also concerned about the possibility of increased selection pressure for resistance against it and it's effects on non-target natural fauna. However, due to ethical, scientific and social considerations, this potential technology has been surrounded by controversies.

Cultural pest control

It includes crop production practices that make crop environment less susceptible to pests. Crop rotation, fallowing, manipulation of planting and harvesting dates, manipulation of plant and row spacing, and destruction of old crop debris are a few examples of cultural methods that are used to manage the pests. Planting of cover crops, nectar producing plants and inter-planting of different crops to provide habitat diversity to beneficial insects are important management techniques. Cover crops, often legume or grass species, prevent soil erosion and suppress weeds. A cover crop can also be used as a green manure, which is incorporated in the soil to provide nitrogen and organic matter to the subsequent crop. Cultural controls are selected based on knowledge of pest biology and development.

Physical or Mechanical controls

These are based on the knowledge of pest behaviour. Placing plastic lined trenches in potato fields to trap migrating Colorado potato beetles is one example of the physical control. Hand picking of insect pests is perhaps the simplest pest control method. Installation of dead as well as live bird perches in cotton and chickpea fields has proved effective in checking the bollworm infestation. Using mulches to smother weeds and providing row covers to protect plants from insects are other examples.

Biological controls

These include augmentation and conservation of natural enemies of pests such as insect predators, parasitoids, parasitic nematodes, fungi and bacteria. In IPM programs, native natural enemy populations are conserved, and non-native agents may be released with utmost caution. Trichogramma spp. is the most popular parasitoids being applied on a number of host crops. A number of microorganisms such as Trichoderma spp., Verticillium spp., Aspergillus spp., Bacillus spp. and Pseudomonas spp. that attack and suppress the plant pathogens have been exploited as biological control agents.

Chemical controls

Pesticides are used to keep the pest populations below economically damaging levels when the pests cannot be controlled by other means. Pesticides include both the synthetic pesticides and plant derived pesticides. Synthetic pesticides include a wide range of man-made chemicals. These are easy to use, fast-acting and relatively inexpensive. Ideally, pesticides should be used as a last resort in IPM programs because of their potential negative effect on the environment. Pesticides with the least negative impacts on non-target organisms and the environment are most useful. Fortunately, new generation pesticides with novel modes of action and low environmental effects are being developed and registered for use. Pesticides that are short-lived or act on one or a few specific organisms fall in this class.

Assessment of Economic Threshold Level

This is based on the concept that most plants can tolerate at least some pest damage. In an IPM program where the economic threshold is known, chemical controls are applied only when the pest's damaging capacity is approaching the threshold, despite application of other alternative management practices.

Use of Botanical Pesticides

These can be prepared in various ways. They can be as simple as raw crushed plant leaves, extracts of plant parts or as complex as chemicals purified from the plants. Pyrethrum, neem, tobacco, garlic, and pongamia formulations are some examples of botanicals. Some botanicals are broad spectrum pesticides. Botanicals are generally less harmful to the environment, because of their quick degrading property. They are less hazardous to transport. The major advantage is that these can be formulated on-farm by the farmers themselves.

Criteria for Pesticide Selection and Use

The procurement of any pesticide in a Bank financed project is contingent on an assessment of the nature and degree of associated risks, taking into account the proposed use and the intended users. With respect to the classification of pesticides and their specific formulations, in reference to the World Health Organization's Recommended Classification of Pesticides by Hazard and Guidelines to Classification. The following criteria apply to the selection and use of pesticides in,

- They must have negligible adverse human health effects.
- They must be shown to be effective against the target species.
- They must have minimal effect on non target species and the natural environment.
- The methods, timing, and frequency of pesticide application are aimed to minimize damage to natural enemies. Pesticides used in public health programs must be demonstrated to be safe for inhabitants and domestic animals in the treated areas, as well as for personnel applying them.
- Their use must take into account the need to prevent the development of resistance in pests.

It is required that any pesticides be manufactured, packaged, labeled, handled, stored, disposed of, and applied according to standards acceptable to the WHO. Formulated products that fall in WHO classes IA and IB, or formulations of products in Class II, if (a) lacks of restrictions on their distribution and use; or (b) they are likely to be used by, or be accessible to, lay personnel, farmers, or others without training, equipment, and facilities to handle, store and apply these products properly are not permissible in the project.

Operational Aspects of IPM

- Growing a healthy crop involves the right varietals selection; appropriate seed bed management, plant nutrition, and plant nutrition, and plant physiology, water and weed management.
- Optimize natural enemies recognize beneficial insects in the field, learning insect population dynamics, life cycles, and food webs; understanding the effects of pesticides on beneficial populations, promoting survivorship of predators through habitat management and making local reference collections.
- Observe fields weekly for damage symptoms, changes in insect populations, to evaluate plant growth and physiology, relationship between plant stages and insect populations, effects of weather conditions, and water and nutrient management.
- Farmers as experts: agro-system analysis and decision making based on information directly observed and collected leads to farmers to make sound conclusions crop management decisions.

The World Bank Operational Guidelines

The World Bank & IFC Pesticide guidelines aims to ensure that the pesticide

- Must have negligible adverse human health effects
- Should be effective against target pests and minimal effect on non target species
- Development of pest resistance to be kept in view
- Public health pesticides must be safe for inhabitants and animals

Integrated pesticide management specifically identifies the following as the key in pest control.

- A categorical preference for bio control methods along with institutional and capacity building for the same.
- Reducing reliance on synthetic chemical pesticides and only if approved by IPM approach.
- Does not permit under any circumstance the use IA, IB and II classified pesticides. Listing of these chemicals and provided by the World Health Organization is given at the end of the report.
- Recommends the use of Participatory IPM along with specific investment components for the same.
- Permits category III type chemicals and these are listed at the end of the report. But even these must be used as part of the IPM strategy. No to all chemical Pesticides if it is likely to be used without training and safety.

Safe Use of Pesticides:

Farmers are not the only ones to be exposed to pesticides. The laborers, whether it is the person spraying or the person engaged in horticulture/ agriculture work in the

field, also faces threats of pesticide poisoning. The target group of the project is focused toward a large number of the land less agriculture/ horticulture labor, especially women who are most often used in hazardous fieldwork. Hence protective measures such as gears and education becomes crucial to ensure that no negative health impacts. A listing of the factors to be borne in mind is listed under:

- Avoid making cocktails of insecticides. If necessary, then each should be used in recommended dose.
- Use two piece protective clothing, hand gloves, a cap, a full sleeved shirt and boots, and preferably a face shield.
- Spray during cooler hours of the day-morning and afternoon. Spray along the wind, not against it.
- Wash the spray equipment at the end of the day.
- Do not eat, drink, smoke, or chew tobacco during spraying.
- No not allow children, especially young girls to work in such fields.
- After handling or spraying pesticides wash hands, face, legs, with soap and water before eating, drinking, smoking or chewing tobacco.
- Seal cuts and wounds with medicated waterproof tape before spraying. Provide first aid in case of poisoning according to the instructions given in the label.

Pesticide Management in water

Drift of pesticides must be avoided when spraying. They should not be applied when rain is imminent and the users should follow the direction given in the container for pesticide handling safety precautions, application rates and proper disposal. To reduce contamination of surface water and ground water from pesticides:

Evaluate the pest problems, previous pest control measures, and cropping history; Use integrated pest management (IPM) strategies that:

- Apply pesticides only when an economic benefit to the producer will be achieved
- Apply pesticides efficiently and at times when runoff losses are unlikely
- When pesticide applications are necessary and a choice of registered materials exists, consider the persistence, toxicity, runoff potential, and leaching potential of products in making a selection
- No use of pesticide belonging to category 1 &2 as classified in the pesticide code

The goal of this management measure is to reduce contamination of surface water and ground water from pesticides. The basic concept of the pesticide management measure is to foster effective and safe use of pesticides without causing degradation to the environment. Pesticide Management Plans (PMP's) identify:

- Identify areas vulnerable to pesticides;
- Monitor source water for pesticide contamination;
- Prevent pesticides from reaching ground water;
- Respond to pesticide detection.

Use of Plastic

- To minimize the use of pesticides as seed treatment to reduce the incidence of disease in nurseries, use of specific plastic sheet can be recommended for soil solarization.
- Plastic sheets will also be helpful in moisture conservation as mulch.
- Use of plastic in the form of poly tunnels and poly houses under adverse climatic conditions. This will also help in growing insect and disease free seedlings, off season vegetables and flowers to improve the economy of farmers, thus minimizing the pesticide application.

Awareness building

Awareness building on safe use among farmers and horticulture/ agriculture workers is another instrument that must be used for implementing the PMP in the project. The highest exposure to pesticides is compelled by poverty to work in unsafe conditions.

All supports to pesticide sprayers and equipment must include making available a protective gear. Pamphlets and posters on safe use of pesticides which deal from purchase, transport, storage, application to disposal must be provided to village organizations. In high pesticide use areas, cultural expressions like folk songs must be provided to village organizations.

A major impact of pesticide usage is on water. Reducing pesticide usage by adopting IPM/NPM and permitting only class III pesticides, while substantially reducing pesticide usage, the threat to water contamination reduction is possible. Educating the community not to spray pesticides during or just before a rain must be included in the awareness material. Monitoring the health on the people, especially workers, on a sample basis in high pesticide use area would be another task taken up by the project.

A multimedia approach that includes Kiosks, Print and e-media, Manuals, pamphlets, brochure, SMS over Mobile phones and Farmers fairs/group discussions would be used to create awareness about IPM in each of the districts.

- Each village in a cluster would have a Master Farmer on whose plot the entire package of practices for a crop, including IPM would be demonstrated.
- Groups of about 20 farmers (both men and women) would be attached to each such Master Farmer and his/her plot for meeting regularly and learning by observation and experimentation.
- At every stage of the crop cycle the FFS groups would meet to observe and evaluate the impact of certain crop management decisions. For example, in IPM, they would observe the relationship between climate and pest incidence, extent of pest attack and economic damage, etc.

Teaching IPM to Farmers – FFS Way

The Farmer Field School is a form of adult education, which evolved from the concept that farmers learn optimally from field observation and experimentation.
It was developed to help farmers tailor their Integrated Pest Management (IPM) practices to diverse and dynamic ecological conditions.
In regular sessions from planting till harvest, groups of neighbouring farmers observe and discuss dynamics of the crop's ecosystem.
Simple experimentation helps farmers further improve their understanding of functional relationships (e.g. pests-natural enemy population dynamics and crop damage-yield relationships).
In this cyclical learning process, farmers develop the expertise that enables them to make their own crop management decisions.
Special group activities encourage learning from peers, and strengthen communicative skills and group building.

- A Field Day would be organized at the time of harvest for the FFS group to evaluate the success of the package of practices, including IPM.
- Based on the success, each FFS group member would be encouraged to adopt the entire package on their own plots and conduct FFS with a set of 20 farmers each.
- Thus, a network of FFS plots and trainers would be created which would ensure that there is farmer-to-farmer dissemination of IPM.
- KWDP-II through Horticulture Department would provide the technical backstopping as well as by providing input incentives to FFS farmers. It would also assist the FFS farmers in procuring inputs needed for implementing IPM.

Monitoring protocol

KWDP-II will develop a protocol in co-ordination with Horticulture Department. The following protocol model is proposed:

Horticulture/ Agriculture Monitoring Protocol Model

Monitoring	Responsibility	Methodology	Strategy
Whether banned list of pesticides and insecticides are circulated in vernacular language to all villages	KWDP-II Horticulture Dept NGO Partner	Periodic Field Visits to the villages and checking for the lists from villagers	If not circulated ask concerned to circulate with the help of NGOs to all GPs.

Purchasing of insecticides and pesticides	KWDP-II Horticulture Dept NGO Partner	From which source they are being purchased, quantity of purchase, etc.	To educate the villages about the need to reduce the consumption of pesticide/insecticide
Use of Bio-fertilizers and bio-pesticides vermi-compost/ bio-compost	KWDP-II Horticulture Dept NGO Partner	How many villages are using them, which are the villages not using them, etc. Data collected through field visits to villages	Declare all villages as bio villages in a phased manner but slowly and judiciously Provide training in bio composting vermi-compost Marketing tie up
Training and Awareness creation	KWDP-II Horticulture Dept NGO Partner	Collect data of untrained persons	A constant monitoring training tie up and exposure visits

Constraints in Implementing IPM

Despite the plans for implementing IPM, several constraints exist. The table below summarizes the constraints in promoting IPM on a large scale.

Constraint/Risks	Mitigation
Availability of selective pesticides, effective against crop pests but not against natural enemies of pests, is a problem.	Make available selective bio-pesticides to farmers, as per their requirements.
One of the basic points of IPM is ETL, which have not been worked out for all the pests and combination of pests for different varieties and regions.	Support participatory research programs with farmers and research organizations to work out ETL for various pests within different project districts
Potential of bio-control agents has not been evaluated fully for many agents.	Do not introduce bio-control agents that have not been worked out in detail and are still in study stage. Use only ready to release and duly approved bio-control agents.
Techniques of mass rearing of several bio-agents are still not well developed.	Ensure timely breeding and supply of predators to farmers; improve linkages with relevant line departments and other institutions.
Farmers in many cases are aware of new technologies but are unable to access it leading to disillusionment and consequently non-adoption of the technology.	Ensure that demonstrations are alongside awareness building and that there is no gap between demonstration and supply of new technology, lest people lose interest.

Constraint/Risks	Mitigation
Lack of adequate trained manpower at the field level to work with farmers to help them learn IPM.	Ensure that a cadre of IPM resource persons are created in every cluster, especially in the SP2 teams. Ensure that regular trainings and refresher courses are conducted for IPM resource persons before the beginning of each crop season. Organizations such as Agri Man Ecology (AME) Foundation, PRADAN, FES, ASA may be contacted to develop appropriate training manuals for promoting IPM through FFS approach.

List of pesticides banned by Government of India

List of pesticides banned by Government of India		
A.	Pesticides Banned for manufacture, import and use (28 Nos.)	
	1.	Aldrin
	2.	Benzene Hexachloride
	3.	Calcium Cyanide
	4.	Chlordane
	5.	Copper Acetoarsenite
	6.	CIbromochloropropane
	7.	Endrin
	8.	Ethyl Mercury Chloride
	9.	Ethyl Parathion
	10.	Heptachlor
	11.	Menazone
	12.	Nitrofen
	13.	Paraquat Dimethyl Sulphate
	14.	Pentachloro Nitrobenzene
	15.	Pentachlorophenol
	16.	Phenyl Mercury Acetate
	17.	Sodium Methane Arsonate
	18.	Tetradifon
	19.	Toxafen
	20.	Aldicarb
	21.	Chlorobenzilate
	22.	Dieldrine
	23.	Maleic Hydrazide
	24.	Ethylene Dibromide
	25.	TCA (Trichloro acetic acid)
	26.	Metoxuron
	27.	Chlorofenvinphos
	28.	Lindane (Banned vide Gazette Notification No S.O. 637(E) Dated 25/03/2011)-Banned for Manufecture,Import or Formulate w.e.f. 25th March,2011 and banned for use w.e.f. 25th March,2013.
B.	Pesticide / Pesticide formulations banned for use but their manufacture is allowed for export (2 Nos.)	
	29.	Nicotin Sulfate
	30.	Captafol 80% Powder
C.	Pesticide formulations banned for import, manufacture and use (4 Nos)	
	1.	Methomyl 24% L
	2.	Methomyl 12.5% L
	3.	Phosphamidon 85% SL
	4.	Carbofuron 50% SP
D.	Pesticide Withdrawn(7 Nos)	

	1.	Dalapon
	2.	Ferbam
	3.	Formothion
	4.	Nickel Chloride
	5.	Paradichlorobenzene (PDCB)
	6.	Simazine
	7.	Warfarin

List Of Pesticides Refused Registration

List of Pesticides Refused Registration	
S. No.	Name of Pesticides
1.	Calcium Arsonate
2.	EPM
3.	Azinphos Methyl
4.	Lead Arsonate
5.	Mevinphos (Phosdrin)
6.	2,4, 5-T
7.	Carbophenothion
8.	Vamidothion
9.	Mephosfolan
10.	Azinphos Ethyl
11.	Binapacryl
12.	Dicrotophos
13.	Thiodemeton / Disulfoton
14.	Fentin Acetate
15.	Fentin Hydroxide
16.	Chinomethionate (Morestan)
17.	Ammonium Sulphamate
18.	Leptophos (Phosvel)

Pesticides Restricted For Use In India

Pesticides Restricted for Use in India	
S. No.	Name of Pesticides
1.	Aluminium Phosphide
2.	DDT
3.	Lindane
4.	Methyl Bromide
5.	Methyl Parathion
6.	Sodium Cyanide
7.	Methoxy Ethyl Mercuric Chloride (MEMC)
8.	Monocrotophos
9.	Endosulfan
10.	Fenitrothion
11.	Diazinon
12.	Fenthion
13.	Dazomet

List of pesticides not permissible (WHO classes Ia, Ib and II)

1. Extremely hazardous (Class Ia):

List of pesticides not permissible (WHO class Ia)	
Common name	
Aldicarb	Ethoprophos
Brodifacoum	Flocoumafen
Bromadiolone	Hexachlorobenzene
Bromethalin	Mercuric chloride
Calcium cyanide	Mevinphos
Captafol	Parathion
Chlorethoxyfos	Parathion-methyl
Chlormephos	Phenylmercury acetate
Chlorophacinone	Phorate
Difenacoum	Phosphamidon
Difethialone	Sodium fluoroacetate
Diphacinone	Sulfotep
Disulfoton	Tebupirimfos
EPN	Terbufos

2. Highly hazardous (Class Ib):

List of pesticides not permissible (WHO class Ib)	
Common name	
Acrolein	Oxydemeton-methyl
Allyl alcohol	Paris green
Azinphos-ethyl	Pentachlorophenol
Azinphos-methyl	Propetamphos
Blasticidin-S	Sodium arsenite
Butocarboxim	Sodium cyanide
Butoxycarboxim	Strychnine
Cadusafos	Tefluthrin
Calcium arsenate	Thallium sulfate
Carbofuran	Thiofanox
Chlorfenvinphos	Thiometon
3-Chloro-1,2-propanediol	Triazophos
Coumaphos	Vamidothion
Coumatetralyl	Warfarin
Zeta-cypermethrin	Zinc phosphide
Demeton-S-methyl	Famphur
Dichlorvos	Fenamiphos

Dicrotophos	Flucythrinate
Dinoterb	Fluoroacetamide
DNOC	Formetanate
Edifenphos	Furathiocarb
Ethiofencarb	Heptenophos
Isoxathion	Methiocarb
Lead arsenate	Methomyl
Mecarbam	Monocrotophos
Mercuric oxide	Nicotine
Methamidophos	Omethoate
Methidathion	Oxamyl

3. Moderately hazardous (Class II):

List of pesticides not permissible (Class II)	
Common name	
Alanycarb	Endosulfan
Anilofos	Endothal-sodium
Azaconazole	EPTC
Azocyclotin	Esfenvalerate
Bendiocarb	Ethion
Benfuracarb	Fenazaquin
Bensulide	Fenitrothion
Bifenthrin	Fenobucarb
Bilanafos	Fenpropidin
Bioallethrin	Fenpropathrin
Bromoxynil	Fenthion
Bromuconazole	Fentin acetate
Bronopol	Fentin hydroxide
Butamifos	Fenvalerate
Butylamine	Fipronil
Carbaryl	Fluxofenim
Carbosulfan	Fuberidazole
Cartap	Gamma-HCH , Lindane
Chloralose	Guazatine
Chlorfenapyr	Haloxyfop
Chlordane	HCH
Chlorphonium chloride	Imazalil

Chlorpyrifos	Imidacloprid
Clomazone	Iminoctadine
Copper sulfate	Ioxynil
Cuprous oxide	Ioxynil octanoate
Cyanazine	Isoprocarb
Cyanophos	Lambda-cyhalothrin
Cyfluthrin	Mercurous chloride
Beta-cyfluthrin	Metaldehyde
Cyhalothrin	Metam-sodium
Cypermethrin	Methacrifos
Alpha-cypermethrin	Methasulfocarb
Cyphenothrin [(1R)-isomers]	Methyl isothiocyanate
2,4-D	Metolcarb
DDT	Metribuzin
Deltamethrin	Molinate
Diazinon	Nabam
Difenzoquat	Naled
Dimethoate	Paraquat
Dinobuton	Pebulate
Diquat	Permethrin
Phenthoate	Quizalofop-p-tefuryl
Phosalone	Rotenone
Phosmet	Spiroxamine
Phoxim	TCA [ISO] (acid)
Piperophos	Terbumeton
Pirimicarb	Tetraconazole
Prallethrin	Thiacloprid
Profenofos	Thiobencarb
Propiconazole	Thiocyclam
Propoxur	Thiodicarb
Prosulfocarb	Tralomethrin
Prothiofos	Triazamate
Pyraclofos	Trichlorfon
Pyrazophos	Tricyclazole
Pyrethrins	Tridemorph
Pyroquilon	Xylylcarb
Quinalphos	

3.1 Guidance on Proper Storage Handling and Disposal of Pesticides

Introduction

General safety precautions while handling pesticides and guidelines for proper storage, transportation and safe disposal of pesticides and pesticides containers are mentioned below for further reference.

General safety precautions while handling pesticides

Exposure to pesticides may occur when handling and spraying pesticides. The exposures to pesticides may occur in following situations:

- When handling the pesticides product during opening of the package, mixing and preparation of the spray.
- When spraying the pesticides.
- When disposing the pesticides solution and containers General precautions:

1. The operator should also wear a protective hat and face shield or goggles.
2. Do not eat, drink or smoke while working.
3. Wash hands and face with soap and water after spraying and before eating, smoking or drinking.
4. Shower or bath at the end of every day's work and wear new clean clothes.
5. Wash overalls and other protective clothing at the end of every working day in soap and water and keep them separate from the rest of the family's clothes.
6. If the insecticide touches the skin, wash off immediately with soap and water.
7. Change clothes immediately if they become contaminated with pesticides.
8. Inform the supervisor immediately if one feels unwell.

Protective clothing and equipment

Absorption of pesticides occurs mainly through the skin, lungs and mouth. Specific protective clothing and equipment given below must be worn in accordance with the safety instructions on the product label.

- Broad-rimmed hat (protects head, face and neck from spray droplets).
- Face-shield or goggles (protects face and eyes against spray fall-out).
- Face mask (protects nose and mouth from airborne particles).
- Long-sleeved overalls (worn outside of boots).

- Rubber gloves.
- Boots

Storage

1. Pesticides storehouses must be located away from areas where people or animals are housed and away from water sources, wells, and canals.
2. They should be located on high ground and fenced, with access only for authorized persons. However, there should be easy access for pesticides delivery vehicles and, ideally access on at least three sides of the building for fire-fighting vehicles and equipment in case of emergency.
3. Pesticides must NOT be kept where they would be exposed to sunlight, water, or moisture which could affect their stability.
4. Storehouses should be secure and well ventilated.
5. Containers, bags or boxes should be well stacked to avoid possibility of spillage. The principle of .first expiry first out. should be followed.
6. Stock and issue registers should be kept upto date. Access to the pesticides should be limited to authorized personnel only.
7. The store room should have a prominently displayed mark of caution used for poisonous or hazardous substances. It should be kept locked.
8. Containers should be arranged to minimize handling and thus avoid mechanical damage which could give rise to leaks. Containers and cartons should be stacked safely, with the height of stacks limited to ensure stability.

Transportation

1. Pesticides should be transported in well sealed and labeled containers, boxes or bags.
2. Pesticides should be transported separately. It should NOT be transported in the same vehicle as items such as agricultural produce, food, clothing, drugs, toys, and cosmetics that could become hazardous if contaminated.
3. Pesticides containers should be loaded in such a way that they will not be damaged during transport, their labels will not be rubbed off and they will not shift and fall off the transport vehicle onto rough road surfaces.
4. Vehicles transporting pesticides should carry prominently displayed warning notices.
5. The pesticides load should be checked at intervals during transportation, and any leaks, spills, or other contamination should be cleaned up immediately using accepted standard procedures. In the event of leakage while the transport vehicle is moving, the vehicle should be brought to a halt immediately so that the leak can be stopped and the leaked product cleaned up. Containers should be inspected upon

arrival at the receiving station. There should be official reports to the national level and follow-up enquiries in the event of fires, spills, poisonings, and other hazardous events.

Disposal of remains of pesticides and empty packaging

1. At the end of the day.s work during IRS activities, the inside of the spray pump should be washed and any residual pesticides should be flushed from the lance and nozzle.
2. The rinsing water should be collected and carefully contained in clearly marked drums with a tightly fitted lid. This should be used to dilute the next day's tank loads or disposed properly by the supervisor at disposal sites like pits or digs.
3. Never pour the remaining pesticides into rivers, pools or drinking-water sources.
4. Decontaminate containers where possible. For glass, plastic or metal containers this can be achieved by triple rinsing, i.e. part-filling the empty container with water three times and emptying into a bucket or sprayer for the next application.
5. All empty packaging should be returned to the supervisor for safe disposal according to national guidelines.
6. Never re-use empty insecticide containers.
7. It shall be the duty of manufacturers, formulators of pesticides and operators to dispose packages or surplus materials and washing in a safe manner so as to prevent environmental or water pollution.
8. The used packages shall not be left outside to prevent their re-use.
9. The packages shall be broken and buried away from habitation.

Disposal of Expired Pesticides

1. Adequate measures should be undertaken to avoid expiry of stocks in storehouses.
2. First Expiry First Out. principle should be strictly followed during stock movements.
3. The expired stock should be returned to manufacturer for disposal as per guidelines preferably through incineration process.
4. The chemical efficacy should be tested before disposal of expired pesticides to find out possibility of usage. The efficacy and active ingredient percentage of pesticides is tested and certified by the authorized testing laboratory.

Health Monitoring

1. In case of accidental exposures or appearances of symptoms of poisoning, medical advice must be sought immediately.
2. In case of organophosphorus (Malathion), regular monitoring of cholinesterase (CHE) level should be carried out and spraymen showing decline in CHE to 50% should be withdrawn and given rest and if needed medical aid