SFG3745

ENVIRONMENT MANAGEMENT FRAMEWORK

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Project on Climate Resilient Agriculture (POCRA)

Government of Maharashtra

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Abbreviations

AMSL	Above Mean Sea Level
APMC	Agricultural Produce Market Committee
ATMA	Agricultural Technology and Management Agency
BBF	Broad Bed Furrow
BCM	Billion Cubic Meter
BEE	Bureau of Energy Efficiency
CBO	Community Based Organisation
CC	Cluster Committee
CGWB	Central Ground Water Board
CHC	Custom Hiring Centre
CIB & RC	Central Insecticides Board and Registration Committee
CPCB	Central Pollution Control Board
CRPP	Climate Resilient Perspective Plan
CSIRO	Commonwealth Scientists and Industrial Research Organisation
DPAP	Drought Prone Area Programme
DPMU	District Project Management Unit
DSAO	District Superintending Agriculture Officer
DTR	Diurnal Temperature Range
EAMF	Environment Assessment and Mitigation Framework
EC	Electrical Conductivity
EIA	Environment Impact Assessment
EMF	Environment Management Framework
EMP	Environment Management Plan
ETL	Economic Threshold Level
FAO	Food and Agriculture Organisation
FFS	Farmer's Field School
FLD	Field Level Demonstration
FPC	Farmer Producer Company
FPO	Farmer Producer Organisation
GCA	Gross Cropped Area
GHG	Greenhouse Gas
GM	Genetically Modified
GP	Gram Panchayat

ICT	Information Communication and Technology
ICAR	Indian Council of Agricultural Research
IMD	Indian Meteorological Department
INM	Integrated Nutrition Management
IPM	Integrated Pest Management
IPNM	Integrated Plant Nutrient Management
IWMP	Integrated Watershed Management Program
JSA	Jalayukt Shivar Abhiyan
KVK	Krishi Vigyan Kendra
LGP	Length of Growing Period
LP	Linear Programming
MCIC / CIC	Maharashtra Climate Innovation Centre
MCM	Million Cubic Meter
MF	Marginal Farmer
MGNREGS	Mahatma Gandhi National Rural Employment Guarantee Scheme
MI	Micro Irrigation
MSAMB	Maharashtra State Agriculture Marketing Board
MWRRA	Maharashtra Water Resources Regulatory Authority
NBSSLUP	National Bureau of Soil Survey and Land Use Planning
NIDM	National Institute for Disaster Management
NPK	Nitrogen, Phosphorous and Potash
NSA	Net Sown Area
OC	Organic Carbon
PCN	Project Concept Note
PCR	Physical Cultural Resource
PDO	Project Development Objective
PMU / SPMU	Project Management Unit (State)
PoCRA	Project on Climate Resilient Agriculture
PPE	Personal Protective Equipment
PRI	Panchayati Raj Institution
RF	Rain Fall
RKVY	Rashtriya Krishi Vikas Yojana
SAU	State Agriculture University
SDAO	Sub-Divisional Agriculture Office
SF	Small Farmer
SFAC	Small Farmer Agri-Business Consortium
SOC	Soil Organic Carbon
SOM	Soil Organic Matter
SREP	Strategic Research and Extension Plan
SRR	Seed Replacement Rate
TAO	Taluka Agriculture Officer
TDET	Technology Development, Extension and Training
TDS	Total Dissolved Solid
TMC	Terminal Market Complex
TMC	Technology Mission on Cotton
VCRMC	Village Climate Resilient Agriculture Management Committee
WHS	Water Harvesting Structure
WUA	Water User Association
WUE	Water use Efficiency

ENVIRONMENT MANAGEMENT FRAMEWORK
Executive Summary

Project Background:

The Government of Maharashtra has approved a project on Climate Resilient Agriculture (PoCRA) to address the drought related vulnerability in the agriculture sector with the support of World Bank. Essentially, it is proposed to enhance the resilience of the farmers practicing rainfed farming from vagaries of climate change and thus ensure stable and secured livelihood, especially, to the poor and vulnerable farming communities in the state.
The Project Development Objective (PDO) is "to enhance climate-resilience and profitability of smallholder farming systems in selected districts of Maharashtra". The project will be implemented in 4210 drought prone villages and 932 salinity affected villages in Purna river basin spread across 15 districts of the State. The project has main three components

(1) Promoting Climate Resilient Agriculture Systems
(2) Climate Smart Post-Harvest Management and Value Chain Promotion, and
(3) Institutional Development, Knowledge and Policies for a Climate-resilient Agriculture.

Objectives of the EMF:

Based on the project design, the overall environmental impacts of the project would be positive, and any impacts arising from project financed investments will be minor, and temporary, and can be addressed using standard mitigation and monitoring methods; hence the project has been classified as "category B" (partial assessment) project as per the World Bank's Operational Policy on Environmental Assessment (OP 4.01).
An Environment Mitigation Framework (EMF) has been prepared with the overall objective of guiding the project in implementation of major activities in line with the identified risk mitigation strategies, making the interventions socially and environmentally sustainable. Best practice measures and environmental guidelines have also recommended for each typology of investment, from design, implementation and operational stages to improve the environmental performance of the project activities.

Approach and Methodology:

A participatory and consultative approach has been adopted to prepare EMF and its components. Project stakeholders at various levels viz state, district and sub district level, including small and marginal farmers (men and women), tribal, marginalized social groups, and experts were consulted. Their views and concerns have been incorporated in EMF document.

Components of the EMF:

Environment Management Framework will include: (i) basic criteria and procedures for screening all interventions, and guide the design and implementation of activities; (ii) regulatory requirements screening such that selected activities do not contravene the national, state and world bank safeguard policies (iii) mitigation action to contain, minimize and/or reverse identified adverse impacts; (iv) good practices guidelines for specific investments; (v) Technical guidelines on specific activities; and (vi) Specific strategies such as pest and nutrient management. The EMF also contains EMP checklist formats for mitigation of all impacts arising from civil works interventions. A list of ineligible activities has also been included as part of the EMF. Apart from above, a capacity building plan, implementation arrangements, budget and monitoring & evaluation system has been designed as an integral part of environment management framework.

Legal and Regulatory Framework:

The key Policies, Laws and Regulations of Central and State Government, that are applicable to the project are like (1) National Environment Policy 2006, (2)National Water Policy 2012, (3) Policy on Abatement of Pollution 1992, (4) National Conservation Strategy & Policy on Environment & Development 1992, (5) The Water (Prevention and Control of Pollution) Act, 1974 and the Air (Prevention & Control of Pollution) Act, 1981, (6) The Environment (Protection) Act, 1986, (7) The Solid Waste Management Rules, 2016, (8) Construction and Demolition Waste Management Rules, 2016 (9) Insecticides Act, 1968 and Insecticides Rules, 1971, (10) Water Policy 2003 of Government of Maharashtra, (11) Maharashtra Felling of Trees (Regulation) Act, 1964 and Guidelines for Tree Felling and Transit Permission, 2017 etc (12) Rural Producers
Companies Act, 2002 and (13) Fertilizer Order, 1985.

World Bank Safeguard Policies:
In line with World Bank Operational Policy OP 4.01, Environmental Assessment has been undertaken and the Environment Management Framework is developed. In accordance to OP 4.09, a Pest Management Plan (PMP) has been prepared. The project will not intervene in natural habitats, forest areas or impact any physical and cultural properties.

Environmental Issues:
The key environmental issues that are having implications for the project are (1) high climate vulnerability of some of the project districts (2) Variability of rainfall in pre-monsoon and post-monsoon period. Rainfall confined to monsoon only. It has impact on agricultural activities (3) Decreasing trend in rainfall in monsoon months in project districts; High evaporation / evapotranspiration in some of the project districts. (4) Soil of most of the project districts have low Nitrogen and Phosphorous (5) Land not available for cultivation (non-agricultural use and barren and uncultivable land) is gradually increasing; and the fallow land (current fallow) is increasing. (6) Predominantly land holdings are small or marginal and 78.98 percent farmers holding less than or equal to two ha land (7) deficient water availability with overexploited ground water in some of the project talukas whereas less utilization of irrigation potential, (8) increasing use of chemical fertilizers and pesticides for higher production / productivity etc.

Potential Environmental Impacts of Project Activities:
Based on the nature of activities framed under the project and categorized into "No Impact", "Low Impact" or "Moderate Impact" on the environment. Categorization of activities is largely based on the implementation process and its expected impact. The impact categories may not be constant across the project clusters and same activity may not have same level of impact across all the project districts and clusters. Infrastructure development activities can be categorized under "Moderate Impact" level due to associated construction related issues, energy consumption, expected generation of wastes etc. that require appropriate management. Similarly, activities under 'low impact' are not expected to cause any significant negative impact. Best practice measures and mitigation strategies are also recommended where appropriate to improve the environmental performance of the project activities.

Interventions not complying with the Policies/Regulations:
Project interventions with severe environmental impacts and those not complying with the policies/regulations of GoM, GoI, and World Bank's safeguard policies should not be promoted under PoCRA. These activities includes- Digging of bore well / deep bore well without ground water recharging structure will not be supported; No activity will be carried out in Critical or Endangered Natural Habitats (as certified); Embankment / check dam exceeding 10 meters in height will not be supported; use of pesticides will not be supported classified in Class Ia, Ib of WHO classification and banned by the GoI

Integrated Pest and Management Plan (IPMP):
Integrated Pest Management (IPM) includes soil, nutrient, water, crop, and vegetation management practices, tailored to a cropping and farming system appropriate to Marathwada and Vidharbha regions of Maharashtra. The IPMP aims at improving and sustaining soil fertility and land productivity and reducing environmental degradation. IPMP optimizes the condition of the soil, with regard to its physical, chemical, biological and hydrological properties, for the purpose of enhancing farm productivity, while minimizing land degradation. The field level management practices considered under IPMP would include the use of farmyard manures, natural and mineral fertilizers, soil amendments, crop residues and farm wastes, agro-forestry (suitable cases) and tillage practices, green manures, cover crops, legumes, intercropping, crop rotations, irrigation, drainage, and a variety of other agronomic, vegetative and structural measures designed to conserve both water and soil. The project will adopt Integrated Pest Management (IPM) as the key strategy to combat pests and diseases in the project and regulate its environmental impact, and recommends the use of bio- pesticides instead of chemical alternatives. This will be done through sensitization and awareness on IPM, demonstrations and trainings in the community mobilization phase and also to educate farmers on environment impact of indiscriminate use of pesticides, restricted and banned pesticides. Regular orientation training and follow up, field guidance and monitoring the adoption of IPM will also be conducted during the project.

Institutional Arrangement: The project will make required institutional arrangement to ensure EMF compliance of the project components as per the EMF. A dedicated project official at the PMU level will be the responsible person to guide the overall process related to environmental aspects. The district / sub-district level implementing agencies will be given required training to execute and monitor the environmental components in consultation with the PMU. They will be associated in the screening process of such activities that require detail environmental plan and will monitor the processes followed in execution of the planned activities and realization of the environment safeguard norms. It will be ensured that the project interventions are consistent with the agreed strategies and framework.

Capacity Building Plan: The official/s dealing with environmental aspects at the project management unit and district project management unit be oriented on environmental aspects with an objective to equipped them well by which they can manage the concerned components of the project effectively and efficiently. The capacity building on environmental aspects would take into account the current environmental issues in the State / project districts, project specific initiatives to adapt to the changes and taking mitigating measures. The project will also take up awareness and sensitization drive at community level (cluster / village level) to educate people on impacts of climate variability on agriculture and measures to be taken.

Monitoring and Evaluation: Project has developed an M&E system and indicators for all components which are to be monitored and evaluated, under which feedback from beneficiaries and data from the field is systematically collected and analyzed. EMF will be integral part of such M&E mechanism and this will be helpful in taking informed decisions and making any mid-course correction in implementation strategy and activities. The M&E system will be closely linked with the project's results framework also provides a mechanism for third party audit to ensure that environmental due diligence is being conducted in accordance with the provisions of the EMF.

Budget: EMF will be a part of complete implementation strategy at field level through FFS approach and other climate resilient interventions. Various steps of EMF i.e. identification, screening, scrutiny, applicable guidelines for particular activity/crop will be inbuilt steps under project interventions. There is sufficient fund allocation for implementation capacity, and manpower for supervision of the EMF.

1.0 PROJECT INTRODUCTION

1.1 Background of the Project

The Government of Maharashtra has approved a Project on Climate Resilient Agriculture (PoCRA) to address the drought related vulnerability in the agriculture sector. Essentially, it is proposed to enhance the resilience of the farmers practicing rainfed farming from vagaries of climate change and thus ensure stable and secured livelihood, especially, to the poor and vulnerable farming communities in the state.

1.2 Project Development Objective (PDO)

The Project Development Objective (PDO) is "to enhance climate-resilience and profitability of smallholder farming systems in selected districts of Maharashtra".

1.3 Project Area

The project is in the State of Maharashtra in India. Maharashtra is the second largest state in the country in terms of population[1] and has geographical area about 3.08 lakh sq. km. The state is highly urbanized[2] and having a population density of about 365 persons per sq. km. The state is geographically located in the western and central parts of the country and has a long coastline along the Arabian sea of about 720 km.

The project would promote adoption of climate resilient agriculture technologies, duly integrated with community led soil and water management practices, in the project area. There are 18768 villages in the project area. Out ofthese, PoCRA plans to intervene in about 4000 drought affected villages (3,000 in Marathwada and 1000 in Vidarbha) and 932 salinity affected villages in Purna river basin. Thus, the total number of villages proposed to be covered under the project is about 5,000.

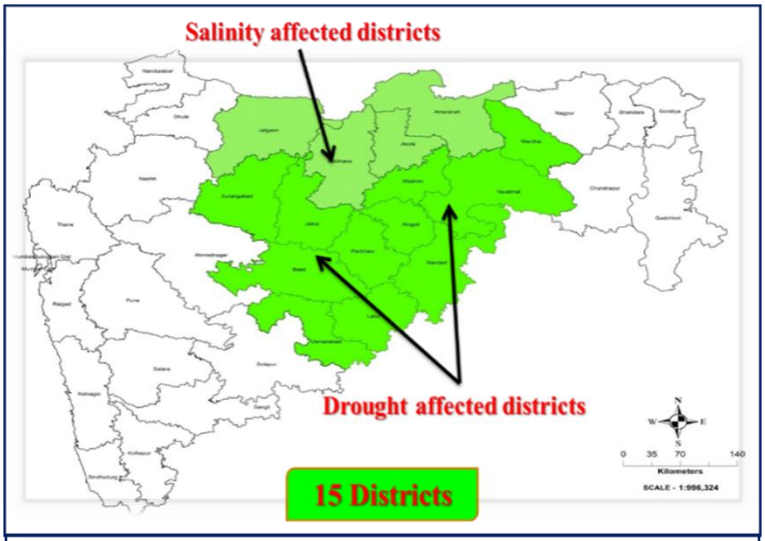

Figure 1: Project Area Map, Maharashtra

1.4 Project Components / Sub-Components

The project has three components namely (A) Promoting Climate Resilient Agriculture Systems (B) Climate Smart Post-Harvest Management and Value Chain Promotion and (C) Institutional Development, Knowledge and Policies for a Climate-resilient Agriculture.

Under component A, there are three sub component i.e. A.1: Participatory development of mini watershed plans A.2: On-farm climate-resilient technologies and farming systems and A.3: Climate-resilient development of catchment areas. Under Component B, there are three sub components i.e. B.1: Promoting Farmer Producer Companies B.2: Strengthening emerging value-chains for climate-resilient commodities

[1] As per population census, 2011 the population of the State is 11.24 crore which is 9.3 per cent of the total population of India
[2] About 45.2 per cent people residing in urban areas

and B.3: Improving the performance of the supply chain for climate-resilient seeds. Component C, consist of three sub component i.e. C.1: Sustainability and institutional capacity development C.2: Maharashtra Climate Innovation Center and C.3: Knowledge and policies

The project envisages increasing access to water, improving farm productivity by adopting climate resilient agricultural practices, soil management and adoption of water conservation technologies, and providing agro-meteorological services to farmers. In order to improve the market share of the agriculture produce at the producer's end, the project intends to promote / strengthen supply chain and value chain of select agricultural / horticultural commodities, using Farmer Producer Organizations (FPOs) / Farmer Producer Companies. Project intends to establish Maharashtra Climate Innovation Centre (MCIC) for knowledge sharing and learning for climate resilient technologies and practices in different segments, including agriculture and allied sectors.

1.5 Need of Environment Management Framework

It is anticipated that environmental issues and impacts would be minimal since the project's underlying objective is to improve the climate resilience *of smallholder farming systems in selected districts of Maharashtra*. Overall, the project related impacts are mostly positive, hence, it has been classified as category B project (partial assessment) under World Bank environmental classification of projects. The project design ensures that it will not intervene in any critical natural habitats, wildlife sanctuaries, tiger habitats located in Marathwada and Vidarbha regions.

Keeping in view the farmers' vulnerability to climate variability and current biophysical & socio-economic condition of the regions, an 'Environmental Management Framework (EMF) has been prepared. The EMF is in line with GoM and World Bank operational safeguards policies and addresses the potential environmental impacts of the project along with mitigation strategy to minimize the concern, improve resilience and adaptive capacity of stakeholders.

This EMF identifies the responsibilities of project stakeholders, procedures for environmental and social safeguards screening and enhancing institutional capacity. The environment assessment will guide the project in implementing major activities in line with the identified risk mitigation strategies, making the interventions socially and environmentally sustainable.

1.6 Objective and Scope of EMF

The objective of the EMF is to "Comply with the legal framework, and establish procedures and methods for environmental screening & assessment along with environmental impact of the project".

The scope of EMF will be to provide essential baseline data, confirm policies that are triggered, and assess likely impacts of the project interventions. The EMF will propose mitigation measures for any adverse impacts that may be envisaged through the design and construction phases of various project interventions. The participatory environment assessments will be conducted with due and extensive consultations with all the stakeholders, especially, the poor and vulnerable farming community. Further, the EMF will also outline arrangements for consultations with the stakeholders and disclosures thereof both during preparation as well as implementation phases. Preparation of the EMF included the following stages:

- Desk review of similar projects, applicable research papers, GoM schemes on climate resilience such as NICRA, and PoCRA PIP.

- Development of environmental baseline of project area, and identification of key environmental issues
- Stakeholder analysis and consultations, focus group discussions
- Analysis of Legal and policy framework
- Environmental assessment of all positive and adverse impacts relating to project financed activities
- Development of Screening checklists, Mitigation Measures, and EMP formats
- Institutional arrangements, capacity building, training needs for impmentation of EMF provisions.

Environmental Baseline: Developing a summary of existing environment baseline in the state of Maharashtra with particular reference to the project areas from the existing literature and technical documents. In particular, the assessment covered different environmental aspects, such as climate, land use pattern, agriculture, fertilizers and pesticide consumption, forest cover, production and yield of different crops, livestock, irrigation and water resources.

Stakeholder Analysis and Consultations: Identification of key stakeholders who are expected to be associated in the project / benefitted due to the project, directly or indirectly, and describe their roles, responsibilities and relationship with the project activities. In the assessment process, consultations with the identified stakeholders helped to understand their concerns and their inputs helped in preparing the management framework.

Legal and Policy Environment: Providing a brief coverage of the existing legal and policy environment in relation to the project, (GoI and GoM) which may be applicable to the project investments. Also, determining the World Bank safeguards policies that will be applicable to the project. Enlisting and summarizing ongoing relevant development programs and schemes in the project districts is objectively discussed to foster convergence in relevant areas.

Analysis of Key Environmental and Climate Risks and Vulnerabilities: Providing a summary of types of risks and impacts that may result from the anticipated activities interacting with environmental baseline typologies, and what probability, magnitude, duration and geographic scope these risks and impacts could assume. The assessment would include cumulative and induced impacts (where applicable), highlighting the positive environmental aspects of introducing such activities and the benefit linked to project outcomes.

Potential Mitigation Measures: Listing out the realistic, effective, and practical mitigation measures to address and manage the spectrum of potential environmental risks and impacts, identified during assessment; and rough estimates for the cost of mitigation measures.

1.8 Components of Environmental Management Framework (EMF)

Environment Management Framework will include:

(i) basic criteria and procedures for screening all interventions, and guide the design and implementation of activities; (ii) scope and application of the EMF for similar impact typologies; (iii) mitigation action to contain, minimize and/or reverse identified adverse impacts; (iv) good practices guidelines for specific investments; (v) Technical guidelines on specific activities; and (vi) Specific strategies such as pest and nutrient management; NRM strategy to enhance climate resilience of farmers including marginal and landless households; strategy to integrate mitigation measures and other resilience enhancing approaches in cluster level plans, etc.

The EMF includes the following arrangements in an integrated manner.

Capacity Building Plan: Given that the objective is to mainstream environmental safeguards in planning and implementation, a robust capacity building plan for various levels of stakeholders is suggested which may be suitably modified in the course of implementation, taking into account the project requirement.

EMF Implementation Arrangements: Establish a clear understanding of the institutional requirements, roles and responsibilities for adopting and implementing the EMF. Importantly, this includes a thorough review of the authority and capability of institutions at different levels (e.g. block, district and state) and their capacity to manage and monitor EMF implementation.

Budget for EMF: EMF will be a part of complete implementation strategy at field level through FFS approach and other climate resilient interventions. Various steps of EMF i.e. identification, screening, scrutiny, applicable guidelines for particular activity/crop will be inbuilt steps under project interventions. There is sufficient fund allocation for various component and subcomponents for project interventions. Thus, there is no need for separate budget allocation for EMF activities.

Monitoring and Evaluation System for EMF: Project has developed an M&E system and indicators for all components which are to be monitored and evaluated, under which feedback from beneficiaries and data from the field is systematically collected and analyzed. EMF will be integral part of such M&E mechanism and this will be helpful in taking informed decisions and making any mid-course correction in implementation strategy and activities. The M&E system will be closely linked with the project's results framework and avoid duplication in collection of similar information. The M&E system also provides a mechanism for third party audit to ensure that environmental due diligence is being conducted in accordance with the provisions of the EMF. Thus there is no need to develop separate monitoring and evaluation mechanism for EMF part and will be taken care under project's Monitoring and Evaluation system.

1.9 Approach and Methodology

A participatory and consultative approach has been adopted to prepare EMF and its components. Project stakeholders at various levels, including small and marginal farmers (men and women), tribal, marginalized social groups, and experts were consulted. Their views and concerns have been incorporated in this document.

Literature Review- A detailed & in-depth literature review on existing information helped in gaining a further and deeper understanding of the proposed project. A desk review of the central & state govt. legal framework and policies was also conducted in order to get information on the relevant legislations and policy documents that should be considered during project implementation.

- ➢ *World Bank Related Documents* -Aide Memoires; World Bank Safeguards Policies and Procedures
- ➢ *Central and Govt. of Maharashtra Legislative Documents*-National Water Policy**,** National Policy on Environment, Health and Sanitation policy, Plastic Waste Management, Wildlife Protection Act etc.

Review of Secondary data and collection of primary data- Collection and review of the existing secondary data sources mainly consisted of reports, statistics including census information and online publications of the Government of India and the Government of Maharashtra. These datasets was analyzed to illustrate the existing environmental situation, prepare the respective management plans including screening mechanism for the proposed interventions, and prepare plan for capacity building of stakeholders. Primary

data collection consisted of field visit to existing interventions of the Government of Maharashtra that have close resemblance with the climate resilient interventions.

Field visits and Interactive Discussions

Stakeholder consultations were conducted as following-

S. No.	District	Taluka	Date	Stakeholders
1.	Amravati	Dharni	16/11/2016	• Government officials including DSAO, ATC • Research institutes like KVKs, VNMK • APMC • Farmers (small, marginal and large) including women • Tribal communities • Communities based organizations- SHGs, Common Interest Groups, Farmer Producer Organizations • Input suppliers • Local Bodies / PRIs
2.	Amravati	Dharni	17/11/2016	
3.	Akola	Telhara	18/11/2016	
4.	Akola	Telhara	19/11/2016	
5.	Jalna	Ghansavangi	20/11/2016	
6.	Latur	Latur	21/11/2016	
7.	Latur	Latur	22/11/2016	

To understand the expected project risks and people's perception on the project, field visits were conducted in different agro-climatic zones of Maharashtra wherein the project area lies. The field visit and stakeholder consultations were conducted in four districts out of 15 project districts. One taluka (block) each was visited in 4 districts. The selection of the districts for field visit and stakeholder's consultation was based on the vulnerability index as calculated in Maharashtra State Adaptation Action Plan on Climate Change (MSAAPCC), 2014. Similarly, the Human Development Index (2012) of all project districts was considered for the selection of districts. In addition to the community level consultations, different service providing agencies like MAHABEEJ (Maharashtra State Seeds Corporation Ltd.), officials of ATMA, private input suppliers, KVK officials etc. were consulted.

Apart from field level consultations, state level consultations were carried out with different state level institutions, organizations, FPCs etc. and their views were also examined and suitably incorporated in the management framework.

Key Findings/ suggestions from Consultations

1. Lack of access to irrigation facilities coupled with long dry spells affect the production and productivity of crops. Farmers normally suffer from non-availability of water, even during Kharif. Protective irrigation is essential to save standing crops in dry spells and the project can take this up as one area of intervention.
2. The current practice of groundwater exploitation and filling up of the farm pond is to be evaluated scientifically to understand the evaporation rate. People normally extract the charged ground water in monsoon to fill the ponds. However, current practice is less sensitive to recommended adaptation measures as exposed surface area of the water increases evaporation.
3. The current initiative to deepen the natural drainages may be scientifically examined.
4. The project may take concrete measures to prevent burning of farm residues.
5. Current practices of fertiliser and pesticide use may pose risk to human health. The project may promote safety measures through orientation and demonstration.
6. In the Saline-Sodic track, special measures are required. As utilisation of groundwater for irrigation increases sodicity of the soil, maximum use of surface water is to be promoted. The groundwater may be treated with Gypsum before field application.

7. Promotion of BBF, deep drainage line (taking the whole area into account) and green manuring methods can reduce soil sodicity. Integrated reclamation technology would be beneficial to the saline-sodic track.
8. Use of polythene in farm fields (except saline-sodic track) for mulching may be discouraged and appropriate dispose-off plan to be prepared for recycling / destroying the polythene sheets. Vegetative / dry leaves / plant residues may be used instead of polythene sheets.
9. Protected cultivation with drip and sprinkler irrigation system should be promoted widely.
10. Village / cluster level water budgeting may be helpful to understand the water requirement and preparing water conservation plans accordingly.
11. Artificial ground water recharging methods can be introduced in project villages / clusters.
12. Some of the advance farmers have adopted modern techniques along with traditional techniques. One of the means they have adapted is to save input cost by utilizing farm byproducts and biomass as mulching and manuring material. Some of them have resorted to using organic fertilizers and pesticides instead of synthetic ones. Project may think of promoting such approaches which will reduce cost of cultivation.

2.0 LEGAL AND REGULATORY FRAMEWORK

2.1 Introduction

Under legal and regulatory framework, various policies and legislation of the Government of India and the Government of Maharashtra that may have bearing on the Project are presented. This is followed by a brief description of the relevant development programmes and schemes being implemented by the Government of India and the Government of Maharashtra. Later, at the end of the section, the World Bank Safeguard Policies are presented.

2.2 CENTRAL GOVERNMENT POLICIES AND LEGISLATION FOR ENVIRONMENT REGULATION

2.2.1 National Water Policy 2012

The policy notes that climate change is likely to increase the variability of water resources affecting human health and livelihoods. Therefore, special impetus is to be given towards mitigation at micro level by enhancing the capabilities of community to adopt climate resilient technological options. According to the policy, water should be treated as an economic good so as to promote its conservation and efficient use. In the preamble, it is stated that water availability for various users including agriculture will be under strain in future due to a range of causatives like increasing needs of growing population, wastage, inefficient use and pollution etc. The policy mentions that, depletion of groundwater should be arrested by introducing improved technologies of water use, incentivizing efficient water use and encouraging community based management of aquifers.

2.2.2 The Water (Prevention and Control of Pollution) Act, 1974

The Water Act provides for the prevention and control of water pollution. As per this Act, Central Pollution Control Board and State Pollution Control Boards are established at the National and State level as implementation mechanism. Main functions of the State Boards are, (a) to plan a comprehensive programme for the prevention, control or abatement of pollution of streams and wells in the State and to secure the execution thereof; (b) to advise the State Government on any matter concerning the prevention, control or abatement of water pollution; (c) to collect and disseminate information relating to water pollution and the prevention, control or abatement there of; (d) to encourage, conduct and participate in investigations and research relating to problems of water pollution and prevention, control or abatement of water pollution.

2.2.3 The National Environment Policy 2006

It is formulated in response to citizen's' right to clean environment, mandated in the Constitution in Articles 48 A and 51 A (g), strengthened by judicial interpretation of Article 21. It is recognized that maintaining a healthy environment is not the state's responsibility alone, but also that of every citizen. It is intended to mainstream environmental concerns in all development activities. The policy states that Environmental degradation is a major causal factor in enhancing and perpetuating poverty, particularly among the rural poor, when such degradation impacts soil fertility, quantity and quality of water, air quality, forests, wildlife and fisheries. It is stated that the poor are also more vulnerable to loss of resilience in ecosystems. Large reductions in resilience may mean that the ecosystems, on which livelihoods are based, break down, causing distress.

In response to the rapid depletion of groundwater, the policy intends to promote efficient water use techniques, such as sprinkler or drip irrigation, among farmers. Similarly, it intends to provide necessary pricing, inputs, and extension support to feasible and remunerative alternative crops which may be raised by efficient water use. One of the important action points in the policy with reference to the climate change is to assess the need for adaptation to future climate change, and the scope for incorporating these in relevant programmes, including watershed management, coastal zone planning and regulation, forestry management, agricultural technologies and practices, and health programmes

2.2.4 The Environment (Protection) Act, 1986

The genesis of the Environmental (Protection) Act, 1986, is in Article 48A (Directive Principles of State Policy) and Article 51A (g) (Fundamental Duties) of the Indian Constitution. The Act empowers the Central Government to take all appropriate measures to prevent and control pollution and to establish effective machinery for the purpose of protecting and improving the quality of the environment and protecting controlling and abating environmental pollution. This Act also empowers and authorizes the Central Government to issue directions for the operation or process, prohibition, closure, or regulation of any industry. The Central Government is also authorized to stop, regulate the supply of electricity or water or any other service directly without obtaining the order of the Court in this regard.

2.2.5 The Plastic Waste Management Rules, 2016

The rules are meant to exercise the powers conferred by sections 3, 6 and 25 of the Environment (Protection) Act, 1986. These rules apply to every waste generator, local body, Gram Panchayat, manufacturer, Importers and producer. Rule 3 defines, among other definitions, plastic waste management as 'the collection, storage, transportation reduction, re-use, recovery, recycling, composting or disposal of plastic waste in an environmentally safe manner'. Rule 4 sets conditions for manufacture, stocking, distribution, sale and use of carry bags and plastic sheets. As per rule 6(1) 'Every local body shall be responsible for development and setting up of infrastructure for segregation, collection, storage, transportation, processing and disposal of the plastic waste either on its own or by engaging agencies or producers'. Rule 8 provides for responsibility of waste generator that includes not to litter the plastic waste, segregation, storage of waste at source and handover segregated waste to the appropriate agency appointed by the local body or gram panchayat. As per the rule 9, the producers need to establish a system for collecting back the plastic waste generated due to their products.

2.2.6 Hazardous Wastes (Management and Handling) Rules, 1989

The Hazardous Wastes (Management and Handling) Rules, 1989 are to exercise the powers conferred by sections 6, 8 and 25 of the Environment (Protection) Act, 1986 (29 of 1986). These rules apply to hazardous wastes as specified in the Schedule appended to the rules. There are 18 categories of the hazardous waste listed in the schedule. As per the rule 4(1), the person generating hazardous wastes shall take all practical steps to ensure that such wastes are properly handled and disposed of without any adverse effects which may result from such wastes and he shall also be responsible for proper collection, reception, treatment, storage and disposal of these wastes.

2.2.8 Insecticides Act 1968 and Insecticides Rule 1971

The Insecticides Act, 1968 and Insecticides Rules 1971 regulate the import, registration process, manufacture, sale, transport, distribution and use of insecticides (pesticides) with a view to prevent risk to human beings or animals and for all connected matters, throughout India. All insecticides (pesticides) must undergo the registration process with the Central Insecticides Board and Registration Committees (CIB & RC) before they can be made available for use or sale.

2.2.9 Policy for Abatement of Pollution, 1992

This policy looks at abatement of pollution for preventing deterioration of the environment. The policy focus is on the long-term solution to pollution. The emphasis is on increased use of regulations and an increase in the development and application of financial incentives. The objective of the policy is to integrate environmental considerations into decision making at all levels. To achieve this, different steps are suggested in the policy, i.e., (1) preventing pollution at source; (2) encourage, develop and apply the best available practicable technical solutions; (3) ensure that the polluter pays for the pollution and control arrangements; (4) focus protection on heavily polluted areas and river stretches; and (5) involvement of public in decision making.

2.2.10 National Conservation Strategy & Policy on Environment & Development, 1992

The National Conservation Strategy and the Policy Statement on Environment and Development respond to the need of environmental considerations and development process. The agenda for action in the policy looks into the followings;

1. To ensure sustainable and equitable use of resources for meeting the basic needs of the present and future generations without causing damage to the environment;
2. To prevent and control future deterioration in land, water and air which constitute our life-support systems;
3. To take steps for restoration of ecologically degraded areas and for environmental improvement in our rural and urban settlements;
4. To prevent further damage to and conserve natural and man-made heritage;
5. To ensure that development projects are correctly sited to minimize their adverse environmental consequences;
6. To ensure that the environment and productivity of coastal areas and marine ecosystems are protected;
7. To conserve and nurture the biological diversity, genepool and other resources through environmentally sustainable development and management of ecosystems, with special emphasis on our mountain, marine and coastal, desert, wetlands, riverine and island ecosystems; and,
8. To protect the scenic landscapes, areas of geomorphological significance, unique and representative biomass and ecosystems and wildlife habitats, heritage sites/structures and areas of cultural heritage importance.

2.2.11 National Research Centre For Integrated Pest Management (IPM)

ICAR-National Research Centre for Integrated Pest Management (NCIPM), India was established in

February, 1988 to cater to the plant protection needs of different agro-ecological zones of the country. Integrated Pest Management Package is developed for cotton, maize, ground nut, rice, chick pea and soybean. The Centre has a strong institutional network in place to take on the challenges of plant protection in the country in a harmonized manner.

- National Innovations on Climate Resilient Agriculture (NICRA)
- Horti. Pest Surveillance and Advisory Project (HORTSAP) - Maha.(2016-17)
- Crop Pest Surveillance and Advisory Project (CROPSAP) - Maharashtra (2015-16)
- e-Pest Surveillance and Advisory Services for Rice in Tripura

The vision of the centre is minimization of crop losses due to pests through creation and harmonization of plant protection knowledge base and evolution of effective, economically viable and eco-friendly pest management technologies

National Innovations on Climate Resilient Agriculture (NICRA)

National Innovations on Climate Resilient Agriculture (NICRA) was launched during February 2011 by Indian Council of Agricultural Research (ICAR) with the funding from Ministry of Agriculture, Government of India. The project has three major objectives: strategic research, technology demonstrations and capacity building. Assessment of the impact of climate change simultaneously with formulation of adaptive strategies is the prime approach under strategic research across all sectors of agriculture, dairying and fisheries. Evolving climate resilient agricultural technologies that would increase farm production and productivity *vis-à-vis* continuous management of natural and manmade resources constitute an integral part of sustaining agriculture in the era of climate change.

Objectives

- To enhance the resilience of Indian agriculture covering crops, livestock and fisheries to climatic variability and climate change through development and application of improved production and risk management technologies.
- To demonstrate site specific technology packages on farmers' fields for adapting to current climate risks.
- To enhance the capacity of scientists and other stakeholders in climate resilient agricultural research and its application.

2.3 GOVERNMENT OF MAHARASHTRA's POLICIES AND LEGISLATION FOR ENVIRONMENT REGULATION

2.3.1 Integrated Pest Management (IPM)

Agriculture Department of Maharashtra State is entrusted with the responsibility of sustainable Agriculture Development. For increasing crop production and productivity various activities like promoting use of improved / hybrid seeds, balanced use of fertilizers, Integrated Pest Management, land development, micro-irrigation, mechanizations, technology transfer through extension services are carried out by the Department of Agriculture.

In order to minimize the use of hazardous chemical pesticides up to the extent possible & to prevent, manage the insect pests /diseases attack as well as to increase the crop productivity, Government of India,

through the Department of Agriculture & Cooperation (DAC) in Ministry of Agriculture has launched a scheme "Strengthening and Modernization of Pest Management Approach in India" since 1991-92 by adopting Integrated Pest Management (IPM) as cardinal principle and main plank of plant protection strategy in overall crop production programme. Under the ambit of IPM programme, the Govt. of India has established 35 Central IPM Centers in 28 States and one UT. In Maharashtra IPM centre is located in Nashik and Nagpur.

Concept of IPM

The Integrated Pest Management (IPM) is an ecological approach, which aims at keeping pests below economic thresholds level by employing all available alternate pest control methods and techniques such as cultural, mechanical and biological control with greater emphasis on use of bio-pesticides and pesticides of plant-origin like Neem formulation. The use of chemical pesticides is advised as a last resort when pest crosses economic threshold level (ETL).

Objectives

- Maximize crop production with minimum input costs;
- Minimize environmental pollution in soil, water and air due to pesticides;
- Minimize occupational health hazards due to chemical pesticides;
- Conserve ecosystem and maintain ecological equilibrium;
- Judicious use of chemical pesticides for reducing pesticide residues.

Activities

The Central Integrated Pest Management Centers (CIPMCs) undertake following programme and activities:

- Surveillance & Monitoring of insect-pest & diseases.
- Augmentation and Conservation of Natural enemies.
- Production and releases of bio-control agents.
- Human Resources Development (HRD) through Farmers' Field Schools (FFSs), Season-long training programmes, orientation training programme and refresher courses.

Apart from CIPMCs, State Bio-control Laboratories (SBCLs) have been established in Aurangabad and Nandurbar.

Mandate of Central Integrated Pest Management Centers (CIPMCS) and Adoption in Project Area

The mandate of the CIPMC Centers is pest/disease monitoring, production and release of bio-control agents/ bio-pesticides, conservation of bio-control agents and Human Resource Development in IPM by imparting training to Agriculture / Horticulture Extension Officers and farmers at Grass Root Level by organizing Farmers Field Schools (FFSs) in farmers' fields. Basic aim of FFS is to train the farmers on the latest IPM technologies so that they are able to take decision in pest management operation. In FFS the farmers are also trained about the judicious use of pesticides on their crops so that the crop can be grown with minimum use of pesticides.

FFS approach is inbuilt mechanism for project implementation phase. The IPM advisory and other necessary guidelines for the specific crop during kharif and rabi season will be disseminated at grass root level to all farmers of project area through FFS. Department of agriculture with technical support of Krishi Vigyan Kendras (KVKs) of concern districts will be responsible to execute FFS approach in their respective project areas.

Approach of IPM for key crops of the state

In Maharashtra Soybean, cotton, rice, tur, sorghum and bajra are major Kharif crops while, sorghum, gram are the major crops grown in the Rabi season. Farmers are shifting towards cotton and soybean crops in last few years due to good average per hectare yield and market prices. Pest disease management is the crucial factor in crop production. In general, 20-30% loss in yield occurs due to pests and diseases. Vulnerability of rainfall and changes in weather creates congenial conditions for pest and disease attacks. If pest and disease problem is not managed in time, farmers incur heavy economic losses.

To avoid the crop losses due to pest and diseases recurrence as a long term strategy, Department of Agriculture has taken an initiative and formulated and implemented "Awareness-cum Surveillance Programme for management of major pests in cotton-soybean based cropping system in Maharashtra" in 2009-10 under technical guidance of National Integrated Pest Management Centre (NCIPM), New Delhi. This scheme has now been renamed as "Crop Pest Surveillance and Advisory Project" (CROPSAP). The project has been further extended to cover Tur, Gram and Rice crops. A software was developed and implemented for data feeding, interpretation, report generation, GIS based pest mapping and advisory dissemination.

For regular pest surveillance, Pest Scouts are appointed and pre-seasonal trainings are imparted at SAUs. Pest Scouts and Pest Monitors collect pest data and feed it online in the software through their mobile. The data is processed and reports are generated. These reports are scientifically interpreted and necessary real time detail and short advisories are issued by the experts at State Agricultural University (SAUs). Talukawise advisories with hot spot locations are issued on-line to DSAOs on every Thursday and Monday. DSAOs transmit the messages in form of detailed advisories through e-mail to Taluka Level offices. The advisories are displayed at Gram Panchayats and also published in local newspapers and other print and electronic media. Pest situation is discussed in farmers meetings conducted by field staff. Short advisories are sent through SMSes to registered farmers. Awareness is created among the farmers through various training programmes, rallies, village meetings etc. to identify pest, their nature of damage and management. Software has a facility to generate Taluka-wise GIS mapping system for soybean, cotton, paddy, tur and gram pests. The maps generated through this system can be used for identifying epidemic area of particular pest. Wherever the pest population crosses Economic Threshold Level (ETL), subsidized pesticides are supplied on priority through different programmes. Apart from this, correlation of weather parameters is carried out and superimposed on GIS maps. Analysis of weather parameters and pest population dynamics by scientists will be useful in future to develop pest-forecasting modules. In this way, massive statewide campaign is organized and implemented in the state. Through this project, Information and Communication Technology (ICT) has been widely used in the field of plant protection for first time in the country.

Mobile Apps

Under the Department of Agriculture, State of Maharashtra, following mobile apps are available-

- **M-Crop -** M-Cropsap is mobile-based data entry application used for Crop-Pest Surveillance and Advisory Project (CROPSAP). (details about the app are available athttp://mahaagriiqc.gov.in/cropsap/Mcropsap/)
- **Crop clinic mobile -** Crop Clinic Mobile App is helpful to search crop insects and insecticide details (details about the app are available at http://mahaagriiqc.gov.in/cropsap/index.php)

2.3.2 Water Policy of Government of Maharashtra

The Water Policy, 2003 of the Government of Maharashtra focusses on Integrated Development and Management of Water Resources. Some of the important provisions of the policy are:

1. Mandatory public participation in planning, construction and management of water infrastructure.
2. Supply of water to the users on gross volumetric basis.
3. Delegation of irrigation management system to Water User Associations (WUA).
4. Development and dissemination of new technology for improving productivity.
5. Preparation of perspective plan for eradication of poverty and elimination of regional imbalance.
6. Transfer of water from 'water-abundant' regions to 'water-deficit' regions.

Policies of the Government of Maharashtra on water sector are;

1. State Water Policy, 2003;
2. Maharashtra Management of Irrigation Systems by Farmers Act, 2005;
3. The Maharashtra Water Resources Regulatory Authority (MWRRA) Act, 2005:
4. Maharashtra Groundwater (Development & Management) Act, 2009.

2.3.3 Agrarian crisis and agricultural crisis: issues and solutions

Many parts of the country have been facing agrarian distress due to a host of factors, including climate vulnerability and shocks. According to the records of National Crime Bureau, more than 2 lakh farmers across India have committed suicides over the last two decades. Andhra Pradesh, Maharashtra, Karnataka, Kerala, and Punjab witnessed more than 65% of farmers' indebtedness in 2011, which is highest in India.In this regard, Vidarbha is one of the most affected regions in India and Yavatmal is the most affected district in Vidarbha.

Project on climate resilience agriculture (PoCRA) has been designed primarily for small and marginal farmers. Apart from PoCRA, the GoM had declared a special package to help farmers in crisis and natural calamities in Vidarbha region. The details of this initiative are:

S. No.	Item	Implementing Department
1.	Emergency help	Revenue and forest (Relief and Rehabilitation)
2.	Loan rescheduling	Co-operation , Marketing and Textile Department
3.	Regulation of loan from private money lender	
4.	Apply doublization rule to all co-operative loan	
5.	Loan disbursement through farmers self help group	
6.	Regeneration of loan distribution system	Co-operation , Marketing and Textile Department and Agriculture and ADF
7.	Waive of premium of crop insurance scheme	Agriculture and ADF
8.	Financial help to farmers for more production	
9.	Promotion of Agri-allied business	
10.	Promotion of agri-processing industries	Co-operation , Marketing and Textile

		Department and Agriculture and ADF
11.	Promotion of cotton compound farming	Agriculture and ADF
12.	Community marriage scheme for farmers daughters marriage	Women and Child Development
13.	Reimbursement of capital development fund	Co-operation , Marketing and Textile Department
14.	Relief to cotton grower farmers	Agriculture and ADF
15.	Organic farming technology mission	Agriculture and ADF
16.	Vidarbha watershed mission	Water Conservation Department
17.	Starting helpline for farmers guidance	Agriculture and ADF
18.	Monitoring of declared programme	General Administration Department

2.4 APPLICABILITY OF ACTS / POLICIES

Table 1: Applicability of Policies

Policy	Why it is applicable for the Project
National Environment Policy, 2006	The Policy supports the environmental restoration measures and prescribe effective environment safeguard instruments
Environment Protection Act, 1986	The Act suggests to take all appropriate measures to prevent and control pollution and to establish effective machinery for the purpose of protecting and improving the quality of the environment and protecting controlling and abating environmental pollution
Plastic Waste Management Rules	It is applicable to all the GPs / producers apart from other entities. Applicability of Plastic Waste Management Rule is mostly related to current use of people in the project area and expected augmentation due to project intervention.
Hazardous Waste Management Rule, 1989	Waste category No. 18, i.e., discarded containers of hazardous and toxic wastes is particularly applicable to the project, especially with regard to pesticides.
The Wildlife Protection Act, 1972	Some of the project areas having wild life prevalence. Public and private protective measures are in place with compensation provision.
Insecticides Act, 1968	Use of registered and recommended insecticides and non-use of insecticides banned by GoI and WHO
Policy for abatement of pollution, 1992	This policy looks at abatement of pollution for preventing deterioration of the environment. The policy suggests preventing pollution at source.
National Conservation Strategy & Policy on Environment & Development, 1992	The project adheres to the policy prescription in terms of prevention of deterioration of natural resource base like land, water etc. & ecological restoration.
State Water Policy, 2003	The policy looks at participatory planning, construction and management of water use which the project intends to do in its intervention
Maharashtra Management of Irrigation Systems by Farmers Act 2005	Formation of Water User Association (WUA) for irrigation
The Maharashtra Water Resources Regulatory Authority (MWRRA) Act	Water tariff and water use entitlement, promotion of water conservation and management practices
Maharashtra Groundwater (Development & Management) Act 2009	Groundwater regulation for irrigation, drinking and other uses

2.5 World Bank Safeguard Policies and its Implications

The World Bank's environmental and social safeguard policies are a cornerstone of its support to sustainable poverty reduction. The objective of these policies is to prevent and mitigate undue harm to people and their environment in the development process. These policies provide guidelines for Bank and borrower in the identification, preparation, and implementation of programs and projects. Safeguard policies also provide a platform for the participation of stakeholders in project design and have been an important instrument for building a sense of ownership among local populations. In essence, the safeguards ensure that environmental and social issues are evaluated in decision making, help reduce and manage the risks associated with a project or program, and provide a mechanism for consultation and disclosure of information. The safeguards policies of the World Bank are discussed below.

Table 2: Operational Policies and its Implications for the Project

Operational Policy	Why it is applicable to the Project	Implications for the Project
OP 4.01: Environmental Assessment	The project aims at minimizing climate variability related vulnerabilities of agriculture sector through various measures. The project, while taking different environment friendly measures, its possible impact is to be assessed along with current conditions.	Conducting Environmental Assessment and preparing Environment Management Framework. (*Environment assessment conducted and management framework is prepared*)
OP 4.09: Pest Management	In the promotion of adaptive measures to climate variability and adoption of recommended package of practices, pest management will be essential and safeguard measures are to be taken.	Preparing Pest Management Framework and ensuring its implementation and monitoring mechanism. (*IPM Framework is prepared under EMF*)

2.6 Relevant Programmes and Schemes of the Government

Both Central and State Governments have been implementing a number of schemes / programmes under Central Schemes, Centrally Sponsored Schemes and State Schemes, that are relevant to the project. Some of these schemes and their salient features are discussed below.

Table 3: Relevant Programmes / Schemes

S. No.	Scheme	Schematic Provisions and Linkage Potential
1	Strengthening of Agmark Grading Facilities	1. Analysis of samples / research samples for developing and promoting grading and standardization of agricultural commodities under Agmark
2	Development / Strengthening of Agricultural Marketing Infrastructure, Grading & Standardization	1. The scheme is for those States which have amended the APMC Act (Maharashtra included); 2. Direct marketing, contract farming and permit to set up of markets in private and cooperative sectors; 3. Credit linked back-ended subsidy on capital cost of general or commodity specific infrastructure for marketing of agricultural commodities and for strengthening and modernization of existing agricultural markets, wholesale, weekly markets in rural areas
3	Gramin Bhandaran Yojana:	1. Creation of scientific storage capacity with allied facilities in rural areas.
4	Agriculture-Business Development (SFAC):	1. Setting up of agribusiness ventures, 2. Catalyzing private investment in setting up of agribusiness projects 3. Strengthen backward linkages of agri-business projects with producers; 4. Assist farmers, producer groups to enhance their participation in value chain through Project Development Facility; 5. Training and visits of agri-entrepreneurs in setting up identified

S. No.	Scheme	Schematic Provisions and Linkage Potential
		agribusiness projects.
5	Setting up of Terminal Market Complex (TMC):	1. Backward linkages with farmers through collection centers 2. Forward linkages through wholesalers, distribution centers, retail cash and carry stores, processing units for exporters etc.
6	National Agriculture Market (NAM) through Agri-Tech Infrastructure Fund (ATIF):	1. Setting up of common e-market platform that would be deployable in selected regulated wholesale markets (SFAC implements the national e-platform).
7	Integrated Scheme for Agricultural Marketing:	1. Creation of agricultural marketing infrastructure by providing backend subsidy support to State, cooperative and private sector investments; 2. Creation of scientific storage capacity; 3. Promote Integrated Value Chains (up to primary processing); 4. ICT as a vehicle of extension for agricultural marketing; 5. Establishing a nation-wide information network system for speedy collection and dissemination of market information; 6. Support framing of grade standards and quality certification of agricultural commodities; 7. Catalyze private investment in agribusiness projects; 8. Training, research, education, extension and consultancy in the agri-marketing sector.
8	National Agricultural Insurance Scheme (NAIS):	1. Insurance coverage and financial support to the farmers in the event of failure of any of the notified crops as a result of natural calamities, pests and diseases; 2. Encouraging farmers to adopt progressive farming practices, high value inputs and higher technology in agriculture; 3. Stabilize farm incomes, particularly in disaster years.
9	Sub-Mission on Agricultural Mechanization:	1. Increasing reach of farm mechanization to small and marginal farmers and to the regions where availability of farm power is low; 2. Promoting Custom Hiring Centres; 3. Creating hubs for hi-tech & high value farm equipment; 4. Awareness among stakeholders through demonstration and capacity building activities.
10	National Mission for Sustainable Agriculture (NMSA):	1. Promotion of Integrated / Composite Farming Systems; 2. Conservation of natural resources through appropriate soil and moisture conservation measures; 3. Comprehensive soil health management practices based on soil fertility maps, 4. Soil test based application of macro &micronutrients; 5. Judicious use of fertilizers; 6. Efficient water management to expand coverage for achieving 'more crop per drop'; 7. Developing capacity of farmers & stakeholders on climate change adaptation and mitigation measures; 8. Pilot models in select blocks for improving productivity of rain-fed farming by mainstreaming rainfed technologies refined through NICRA;
11	Rashtriya Krishi Vikas Yojana (RKVY):	1. Preparation of agriculture plan; 2. Focused intervention to reduce yield gap in important crops; 3. Distribution of ag. Inputs, extension, soil health management and IPM promotion; 4. Dairy development;

S. No.	Scheme	Schematic Provisions and Linkage Potential
		5. Fishery promotion; 6. Information dissemination; 7. Infrastructure development under Infrastructure and Assets.
12	National Food Security Mission:	1. Extension of improved technologies i.e. seed, Integrated Nutrient Management including micronutrients, soil amendments, IPM and resource conservation technologies; 2. Capacity building of farmers.
13	Development and Strengthening of Infrastructure Facilities for Production and Distribution of Quality Seeds:	1. Establishing seed bank and its maintenance; 2. Development of seed village; 3. Assistance for Creation / Strengthening of Infrastructure Facilities in Public Sector; 4. Strengthening State Seed Testing Laboratories for quality control; 5. Awareness campaign through SAUs, scientific organisations/Institutes; 6. Promotion of tissue culture through SAUs/specialised institutions/seed corporations; 7. Boosting Seed Production in Private Sector.
14	Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)	1. Creation of new water sources; repair, restoration and renovation of defunct water sources; construction of water harvesting structures, secondary & micro storage, groundwater development, enhancing potentials of traditional water bodies at village level, etc. 2. Developing/augmenting distribution network where irrigation sources (both assured and protective) are available or created; 3. Promotion of scientific moisture conservation and runoff control measures to improve groundwater recharge so as to create opportunities for farmer to access recharged water through shallow tube/dug wells; 4. Promoting efficient water conveyance and field application devices within the farm viz, underground piping system, Drip & Sprinklers, pivots, rain-guns and other application devices etc.; 5. Encouraging community irrigation through registered user groups/farmer producers' organizations/NGOs; and 6. Farmer oriented activities like capacity building, training and exposure visits, demonstrations, farm schools, skill development in efficient water and crop management practices (crop alignment) including large scale awareness on more crop per drop of water through mass media campaign, exhibitions, field days, and extension activities through short animation films etc.
15	Mahatma Gandhi National Rural Employment Guarantee Act, 2005 (MGNREGA)	1. Supplementary livelihood in rural areas through unskilled manual work, 2. Categories of work permitted to be taken up for providing employment are water conservation, drought proofing, irrigation, land development, rejuvenation of traditional water bodies, flood control and drainage work, rural connectivity and work on the land of Scheduled Castes (SCs), Scheduled Tribes (STs), Families Below Poverty Line (BPL) and Indira Awas Yojana (IAY) beneficiaries, land reform beneficiaries and individual small and marginal farmers.

3.0 Environment Baseline

3.1 Topography and Physiography

Maharashtra State is spread over a geographical area of 3,07,713 sq. km. Its geographic location is latitude 15°40' N to 22°00' N and longitude is 72°30'E to 80°30'E. Based on topography and physical features, the state can be divided into three physical divisions, viz. The Konkan Coastal Lowland, the Western Ghats and the Maharashtra plateau.

3.2 Geology

The geology of Maharashtra is famous for the Deccan Traps, which occurs in all the districts of the State, except Bhandara, Gondia and Gadchiroli. The other geological formations, older and younger than Deccan Traps, occur in the northeast and as isolated patches in the Sindhudurg and Ratnagiri districts. The stratigraphic succession of the geologic formations in the State is given in the Table No. 8. The variation in hydrological properties is due to inherent physical characteristics of the rocks.

Table 4: Geology of Maharashtra

Formation	Area (in sq km)	Percentage
Quaternary Alluvium	14498	5.71
Deccan Trap lava flows	250026	81.25
Gondwana Rock	4808	1.56
Proterozoic	6190	2.01
Precambrian Basement	32191	10.46

Source: Report on the Dynamic Groundwater Resources of Maharashtra, 201-12; Ground Water Survey and Development Agency, Pune, February 2014

3.3 Climate

The state enjoys a tropical monsoon climate. The summer is from March up to June followed by monsoon from June to September. The seasonal rains from western sea-clouds provide heavy rainfall on the Sahyadri crests.The Western Ghats hill ranges run north to south separating the coastal districts of Thane, Mumbai, Raigad, Ratnagiri and Sindhudurg from rest of the State. The average height of these ranges is about 1000 m above mean sea level (AMSL) form an important climatic divide. The coastal areas receive very high monsoon rains while to the east of the Ghats rainfall drops drastically within short distance from the Ghats. Towards further east, the rainfall increases gradually.

3.4 Temperature

The State experiences four seasons during a year. March to May is the summer season followed by rainy season from June to September. The post monsoon season is October and November. Maharashtra has variable climate from continental to typical maritime depending upon the location and physiography. The coastal districts of Konkan experience heavy rains but mild winter. The weather, however, is mostly humid throughout the year. The maximum and minimum temperature varies between 27°C and 40°C & 14°C and 27°C respectively. The maximum summer temperature varies between 36°C and 41°C and during winter the temperature oscillates between 10°C and 16°C. Rainfall starts in the first week of June and July is the wettest month. Rainfall in Maharashtra differs from region to region.

Table 5: Climatic Condition by Agro-climatic Zone

Agro-climatic Zones	Climatic Condition
South Konkan Coastal Zone	Daily temp. above 20^0C. throughout the year.
North Kokan Coastal Zone	Avg. daily temp 22 to 30^0C. Mini. temp 17 to 27^0 C. Humidity 98%in rainy season & winter-60%
Western Ghat	Maximum temp. ranges from 29-39^0 C. Minimum temp ranges from 13-20^0 C.
Transition Zone-1	Average maximum temperature is between 28-35^0 C and minimum 14-19^0 C
Transition Zone-2	Maximum temperature 40^0 C & minimum 5^0 C.
Scarcity Zone	Maximum temperature 41^0 C minimum 14-15^0 C
Assured Rainfall Zone	Maximum temp 41^0C Minimum temp 21^0C
Moderate Rainfall Zone	Maximum temperature 33-38^0 C Minimum temperature 16-26^0C Average daily humidity 72 % in rainy season, 53 % in winter & 35% in summer.
Eastern Vidarbha Zone	Mean Maximum temperature varies from 32^0 C to 37^0 C. Minimum temperature 15^0C to 24^0 C. Daily humidity 73% for rainy season 62% in winter & 35% in summer

Source: NIDM, Maharashtra

3.5 Rainfall

Geographical location of Maharashtra is widely spread to get different types of climatic features. Due to the climate variability and varied topographical features, the state is divided in four meteorological sub-divisions namely Konkan & Goa; Vidarbha; Madhya Maharashtra and Marathwada. The meteorological sub-division Konkan & Goa is the extreme western part elongated north south along the west coast of India. Due to these topographical features, the region receives very high rainfall during monsoon season. The Vidarbha region is the easternmost part of the state. The mean monsoon or annual rainfall of Vidarbha is lesser than Konkan but more than the other two sub-divisions. The other two sub-divisions viz. Madhya Maharashtra and Marathwada are almost having similar mean rainfall with Madhya Maharashtra having slightly higher mean monsoon or annual rainfall. But the rainfall patterns have high intra seasonal variability. There is high spatial variability of rainfall over districts of Maharashtra.

The State experiences extremes of rainfall ranging from 6000 mm over the Ghats to less than 500 mm in Madhya Maharashtra. The Konkan sub-division comprising of coastal districts and Western Ghats receive the heaviest rains, the Ghats receive more than 6000 mm and the plains 2500 mm. Rainfall decreases rapidly towards eastern slopes and plateau areas where it is minimum (less than 500 mm). It again increases towards east, i.e., in the direction of Marathwada and Vidarbha and attains a second maximum of 1500 mm in the eastern parts of Vidarbha. Thus, the Madhya Maharashtra sub-division is the region of the lowest rainfall in the State.

The State receives its rainfall mainly during the south west monsoon season (June to September) while Konkan receives almost 94% of the annual rainfall during the monsoon season. The other sub-divisions namely Madhya Maharashtra, Marathwada and Vidarbha receive 83%, 83% and 87% respectively during this season. The number of rainy days has great significance in artificial recharge to groundwater. The rainy days normally vary from 75 to 85 days in Konkan and 30 to 40 days in Madhya Maharashtra and Marathwada. The number of rainy days in Vidarbha is around 40 to 50 days during southwest monsoon season.

Table 6: Average Annual Rainfall by Agro-Climatic Zone

S. No.	Agro-Climatic Zone	Avg. Annual Rainfall
1	South Konkan Coastal Zone	3105 mm in 101 days
2	North Kokan Coastal Zone	2607 mm in 87 days.
3	Western Ghat	3000 to 6000 mm. Rainfall recorded in different places of the zone viz Igatpuri, Lonawala, Mahabaleshwar, & Radhanagari.
4	Transition Zone-1	700-2500 mm. Rains received mostly from S-W monsoon.
5	Transition Zone-2	Well distributed rainfall 700 to 1200 mm.
6	Scarcity Zone	Less than 500mm in 45 days. Two peaks of rainfall. 1) June/ July2) September. Bimodal pattern of rainfall.
7	Assured Rainfall Zone	700 to 900 mm.
8	Moderate Rainfall Zone	1130 mm.
9	Eastern Vidarbha Zone	950 to 1250 mm on western side. 1700 mm on extreme east side. Average number of rainy days is 59.

Source: NIDM, Maharashtra

The variability of annual rainfall over the state in general, is high. Only in the coastal areas, the variability is less than 20% otherwise the variability ranges between 20% and 35% over the state. On sub-divisional basis, the variability of annual rainfall in Konkan is the least (23%) while it is the maximum in Marathwada (31%). In Madhya Maharashtra and Vidarbha the variability is 30% and 26% respectively. The climate of Maharashtra State is tropical monsoon type. Its location on the Western Coast and the peculiar topography are additional features which cause regional variation of climate from place to place within the State.

Maharashtra predominantly receives the rainfall from the southwest monsoon. The monsoon normally withdraws by the end of September or early October. The post-monsoon season generally extends for two months between October and November. The winter season lasts for three months from December to February, March, April and May form the hot weather season. The distribution of rainfall across the State is strongly influenced by physiography. Ninety-nine talukas in the State are chronically drought affected.

Table 7: Rainfall in Project Districts of Maharashtra

District	Rainfall									
	Normal Rainfall(mm)					Average number of Rainy days				
	SW monsoon (June-Sep)	NE Monsoon (Oct-Dec)	Winter (Jan-Feb)	Summer (Mar-May)	Annual	SW monsoon (June-Sep)	NE Monsoon (Oct-Dec)	Winter (Jan-Feb)	Summer (Mar-May)	Annual
Akola	711.6	72.6	26.1	15	825.3	37	4	2	1	45
Amravati	775.2	69.6	29.4	12.2	886.4	40	4	3	1	48
Aurangabad	623.5	83.5	3.8	23.3	734.3	33	6			39
Beed	605.4	94.4	6.5	37.1	743.4	26	5			31
Buldhana	684.7	76.8	17	14	792.5	37	3.9	1.5	1.2	43.6
Hingoli	829.5	75.4	10.2	31.5	946.6	39	5	1		45
Jalgoan	639.8	73.4	16.8	20	750	33	4	2	1	40
Jalna	634.1	84.5	5.2	26.6	750.4	33	5			38
Latur	634.9	85.2	6	43.6	769.7	37	6			43
Nanded	862.5	76.4	18.1	36.1	993.1	39	5	1	1	46
Osmanabad	693.9	88.2	8.1	52.2	842.4	36	6			42
Parbhani	804.9	96.2	12.2	44.3	957.6	37	5	1	1	44
Wardha	775.2	69.6	29.4	12.2	886.4	39.9	3.7	2.5	1.2	47.3
Washim	848.6	75.4	26.7	14.6	965.3	41.3	4	2.1	1.2	48.6

District	Rainfall									
	Normal Rainfall(mm)					Average number of Rainy days				
	SW monsoon (June-Sep)	NE Monsoon (Oct-Dec)	Winter (Jan-Feb)	Summer (Mar-May)	Annual	SW monsoon (June-Sep)	NE Monsoon (Oct-Dec)	Winter (Jan-Feb)	Summer (Mar-May)	Annual
Yavatmal	775.2	69.6	29.4	12.2	886.4	39.9	3.7	2.5	1.2	47.3

Source: National Climate Centre, Pune

Analysis of long-term rainfall trends in India reveals that in August, the maximum increase, showing positive trend, was witnessed by Konkan & Goa (1.04 mm/year). For September, decreasing rainfall is observed with the maximum reduction for Marathwada (-0.50 mm/year). The maximum increase in monsoon rainfall was of the order of 1.81 mm/year for Coastal Karnataka followed by Konkan & Goa. While analysing the rainfall data for the 1871–2003 period, Dash et al. (2007) also found the same three sub-divisions showing the maximum increase in monsoon rainfall. Decrease in annual rainfall was found to be maximum for Madhya Maharashtra (-0.04 mm/year) along with other states.

Table 8: Long-term Rainfall Trend in Regions of Maharashtra

Sub-division/Region	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Konkan & Goa	0	0	0	0	0.01	0.33	0.13	1.04	-0.05	0.15	0	0
Madhya Maharashtra	0	0	0	-0.01	0	0.13	-0.23	0.25	-0.17	0.05	-0.01	0
Marathwada	0	0	0	0	0.02	-0.03	0.04	0.28	-0.50	0.21	0	0
Vidarbha	0.01	0.01	0.01	0.01	-0.01	-0.13	-0.40	0.40	-0.45	0.1	0	0
All Subdivisions / Region	0	0.01	0	0.04	0	-0.12	-0.13	0.08	-0.1	0.1	0.01	0

Source: Analysis of long-term rainfall trends in India
Note: Bold values indicate statistical significance at 95% confidence level as per the Mann-Kendall test (+ for increasing and - for decreasing).

Trends and magnitude of change in annual rainfall, in terms of percentage of the mean per 100 years, reflects that Vidarbha region has experienced a decreasing trend of nearly 5–10% of mean per 100 years. Significance of trends in monthly rainfall indicates that, during the non-monsoon months, the increasing rainfall was found statistically significant in Marathwada region in October. During the monsoon months of June, July, August and September, significant trends (both positive and negative) were detected. Significant decreasing trend was detected for Vidarbha during July; and for Marathwada and Vidarbha during September. An increasing trend for Konkan & Goa and Madhya Maharashtra in August was found significant. The rainfall data of more than 100 years over Maharashtra has been analyzed and the impact of climate changes on temporal and spatial pattern over smaller spatial scales is clearly noticed. Significant decreasing trends in monthly rainfall are being observed in many districts from the month of January (seven districts) to May (three districts) with maximum decrease in February (15 districts). Not a single district of Maharashtra reported increasing trends in rainfall from the month January to May. These changing patterns are very crucial in agriculture point of view. In spite of increasing trends in monsoon rainfall in many areas, the decreasing trends in the first five months of the year have resulted increase heating, and may have effect in shortage of soil moisture, groundwater and lowering the groundwater level. Out of twelve months, August

has shown very good for the state Maharashtra as most of the districts have shown increasing trends in August rainfall.

3.6 Evaporation and Evapotranspiration

The evaporation in Maharashtra varies from 1478 mm to 2474 mm. It is lowest in Konkan region where as highest evaporation is observed in Nashik, Dhule, Jalgaon along with Buldhana, Akola and Amravati districts. If mean monthly evaporation and mean monthly rainfall are compared the evaporation appears higher even than rainfall in the months of July and August in Ahmadnagar District and in September in Jalgaon, Buldana and Akola Districts. That is why, even during monsoon, crops are badly in need of irrigation in these districts.

3.7 Agro-Climatic Zone

Depending on the general climatic conditions and the consequent cultivation pattern, the state is divided into nine agro-climatic zones (Table No. 11).

Table 11: State Agro-Climatic Zones

Agro-climatic Zones	Name of the Zone	Climatic condition	Avg. Annual Rainfall
South Konkan Coastal Zone	Very high rainfall zone with laterite soils	Daily temp. Above 20^0C. Throughout the year.	3105 mm in 101 days
North Kokan Coastal Zone	Very high rainfall zone with non-lateritic soils	Avg. daily temp 22 to 30C.Mini. temp 17 to 27 C. Humidity 98%in rainy season & winter-60%	2607 mm in 87 days.
Western Ghat	Western Ghat Zone/Ghat zone	Maximum temp. ranges from 29-39 C. Minimum temp ranges from 13-20 C.	3000 to 6000 mm. Rainfall recorded in different places of the zone viz Igatpuri, Lonawala, Mahabaleshwar, & Radhanagari.
Transition Zone-1	Sub Montane Zone/ Transition Zone 1	Average maximum temperature is between 28-35 C and minimum 14-19 C	700-2500 mm. Rains received mostly from S-W monsoon.
Transition Zone-2	Western Maharashtra Plain Zone /Transition-2	Water availability ranges from 120-150 days. Maxi. temperature 40 C & minimum 5 C.	Well distributed rainfall 700 to 1200 mm.
Scarcity Zone	Western Maharashtra Scarcity Zone/ Scarcity Zone	Suffers from very low rainfall with uncertainty & ill-distribution. Max. temp. 41 C mini.-14-15 C	Less than 750mm in 45 days. Two peaks of rainfall. 1) June/ July2) September. Bimodal pattern of rainfall.
Assured Rainfall Zone	Central Maharashtra Plateau Zone /Assured Rainfall Zone	Maximum temperature 41 C Minimum temperature 21 C	700 to 900 mm 75 % rains received in all districts of the zone.
Moderate Rainfall Zone	Central Vidarbha Zone /Zone of Moderate Rainfall	Maxi. Temp. 33-38 C Mini. Temp. 16-26 C Average daily humidity 72 % in rainy season, 53 % in winter & 35% in summer.	1130 mm.
Eastern Vidarbha Zone	High Rainfall Zone with Soils derived from parent material of	Mean Maximum temperature varies from 32 to 37 C. Minimum temperature 15 to 24	950 to 1250 mm on western side. 1700 mm on extreme east side No of rainy days 59.

Agro-climatic Zones	Name of the Zone	Climatic condition	Avg. Annual Rainfall
	different crops. There are 4 sub-zone based on climate, soils and crop pattern	C. Daily humidity 73% for rainy season 62 winter & 35 summer	

Source: NIDM, Maharashtra; Maharashtra State Adaptation Action Plan on Climate Change (MSAAPC), Dept. of Environment, Govt. of Maharashtra

3.8 Soils

According to the National Bureau of Soil Survey and Land Use Planning (NBSSLP), Maharashtra, can be divided into 356 soil-mapping units, which are broadly categorized as: (1) Soils of Konkan coast, (2) Soils of Western Ghats, (3) Soils of Upper Maharashtra, and (4) Soils of Lower Maharashtra.

Table 12: Soil Types by Agro-Climatic Zones

S. No.	Agro-climatic Zones	Name of the Zone	Soil Type
1	South Konkan Coastal Zone	Very high rainfall zone with lateritic soils	Lateritic,PH-5.5-6.5 acidic, poor in phosphorous rich in nitrogen and Potassium
2	North Kokan Coastal Zone	Very high rainfall zone with non-lateritic soils	Coarse & shallow, PH 5.5 to 6.5, acidic Rich in nitrogen, poor in phosphorus & potash.
3	Western Ghat	Western Ghat Zone/Ghat zone	'Warkas' i.e. light laterite & reddish brown. Distinctly acidic, poor fertility low phosphorous & potash content.
4	Transition Zone-1	Sub Montane Zone/ Transition Zone 1	Soils are reddish brown to black tending to lateritic. PH 6-7. Well supplied in nitrogen but low in phosphorous & potash
5	Transition Zone-2	Western Maharashtra Plain Zone /Transition-2	Topography is plain. Soils greyish black. Moderately alkaline 7.4- 8.4, lowest layer is 'Murum' strata. Fair in NPK content. Well drained & good for irrigation.
6	Scarcity Zone	Western Maharashtra Scarcity Zone/Scarcity Zone	General topography is having slope between 1-2%. Infiltration rate is 6-7 mm/hr. The soils are vertisol. Soils have Montmorillonite clay. Poor in nitrogen, low to medium in phosphate & well supplied in potash.
7	Assured Rainfall Zone	Central Maharashtra Plateau Zone /Assured Rainfall Zone	Soil colour ranges from black to red. Type- 1) vertisols, 2) entisols & 3) inceptisols PH 7-7.5
8	Moderate Rainfall Zone	Central Vidarbha Zone /Zone of Moderate Rainfall	Black soils derived from basalt rock. Medium to heavy in texture alkaline in reaction. Low lying areas are rich and fertile.
9	Eastern Vidarbha Zone	Eastern Vidarbha Zone/ High Rainfall Zone with Soils derived from parent material of different crops. There are 4 sub-zone based on climate, soils and crop pattern	Soils derive from parent rock granite, gneisses, and schist. Brown to Red in colour. PH6 to 7

Source: NIDM, Maharashtra

3.9 Water Resource

Water is one of the most important resource for the agriculture sector. The Vision of the GoM about this resource is "*Optimally conserve allocated water resources of the state in sustainable, equitable and efficient manner to fulfil drinking, irrigation, industrial and environmental needs at reasonable cost by efficient utilisation of water using state of the art technologies, best practices and empowered competent human resources, so as to make MWRD a leader in Water Resources Management by 2020*".

Maharashtra is divided in five major river-basins (Table No. 14).

Table 13: Water Availability of Sub-Basins in Maharashtra

Basin	Geographical Area	% of Geographical Area to State Area (in Lakh Ha.)	CCA (in Lakh Ha.)	% of CCA to State CCA	Annual Average Water Availability (Mcim)	Water Availability with 50% Dependability (Mcum)	Water Availability as per Tribunal (Mcum)	Water Availability Per Ha. of CCA (Mcum)	Category as per Water Availability
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Godavari	154.3	49.5	112.6	49.9	50880	47708	34185	3037	Normal
Tapi	51.2	16.7	37.3	16.6	9118	9780	5415	1451	Deficit
Narmada	1.6	0.5	0.6	0.3	580	482	308	4813	Normal
Krishna	7.1	22.6	56.3	25.0	34032	34504	16818	2989	Normal
Rivers of Konkan	31.6	10.7	18.6	8.2	69210	69300	69210	37130	Abundant
State	**245.8**	**100.0**	**225.4**	**100.0**	**163820**	**161774**	**125936**	**5587**	**Normal**

Source: Maharashtra Water and Irrigation Commission, 1999

Maharashtra Water and Irrigation Commission has distinguished and classified the sub-basins in the entire state based on water availability. The table clearly shows that water availability per cultivable area is least in the Tapi basin, implying that, north Maharashtra (Nasik Revenue Division) and Western Vidarbha (Amravati Revenue Division) suffer from water scarcity. It may be noted that in other river-basins, as well, the availability among sub-basins differs widely. Hence in planning of water-resources, the criterion cannot be uniform or identical across all regions. The 'regions with water scarcity' and 'regions with extreme scarcity' should be considered separately and distinctly from other regions. These regions of scarcity and extreme scarcity account for 13 percent and 33 percent of the total cultivable area (i.e.46 percent of the total cultivable area).

Table 14: Water Availability by Revenue Division

Region	Area (Lakh Ha.)	CCA (Lakh Ha,)	Average Water Availability (Mcum)	Water Availability as per Tribunal (Mcum)	Water Availability per Ha. (Cum) (Col. 6/3)	Category as per Water Availability
1	**2**	**3**	**4**	**6**	**7**	**9**
Konkan	30.7	17.6	64501	65357	36507	Very High
Nashik	57.5	40.2	17478	13635	3395	Normal
Pune	57.3	45.6	32696	16087	3531	Normal
Aurangabad	64.8	59.3	15254	8202	1383	Deficit
Amravati	46.0	35.6	9813	7033	1974	Deficit
Nagpur	51.3	26.8	24077	15622	5818	Abundant
State	**307.7**	**225.4**	**163820**	**125936**	**5587**	**Normal**

Source: Water Resource Subgroup of the High-Power Committee for Balanced Regional Development in Maharashtra, 2013

Except the Konkan and Nagpur division, the natural availability of water in Maharashtra is not very good. Use of Water resources for economic development should, therefore, be planned with extreme care, efficiency and caution. In particular, the regions with 'less than 3000 cubic meter of water per hectare' will have to be seriously re-considered about the appropriate crop-pattern under irrigation. The low rainfall

regions should have an appropriate remunerative crop-pattern duly supported by relevant incentives and provision of agriculture extension services.

In the context of the revenue divisions, Aurangabad and Amravati divisions have irrigation water availability less than 3000 cubic meters per hectare. Such low availability of water has been having significant impact on agriculture. Variability in the annual rainfall causes sharp fluctuations in "water stored" and "irrigated area". On an average, variations have been within the range of 30%. Variations are relatively much less and subdued in the Konkan region. However, in Nashik Division the storage was 3811 million cubic metres in 2006 and it declined to 2723 million cubic metres in 2009. This implies reduction of 25%. Similarly, in Aurangabad division water storage in 2006 was 6204 million cubic meters but declined to 2000 million cubic meters in 2009. In 2008 irrigated area was 2.99 lakh hectares but it declined to 1.27 lakh hectares in 2009.

3.9.1 Surface Water

The 5 river basins are further subdivided into 15 sub-basins and 1505 watersheds.

The average water availability in the state of Maharashtra is 163.82 km^3. According to inter-state water tribunal awards, the allotted quantity of water to the state is 125.94 km^3. Out of the five major river basin systems, 55% of the dependable yield is available in the four river basins (Krishna, Godavari, Tapi and Narmada) east of the Western Ghats. These four river basins comprise 92% of the cultivable land and more than 60% of the population in rural areas. Remaining 45% of state's water resources are from West Flowing Rivers which are mainly monsoon specific rivers emanating from the Ghats and draining into the Arabian Sea, which is not utilised due to geological constraints. However, state aggregates and averages are misleading figures as there is wide variation, both temporal and spatial in the availability of water in the state. Much of the rainfall occurs within a period of a few months during a year, and even during that period the intensity is concentrated within a few weeks.

3.9.2 Ground Water

On the basis of geological formations, the State can be divided into five groundwater provinces, (1) Precambrian metamorphic groundwater province (2) Proterozoic sedimentary groundwater province (3) Gondwana groundwater province (4) Deccan Trap volcanic groundwater province and (5) Alluvial groundwater province.

Some of the project districts viz., Akola, Aurangabad, Hingoli, Jalgaon, Latur, Osmanabad, Parbhani have relatively deeper groundwater levels (>10 m) and the mean groundwater level is below 15 m in these districts. However, in Akola, Jalgaon, and Latur, the coefficient of variation is relatively higher (>70%), which suggests that there is high spatial variability and there could be regions with both deeper as well as shallower groundwater levels in these districts with respect to the mean level and may present higher uncertainty in the spatial variability of groundwater levels. On the other hand, in Hingoli, Jalna, Wardha, and Washim the coefficient of variation is lower than 40% and hence it suggests that uncertainty in the spatial variability of groundwater level with respect to the district mean is relatively lower. In most of the PoCRA districts the mean groundwater levels are below 10 m indicating that the groundwater is relatively in good situation. Large fraction of the monitoring stations is dug wells, which also suggest that the groundwater table is shallow (Shekhar, 2017)[3]. The report further suggests that it appears feasible to utilize the groundwater resources for development of key plans in PoCRA districts. The approaches towards this would

[3] Hydrology & Hydrogeology of the PoCRA districts and Summary of Observations. Prof Sekhar Muddu. IISc Bengaluru

be develop the groundwater resources in the rainfed areas of the PoCRA districts for one supplementary irrigation combining with Kharif rainfall through state-of-art irrigation technologies, which will limit least use of groundwater resources. Since this additional development proposed would result in additional increase to the stage of groundwater development in the watersheds the complementary approach that need to be addressed would be to reduce the current irrigation drafts in these watersheds in higher intensive cultivated areas through improved irrigation methods, reduced use in non-Kharif seasons and alteration in cropping choices in such a manner that the stage of groundwater development is maintained overall in the watersheds at or around the current levels.

Purna basin covers 4.70 lakh ha. of saline land having shrink-swell black soils with low hydraulic conductivity. Poor quality of groundwater (saline) has resulted in low cropping intensity of 112% in this region. Several studies (Raja et.al.) have concluded that the river water is suitable for irrigation with moderate salinity and low sodicity. The dug well and bore well waters have high salinity in pre- and post-monsoon seasons but show perceptible variations with medium to high sodicity in pre-monsoon and low to medium sodicity in post-monsoon samples. This water is unsuitable for irrigation and requires management techniques such as artificial recharge and other soil-management measures.

Reducing existing yield gaps and increasing crop productivity in the semi-arid areas of Maharashtra requires first and foremost an increase in the supply of water for agriculture, especially during the period of soil moisture stress. To that effect, proposed activities (demonstrations, knowledge sharing and skill

development, building farm/community assets) will: (i) help significantly scale up the adoption by small and marginal farmers of micro irrigation systems (specifically, drip and sprinkler irrigation systems) and associated water storage, delivery systems and drainage facilities; and (ii) improve water availability through a sustainable management of water resources at farm, community and mini watershed level. This sub component will also promote "protective irrigation" and support efforts to monitor the quality of the water available for agriculture.

3.10 Watersheds

Measures to conserve recharge and storage of rainwater forms the basic strategy of water resource management. Watersheds are proven and technologically sound option of in-situ and ex-situ conservation of rainwater. Maharashtra has 241.0 lakh ha area suitable for watershed development[4].

Table 19: Number of Watersheds by River Basin

S. No.	Basin	No. of Watersheds	Area (sq. km)	S. No.	Basin	No. of Watersheds	Area (sq. km)
1	Narmada	8	1595	9	Godavari Purna	105	16362
2	Tapi East	194	32770	10	Penganga	108	22972
3	Godavari	189	43283	11	PurnaTapi	106	16732
4	Krishna	96	20237	12	Manjara	79	15835
5	Westerly Flowing	99	31933	13	Sina	59	12234
6	Bhima	160	35922	14	Indravati	31	5488
7	Wainganga	166	27558	15	Pranhita	16	3395
8	Wardha	115	21397		**Total**	**1531**	**307713**

Source: Assessment of Dynamic Groundwater Resources of Maharashtra - 2011-2012

3.11 Forest Cover

According to the India State of Forest Report 2009, the recorded forest area of the State was 61,939 sq. km. Reserve forest was constituting 79.47 percent, 13.23 percent under protected forest and unclassed forest was constituting 7.30 percent of the total forest area of the State. Forest Statistics, 2013 reveals that the forest area in Vidarbha region is 10.79 percent of the total geographical area. The forest cover in the Marathwada region is 0.94 percent of the total geographical area, whereas 8.21 percent of the total geographical area is covered under forest in Western Maharashtra. So, of the total geographical area of the State, 19.94 percent was under forest cover during 2013.

Table 20: Forest Cover in Different Regions of the State

S. No.	Region	Forest Area	Percentage to Total Geographical Area
1	Vidarbha	33198	10.79
2	Marathwada	2883	0.94
3	Western Maharashtra	25277	8.21
	Total	**61358**	**19.94**

Source: Statistical Outline, Forest Statistics, 2013; Forest Department, Government of Maharashtra
Note: Total Geographical Area of the State: 3, 07, 713 Sq. Km

Forest cover in project districts is presented in Table No.21.

Table 21: District wise Forest Cover of Maharashtra (Area in Sq. Km.)

Project District	Geographical Area	Very Dense Forest	Moderately Dense Forest	Open Forest	Total	Percentage of GA	Scrub
1	**2**	**3**	**4**	**5**	**6**	**7**	**9**
Akola	5390	11	96	215	322	5.97	8

[4]Report of The High-Level Committee on Balanced Regional Development Issues in Maharashtra, Government of Maharashtra, Planning Department, October 2013.

Amaravati	12210	655	1455	1077	3187	26.1	116
Aurangabad	10107	19	101	437	557	5.51	193
Beed	10693	0	13	162	175	1.64	357
Buldhana	9661	23	137	430	590	6.11	163
Hingoli	4686	0	10	104	114	2.43	47
Jalgaon	11765	51	359	773	1183	10.06	69
Jalna	7718	1	16	48	65	0.84	55
Latur	7157	0	0	5	5	0.07	25
Nanded	10528	60	434	420	914	8.68	128
Osmanabad	7569	0	3	40	43	0.57	49
Parbhani	6355	0	4	46	50	0.79	49
Wardha	6309	10	419	430	859	13.62	62
Washim	5184	5	113	214	332	6.4	28
Yavatmal	13582	123	1110	1371	2604	19.17	97
State Total	**307713**	**8712**	**20747**	**21169**	**50628**	**16.45**	**4157**

Source: India State of Forest Report, 2015

A number of non-timber forest produces are collected by the people like Bamboo (*Bambusaarundinacea* / *Dentrocalamusstructus*), Tendu (*Diouspyrosmelanoxylom*), Grass (Poaceae spp.), Gum (resin), Lac (resin of *Shorearobusta*), Harida (*Terminalia chebula*), Shikekai (*Acacia concinna*) etc.

Table 22: Forest Area (in Sq. Km) in Different Regions of Maharashtra, 2015-16.

Region	Reserved	Protected	Unclassed	Total Forest Area	% to Total Forest area
Vidarbha	27,727.25	4,599.40	1,541.75	33,868.40	55.0
Marathwada	2,792.41	129.23	170.56	3,092.20	5.0
Western Maharashtra	20,650.46	1,951.98	2,009.99	24,612.43	40.0
Total	**51,170.12**	**6,680.61**	**3,722.30**	**61,573.03**	**100.0**

Source: Office of the Principal Chief Conservator of Forest, Govt. of Maharashtra

3.12 Land and Land Use Pattern

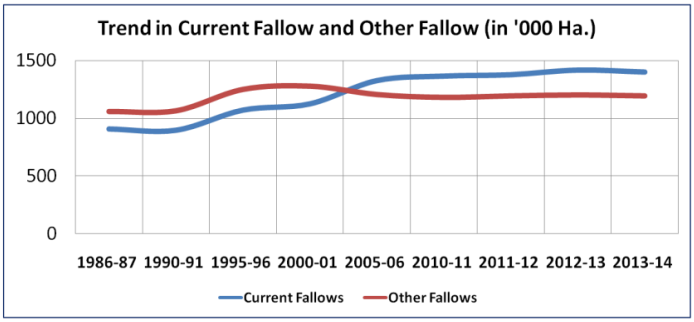

Figure 6: Trend of Current Fallow and Other Fallow.

The total geographical area of the state is about 30,758 thousand Ha. of which 5205 thousand Ha. (16.92 percent) are under forest cover. Barren and uncultivable land comprises 1,723 thousand ha. (5.6 percent). About 4.75 percent area of the total geographical area (1,460 thousand ha.) are used for non-agricultural purposes. So, 10.35 percent land of the state is not available for agricultural purposes. Other uncultivable land comprises 2,406 thousand ha., i.e., 915 thousand ha. Under cultural waste (2.97 percent of the geographical area), 1,242 thousand ha. under permanent pasture and grazing (4.04 percent of the geographical area) and 249 thousand ha. (0.81 percent of state geographical area) under miscellaneous tree crops and grooves. Current fallow and other fallow together comprise 8.43 percent of the geographical area of the state, i.e., 2,593 thousand ha. (current fallow: 1401 thousand ha.; other fallow:1192 thousand ha.) (reference: land use statistics of 2013-14) (Table No. 23).

Table 23: Land Utilization in the State, 1986-87 to 2013-14 (Area in '000 Ha.)

Year	Geographical Area	Area Under Forest	Land Not Available for Cultivation		Other Uncultivated Land			Fallow Land		Cropped Area		Gross Cropped Area
			Barren & Uncultivable Land	Land Put to Non-Ag. Use	Culturable Waste	Permanent Pasture & Grazing Land	Land Under Miscellaneous Tree Crops & Groves	Current Fallows	Other Fallows	Net Area Sown	Area Sown More than Once	
1	2	3	4	5	6	7	8	9	10	11	12	13
1986-87	30,758	5,350	1,679	1,152	1,044	1,367	196	909	1,057	18,004	2,320	20,324
1990-91	30,758	5,128	1,622	1,091	966	1,125	301	898	1,063	18,565	3,295	21,859
1995-96	30,758	5,148	1,544	1,349	960	1,166	292	1,072	1,248	17,980	3,524	21,504
2000-01	30,758	5,150	1,544	1,364	959	1,168	327	1,126	1,276	17,844	3,775	21,619
2005-06	30,758	5,212	1,720	1,407	914	1,252	249	1,327	1,204	17,473	5,083	22,556
2010-11	30,758	5,216	1,731	1,449	919	1,242	250	1,366	1,179	17,406	5,769	23,175
2011-12	30,758	5,211	1,728	1,451	919	1,244	250	1,378	1,192	17,386	5,720	23,106
2012-13	30,758	5,207	1,722	1,456	916	1,245	251	1,418	1,200	17,344	5,772	23,116
2013-14	30,758	5,205	1,723	1,460	915	1,242	249	1,401	1,192	17,368	6,012	23,380

Source: Dept. of Agriculture, Govt. of Maharashtra

Present land use pattern reflects that out of total 1255.62 Ha of geographical area, total net sown area is 9753.72 Ha. (Table No. 24).

Table 24: Land use Pattern in Project Districts (area in 000' Ha.)

District	total_geographical_area	Agricultural Land/ Total culturable Land / Total Cultivable Area	Total Cultivated Area/Land	Net Area Sown	Forest Area	Area under Non-Agricultural Uses	Barren &Unculti vable Land Area	Permanent Pastures and Other Grazing Land Area	Land Under Miscellaneous Tree Crops etc.
Akola	540.74	443.96	429.30	421.48	45.17	45.17	16.49	13.43	1.21
Amravati	959.26	758.96	717.27	702.53	86.65	86.65	31.17	31.58	12.70
Aurangabad	1038.52	855.46	812.68	804.29	89.84	89.84	15.85	25.54	2.09
Beed	1088.59	968.99	928.97	912.32	20.56	20.56	28.62	25.94	4.12
Buldana	961.66	767.18	739.09	724.00	84.50	84.50	33.15	27.81	2.68
Hingoli	478.06	415.84	397.58	394.03	16.45	16.45	8.12	8.79	1.20
Jalgaon	775.09	847.84	812.50	799.26	93.57	93.57	58.80	31.99	4.92
Jalna	1091.35	703.76	680.13	671.74	9.09	9.09	15.86	16.68	1.76
Latur	726.80	676.12	655.38	639.59	2.32	2.32	14.98	8.12	1.93
Nanded	1061.92	854.86	815.49	789.26	102.90	102.90	26.64	36.29	4.47
Osmanabad	772.55	729.14	709.97	700.74	6.67	6.67	10.81	6.61	1.52
Prabhani	621.92	575.88	566.01	561.49	6.40	6.40	11.93	6.26	0.84
Wardha	575.34	457.83	414.04	400.27	36.68	36.68	17.78	17.68	4.94
Washim	507.26	407.06	388.65	382.12	39.89	39.89	17.92	25.51	2.12
Yevatmal	1351.55	930.76	873.77	850.59	242.63	242.63	41.31	45.86	7.90

District	total_geographical_area	Agricultural Land/ Total culturable Land / Total Cultivable Area	Total Cultivated Area/Land	Net Area Sown	Forest Area	Area under Non-Agricultural Uses	Barren &Unculti vable Land Area	Permanent Pastures and Other Grazing Land Area	Land Under Miscellaneous Tree Crops etc.
GT	12550.62	10393.64	9940.81	9753.72	883.33	883.33	349.44	328.09	54.39

Source: Dept. of Agriculture, Govt. of Maharashtra

3.13 Agriculture

The project districts are selected based on its/their overall vulnerability to climate variability. Agriculture, including horticulture, sector has been and expected to be more vulnerable in coming days in these districts due to poor irrigation infrastructure and rain-fed condition. Area under different crops has been decreasing and crop yield rate is significantly impacted due to dry spells.

The cropping intensity of the project districts varies between 102 percent to 161 percent. The project district of Osmanabad is having the highest cropping intensity (161 percent) followed by Jalgaon (157 percent) and Wardha (156 percent). Lowest cropping intensity is observed in Yavatmal (102 percent), followed by Buldana (106 percent) and Washim (110 percent) (Table No. 25).

Table 25: Gross Cropped Area and Cropping Intensity (area in '000 Ha.)

District	Net Sown Area (NSA)	NSA to CA	Area Sown More than Once	Area sown more than once to Net Sown Area	Gross Cropped Area	Cropping Intensity (CI) %	CI Rank
Akola	434.9	95.58	91.1	20.95	526.0	121	7
Amravati	602.0	78.59	110.0	18.27	712.0	118	11
Aurangabad	654.0	80.54	130.4	19.94	784.4	120	8
Beed	876.0	85.97	175.2	20.00	1051.2	120	8
Buldhana	712.0	96.22	44.0	6.18	756.0	106	14
Hingoli	382.1	86.51	120.4	31.51	502.5	132	4
Jalgoan	844.2	99.03	480.6	56.93	1324.8	157	2
Jalna	529.0	74.21	159.0	30.06	688.0	130	5
Latur	529.0	80.46	159.0	30.06	688.0	130	5
Nanded	711.0	87.92	100.1	14.08	811.1	114	12
Osmanabad	519.3	89.09	321.9	61.98	841.2	161	1
Parbhani	518.8	88.88	103.8	20.00	622.5	120	8
Wardha	284.0	60.04	158.0	55.63	442.0	156	3
Washim	386.0	100.00	38.0	9.84	424.0	110	13
Yavatmal	884.0	100.00	15.0	1.70	899.0	102	15

Source: Agriculture Statistics, 2013-14, Maharashtra

Area (A) and productivity (P) of some of the crops by project districts are presented in the Table No. 26.

Table 26: Area (A) and Production (P) of Selected Field Crops in the Project Districts

Area and Production of Major crops in Project districts (Av of 2010-11 To 2014-15) (Area in "00" Ha & Production in '000Kg)											
S. No.	District	Kh Sorghum		Pigeon pea		Soyabeen		Cotton (Lint)		Gram	
		A	P	A	P	A	P	A	P	A	P

Area and Production of Major crops in Project districts (Av of 2010-11 To 2014-15) (Area in "00" Ha & Production in '000Kg)											
S. No.	District	Kh Sorghum		Pigeon pea		Soyabeen		Cotton (Lint)		Gram	
		A	P	A	P	A	P	A	P	A	P
1	Jalgaon	803	1794	170	135	167	290	5294	10526	454	497
2	Aurangabad	52	82	389	259	107	108	3873	6469	431	285
3	Jalna	21	23	487	304	712	755	2984	4669	244	134
4	Beed	257	280	560	262	860	1112	3293	3792	530	312
5	Latur	1028	1449	1054	1048	2741	4750	44	112	744	680
6	Osmanabad	496	360	975	638	1069	1372	247	374	765	487
7	Nanded	1124	1117	685	362	1963	2249	3237	4096	557	496
8	Parbhani	709	732	684	379	1333	1460	2572	4260	559	366
9	Hingoli	458	486	363	303	1506	1906	926	1593	616	854
10	Buldhana	409	556	662	327	2879	3777	2329	3752	606	503
11	Akola	365	545	606	541	1677	1916	1602	2637	799	715
12	Washim	170	171	538	298	2403	2562	475	749	671	609
13	Amravati	376	418	1142	951	3233	3541	1932	4095	930	942
14	Yavatmal	573	484	1121	820	2497	2429	4532	6917	417	440
15	Wardha	35	20	701	580	1655	1359	1852	2727	306	241

Source: Crop statistics, Department of Agriculture, GoM

According to the Report of the High-Level Committee on Balanced Regional Development Issues in Maharashtra (Government of Maharashtra, Planning Department, October 2013), The state has created 48.25 lakh ha irrigation potential out of which 29.54 lakh ha is actually irrigated. Maharashtra has 82% rainfed area and region wise distribution shows 92.6% area in Konkan, 77.0% in Western Maharashtra, 95.2% in Marathwada and 81.2% in Vidarbha. Efficient use of stored water and its distribution becomes a key area of intervention. Marathwada has very high percentage of non-irrigated land and approximately 40% area of Marathwada is drought prone.

The report finds that Water requirement for surface irrigation of crops is 1,97,958 million cubic meters (Mm^3) and adoption of micro irrigation methods will reduce the water requirement to **1,01,240** Mm^3 i.e. saving of 49% water. Maharashtra has 36% deficit of water needed for agriculture. If water requirement for drinking and industry is considered then water deficit for agriculture will further fall.

Table 27: Irrigation Status and Rate of Growth

Item	Year 1960-61	Year 2010-11	Rate of Growth (Times)
Designed Water Storage (Mcum)	1574.4	33385	21.2
Irrigation potential created (Lakh Ha.)	3.96	47.4	11.96
Irrigated Area (in lakh Ha.)	2.26	29.55	13.06
Water Use Non-Irrigation (in Mcum)	-	6955	-

Source: Irrigation Status Report, Government of Maharashtra, 2010.

Data on Region-wise water use indicates sizable large disparity in the use of available water. Western Maharashtra with 36% crop area uses 47% of the water, Vidarbha with 30% crop area uses 28% water, Marathwada with 31% crop area uses 14% water and Konkan with 3% crop area uses 11% water.

Table 28: Irrigation Potential Created by Revenue Division, 2010-11

S. No.	Revenue Division	Cultural Area (in Lakh Ha.)	Irrigation Potential Created as in 2010	Percentage of Cultural Area
1	Konkan	17.93	0.98	5.46
2	Nashik	40.16	9.7	24.15
3	Pune	45.56	15.41	33.82
4	Aurangabad	59.30	10.50	17.70
5	Amravati	35.62	4.6	12.91
6	Nagpur	26.85	6.1	22.71
	Maharashtra	**225.42**	**47.4**	**21.02**

Source: Report of The High-Level Committee on Balanced Regional Development Issues in Maharashtra, Government of Maharashtra, Planning Department, October 2013, with reference to Irrigation Status Report, Govt. of Maharashtra, 2010.

So, managing the available water more efficiently seems an essentiality. The report highlights that converting irrigated crops to micro irrigation, implementation of watershed program at much accelerated rate, building water conservation and storage structures, saving conveyance losses by using conduit pipes, shifting to crops with low water requirement are the important and priority initiatives required for sustainable growth of agriculture. Efficient use of surface water and groundwater will be helpful in this regard.

3.15 Pesticide and Fertilizer Usage

The fertilizer consumption for the year 2014-15 was 60.13 lakh MT in the State, with an average of 125.9 kg per hectare. For the year 2015-16, Consumption of chemical fertilizers in the State was anticipated to be 58.25 lakh MT with average per hectare consumption of 107 Kg. The year wise use of chemical fertilizers is presented in the Table No. 29 along with use of chemical and bio-pesticides.

Table 29: Use of Chemical Fertiliser and Pesticides in the State, 2013-14 to 2015-16

S. No.	Year	Fertilizer Consumption (Lakh MT)	Per Ha.Fertilizer Consumption (Kg)	Pesticides	
				Chemical	Bio
1	2013-14	59.90	119.4	10,969	1,433
2	2014-15	60.13	125.9	11,239	1,124
3	2015-16	58.25	107.0	11,280	4,292

Source: Economic Survey, 2015-16 as Reported by Commissionerate of Agriculture, GoM

3.15.1 Fertilizer Consumption

In the State, about 60 % of the total area is cultivated during Kharif season. Accordingly, 60-70 % of the annual fertilizer consumption is effected in the Kharif season. Almost 40 Lakh M.T. of fertilizers are consumed in Kharif season and 30-lakh MT are consumed in Rabi season. Normal area in Rabi is 58.60 lakh ha, while it is 139.42 lakh ha in Kharif season.

Table 30: Fertilizer Consumption in Maharashtra (Lakh MT)

Year	Urea	DAP	MOP	NPK	SSP	Others	Total
2001-02	16.48	4.17	2.27	8.7	5.3	0.53	37.45
2002-03	15.62	4.25	2.18	8.79	5.21	0.42	36.47
2003-04	14.02	3.51	1.41	7.91	5.14	0.43	32.42
2004-05	15.41	5.47	2.21	8.71	5.11	0.55	37.46
2005-06	17.34	5.23	2.64	10.62	6.17	0.63	42.63

Year	Urea	DAP	MOP	NPK	SSP	Others	Total
2006-07	19.85	6.54	2.81	11.72	6.65	0.66	48.23
2007-08	21.31	6.24	3.27	12.09	4.37	0.63	47.91
2008-09	22.58	8.52	4.9	10.13	5.06	0.45	51.64
2009-10	22.89	14.57	6.68	11.06	4.96	0.77	60.93
2010-11	25.38	13.27	6.58	17.22	6.9	0.9	70.25
2011-12	24.81	10.31	3.86	17	9.11	0.75	65.84
2012-13	23.32	7.79	3.17	13.18	6.48	0.71	54.65
2013-14 estimated	26.15	5.21	3.37	16.03	7.14	0.5	58.4

Source: Department of Agriculture, Government of Maharashtra

According to the Department of Agriculture, Cooperation and Farmers Welfare, overall consumption of fertilizer in the State of Maharashtra by 2013-14 was comparatively less than that of average national consumption (national consumption of fertilizer per ha. was 141.33 Kg/Ha.)

Bio-fertilizer production in the state has increased during the period 2003-04 to 2013-14 by 104.90 percent with an increased production of 3184 MT. Increase in the production of bio-fertilizer reflects that there is increasing demand for use of bio-fertilizer in the State. Increasing local movement for organic farming has been one of the factors for improved production of bio-fertilizer.

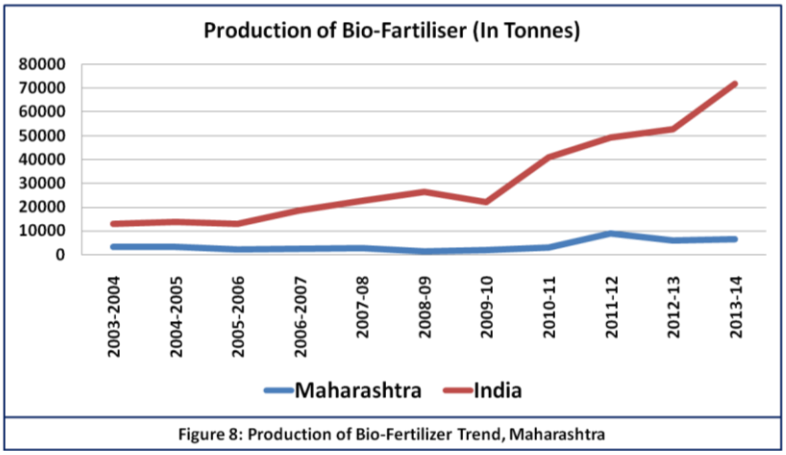

Figure 8: Production of Bio-Fertilizer Trend, Maharashtra

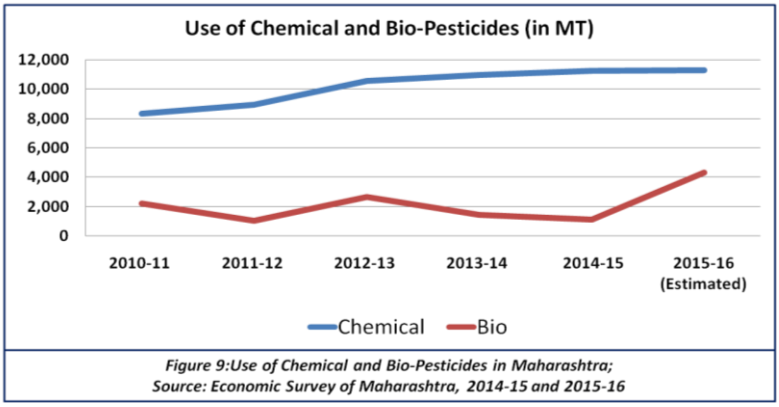

Figure 9:Use of Chemical and Bio-Pesticides in Maharashtra;
Source: Economic Survey of Maharashtra, 2014-15 and 2015-16

4.15.2 Pesticides

Use of chemical pesticides to control pest is common in in the state. However, there is an encouraging trend with regard to use of bio-pesticides. Between 2010-11 and 2014-15 there is growth of about 35.13 percent in use of chemical pesticides in the State, i.e., use of chemical pesticides increased by 2922 MT. Whereas, use of bio-pesticides has decreased by 1076 MT, i.e., a reduction of 48.91 percent by 2014-15 in comparison to 2010-11.

3.16 Climate Vulnerability

3.16.1 Climate Change Trends

Long-term changes in surface temperature and precipitation in India were analyzed by India Meteorological Department[5] using observational records of IMD from 1951 to 2010. The analysis covers 282 stations having continuous temperature records from 1951 onwards. For precipitation trends, data of 1451 stations were taken into account that have continuous records from 1951 onwards.

Annual mean temperatures have increased significantly over a number of states of India, including Maharashtra. State wise averaged annual mean maximum temperature time series has shown increasing trends over many states of India, which includes the State of Maharashtra. The increasing trends were significant over Maharashtra, including many other states. However, Maharashtra does not indicate any trend in annual mean minimum temperature during last six decades. Significant increase in annual mean Diurnal Temperature Range (DTR) trends have been observed over Maharashtra, among some other States during 1951-2010.

The spatial pattern of increase in mean temperature in 2030s with baseline shows that spatially there is a difference in warming in a few regions compared to other regions. Annual Mean temperature is found to be 1.2-1.5 degree centigrade increase in the Vidarbha region, Marathwada and Nashik regions as compared to Pune and Konkan region where the increase in temperature was found to be 1-1.2 degrees centigrade. Similarly, the increase in maximum temperature and minimum temperature were found to be high in a few regions and less increase in few other regions. Similar to the mean temperature, maximum temperature is also found to increase around 1-1.2 degrees centigrade in the Vidarbha, Marathwada regions compared to Nashik, Pune and Konkan regions where the increase in temperature ranges from 0.5-1 degrees centigrade. The increase in minimum temperature was found to be more than maximum temperatures and in similar regions as mean temperature and maximum temperature.

Average annual rainfall trends (State averaged) have increased in many States of the Country whereas it has decreased in Maharashtra and some other States of the Country. As per Maharashtra State Adaptation Action Plan on Climate Change (MSAAPCC), the districts of Ratnagiri, Sindhudurg, Thane, Mumbai City and Kolhapur have more number of rainy days as compared to other districts. On the other hand, the districts of Ahmednagar, Sholapur, and Beed are in the range of least number of rainy days. The number of rainy days is high in few districts, medium in some and low in other districts.The normal monthly mean temperature of different districts over Maharashtra shows that maximum temperature in March to May for almost all the districts of Maharashtra with high temperatures in few districts where the rainfall is also less compared to other regions. Satara region has the lowest temperature compared to many other districts. The observations show that rainfall has large variation in different districts of Maharashtra as compared to the temperature that show equal distribution in the seasonal cycle.

The regional climate projections over Maharashtra for 2030 highlights that a few regions in Maharashtra will experience increase in rainfall, especially the north-central Maharashtra region compared to east, west and southern Maharashtra. The extreme rainfall index shows that the extreme rainfall (99th percentile) intensity

[5]Lathore L.S., Attri S.D., Jaswal A.K.; State Level Climate Change Trends in India; India Meteorological Department, Ministry of Earth Sciences, Government of India.

increases in all regions, and with large amount of increase in Aurangabad and northern regions of Nashik division compared to Konkan belt and Vidarbha region.The projection reveals that there may increase in the number of days of rainfall in some parts of south central Maharashtra region.

3.16.2 Vulnerability of the State

Maharashtra is prone to various disasters such as drought, floods, cyclones, earthquake and accidents. While low rainfall areas of the state are under the constant risk of droughts, high rainfall zones of eastern and western Maharashtra are prone to flash floods and landslides.

From environment point of view, the state has suffered huge losses, both direct and indirect, caused by various disasters. For example, the infamous Latur earthquake of 1993, resulted in the loss of several thousands of human and animals lives. In addition, it caused damage to entire infrastructure such as buildings, roads, railways, pipelines, and electricity network, etc. In order to avoid such losses due to disasters, the GoM has established a mechanism for disaster preparedness and mitigation by integrating science and technology with communication network facilitates.

In 2001, droughts affected about 20,000 villages in 23 districts; 28.4 million people and 4.5 million hectares of crops in the State. Number of districts affected by droughts in the year 2002-03 and 2003-04 were 33 and 11, respectively. The situation of droughts in Maharashtra continued to deteriorate in 2004. Following the failure of monsoon in 2003, the Govt. of Maharashtra (GoM) declared droughts in 11 districts namely, Pune, Satara, Sangli, and Solapur (Pune Division), Nashik and Ahmednagar (Nashik Division) and Beed, Latur, Dharashiv and Aurangabad (Aurangabad Division). Altogether 71 talukas in these 11 districts are seriously affected by the droughts.

Apart from these extreme events, state is susceptible to agriculture vulnerability that includes temperature and precipitation. Both are undergoing rapid changes due to anthropogenic and climatic reasons. Other biophysical factors that affect productivity in agriculture are soil and water conditions. There are inherent structural constraints largely in the domain of social structure, demography, dependency and counter-dependence that contributes to the backwardness of certain regions. There are environmental conditions that degrade water quality, increase pollution and causes higher greenhouse gas emission due to certain types of agricultural practices or energy use. Together these factors contribute to the vulnerability.

To include various vulnerability criteria project has developed vulnerability assessment indicators for the selection of project villages under two broad categories i.e. Sensitivity Indicator and Adaptive Capacity Indicator. The sensitive indicators includes (i) Net sown area as % to geographical area (ii) Degraded land as % to geographical area (iii) Drought proneness (paisewari < 50 paisa) (iv) Groundwater Prospects (v) Area operated by small & marginal farmers. The adaptive capacity indicators includes (i) Agrarian distress (ii) Proportion of SC/ ST farmers (iii) Agriculture workers (iv) Proportion of Rural poor (v) Female Literacy Gap and (vi) Livestock population.

The impact of disaster vulnerability and district-wise vulnerability of the state is given in table:

Table 32: Vulnerability of Project Districts (Extreme events)

Districts	Flood	Earthquake	Cyclone	Drought
Akola	Patur taluka has the largest flood-prone area (57%), followed by BarsiTakli (48%), Akot (45%), Balapur (40%) etc.	Yes	No	Yes
Amravati	Flood-prone along the Wardha river;	Yes	No	Yes

Districts	Flood	Earthquake	Cyclone	Drought
	eight floods in the last 15 years			
Beed	Flood-prone: almost 26 % of the population lives in flood-prone areas	Yes	No	Yes
Jalna	7 floods in the last 30 years; 196 villages flood prone	Weak zone followed by Marathwada earthquake of 1993	No	Yes
Nanded	History of frequent floods due to heavy rainfall and release of water from irrigation projects	Yes	Sensitive tocyclones because of Proximity to Andhra Pradesh	Yes
Parbhani	Yes	Yes	No	Yes
Wardha	Great threat of floods. Major flood in 1994	Yes	No	Yes
Yavatmal	Heavy floods in 1994	Yes	No	Yes

Source: NIDM, Maharashtra

All the project districts, falling in to Vidarbha and Marathwada region, are high in vulnerability. (Table No. 33).

Table 33: Vulnerability Index of Project Districts

S. No.	District	Exposure	Sensitivity	Adaptive Capacity	Vulnerability Index
1	Akola	4	6	11	21
2	Amravati	13	8	20	16
3	Aurangabad	12	1	13	27
4	Bid	24	16	22	14
5	Buldhana	8	17	32	3
6	Hingoli	15	21	31	5
7	Jalgaon	1	13	26	4
8	Jalna	17	18	30	7
9	Latur	28	2	17	24
10	Nanded	25	5	28	15
11	Osmanabad	29	3	27	17
12	Parbhani	22	10	18	18
13	Wardha	14	7	4	29
14	Washim	9	22	24	9
15	Yavatmal	10	15	19	13

Source: Maharashtra State Adaptation Action Plan on Climate Change.
Note: Index in descending order, 1 for highest vulnerability

3.16.3 Agrarian Distress

There are number of reasons for agrarian distress such as monsoon failure, high debt burdens, genetically modified crops, government policies, public mental health, personal issues and family problems but farmers indebtedness and bankruptcy and farms regarding issues i.e. fragmentation and subdivision of land holdings are the root causes.

According to the records of National Crime Bureau, more than 2 lakh farmers across India have committed suicides over the period of last two decades.

The key challenges for small and marginal farmers are to address the climate variability and assured source of irrigation. PoCRA will be the first large scale climate resilient agriculture project to develop a drought

proofing and climate resilient strategy for the agriculture sector as a long term and sustainable measure to address the likely impacts due to climate variabilities. The project will help to reduce agrarian distress and shift to a Climate Resilient Agricultural system in the long term.

3.17 Summary and Implications for EMF

Climate variability and its possible impact on agriculture is well established by national and state level researches. In the context of the state, change in rainfall pattern in different regions are also recognized by analysing long term trends. Further, the evaporation appears higher than rainfall in the months of July and August in some of the districts of the state. The state is prone to various disasters and while low rainfall areas of the state are under the constant risk of droughts, high rainfall zones of eastern and western Maharashtra are prone to flash floods and landslides. Many areas of the State have faced droughts for consecutive years.

Table 34: Summary of Key Environmental Issues and Implications for EMF

Environmental Baseline	Environmental Issues Identified	Approach for EMF
Rainfall	1. Variability of rainfall in pre-monsoon and post-monsoon period. Rainfall confined to monsoon only. It has impact on agricultural activities; 2. Decreasing trend in rainfall in monsoon months in project districts; 3. High evaporation / evapotranspiration in some of the project districts. Higher evaporation than rainfall in monsoon months in some districts.	1. Appropriate agricultural planning taking expected moisture stress condition during Rabi. 2. Cluster specific water conservation and crop management planning 3. Water management strategy at the farm level 4. Management of water stress situation which may arise during July and September. 5. Farm level water management plan for the conservation of run-off water
Soil	Soil of most of the project districts have low Nitrogen (N) and Phosphorous (P)	1. Soil nutrient assessment at farmer's field on regular interval; 2. Devising soil nutrient management plan and strategy. 3. Application of nutrients (N/P) as per the identified / assessed deficiencies and taking the cultivated crop into account (assessment includes micronutrients and its deficiency, if any)
Land Use Pattern	1. Land not available for cultivation (non-agricultural use and barren and uncultivable land) is gradually increasing; 2. The fallow land (current fallow) is increasing while other-fallow is remaining more or less same.	1. Micro level planning to convert culturable waste / fallow to productive use; 2. Devising strategy to improve the land suitability for cultivation through land levelling and required other vegetative and mechanical measures; 3. Covering fallow land with plantation / agro-forestry

Environmental Baseline	Environmental Issues Identified	Approach for EMF
Agriculture	1. 78.98 percent belongs to the marginal and small farmers with land holding less than or equal to two ha (Agricultural Census 2010-11); 2. The average size of landholding of SC & ST is 1.27 ha & 1.80 ha respectively as against 1.44 ha for all operational holdings; 3. Area under different crops (cotton, sugarcane, cereals, etc.) is decreasing	1. Improving production and productivity through appropriate agronomic practices; 2. Requirement of focus on small and marginal farmers in improving yield by adopting practices that are environment friendly and promote resilience; 3. Localised agricultural planning for need based interventions, taking local environmental concerns into account.
Irrigation	1. Aurangabad and Amravati divisions have irrigation water availability less than 3000 cubic meters per hectare. Such low availability of water has been having significant impact on agriculture; 2. Variability in the annual rainfall causes sharp fluctuations in 'water stored' and 'irrigated area'	1. Water resources should be planned taking watershed as the unit; 2. The regions with 'less than 3000 cubic meter of water per hectare' will have to be taken into account in crop water budgetingand improving scope of irrigation through conservation and efficient use; 3. Improving water use efficiency and water productivity; 4. More farm level structures for conservation of rainwater / run-off water; 5. Improving area under irrigation with renovation of derailed structures and creation of new water harvesting structures; 6. More area under irrigation through the promotion of water optimizing instruments like drip, sprinkler etc.; 7. Water budgeting and crop planning taking mini/micro watershed as unit; 8. Using the groundwater for irrigation along with recharging the groundwater to maintain groundwater balance
Integrated Farming System (Animal Husbandry)	1. State ranks sixth at national level; 2. Decreasing livestock population by 9.7 percent (livestock census 2012); 3. Population of poultry increased by 20.1 percent during 2012.	1.Livestock is an important component for sustainable and climate resilient agriculture system promotion; 2.Using animal husbandry as the supportive livelihood system for small and marginal farmers and for the promotion of organic farming system.
Climate Vulnerability	1. Some project districts are high to medium in exposure, sensitivity and adaptive capacity indicators; 2. Some districts are high in vulnerability[6] index and most are in the lower middle to middle range	1. Micro level planning based on local vulnerability parameters and its consolidation at district / state level for devising measures for vulnerability reduction; 2. Vulnerability reduction through scientific management of natural resources; 3. Using ICT and providing weather information to farmers for agricultural

[6] as per MSAPCC

Environmental Baseline	Environmental Issues Identified	Approach for EMF
		planning; 4. Drought contingency planning at micro / watershed level and provision of required agricultural support system accordingly.
Use of Fertilizer & Pesticides	1. Application of fertilizer (Kg/Ha.) has reduced in 2015-16 (107.0) in comparison to 2013-14 (119.4) and 2014-15 (125.9); 2. Use of chemical pesticides is increasing along with use of biopesticides.	1. Increasing trend of using organic / bio-fertilizer / pesticides can be further augmented and consolidated to reduce the cost of cultivation and improve the environmental parameters; 2. Adoption of scientific method of nutrition and pest management (INM and IPM) can help the farmers and the environment; 3. An approach that helps to take up using both organic and synthetic fertilizer and pesticides can help the farmers and the environment in longer run.

The findings related to climate vulnerability of the state have implications of long term changes rather than the short term. However, such changes are likely to have negative impacts on agriculture and production system in the long run. While the EMF looks into expected adverse impacts due to the implementation of the project, the planned activities will be supportive to minimize the current impacts of climate variability on agriculture and improve the resilience. So, the EMF will look into some specific aspects contextually, that are linked to agriculture like improving water use efficiency, improving soil health, managing plant nutrient, recharging ground water, etc. Such measures will have long term benefit to the ecosystem and environment and will promote resilience in agriculture system. So, the EMF will also look into adaptation and mitigation measures and bringing overall improvement in the current farming conditions.

4.0 Potential Impact of Environmental Management Framework

Environmental Management Framework elaborated the potential negative and positive impacts of project activities on environment. This assessment based on the secondary data and stakeholder consultations. This section deals with the potential impacts of the project interventions on the local environment and suggests relevant measures that may be required for mitigation of any adverse impact, if so arises.

4.1 Analysis of 'no project' Scenario

This section gives an overview of no project scenario, taking into account the current interventions and value addition to be made by the project. It is expected that the current "as-is" situation may prevail and agricultural practices will continue the way it has been for years. A change in positive direction is expected to happen in due course as a part of natural adaptation instinct of farmers. Scientific way of making agriculture resilient and adaptive through demonstrative effects, cross learning and technology transformation can augment the adaptation process across the project districts and at the State level. Now, it is important to promote adaptation measures in agriculture sector to the climate variability using different package of practices and driving the agriculture sector to a new height where expected level of growth is

attained without hampering the natural capital base. With project and without project scenario is presented in the Table No. 35.

Table 35: With and Without Project Scenario

Particulars	"No Project" Scenario	"With Project" Scenario
Component A-A.1: Participatory Development of Mini Watershed Plans		
Development of Mini Watershed Plan	Such plans would not have developed which captures key needs to promote climate resilient activities which is more localized.	Project improves the following- 1. Efficiency leading to improve resilience to all land based interventions 2. Mini watershed plan allows people to undertake comprehensive watershed treatment at cluster level 3. Multi disciplinary teams helping & guiding the community to preparing the plan - owned by the community .
Component A-A.2: Climate Smart Agriculture and Resilient Farming System		
Soil and Water Conservation	Current interventions under other schemes may not adequately focus on the overall perspective of climate resilient agriculture in an integrated manner	Focused intervention and integrating soil & water conservation measures with allied climate resilient agricultural practices will improve the soil cover and water availability
	Erosion of topsoil due to lack of scientific conservation measures leading to soil nutrition deficiency	Project is primarily aimed at undertaking runoff management thus significantly enhancing topsoil conservation, helping in restoring soil fertility
Integrated Nutrition and Pest Management	Current level of adoption of INM & IPM is low because of low awareness about the proper package of practices at the farm level	The project will promote INM and IPM which will improve fertilizer and pesticide use efficiency. The project will not support use of banned pesticides (WHO Class I and II).
	Use of pesticides that are either inappropriate or in low / high doses.	Farmers will be aware of recommended doses as per label claims by crop type and use it in a more scientific manner.
	May continue polluting local environment due to unscientific application	Reduced risk to environmental pollution due to appropriate application
	Poor adherence to recommended storage, handling and application with respect to human and animal safety measures.	Project will promote ICAR recommended storage, handling, application with required safety measures.
Protected Cultivation	Current level of coverage may not fulfill the requirement and aspiration of the farmers. Current practices in selected pockets may lead to overexploitation of resources (e.g. groundwater)	Improved coverage of area under protective cultivation will improve resource use efficiency. Water budgeting, water productivity being the integral part of project will only lead to conjunctive water use.
	Less no. of farmers involved in protected cultivation due to cost factor	Expected increase in farmers having protected cultivation due to systematic convergence approach & project support
	Crop loss due to climate variability in unprotected farming	Less crop loss due to protected farming during unfavourable climatic condition

Particulars	"No Project" Scenario	"With Project" Scenario
Saline Land improvement	Current agricultural programmes do not address the issue of salinity problem in the affected districts.	PoCRA's intervention is first of its kind in the state: targeted interventions to bring saline areas for optimal agriculture productivity. ● Vertical drainage for dilution ● farm ponds for maximising rainwater storage and dilution ● precision farming for targeted farm inputs ● Use of gypsum if required
Component A-A.3: Promoting an Efficient and Sustainable Use of Water for Agriculture		
Renovation / Creation of Water Bodies	Current programs are not adequate to meet the requirement of Small & marginal farmers.	Acceleration in water conservation measures. Small farm ponds in the fields of SF & MF, promoting in-situ moisture conservation.
Ground Water Recharging	Poor recharge due to inadequate interventions in groundwater development	● Catchment treatment will improve the recharge ● Artificial recharge structures will improve the groundwater situation.
Water Use Efficiency through Micro Irrigation System (MIS)	Less accessibility to MIS by farmers due to poor investment capacity	Increased area under micro irrigation, Utilisation of conserved water for irrigating additional land, Wider coverage of SF & MF with micro irrigation system
	Less water productivity because of conventional irrigation process	Improved water productivity in field crops Reduction in energy use as compared to prevailing irrigation practices
Component B-B.1: Promoting Farmer Producer Companies		
Strengthening of existing FPO / FPC	Areas not having any FPCs may remain excluded from the emerging scope.	● Activities will be demand driven ● All project area will have opportunity to strengthening the existing for FPCs / FPOs for product aggregation and marketing of produces. ● Project will use environment checklist for any anticipated structures for undertaking construction
Forward and Backward Linkage	FPCs may continue to function as they have been with limited forward and backward integration	Buyer-seller interface and use of ICT platform will expedite the forward linkage. Increment in membership and strategic linkage with other producer groups will consolidate backward linkage.
	Business growth rate may be slower and volume of business may be restricted.	Product aggregation, commodity specific linkage and outsourced procurement strategy with ensured market will enhance volume of business and higher value share for the farmers.
	Net Worth of the FPCs may grow in a normal pace or may remain static.	With product value addition scope, improved market linkage and increased volume of operation, income from business is expected to rise and thereby asset value and net worth of the company
Component B-B.2: Strengthening Emerging Value Chains for Climate Resilient Commodities.		
Infrastructure for Value	Marketing of commodities with limited or no value addition may continue and	Infrastructure improvement support to the FPCs for value addition and branding will

Particulars	"No Project" Scenario	"With Project" Scenario
Addition / Post-harvest Management	thereby limited profitability to the FPCs and its members	yield value added products, better positioning in the market and improved profitability. It will help to enhance income of small producers / shareholders.
Component B-B.3: Improving the Performance of the Seed Supply Chain.		
Availability of Climate Resilient Seeds	Adequate short duration climate seed varieties are not available in adequate quantity in the state	Project is designed to support production climate resilient seed varieties and encourage their adoption. Existing agencies i.e. Mahabeej will forge partnership with the project to enhance such production
Component C: Institutional Development, Service Delivery & Knowledge on Climate Resilient Agriculture		
Capacity Building	Present initiatives may not be adequate to focus on developing farmer's knowledge base on climate smart agriculture.	Initiative to build farmer's capacity around climate smart agriculture will be more beneficial contextually. It will help to improve adoption of climate smart practices. Focus will be more on small and marginal farmers for improved adoption as their percentage is relatively high.
Technology Demonstration	Existing practices may continue with less or no focus on integrated approach (INM, IPM, BBF, micro irrigation, protective farming etc. under one demo.)	Technology demonstration in an integrated manner (including best practices in IPM and INM) through Farmer Field School (FFS) approach will be beneficial for farmers, including small and marginal farmers for getting exposure, learning and replication.
MIS/ ICT Integration	MIS and ICT system in general weak in agricultural projects.	PoCRA will have a GIS based system backed by ICT and a comprehensive MIS system to have systematic tracking of compliance.

4.3 Analysis of Alternatives

On alternatives to the proposed project and its activities, the assessment procedure stipulates that an environmental investigation needs to identify main project alternatives during the course of implementation. It is required that available alternatives for accomplishing the same objectives are to be considered at the cluster and village level while implementing different activities. In principle, these should include an analysis of the technology, location, timing, input and design alternatives as well as the "not to do" option. Different agricultural technology which the project is expected to promote will be more localized, based on its suitability to the agro-climatic condition, soil characteristics, water availability etc. Same farming practices may not be proposed across all the project location as it will vary significantly depending upon the local characteristics. For example, measures to be taken in saline tracks may not be same for other rain-fed areas where soil salinity is less. Similarly, technological options for catchment treatment and development of structures for soil and water run-off management may not be same across all the project locations. So, alternatives will be more activity driven and location specific which will be assessed before implementation and after careful selection of alternatives.

4.4 Categorization of Intervention

Based on the nature of activities framed under the project, the activities can be categorized into "No Impact", "Low Impact" or "Moderate Impact" on the environment. Categorization of activities is largely based on the implementation process and its expected impact. The impact categories may not be constant across the project clusters and same activity may not have same level of impact across all the project districts and clusters. Infrastructure development activities can be categorized under "Moderate Impact" level due to associated construction related issues, energy consumption, expected generation of wastes etc. that require appropriate management. Similarly, activities under 'low impact' are not expected to cause any significant negative impact. Best practice measures and mitigation strategies are also recommended where appropriate to improve the environmental performance of the project activities.

Table 36: Degree of Environmental Impact of Selected Project Activities

Broad Project Activities	Impact Category	Suggested framework for mitigation
Mini Watershed Planning	Minimal Impact	All activities will be screened according to screening Formats • Section 1: Background Information • Section 2: Check if the activities are in the 'list of non-permissible activities' • Section 3: Check compliance with regulatory requirements • Section 4: Check the Baseline Conditions • Section 5: Identify the Potential Environmental Impacts
Promotion of FPC		
Farmer Field School	Minimal to Low	Promotion of IPM Strategy by Crop Type Screening Formats: • Section 1: Background Information • Section 2: Check if the activities are in the 'list of non-permissible activities' • Section 3: Check compliance with regulatory requirements • Section 4: Check the Baseline Conditions and impacts Environmental Guidelines –To be used for Mini Watershed Plans Part 1: General Environmental Guidelines (applicable to all activities) Part 2: Activity Specific

		Environmental Guidelines
Sub-Surface Drainage in Saline-Sodic Land		
Farm Pond		
Construction of Water Harvesting Structures		
Drainage Line Treatment		
Micro Irrigation System		
Support to FIG/FPO/FPCs for product aggregation, handling, transformation & marketing	Low to Moderate	Model format to be used for developing EMPs for Post-Harvest Management and Value Chain Promotion activities (Annex 2) Part 1: EMP for Construction Activities Part 2: EMP for Operation and Maintenance Phase
Seed Production and Processing infrastructure		

Broadly it has been assessed that project will not have any major negative environmental impacts. Rather, it will be helpful for the environmental restoration. However, some of the apprehension, that the assessment identifies, like increase in use of synthetic fertilizer and pesticides due to improved and intensive farming system, increase in ground water draft etc. need to be addressed. It can be done through appropriate measures outlined in the environment management plan and through the promotion of recommended package of practices.

Potential Impacts of the Project

Table 37: Potential Impacts

Particulars of Components & Subcomponents	Environmental Impact (Yes / No)	Potential Environmental Impact
Promoting Climate-resilient Agricultural Systems		
Participatory development of mini watershed plans	No	
Climate smart agriculture and resilient farming systems		
Demonstration of climate resilient agronomic practices: Farmers Field Schools	No	
Enhancement in Carbon sequestration		

Particulars of Components & Subcomponents	Environmental Impact (Yes / No)	Potential Environmental Impact
Afforestation in upper reaches	Yes (+ve Impact)	Check on topsoil erosion Check on siltation of water courses and waterbodies Check on speed of runoff water Improvement in infiltration of the water into the ground Improvement in groundwater level Improvement in carbon sequestration (depending on the species being planted) Improvement in biomass availability
Plantation of horticulture plants	Yes (+ve Impact)	Improved availability of biomass and organic content in the long run
Conservation agriculture	Yes (+ve Impact)	Improvement in soil moisture Improvement in soil carbon Improvement in benevolent soil microbes and fauna Lowering in consumption of synthetic fertilizers and pesticides
Improvement of saline and sodic soils		
Farm Field Schools (FFS)-Saline soils	No	
Subsurface drainage	Yes (+ve Impact)	Decrease in soil salinity
Application of soil amendments	Yes (+ve Impact)	Decrease in soil salinity Increase in application synthetic fertilizers
Catchment / Land Treatment		
Catchment treatment; Continuous Contour trenches	Yes (+ve Impact)	Decrease in topsoil erosion Decrease in speed of volume of runoff water Increase in water infiltration and thus volume of groundwater
Drainage line treatment		
Construction of Earthen Nala Bunds	Yes (+ve Impact)	Decrease in runoff water Increase in water infiltration and thus volume of groundwater Increase in volume of surface water Decrease in siltation of watercourses
Construction of Cement Nala Bunds	Yes (+ve Impact)	Decrease in runoff water Increase in water infiltration and thus volume of groundwater Increase in volume of surface water Decrease in siltation of watercourses
Improvement of water courses; Deepening of nalas	Yes (+ve Impact)	Increase in volume of surface water available
Construction of new water harvesting structures		

Particulars of Components & Subcomponents	Environmental Impact (Yes / No)	Potential Environmental Impact
Construction of community farm ponds	Yes (Overall +ve Impact)	Increase in use of non-biodegradable material (if plastic sheet lining is used) Increase in volume of surface water Increase in water infiltration and thus volume of groundwater available
Construction of individual farm ponds	Yes (Overall +ve Impact)	Increase in use of non-biodegradable material (if plastic sheet lining is used) Increase in volume of surface water Increase in water infiltration and thus volume of groundwater available
Rejuvenation or desilting of existing water harvesting structures	Yes (+ve Impact)	Increase in volume of surface water Increase in water infiltration and thus volume of groundwater available
Construction of groundwater recharge structures; Recharging of open dug wells/ bore wells	Yes (+ve Impact)	Increase in water infiltration in the soil Increase in volume of groundwater
On-farm water security; Compartment bunding	Yes (+ve Impact)	Decrease in soil erosion
Micro irrigation systems		
Installation of drip irrigation systems	Yes (+ve Impact)	Increase in energy consumption (due to pumping of water) Decrease in water consumption Decrease in water wastage Improved water use efficiency / water productivity
Installation of sprinkler irrigation systems	Yes (+ve Impact)	Increase in energy consumption (due to pumping of water) Decrease in water consumption Decrease in water wastage
Strengthening Emerging Value-chains for Climate-resilient Commodities		
Support to FPCs for product aggregation, handling, transformation and marketing.	Yes (+ve impact)	Aggregation and bulk handling will reduce post-harvest wastage

The project by virtue of PDO and by design is a positive mitigation project and there is no major anticipated negative impact. However, if any project intervention if not implemented properly there may have some temporary and localised adverse impacts for which the mitigations measures are listed below:

Table 37: Expected Negative Impacts and Mitigation Measures

Project Activities	Anticipated Impacts	Potential Mitigation Measures
A2. On-farm climate-resilient technologies and agronomic practices		
A2.1 Demonstration of Climate Smart Agriculture	● Inappropriate use of chemical fertilizer and pesticides ● Increased incidence of pests if the same crop is promoted	● Encourage use of bio-fertilizers; bio-compost, vermicompost, green manure, microbial inoculants, etc. ● Adoption of INM / IPM to reduce chances of soil contamination and water pollution.

Project Activities	Anticipated Impacts	Potential Mitigation Measures
	repeatedly ● Safety issues in storing and using pesticide	●Promotion of bio-pesticides ●Prohibition of banned pesticides ●Plantation of pest controlling plants (in feasible / suitable cases). ●Promotion of suitable cultural practices like deep ploughing, seed treatment, mixed cropping etc.
Catchment treatment	All efforts made under PoCRA aims at maintaining standard hydrological flow around drainage line in addition conjunctive use around catchment	This will be judiciously monitored
A2.4 Protected Cultivation Shed net house (GI/MS pipes); Shed net house – Bamboo; Poly house (open vent)	By default protected cultivation should reduce adverse pest attack, however, if there is any incidence of pest / insect due to conducive environment may be higher	● Remove debris materials that might harbour or provide habitat for pest multiplication on the site of the greenhouses ● Avoid fumigation of soils by chemicals wherever possible ● Sterilize soil by Soil solarization ● Maintenance / repair of faulty greenhouse structures which help in the entry of insect-pests ● Always use insect-proof net screens ● Shade Net / Poly House Structure can have double entry gates so as to minimize the risk of pest entry and staying back (if economically feasible) ● Preparation of bed by building up rich flora of biological control agents for the management of soil borne pathogens especially nematodes. ● Pest Monitoring measures using sticky traps ● Introducing cultural control methods like resistant seed varieties, ● Integrated Pest Management (IPM) strategies ● Applying pesticides only when pest populations are large enough to cause economic losses (Above ETL) ● Developing understanding of farmers on the impact of their activities on environment
Component B. Climate Smart Post-Harvest Management and Value Chain Promotion		
Support to FIG/FPO/FPCs for product aggregation, handling, transformation &marketing	General construction related safeguards	Standard EMP checklist developed as part of the project will meet the compliance requirement
B3. Improving the Performance of the Seed Supply Chain B3.2 Development of seed hub- infrastructure support	General construction related safeguards	Standard EMP checklist developed as part of the project will meet the compliance requirement

4.6 Environment Improvement Measures

Table 38: Environmental Improvement Measures

Environmental Aspects	Improvement Measures under Project Interventions
Enhancement in Soil Organic Carbon (SOC)	**Crop Management:** (1) Soil fertility enhancement, (2) Better rotation, (3) Erosion control, (4) Irrigation. **Conservation Tillage:** Discouraging deep tillage and introducing minimum / conservative tillage, including(1) Stubble retention, (2) Reduced tillage **Pasture Management:** (1) Fertilizer management, (2) Grazing management, (3) Earthworm introduction (vermicompost), (4) Irrigation, (5) Improved grass species, (6) Introduction of legumes, (7) Sown pasture, (8) Introduction of Perennial pastures (Introducing pasture rotations wherever possible and use pastures in the inter-rows for tree crops and vines. Promotion of perennial plant species as per need. Educating farmers on appropriate grazing management strategies that minimize the impact of grazing on soil structure and maximize organic matter returns. Promoting maintenance and conservation of ground cover to minimize topsoil erosion by wind. Farmers will be educated to cover a minimum of 70% of the soil surface using plant residues / green cover. Grow high yield, high biomass crops and pastures, and in continuous cropping systems maximize crop frequency to increase organic matter returns to the soil.). **Organic Amendments:** Application of manure/compost and other organic amendments (1) Animal manure use, (2) Green manuring (3) Recycling of organic matters. Maintain soil fertility with inorganic and organic fertilizers to maximize production;
Integrated Pest Management	**Cultural Control:** (i)Crop Rotation (ii) Sanitation (iii) Soil Solarization (iv) Use of Resistant Variety of Seeds (v) Intercropping / Companion Planting (vi) Use of Farm Yard Manure Living and Organic Mulches **Physical and Mechanical Control:** Light Trapping (ii) Tillage using Harrows, Hoes and Brushes (iii) Yellow colored sticky traps **Biological Control** Bio-pesticides(microbial pesticides, plant pesticides and biochemical pesticides) **Chemical Control:** Application of chemical pesticides as per the recommended doses by crop type.
Integrated Plant Nutrient Management	**On-site Resource Utilization**: Use of on-site resources by recycling of crop residues, animal manure etc. **Judicious Application of off-site Nutrient Resources**: Judicious application of chemical nutrients, as per the prescribed doses. **Resources Integration**: The resources responsible for on-site generation of nutrients and energy will be appropriately integrated with chemical forms of nutrients and other management factors which enhances productivity. **Resources Management**: Farmers will be oriented to manage all the sources appropriately at the optimum level of efficiency. The integrated nutrient supply system will look into the management of the farming system as a whole, involving cattle, poultry, animals and plant resources and the use of chemicals. **Schematic Convergence**: Convergence with schemes like the 'Balanced and integrated use of fertilizer with the aim of promoting the use of organic manures and bio-fertilizers.
Water Use and Irrigation Efficiency	● Cluster based water budgeting taking all available water sources into account and the potentials; ● Promotion of Crop Planning (village / cluster based) based on water availability; ● Improving conveyance efficiency through lining of unlined sections of canal network; ● Promotion of Micro Irrigation System (Drip and Sprinkler Irrigation System);

Environmental Aspects	Improvement Measures under Project Interventions
	● Fostering convergence with existing schemes of Govt. for micro irrigation promotion; ● Monitoring and field assessment of improvement in irrigation efficiency.

4.7 Interventions not complying with the Policies/Regulations

Project interventions with severe environmental impacts and those not complying with the policies/regulations of GoM, GoI, and World Bank's safeguard policies should not be promoted under HPHDP. A list of these activities is given below:

1. Digging of bore well / deep bore well without ground water recharging structure will not be supported;
2. No activity will be carried out in Critical or Endangered Natural Habitats (as certified);
3. Construction of processing & value addition structures, check dams, embankments, etc., will not be supported without prior approval of the design by a qualified engineer;
4. Instruments to be purchased for processing / value addition should adhere to the recommended Government Standards and energy consumption rating. Project will not support any such instruments which does not comply with the Government recommended specification;
5. Embankment / check dam exceeding 10 meters in height will not be supported by the project;
6. Activities involving direct/untreated discharge into any water body (beyond the threshold / recommended/ permissible limit) will not be supported;
7. Purchase, stock, sale or distribution of the following pesticides will not be supported:
    a. Pesticides classified in Class Ia, Ib and II of WHO classification;
    b. Pesticides banned by the Government of India;
    c. Purchase, stock, sale, distribution or exhibition of pesticides and chemical fertilizers will not be supported without the requisite licenses.

5.0 Implementation Arrangement

5.1 Institutional Arrangement

The project will make required institutional arrangement to ensure EMF compliance of the project components as per the EMF. A dedicated project official at the PMU level will be the responsible person to guide the overall process related to environmental aspects. The district / sub-district level implementing agencies will be given required training to execute and monitor the environmental components in consultation with the PMU. They will be associated in the screening process of such activities that require detail environmental plan and will monitor the processes followed in execution of the planned activities and realisation of the environment safeguard norms. It will be ensured that the project interventions are consistent with the agreed strategies and framework.

5.2 Project level Institutional arrangement for IPM

- As Department of Agriculture is the implementing agency for PoCRA, IPM strategy designed by department and project will be implemented in project area.
- IPM package will be adopted by the project as a part of FFS approach (sub component A2) and various other interventions at field level and all necessary arrangements to demonstrate IPM technology for respective crops will be made. The critical inputs required for IPM will be availed by

the beneficiary and the cost of the inputs will be reimbursed by the project through Direct Benefit Transfer (DBT) mode.

- IPM as a part of FFS will be demonstrated in each project village for cotton, soybean, pigeonpea in Kharif season and for Gram and horticultural crop in Rabi season. In all project is proposing IPM demonstrations on farmers' farms under dry land and saline conditions. It is expected that IPM technology will be disseminated to about 10 lakhs farmers.
- Under component C. Institutional Development, Service delivery and Knowledge for Climate-resilient Agriculture, project incorporated contingency plan; development & testing of agricultural technologies and practices for climate adaptation; long term climate change model; on farm participatory action research and risk analysis framework; development of Climate Innovation Centres (CICs) etc. which will directly and indirectly strengthen the holistic IPM approach for climate resilient agriculture.
- At village level, Krishi Mitra/ Village motivator will be responsible to work in close coordination with VCRMC and KVKs. Krishi Mitra/ Village motivators are the key person placed at village level to share/ disseminate information regarding project interventions. These key persons will be imparted knowledge and skills regarding IPM technology.

5.3 Environmental Monitoring

Although most of the activities planned under project have minimal negative impact on environment, it will ensured that during project implementation the mitigation measures are complied with for each activity. It will also be taken care that environment improvement measures adopted wherever these are necessary. Project will monitor all the activities including EMF as integral part of each project components through MIS system and periodic monitoring and evaluation process.

5.4 Capacity Building Plan

The official/s dealing with environmental aspects at the PMU and DPMU level will be oriented on environmental aspects. The objective of organizing orientation programme for the officials (operating at different levels) is to equipped them well by which they can manage the concerned components of the project effectively and efficiently. As the project objectively looks at promoting climate resilience in agriculture sector, it is expected that the concerned officials are oriented in that direction. The capacity building on environmental aspects would take into account the current environmental issues in the State / project districts, project specific initiatives to adapt to the changes and taking mitigating measures. The project will also take up awareness and sensitization drive at community level (cluster / village level) to educate people on impacts of climate variability on agriculture and measures to be taken.

5.5 Reporting Plan

A dedicated project official will be responsible for environment related concerns and report directly to the Project Director at the State level Project Management Unit. The institutions / agencies associated in the implementation process will prepare their reports, covering environmental aspects as per the environment management frame. Environmental concerns and necessary environmental mitigation and improvement measures will be part of project's time based reporting.

5.6 Sustainability of Project Interventions

The planned interventions are in conformity to the environmental parameters and norms. The sustainability of the planned measures is further ensured due to its alignment with mainstream execution of project activities. Location specific and activity based assessment; planning and execution will further ensure its sustainability after the life of the project. The involvement of people from identification to planning and execution will enhance ownership and sustainability. The project is attempting viability gap through a sharing mechanism and not fully grant based unlike many other projects. This will help in their sustainability.

6.0 Pest and Nutrient Management Plan

6.1 Pest Management Plan

The state has gone through series of droughts since 1971. As reported, the current level of fertilizer and pesticide use are low in project areas as compared to the national average. While there is no evidence to suggest that the use of pesticide may increase due to the project interventions, yet the project would like to promote bio-pesticides and organic farming across the project areas. Hence, appropriate strategy has been proposed to minimize the environmental impacts of pesticides and nutrition deficiencies. This includes a detailed strategy on IPM (Integrated Pest Management) in project locations. The project is conscious of the fact that there could be several externalities (not necessarily related to project) may induce pesticide use with or without the project interventions.

Soil Productivity: Promotion of soil and plant nutrient management as an integral part of a productive farming system. Focus for IPNM would be on sustaining the productive potential of the soil resource.

Rain Water Harvesting and Conservation: Under rain-fed dry land farming, soil moisture availability is the primary limiting factor on crop yields. Hence IPNM strategy will adopt improved rainwater conservation and management practices, in-situ water conservation and improve water use efficiency.

Soil Organic Matter: With declining soil organic matter levels following cultivation, the adoption of improved organic matter management practices are a prerequisite for restoring and maintaining soil productivity (improved soil nutrient levels, soil moisture retention, soil structure and resistance to erosion). So, restoration and improvement of soil organic matter be the essential part of the IPNM strategy.

Agricultural Practices for Nutrient Management

Integrated plant nutrient management also contributes to pest management (refer annexure I for IPM). Stressed crops are more susceptible to disease and to the effects of pest attacks. Crops growing in poorly structured soil, under low or unbalanced nutrient conditions or with inadequate water supply will be stressed. Responding to disease or pest attacks by applying pesticides is a costly symptomatic approach to a syndrome which is better addressed by improving the ecological conditions and systems within which the crops are cultivated. In addition, agricultural products with less pesticides residues are less risky to consume, and healthy plants with a properly balanced nutrient supply provide better quality feed and food, improving animal and human health.

To achieve this, the project will promote Integrated Pest Management (IPM) approaches for the selected crops in the project locations. Crop wise IPM plans (discussed in Annexure I) will be prepared and farmers will be oriented on such practices. This will help to minimize the environmental and social risk from pesticide residues and improving the cost-effectiveness of farming.

Attempt will be made to improve production efficiencies through integrated nutrient management practices promoting combined use of inorganic, organic and biological resources in a reasonable way to balance efficient use of limited resources and ensure ecosystem sustainability. Efficient fertilizer use will be promoted with application of appropriate quantities and method of application to minimizes losses. Rather than broadcasting, project will educate farmers to apply fertilizer into the soil directly. Plant nutrient status during the growing season will be monitored using leaf-colour charts and managing fertilizer application accordingly.

Nutrients are also linked to different other practices that are related to sustainable crop production and intensification. Management of nutrient cycling will be the main focus of “Conservation Agriculture” in which minimum soil disturbance, intercropping, crop rotations and a permanent soil cover will be promoted to minimize the need for chemical fertilizers. Promotion of such practices will help the crops to have required nutrients by which their susceptibility to pests will reduce and thus will be helpful to Integrated Pest Management. As it is expected that application of fertilizers may increase the occurrence of harmful weeds, project will promote “Integrated Weed Management” by improving the timing, dosing and application method of nutrients and thus minimizing the potential impact on weed growth. Application of nutrients is a regulated and scientific manner will contribute in maintaining the overall agricultural biodiversity and will be supportive to pollination. The project will also promote crop-livestock system, as a part of nutrient management.

6.3 Nutrient Management at Farm Level

Farmers can get higher benefit from the supply of additional plant nutrients, in the form of organic / inorganic fertilizer, only after they have made improvement in the biological, physical and hydrological properties of their soil. At the farm level, integrated and synergistic approach will be adopted under IPNM, involving the following.

1. Matching the land use requirements with the land qualities present in the area, i.e., the biological, chemical and physical properties of the soil, and the local climatic conditions (temperature, rainfall etc.);

2. Seeking to improve yield by identifying and overcoming the most limiting factors that influence yield;
3. Better plant management, i.e., (i) planting at the beginning of the rain to increase protective ground cover to enhance infiltration and biological activity and (ii) timely weeding to reduce crop yield losses;
4. Promotion of complementary crop, livestock and land husbandry practices in combination to maximize addition of organic materials and recycle farm wastes, so as to maintain and enhance soil organic matter levels;
5. Land management practices that ensure favorable soil moisture conditions for the proposed land use (e.g. moisture conservation in low rainfall areas, drainage in high rainfall areas);
6. The replenishment of soil nutrients through an integrated plant nutrition management approach like organic manuring, application of crop residues, rhizoidal N-fixation, Phosphorous and other nutrient uptake;
7. Combinations of crop, livestock and land husbandry practices that reduce rainfall impact, improve surface infiltration, and reduce the velocity of surface run-off thereby ensuring soil loss below the 'tolerable' level;
8. Conservation tillage, crop rotation, agro-forestry and soil restorative practices that maintain and enhance the soils physical properties thereby encouraging root development and rainfall infiltration;
9. Promotion of crop-livestock system in project clusters as a part of integrated nutrient management strategy;
10. Nutrient monitoring during growing stage by using colour chart and application of nutrients accordingly.
11. Apart from IPNM, details on Integrated Pest Management (IPM) are outlined below.

IPM combines different approach to control the pests, minimize the economic loss and protect the environment. While the importance of chemical pesticides in controlling pests and its use by the farmers cannot be fully denied, better management approach can be promoted to ensure that its adverse impact on the environment is minimized. IPM is a broad ecological approach of pest control (insects, diseases, weeds, rodents etc.) employing different appropriate and suitable methods and techniques in an integrated manner to keep pest population below Economic Threshold Level (ETL) and also reduces the residual effects of chemicals on both plants and animals. The project will adopt Integrated Pest Management (IPM) as the key strategy to combat pests and diseases in the project and regulate its environmental impact. However, appropriate strategy to be adopted for its promotion among the farmers like sensitization on environment, awareness on environmental impact of indiscriminate use of pesticides, educating farmers on restricted and banned pesticides, regular orientation training and follow up, providing hand holding / field guidance and monitoring the implementation of IPM.

6.5 The World Bank Operational Guidelines

The World Bank & IFC pesticide guidelines aim to ensure that;

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

5. Integrated pesticide management specifically identifies the following as the key in pest control.
6. A categorical preference for bio control methods along with institutional and capacity building for the same.
7. Reducing reliance on synthetic chemical pesticides and only if approved by IPM approach.
8. 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.
9. Recommends the use of Participatory IPM along with specific investment components for the same.
10. Permits category III type chemicals as a part of the IPM strategy.

6.6 Objectives of IPM Plan

The objective of IPM is to promote and support safe, effective and environmentally sound pest management under the project. Along with regulating the use of synthetic pesticides (based on prescribed doses and type of pesticides to be used), the objective of IPM is to promote the use of biological and environmental control methods and the reduction in reliance on synthetic chemical pesticides. Promotion of IPM is objectively driven to achieve the followings.

1. Minimize crop loss, augment farm production with scientific application of synthetic pesticides;
2. Reduce environmental pollution caused due to the application of synthetic pesticides;
3. Introduction and adoption of biological and cultural methods and managing pests below ETL;
4. Reduction in health hazards arising due to chemical pesticides during handling;
5. Minimizing pesticide residues through the application of appropriate doses;
6. Promotion of bio pesticides

6.7 Salient Features of the Project Approach:

All IPM measures proposed in this project will be used after the second year of project implementation as most of the interventions pertaining to crop and production system will strt after the first year of mobilization.

1. Popularizing IPM approach among farming community through demonstration, awareness, training and exposure;
2. Organizing regular pest surveillance and monitoring to assess pest/disease situation and study agro-eco-system to advise timely IPM control measures;
3. Encourage farmers to rear biological control agents for their field use and conservation of naturally occurring biological control agents for control of crop pests;
4. Promoting use of bio-pesticides, neem based pesticides, bacillus based bio-pesticides, insect pathogen as alternative to chemical pesticides;
5. To play a catalytic role in transfer of innovative IPM skills/methods/ techniques to farmers through extension services and App based applications.
6. Human Resource Development in IPM by imparting training to master trainers, extension workers and farmers by conduct of trainings and establishment of Farmers' Field Schools (FFSs).
7. Issuing insect-pest and disease related information (app based / agri-watch / agri-met services) and control measures to farmers.

Alternative pest control strategies such as IPM that deploys a combination of different control measures such as cultural control, use of resistant genotype, physical and mechanical control, and rational use of pesticide

would reduce the number and amount of pesticide applications. Sensitization, awareness and extension support would educate and encourage farmers to adopt the innovative IPM strategies that would be key to reduce the harmful impact of pesticides on life and environment.

Table 1: Insect Scouting Chart (Use it after the second year)

S. No.	Insect / Pest	June	July	Aug.	Sept.	Oct.	Nov	Dec.	Jan
1									
2									
3									
4									

The project intervention may result with agricultural intensification for which the project needs to have a strategy to manage pest. As the project, would encourage farmers to take up better farm practices that are climate resilient without compromising farm-based productivity, it would be crucial to introduce IPM at the farmer end. Effective implementation of IPM practices will reduce the risk of water pollution through leaching of chemicals residues from farmlands to water sources, both surface and sub-surface. A detailed strategy for implementing IPM is presented below.

Table 2: Integrated Pest Management Approach

S. No.	Standard Pest Control Measures	Integrated Pest Management
1	Use of synthetic pesticides is common and widespread	More knowledge intensive
	Less emphasis on preventive approach	Emphasis on prevention of pest problems
	More reactive to pest outbreaks	Systematic approach for long-term pest control
2	Pesticide application is more chemical intensive	Change in field conditions that prevent pest attack
3	Use of synthetic pesticides focus more on killing pests directly	Regular inspection / monitor and taking recommended actions
4	Use of Higher Doses	Doses and type of pesticides use as per need

The project will adopt the suggested steps for IPM implementation. A baselinesurvey (benchmarking) will be undertaken after the first year of mobilisation phase of the project to assess knowledge, attitude and practice of farmers and identification of major pest problems by location. Specific IPM measures that the project will promote are;

- Deep summer ploughing (only in suitable cases).
- Recycling and appropriate disposal of crop residues, weeds etc.
- Seed treatment.
- Growing pest and disease resistant/tolerant varieties.
- Timely and synchronous sowing operation.
- Maintaining optimum plant spacing.
- Post-sowing cultural operations.
- Balanced use of fertilizers.
- Proper water management.
- Timely weed control.
- Use of light, yellow, sticky and pheromone traps for monitoring of pests.
- Regular monitoring on pests and their natural enemies.
- Conservation of crop defenders (parasites, predators and pathogens).
- Use of bio-pesticides against crop pests.
- Observation of pests and defenders ratio (2:1) before taking control action.

- Need based and judicious use of the pesticides on the basis of ETL (Economic Threshold Level) as a last resort.

The IPM strategy will cover (1) identification of pests & diseases for the crop in the area through regular monitoring, (2) assessment of ETL for major pests/diseases for different crops, (3) promotion of physical / mechanical / cultural / biological control methods, (4) facilitating use of bio-pesticides and (5) prescribing appropriate use of synthetic pesticides with recommended doses.

Identification Process

Field monitoring helps to keep track of the pests and their potential damage, which forms the base of IPM. So, the process starts with monitoring, which includes inspection and identification, followed by the establishment of ETL (crop specific). This provides knowledge about the current pests and crop situation and is helpful in selecting the best possible combinations of the pest management methods. Identification of minor and major pests, diseases in the project areas will be conducted regularly for the purpose. Package of practices developed by the State Agriculture Universities can be adopted accordingly.

Assessment of Economic Threshold Level (ETL)

The ETL differs by pest and also by crop types. Pest population is expected to be maintained at levels below those causing economic loss. It is generally assumed that pest tolerant capacity of different crops is limited and when it exceeds or approaching the ETL, chemical control methods can be used. Different pest / disease control methods of IPM will be applied, based on the determination of ETL and pest density. A priority list of different control methods of IPM is presented below.

Table 3: Adoption of IPM Methods and its Priority

IPM Procedures	Methods of Executing	Priority in Application
Cultural	Avoidance of monoculture Improved disease resistant varieties. Summer ploughing. Optimum plant densities. Avoiding excessive irrigation. Avoiding high nitrogenous fertilization. Trap crops	To be given preference as preventive mechanism
Biological	Conservation / promotion of bio agents like birds, parasites & pathogens for biological control of pests.	Second Priority
Mechanical	Damage/Destroying all the eggs of the insect; Destroy any material infested by insect, pest and diseases.	Third Priority
Chemical	Chemical Control when the loss is beyond ETL Use of recommended chemicals only	Last Priority when crop loss is beyond ETL

6.8 Capacity Building on IPM

Under the promotion of IPM, it is important that farmers understand its importance and adopt it in their field, following the prescribed procedures. To improve the understanding of farmers, it is essential to develop their knowledge base through training, exposures, handholding and extension services. While the Farmer's Field School (FFS) will be a good place for exposure of farmers for practical learning (demonstration of IPM), classroom teaching and field level support is also essential. For the capacity building of farmers, the project will adopt a cascading approach where resource farmers will be developed through Training of Trainers (TOT) programme. The ground force available for agriculture support, i.e., *KrsihiMitras* will also be trained

and exposed to IPM initiatives. They will be providing hand holding support to farmers at the time of need in consultation with the SAO.

6.9 Monitoring and Supervision

The IPM approaches adopted for different crops in project locations will be monitored on regular intervals by the executing entities and the farmers. The participatory monitoring system will help to understand the key challenges and emerging good practices. The challenges will be taken up for amicable solution at implementation level, with the support of technical institutions / SAUs whereas the learning will be replicated in different other clusters / villages. The project will also evaluate the impact of adopting IPM approaches (change in use of different IPM methods, incidence of pest attack, application of pesticide vis-a-vis pollination, economic damage, success of the package of practices including IPM, crop production and productivity etc.), with the support of technical institutions / SAUs. Key monitoring indicators covering both adoption as well as knowledge of IPM among the farmers will be assessed periodically as part of internal monitoring and periodic monitoring by third party.

Table 4: Monitoring of IPM

S. No.	Activity	Monitoring Areas	Responsibility	Time Frame
1	Development of IPM Related Learning Materials and its Distribution to Farmers / Farmer's Organisations	Learning materials cover crop specific IPM practices	District Project Management Unit	6 Months from project inception (printed materials)
		Availability of reading / reference materials with the farmers (distributed at village level)	Cluster Coordinator at SAO level	• 1 month from printing of documents • Monitoring of adoption by farmers during field visits
2	Promotion of Cultural Procedures	Availability of resistant varieties of seeds, plant density maintenance etc.	Cluster Coordinator at SAO level	Extending support (physical / technical) prior to sowing Regular monitoring
3	Promotion of Bio-Control Agents	Support to farmers in getting bio-control agents	SAO at Sub-division level	During initial identification of pest / disease, within 7-10 days of such identification
		Application of bio-control agents by the farmers	Ground level Staff with Cluster Coordinator	Regular field visit and preparation of report
4	Purchase and use of Pesticides	Purchase and use of banned pesticides	SAO at sub-division level	Periodic field visits
		Use of pesticides as per the crop specific prescription of doses.	Agriculture Expert	Periodic field visits
5	Use of Bio-fertilizers and vermi-compost	• Awareness inputs • Extension of Required Technical Support • Use of bio-fertiliser / pesticides / vermi-compost	SAO at sub-division level	Periodic field visits, physical observation and consultations
6	Training and awareness creation	• Organisation of Training on IPM; • Understanding of farmers on IPM • Organisation of awareness camps	SAO at sub-division level	• Periodic field visits, consultation with farmers and their organisation • Review of training materials • Assessment of application of training inputs

6.10 Pest and Disease Surveillance

As part of IPM strategy, a pest and disease surveillance will be undertaken electronically. Pest surveillance is an effective tool as an information system, which renders all pest control methods more effective. It aims at monitoring and forewarning of likely build-up of pests in order to facilitate planning and adoption of suitable control strategy based on ETL. It acts as a guiding principle in determining the areas and time needing the pest control. The proposed pest and disease surveillance system in EMF is based on practices followed by the Government of Maharashtra and recommended by ICAR (Indian Council of Agriculture Research) for this project.

Major Activities under IPM Strategy

Table 5: IPM Strategy and Key Activities

Key Activities	Execution Strategy	Cropping Season (Kharif / Rabi)							
		K	R	K	R	K	R	K	R
Training of project officials on IPM (all levels)	Orientation training by crop type								
Training of Farmers and their organizations	Crop specific orientation on IPM in phased manner								
Developing IEC materials and distribution with list of banned pesticides	IEC materials (crop specific IPM) in local language with visual display; Using these materials in orientation								
Organising awareness camps at village level (crop specific during seasons)	Awareness camps covering IPM concept, safe use, handling and disposal of insecticides / pesticides, IPM methods, vermi-composting etc.								
Demonstration of IPM in demonstration plots / FFS (Crop Specific IPM Practices)	Involving farmers, irrespective of land holding size								
Extending technical inputs and support to farmers	Inputs support, i.e., bio-pesticides, bio-weedicides, bio-fungicides, bio-fertilizers, bio-control agents (predators) etc.; Converge with relevant departments and schemes								
Conduct study and preparing checklist of pests/pathogens by crop types	As part of pest surveillance for adopting appropriate INM by crop type								
Legume plantations (in farm bunds and fields), promoting use of mulch, setting up of vermi-compost units	Encouraging farmers for inter-cropping / planting of legume plants; technical support for vermi-compost establishment.								
Providing / supporting farmers with bio-control agents	Collaboration with other agencies / state bio-control labs.								
Process monitoring and documentation of learning cases / best practices	Periodic on-field assessment and documentation of economic gain.								

Note: K: Kharif, R: Rabi

Associated Risks and Mitigation Measures

The plan for implementation of IPM may be constrains due to various factors which are discussed below. However, the project will take multi prong remedial measures to minimize the associated risks, in collaboration with different other research institutions, agricultural universities and technical support organizations.

Table 6: Risks and Mitigation Measures

Constraint/Risks	Mitigation
Availability of prescribed / selective pesticides, effective against pests but not against natural enemies of pests.	Making available selective bio-pesticides to farmers, as per their requirements through linkage and collaboration.
Determining the ETL for different crops taking location specific characteristics, pest species and pest density.	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 to deal with different insects / pests / diseases.	Use of only duly approved bio-control agents.
Techniques of mass rearing of several bio-agents are still not well developed.	Fostering collaboration / convergence with different institutions / universities for timely supply of bio-agents to farmers.
Limited access to new technologies may result with non-adoption of technology.	Ensuring availability of technologies at village / farmer end as per the demonstrations conducted in FFS or their exposure to such technologies.
On field guidance and providing hand holding support to the farmers during different cropping seasons through extension services.	Project envisages to develop a cadre at the cluster level who are trained in IPM for extending support. Apart from this, the existing extension mechanism of ATMA will be useful for supporting farmers in adopting IPM.

Criteria for Pesticide Selection and Use

The criteria to be followed for the selection and use of pesticides are (1) they must have negligible adverse human health effects, (2) they must be shown to be effective against the target species and (3) they must have minimal effect on non-target species and the natural environment.

Pesticide Storage, Handling and Disposal

The project will monitor (after 2 years of implementation) the compliance of the dose response and safety measures prescribed on the pesticides packages (or recommended by the Government of Maharashtra). Please note that there could be many externalities influencing such factors.

Precautionary Measures

When administering the pesticides, general precautions to be taken are:

1. Wearing protective body cover by the operator;
2. While applying pesticide, restraining from taking food items, drink or smoke;
3. Washing hands, face and other body parts with soap after spraying;
4. 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.
5. In case if any part of the body is exposed and come in contact with the pesticide, it should be washed-off immediately;
6. Change clothes immediately after spray and cleaning body properly.

7. Visit to doctor in case of feeling unwell.

Storage

Precautions to be taken in storing the pesticides are (1) keeping the place of storing of pesticides away from human and animals, (2) keeping away from water sources, (3) keeping at a height which should be out of reach of children, (4) keeping away from exposure to sunlight and moisture, (5) well ventilated place of storing, (6) well stacking to avoid of spillage, (7) the place of storage should be out of reach of children.

Transportation

Pesticides should be transported (1) in well-sealed and labelled containers, (2) should be transported separately, i.e. not with any other consumable items, cloths, drugs etc., (3) proper stacking to prevent leakage, (4) display of warning notice on the vehicle transporting pesticides, if transported in bulk with regular checking during transportation.

Disposal System

1. At the end of the day's work, the inside of the spray pump should be washed and any residual pesticides should be flushed out.
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. Pour the remaining pesticides into surface water sources like stream, nala, rivers, wells or any drinking-water sources is strictly prohibited.
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 kept away from common approach space and should be returned to the designated organisation / individual for safe disposal. Re-use of empty insecticide containers will be prohibited. The used packages shall not be left outside to prevent their re-use. Used packages shall be broken and buried away from habitation.
6. While purchasing, date of manufacture and date of expiry will be reviewed, as per the print;
7. In case the stock remained unutilised and crossed the date of expiry, it should be returned to the supplier.

6.11 Major Insect / Pest by Cultivated Crops and IPM Strategy

Table 7: IPM Strategy by Crop Type

Crop	Major insect pest/diseases	IPM strategy
Sorghum	Sorghum Shoot fly	Remove dead hearts High seed rate 8 – 12 kg/ha Seed treatment 60 % carbofuran 50% SP (100 gm/kg) Application of chlorantraniliprole 5 G or carbo-sulfan (yellow category) G, Use organic pesticides which are neem based or follow pesticide treatment prescribed on seed packages or follow Indian Council of Agricultural Research (ICAR) recommendations, Dimethoate 0.03% Tall variety with yellow glossy stem less attacked. Use resistant variety IS-2205, IS-3962, I-5469, IS-1054, s-386, SPV-102

Crop	Major insect pest/diseases	IPM strategy
	Stem borer	Use organic pesticides which are neem based or follow pesticide treatment prescribed on seed packages or follow Indian Council of Agricultural Research (ICAR) recommendations. Larval parasite Apentelisflavipes and egg parasite Trichogramma is effective.
	Aphids	Dimethoate 0.03%, neem seed kernal suspension 0.04%+soap. Usually natural enemies such as lady beetles, Chrysopa, hover fly larvae, parasitic wasps and others will control aphid infestations.
	Grain/Earhead Midge	Larval parasite Tetrastichus spp. is Effective. Predator Anthocordbug,Orius,Ant(Tepinomaindicum) Use organic pesticides which are neem based or follow pesticide treatment prescribed on seed packages or follow Indian Council of Agricultural Research (ICAR) recommendations. Malathion 0.05% or Phosalone 0.07% or Late sowing has less incidence.
	Semi looper	Collection and destruction of egg masses and hand picking of larvae. Summer ploughing and poison baiting. Erection of light traps soon after the monsoon for 20-45 days and collecting and killing of adult moths are found very effective. Poision baite preparations 10 kg rice bran + 1 kg jaggery +1 liter quinolphos.
	Downy Mildew	The eradication of wild hosts near sorghum fields. Removal of infected sorghum plants in the field. Destruction of plant debris by deep ploughing and other methods. Growing resistant varieties and hybrids like CSV5, CSV 6 etc. Seed treatment with Metalaxyl at 4 g/kg of seed or with Redomyl MZ @ 6 g/kg seed before sowing of sorghum. Foliar spray of Mancozeb 2.5 g/liter or Metalaxyl MZ at 2g/liter is recommended if standing crop is infested with downy mildew.
	Leaf Blight	Rotation with non susceptible crops i.e., crops other than grassy crops like maize, rice, pearl millet etc., aids in the destruction of infected residue. Foliar application of fungicides may be needed in seed production fields but it is not economical in grain production fields.
	Rust	Growing less-susceptible or resistant cultivars like PSH 1, SPH 837, CSV 17 etc. is the only solution. Selective fungicides that suppress the disease are usually not economical.
	Anthracnose	Clean cultivation, elimination of weed hosts, removal of crop residues will help in controlling this disease. A 2-year crop rotation with crops other than sorghum. Growing resistant cultivars like SPV 462, CSV 17 etc.
Pigeon pea	Pod borer Blister beetle Mealybug Plume moth	Installation of bird perches @ 50/ha for rigorous feeding of insects. Use H. armigera pheromone trap @ 12/ha.; Hand collection and destruction of fully grown larvae. Mechanical collection of grown up larva and blister beetle is effective. Practice crop rotation, planting non-leguminous crops every cropping season breaks the life cycle of bean pod borers. Spraying Neem seed kernel extract (NSKE) 5 per cent at 50% flowering stage to manage the insect's populations. Spraying HaNPV at (500 larval equivalent per hectare) at 15 days after first spray. Spraying of NSKE 5% twice followed by triazophos 0.05% is also effective. The recommended action threshold for Helicoverpa to initiate protection operations in pigeonpea when one notices. 1 small larva or 3 eggs per plant in short-duration, 3 small larvae or 5 eggs per plant in medium-duration and 5 small larvae or 10 eggs per plant in long-duration. Apply Ha NPV 3 x1012 POB/ha in 0.1% teepol for Helicoverpa. Apply

Crop	Major insect pest/diseases	IPM strategy
		chlorpyriphos @ 2.5 l/ha or quinalphos @ 2.0 l/ha or acephate @ 1.0kg/ha alternatively during flowering & pod formation stage. Ensure thorough coverage (900-1000 l/ha). Insecticide / Ha NPV spray should be made when the larvae are upto third instar. Two sprays of Spinosad @ 75 g a.i. /ha, first at grain filling stage of pods and second at full grain stage followed by Indoxacarb @ 60 g a.i. /ha. were found best in pod fly suppression,
	Fusarium wilt Phytophthora Blight Powdery mildew Cercospora leaf spot Sterility Mosaic	Long crop rotations for 3-4 year with non-host crop like tobacco, sorghum, pearl millet, cotton is recommended and has been found very effective for wilt and sterility mosaic disease management. Selection of disease-free fields, soil solarization or summer ploughing and wide row interspacing are good agricultural cultural practices advocated for disease management. Mixed cropping with sorghum, amendment of soil with oil cakes, appliances of trace elements such as boron, zinc and manganese and heavy dose of green leaf manure crops are remedial measures helps in checking the severity of wilt and blight diseases. Cultivation of pigeonpea on ridges with proper drainage system and avoiding the sowing in heavy soil helpful in disease management. Soil amendment with Trichoderma @ 1.0 kg + 100 kg FYM at the time of field preparation to reduce the incidence of wilt disease. Treat the seeds with hexaconazole + captan @ 2.5g/kg seed or metalaxyl @ 2.0 g per kg of seeds (or) carbendazim or thiram @ 2 g/kg of seed 24 hours before sowing (or) with talc formulation of Trichoderma viride @ 4 g/kg of seed (or) Pseudomonas fluorescens @ 10 g/kg seed for better management of diseases. First treat the seeds with biocontrol agents and then with Rhizobium. Fungicides and biocontrol agents are incompatible. There should be an interval of atleast 24 hours after fungicidal treatment for giving the bacterial culture treatment. Preventive sprays of mancozeb, wettablesulphur or metalaxyl at 15-20 days interval starting from 15 days after germination reduces the incidences of diseases. Cultivation of disease tolerant varieties is the most effective method to manage wilt and other diseases of pigeonpea such as Pusa- 9, NP 15, NP 38, AL 1430, which are resistant or relatively less susceptible.
Soyabean	Girdle beetle Hairy caterpillar Stem fly Whiteflies	Where possible, avoid successive plantings of summer legumes. Good agronomy and soil moisture are crucial as large, vigorously-growing plants suffer less defoliation for a given helicoverpa population and have less risk of terminal damage. In water-stressed crops, terminals are more attractive to larvae than wilted leaves. Vigorously growing plants with adequate available moisture are better able to replace damaged leaves and compensate for flower and pod damage Prior to flowering, biopesticides, particularly Helicoverpanucleopolyhedrovirus (NPV), are recommended in preference to chemical insecticides. This helps conserve beneficial insects to buffer crops against helicoverpa attack during the susceptible reproductive stages, and avoids flaring of other pests such as silverleaf whitefly and mites. For best results, all ingestion type products require thorough plant coverage. For biopesticides, addition of Amino Feed or an equivalent product is recommended
	Phytophthora	Plant in good seedbed conditions.

Crop	Major insect pest/diseases	IPM strategy
	seedling blight	Phytophthora is more likely to occur in low, wet areas, poorly drained areas or compacted areas of a field. Tiling to improve drainage and taking steps to reduce or prevent compaction may help minimize disease problems. Avoid the application of high levels of manure or fertilizer (KCl) just before planting. Rotate crops to prevent the increase of inoculum levels in a field. Use an appropriate fungicide seed treatment or an at-planting fungicide treatment. Products containing either metalaxyl or mefenoxam as an active ingredient are particularly effective against water mold fungi such as Phytophthora sojae
	Rhizoctonia seedling blight	Plant good-quality seed with a good germination rate. Plant in good seedbed conditions. Minimize or avoid stresses that delay germination or emergence, i.e., avoid or prevent herbicide injury and insect injury, correct soil compaction and hard pan layer problems and reduce injury from soybean cyst nematode. Use an appropriate fungicide seed treatment. Cultivate to ridge soil around the base of plants, thereby promoting root growth above the area of the stem that is diseased. This may be helpful only if there is sufficient soil moisture after cultivation for roots to grow
	leaf spot	Plant disease-free seed. Select resistant varieties. Rotate crops with at least one year between soybean crops. Use of a foliar fungicide is seldom warranted, except on high-value fields (e.g., seed production fields) or in years when weather is especially favorable for disease development
	Downy mildew	Plant disease-free seed. Rotate crops with at least one year between soybean crops. If infected seed must be planted, use a fungicide seed treatment.
	Powdery mildew	Select resistant varieties. Use of foliar fungicides is seldom warranted.
Gram	Pod borer	Use organic pesticides which are neem based or follow pesticide treatment prescribed on seed packages or follow Indian Council of Agricultural Research (ICAR) recommendations. or Quinalphos 25 EC or carbaryl @ at about 625 ml/ha, Spray neem seed extract (5%)
	Cut worm	Deep ploughing, Crop rotation, Inter-cropping with wheat or linseed or mustard, Grow marigold on bunds Dust Heptachlor @ 25 kg! hectare or Aldrin 5% @ 20 kg/hectare on the appearance of the pest, Use organic pesticides which are neem based or follow pesticide treatment prescribed on seed packages or follow Indian Council of Agricultural Research (ICAR) recommendations.
	Fusarium wilt	Use disease-free seed, avoid late sowing, Follow 4 years crop rotations; Seed treatment with carbendazim @ 2 g/kg or benomyl @ 3 g/kg Seed treatment with Pseudomonas fluorescens, Trichoderma harzianum, T. viride, Bacillus subtilis etc @ 4 g/kg see
	Collar rot	Soil solarization in summer, Avoid high soil moisture at sowing and seedling stage Seed treatment with carboxin @ 3 g/kg of seed Use of biocontrol agents such as Trichoderma harzianum, T. viride, Bacillus subtilis etc.

Crop	Major insect pest/diseases	IPM strategy
	Black root rot	Avoid high soil moisture and water logging Seed treatment with thiram or captan @ 3 g/kg see
	Blight	Late sowing, Remove and destroy debris of dead plants, Crop rotation, intercropping with barley, wheat, mustard Seed treatment with thiram @ 3 g/kg, Foliar spray of chlorothalonil @ 2 ml/L
Safflower	Leaf Eating Caterpillar	Collect and destroy the caterpillars. Use organic pesticides which are neem based or follow pesticide treatment prescribed on seed packages or follow Indian Council of Agricultural Research (ICAR) recommendations.
	Aphids	Spraying of 0.03% dimethoate or 0.02% thiometon for two times at 15 days interval. Use organic pesticides which are neem based or follow pesticide treatment prescribed on seed packages or follow Indian Council of Agricultural Research (ICAR) recommendations. Timely sowing of safflower
	Rust	Treat the seed with thiram @ 3 g/kg or captan 2.5 g/kg seed. Grow resistant varieties. Spray 0.3% dithane M-45 at 15 days interval for 3 to 4 times
	Bacterial Bligh	Spray streptocyclin 500 ppm of 2 to 3 time
Cotton	Jassids / Aphids / Thrips	Neem products (1500 ppm) 2.5 lit / ha Early phase of crop growth Oxydemeton methyl 25 EC 300 Early phase of crop growth Phoshamidon 85 WSC 200 Early phase of crop growth Acephate 75 SP 290 Above 60 days Quinalphos or carbaryl 1200 ml/ha. Above 60 days
	Whitefly	Neem products (1500 ppm) 2.5 lit Triazophos 40 EC 600 – 800 Acetamiprid 30 – 40 Imidacloprid 25 Thiomethoxam 25
	Bollworm	Neem products (1500 ppm) 2.5 lit 40 – 60 day, Phosalone 65 EC 35 EC 700 – 900 40 – 60 day Quinalphos 20 A F 500 – 700 During fruiting stages Chloropyriphos 20 EC 500 – 700 During fruiting stages Profenofos 50 EC 1000 – 1250 During fruiting stages Thiodicharb 75 SP 500 During fruiting stages
	Angular Leaf Spot	Field sanitation. Externally seed borne infection can be eradicated by delinting the seed with Cone H2SO4 for 5 minutes, wash with lime solution to neutralise the effect and finally washing with running water to remove the residue and drying seeds. Internally seed borne infection can be eradicated by soaking seeds overnight in 100 ppm streptomycin sulphate or Agrimycin. Secondary spread of the disease can be controlled by spraying the crop with streptomycin sulphate 100 ppm + Copper oxychloride (0.25%) at an interval of 15 days.
	Wilt	Field sanitation, crop rotation and mix cropping are useful for reducing the incidence. Use of resistant varieties. G. arboreum and G. herbaceum are susceptible whereas G. hirsutum and G. barbedanse are immune.
	Grey Mildew	Destruction of infected plant debris. Dust the crop with 300 mesh sulphur at the rate 20 kg/ha or spray crop with 0.05% propiconazole
	Anthracnose	Seed treatment with Thiram 3 g or Carbendazimm 1 g + Thiram 3 g/kg of seed. Spray the crop once or twice with copper oxychloride (0.25%) or Zineb

Crop	Major insect pest/diseases	IPM strategy
		(0.25%) after boll formation
	Root Rot	Seed treatment with Thiram or Captan at the rate 3 g +1 g Carbendazim/ kg seed. Soil mulching after rains. Mixed cropping with legumes and sorghum. Soil disinfection with 0.1% Carbendazim helps in controlling the disease.
	Boll Rot	Spray Fenvalerate 75 g a.i./ha + Copper oxychloride 0.2% or Carbendazim 0.1% or Mancozeb) 0.2% from 45th day at 15 days interval. Two or three sprays are necessary.
	Leaf Spot/ Blight	Remove and destroy the infected plant residues. Spray 0.2% Mancozeb or Copper oxychloride at the initiation of the disease. Four to five sprays may be given at 15 days interval
Sweet lime	Bark Borer	The pest is satisfactorily controlled by Quinalphos 25 EC @ 1.5 ml/lit or Carbaryl 50 WP @ 2 g/lit.or injecting kerosene oil. The holes are then sealed with mud.
	Citrus Leaf miner	Pruning of all the affected parts during winter should be done. Spraying the plants with Quinalphos WSC @ 1.5 ml/lit or neem seed kernel extract (NSKE) @ 50g/lit or 3 % neem cake extract or neem oil at the emergence of new leaves is highly beneficial.
	White fly	Drenching the trees with sufficient solution (preferably 8-10 litres for fully-grown tree) of either Quinalphos (2 ml/litre of water) or Acephate (0.8 ml/litre of water) controls the pest effectively
	Aphids	Spraying the plants with Quinalphos 25 EC 2ml/lit to control the pest. and Malathion (0.03%) effectively controls this pest.
	Fruit Sucking Moths	1. Elimination of alternate hosts plants from the vicinity of the orchards (especially Tinosporacardifolia) and collection and destruction of affected fruits reduce the pest population. 2. Uses of poison baits have proved useful. 3. Effective bait may be prepared by mixing 15g lead arsenate and 450g molasses in 10 litres of water. A little vinegar may be added to it and the bait should be suspended from trees in shallow wide-mouthed containers. 4. Bagging of fruits at small scale is effective. 5. Creating smoke in the orchards after sunset. 6. Fallen fruits should be disposed-off as they attract the moths. 7. Use organic pesticides which are neem based or follow pesticide treatment prescribed on seed packages or follow Indian Council of Agricultural Research (ICAR) recommendations.
	Citrus Mite	application of Dicofol (1.5 ml/litre of water) or Wettable Sulphur (3.0 g/litre of water) or Quinalphos EC25 (1.5 ml/litre of water)
	Mealybug	1. Regularly monitor the infestation of trees by this insect. 2. Sanitation of the orchard is extremely important as weeds act as additional hosts. 3. Uproot and destroy congress grass and castor plants in the vicinity of the orchards. 4. Do not allow the branches of trees to touch the ground. 5. Debark the branches and apply methyl parathion paste. 6. Use sticky trap on the fruit bearing shoots at a length of 5 cm. 7. Use fish oil resin soap (25g/lit) as spray or for dipping the fruits for two minutes. 8. Single soil application of Phorate 10G @ 50g per tree around the base at the time of pruning is essential.
	Canker	Cutting of affected twigs followed by spraying of 1% Bordeaux mixture or

Crop	Major insect pest/diseases	IPM strategy
		copper fungicide
	Gummosis	Scrapping of the affected area and spraying with Bordeaux mixture or copper oxifluoride
	Powdery mildew	Cutting of affected twigs followed by spraying of wettable sulphur 2gm/ltr, copper oxichloride 3gm/ltr of water
	Anthracnose	Cutting of affected twigs followed by spraying of copper oxichloride 3gm/ltr of water fortnightly

Note: This IPM strategy is suggestive and may be changed based on location specific assessment

Source& Reference:

(1) http://www.krishisewa.com/articles/disease-management/65-dsorghum_pests.html;
(2) www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/insect-pest-management-in-sorghum;
(3) http://www.krishisewa.com/articles/disease-management/268-pigeon-pea-insect-pests.html;
(4) http://www.hpagrisnet.gov.in/hpagris/Agriculture/Default.aspx;
(5) www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/integrated-pest-management/ipm-information-by-crop/insect-pest-management-in-soybeans;
(6) http://www.soybeanresearchinfo.com/pdf_docs/MissouriSoybeanDiseaseandIPMbook.pdf;
(7) www.researchgate.net/publication/255730967_CHICKPEA_DISEASES_AND_INSECT-PEST_MANAGEMENT;
(8) http://www.agriinfo.in/default.aspx?page=topic&superid=1&topicid=1237;
(9) http://www.cicr.org.in/pdf/ipm.pdf;
(10) http://www.krishisewa.com/articles/disease-management/225-citrus_ip.html

ANNEXURE 1

Environmental Screening Checklist – (A)

To be used for each Mini Watershed Plan

Section 1: Background Information

1.Name of the cluster:

2.Name of the district:

3.GPS coordinates of cluster HQ:

4.Number of villages in the cluster:

5.Number of farmers to be covered:

6.Area to be covered in hectares:

7.List of activities included in the Mini Watershed Plan:

Activity		**Is this activity included in the MWP?**
Climate smart agriculture and resilient farming systems		
1. Demonstration of climate smart agronomic practices(CSAP)	Farmer Field Schools (FFS)	Yes / No
2. Enhancement in Carbon Sequestration	Agro-forestry - Farm periphery	Yes / No
	Agro-forestry - Small block of 100 plants	Yes / No
	Plantation – Mango	Yes / No
	Plantation – Citrus	Yes / No
	Plantation - Custard Apple/Guava/Amla	Yes / No
	Plantation - Pomegranate	Yes / No
3. Improvement of saline and sodic lands	Improvement through subsurface drainage	Yes / No
	Improvement through soil amendment application	Yes / No
	Improvement through improved agronomic practices	Yes / No
	Farm pond with inlet & outlet and grass cultivation	Yes / No
	Water pumps	Yes / No
	Water sprinkler	Yes / No
4. Protected Cultivation	Shade net house (GI/MS pipes)	Yes / No
	Shed net house - Bamboo	Yes / No
	Polyhouse (open vent)	Yes / No
	Poly tunnels	Yes / No
	Planting material polyhouse/ shade net house	Yes / No
	Planting material in polytunnels	Yes / No
5. Integrated Farming Systems	Small ruminants	Yes / No
	Backyard poultry	Yes / No
	Sericulture	Yes / No
	Apiculture	Yes / No
	Inland fisheries	Yes / No
	Other agro based livelihoods	Yes / No
6. Organic Farming Systems	Vermicompost units	Yes / No
	Organic input production unit	Yes / No

Activity		Is this activity included in the MWP?
Efficient and sustainable use of water for agriculture		
1. Catchment treatment	Continuous Contour trenches Model 1	Yes / No
	Continuous Contour trenches Model 2	Yes / No
2. Drainage Line Treatment	Construction of Loose Boulder Structures	Yes / No
	Construction of Earthen Nala Bunds	Yes / No
	Construction of Cement Nala Bunds	Yes / No
3. Construction of new water harvesting structures	Construction of community farm ponds	Yes / No
	Construction of Farm Ponds (without lining)	Yes / No
	Construction of Farm ponds (with lining)	Yes / No
	Open Dug well	Yes / No
4. Rejuvenation by desilting/repairs of old water harvesting structures	Desilting of old water storage structure	Yes / No
5. Construction of groundwater recharge structures	Open dug wells/bore wells	Yes / No
6. On-farm water security	Compartment /graded bunding	Yes / No
7. Micro irrigation systems	Drip irrigation systems	Yes / No
	Sprinklers	Yes / No
8. Protective Irrigation	Water pumps	Yes / No
	Water carrying pipes	Yes / No

Section 2: Check if the activities are in the 'list of non-permissible activities'

8.Does the Mini Watershed Plan (MWP) include any of the following non-permissible activities?

S. No.	List of non-permissible activities	Is this type of activity in the MWP?
i	Digging of deep wells (borewells/tubewells) that are 60 meters or more in depth in notified areas[1].	Yes / No
ii	Construction or repair of check dams or embankments more than 10 meters in height.	Yes / No
iii	Any activities located within National Parks[2].	Yes / No
iv	Any activities located within a notified Eco Sensitive Zone (ESZ) and prohibited within ESZ[3]?	Yes / No
v	Any activities involving pesticides that are banned by the Government of India[4].	Yes / No
vi	Any activities involving pesticides that are in Classes Ia, Ib and II of the WHO Recommended Classification of Pesticides by Hazard[5].	Yes / No
vii	Any activities involving construction within 100 meters from an archeological site/monument[6].	Yes / No
viii	Any activities involving use of Asbestos Containing Materials (e.g., AC pipes for irrigation).	Yes / No

Section 3: Check compliance with regulatory requirements

9.Do the activities in the Mini Watershed Plan (MWP) comply with the following regulatory requirements (as applicable)?

S. No.	Regulatory requirements	
i	Do any of the activities involve digging of wells within 500 meters of a notified public drinking water source. If yes, is permission taken from the State Groundwater Authority[7].	Yes / No Yes / No
ii	Are any of the activities located within Wildlife Sanctuaries. If yes, is permission taken from the State Forest Department[8]?	Yes / No Yes / No
iii	Will any of the activities involve felling of trees? If yes, is permission taken as per the guidelines of the Revenue and Forest Department[9]?	Yes / No Yes / No
iv	Are any of the activities located within a notified Eco Sensitive Zone (ESZ)[10]? If yes, Are any of the activities on the list of activities regulated in ESZ? If yes, Has the required permission been taken?	Yes / No Yes / No Yes / No
v	Are any of the activities involving construction located between 100-300 meters from an archeological site/monument[11]. If yes, has permission been taken from the Archeological Survey of India?	Yes / No Yes / No
vi	Do any of the activities require consent from the Pollution Control Board? If yes, has consent been taken?	Yes / No Yes / No

Section 4: Check the Baseline Conditions

10.Are any of the activities in the Mini Watershed Plan (MWP) located in the following areas?

S. No.	Baseline Conditions		Details
i	Are any of the activities located in or near forest areas?	Yes / No	Specify distance:
ii	Are any of the activities located in or near natural water bodies (rivers, streams, lakes, ponds)?	Yes / No	Specify distance:
iii	Are any of the activities located on hill slopes?	Yes / No	
iv	Are any of the activities located in the following[12]: a.Overexploited groundwater basin b.Flood prone area	Yes / No Yes / No	

Section 5: Identify the Potential Environmental Impacts

11.Identify the potential environmental impacts of the activities in the Mini Watershed Plan (MWP) using the following table.

S. No.	Category	Impact	Scale of Impact	Probability of Impact Occurrence
A	Natural habitats and biodiversity	Clearance of native vegetation (including felling of trees) to clear land for cultivation/plantation	o High o Medium o Low o Not applicable	o High o Medium o Low o Not applicable

S. No.	Category	Impact	Scale of Impact	Probability of Impact Occurrence
		Degradation of natural vegetation due to open grazing by livestock	o High o Medium o Low o Not applicable	o High o Medium o Low o Not applicable
		Human wildlife conflict (in areas close to forests)	o High o Medium o Low o Not applicable	o High o Medium o Low o Not applicable
		Transmission of livestock diseases to wildlife (in areas close to forests)	o High o Medium o Low o Not applicable	o High o Medium o Low o Not applicable
		Introduction of exotic species of animals or plants	o High o Medium o Low o Not applicable	o High o Medium o Low o Not applicable
B	Solid Waste	Pollution due to improper disposal of solid waste (e.g., plastic mulch)	o High o Medium o Low o Not applicable	o High o Medium o Low o Not applicable
		Pollution and safety risk due to improper disposal of hazardous waste (e.g., pesticide containers)	o High o Medium o Low o Not applicable	o High o Medium o Low o Not applicable
		Pollution and health risk due to improper disposal of biological waste (e.g., dead animal carcasses)	o High o Medium o Low o Not applicable	o High o Medium o Low o Not applicable
		Pollution and health risk due to improper disposal of organic waste (e.g., burning of crop residues, open dumping of manure)	o High o Medium o Low o Not applicable	o High o Medium o Low o Not applicable
C	Water Quality	Pollution of water bodies due to release of wastewater	o High o Medium o Low o Not applicable	o High o Medium o Low o Not applicable
		Pollution of water bodies due to leaching of excess fertilizer or manure	o High o Medium o Low o Not applicable	o High o Medium o Low o Not applicable
		Pollution of water bodies due to excess fish feed	o High o Medium o Low o Not applicable	o High o Medium o Low o Not applicable

S. No.	Category	Impact	Scale of Impact	Probability of Impact Occurrence
D	Water Availability	Depletion of groundwater due to over-extraction (water intensive crops, evaporation losses from well-fed farm ponds, etc.)	o High o Medium o Low o Not applicable	o High o Medium o Low o Not applicable
		Reduction in yield in nearby wells due to over-extraction or close spacing of wells	o High o Medium o Low o Not applicable	o High o Medium o Low o Not applicable
		Reduction in downstream flows due to diversion/damming/bunding of streams/rivulets/nalas	o High o Medium o Low o Not applicable	o High o Medium o Low o Not applicable
E	Health & Safety	Safety risk from improper storage and/or handling of hazardous chemicals (e.g., pesticides)	o High o Medium o Low o Not applicable	o High o Medium o Low o Not applicable
		Safety risk from unguarded wells, borewell holes, farm ponds, etc.	o High o Medium o Low o Not applicable	o High o Medium o Low o Not applicable
		Risk of transmission of zoonotic diseases (e.g., bird flu, anthrax)	o High o Medium o Low o Not applicable	o High o Medium o Low o Not applicable
		Accidental injury (e.g., from agri-machinery)	o High o Medium o Low o Not applicable	o High o Medium o Low o Not applicable

12. Any other significant information:

Section 6: Screening Details

13. Date of filing this screening checklist:

14. Name, Designation and Signature of individual who filled this screening checklist:

Name: Designation: Signature:

15. Name, Designation and Signature of individual who verified this screening checklist:

Name: Designation: Signature:

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[1] Maharashtra Groundwater (Development and Management) Act, 2009.
[2] For list of National Parks and Wildlife Sanctuaries in Maharashtra, refer to:http://www.wiienvis.nic.in/Database/Maharashtra_7829.aspx
[3] For list of Eco Sensitive Zones in Maharashtra and lists of prohibited and regulated activities, refer to:http://envfor.nic.in/content/esz-notifications
[4] For list of pesticides banned in India, refer to:http://cibrc.nic.in/ibr2012.doc
[5] For list of pesticides in WHO classes Ia, Ib and II, refer to:http://www.who.int/ipcs/publications/pesticides_hazard_2009.pdf

[6] For list of protected monuments in Maharashtra, refer to:http://asi.nic.in/asi_monu_alphalist_maharashtra.asp
[7] Maharashtra Groundwater (Development and Management) Act, 2009.
[8] For list of National Parks and Wildlife Sanctuaries in Maharashtra, refer to:http://www.wiienvis.nic.in/Database/Maharashtra_7829.aspx
[9] For Guidelines for Tree Felling and Transit Permission, refer to:http://mahaforest.gov.in/fckimagefile/Ease%20of%20Doing%20Business%20Guidelines%20for%20Tree%20Felling(1).pdf
[10] For list of Eco Sensitive Zones in Maharashtra and lists of prohibited and regulated activities, refer to:http://envfor.nic.in/content/esz-notifications
[11] For list of protected monuments in Maharashtra, refer to:http://asi.nic.in/asi_monu_alphalist_maharashtra.asp
[12] For district-wise details on vulnerability to floods and earthquake, refer to:http://nidm.gov.in/PDF/DP/MAHARASHTRA.PDF

ANNEXURE 2

Environmental Management Plan – (B)

A model format to be used for developing EMPs for Post-Harvest Management and Value Chain Promotion activities

Part 1: EMP for Construction Activities

Section 1: List of Impacts and Mitigation Measures at Construction Phase

Environmental Aspect	Impact	Mitigation Measure	Responsibility for Implementation	Applicability
Site Selection	Improper location can have multiple impacts on sustainability, biodiversity, disaster proofing, etc.	The site selected for the activity will not be in areas that are: wildlife conflict areas, waste dumpsites, highly polluted/ contaminated land or water areas, natural drainage courses, areas prone to floods.	VCRMC Krishi Mitra Division Level Multi-Disciplinary Team.	o Applicable o Not Applicable
Legal and Regulatory Compliance	Activities that do not comply with the relevant laws and regulations cannot be supported under the project.	Refer to the Screening Checklist –B and confirm the following: The proposed construction is not on the 'list of non-permissible activities' given in Section 2 of the Screening Checklist-B. The proposed construction complies with the legal and regulatory requirements including those listed in Section 3 of the Screening Checklist-B.	VCRMC FPC/FPO Division Level Multi-disciplinary Team.	o Applicable o Not Applicable
Felling of trees and clearing of vegetation	Loss of green cover including trees	Compensatory plantation will be undertaken in accordance with the conditions prescribed in the tree felling permission. Proportionate quantity/ numbers of diverse, local species will be planted for every tree that is felled. Provision for tree guard and plantation aftercare will be ensured.	Division Level Multi-disciplinary Team.	o Applicable o Not Applicable

Environmental Aspect	Impact	Mitigation Measure	Responsibility for Implementation	Applicability
Health & Safety	Risk of accidents at worksite.	All workers will be provided adequate (Personal Protective Equipment (PPE). The use of PPE at the construction site will be mandatory.	In Case of individual asset building beneficiary will be responsible for follow safety measures Incase of community works VCRMC/ group will follow safety measures as per guidelines. Division Level Multi-disciplinary Team.	o Applicable o Not Applicable
Water Quality	Runoff and release of untreated wastewater may pollute nearby water bodies.	Release of wastewater into water bodies, streams, etc., without any treatment will be avoided. All wastewater will meet the 'CPCB General Standards' prior to disposal.	ATMA FPC/FPO Division Level Multi-disciplinary Team.	o Applicable o Not Applicable
Waste Management	Pollution and health impacts due to improper disposal of wastes such as open dumping, burning, unauthorized recycling, etc.	Dispose biodegradable and non-biodegradable wastes separately. Follow all GoI & GoM applicable law related to waste management, ,	FPC/FPO	o Applicable o Not Applicable
Physical Cultural Resources	Loss of cultural artifacts.	If in case of chance finds of archaeological significance (such as coins, utensils, artefacts, structures, etc.) are found during the excavation works, the Department of Archeology will be notified.	VCRMC FPC/FPO	o Applicable o Not Applicable
Human Resource Capacity	Poor capacity for environmental management.	Capacity building activities through orientation, training and use of IEC (information, education, communication).	PMU ATMA	o Applicable o Not Applicable

Environmental Aspect	Impact	Mitigation Measure	Responsibility for Implementation	Applicability
Compliance Monitoring	Weak compliance of the environmental management plan will lead to aggravated impacts and undermine sustainability.	Monitoring and reporting OF as per project's M&E strategy.	As per project's monitoring and evaluation system	o Applicable o Not Applicable

Part 2: EMP for Operation and Maintenance Phase

Section 1: List of Impacts and Mitigation Measures at O&M Phase

Environmental Aspect	Impact	Mitigation Measure	Responsibility for Implementation
Legal and Regulatory Compliance	Activities that do not comply with the relevant laws and regulations cannot be supported.	Refer to the Screening Checklist –B and confirm the following: The proposed activity is not on the 'list of non-permissible activities' given in Section 2 of the Screening Checklist-B. The proposed activity complies with the legal and regulatory requirements including those listed in Section 3 of the Screening Checklist-B.	VCRMC Board of Directors and CEO of the FPO/FPC.
Air and Water Pollution	Air and water pollution from processing units (grain and pulse processing, flour mills, etc.)	All manufacturing processes will comply with the relevant CPCB standards: industry specific standards for 'Grain Processing, Flour Mills, Paddy Processing, Pulse Making or Grinding Mills[5]', or, in cases where industry-specific standards are not relevant/available, with the CPCB General Standards[6].	State Coordinator – Environment in the PMU. Division Level Multi-disciplinary Team.
Health & Safety	Equipment, machinery, vehicles, etc., that do not comply with relevant safety and environmental standards may pose risk to human and environmental health and safety.	All procured equipment and machinery will comply with relevant BIS standards. All vehicles (carriers, reefer vans, etc.) will comply with the relevant Bharat Stage (BS) emission norms.	State Coordinator – Environment in the PMU. VCRMC Board of Directors and CEO of the FPO.

Environmental Aspect	Impact	Mitigation Measure	Responsibility for Implementation
	Risk of accidents (use of agri-machinery, in the processing unit, etc.). .	Safety instructions will be provided to users of agri-machinery in the local language. Adequate PPE will be provided to users of agri-machinery and workers in processing units. The use of (Personal Protection Equipment)PPE will be mandatory. A fully-provisioned first-aid box will be available at the processing unit. Adequate number of functional fire extinguishers will be available at the processing units	
	Risk of use of hazardous chemicals.	Un-authorized chemical ripening agents (e.g., calcium carbide) will not be used.	
Pest Management	Risk to human and environmental health from use of hazardous pesticides, and from improper use of pesticides.	Pest management in godowns, warehouses, etc., will be as per the Pest Management Plan.	State Coordinator – Environment in the PMU. Division Level Multi-disciplinary Team. VCRMC
Waste Management	Pollution and health impacts due to improper disposal of organic wastes such as open dumping, burning, etc.	All organic/biodegradable wastes (from sorting-grading units, from processing units, from godowns, etc.) will be segregated and disposed through reuse as animal feed, composting, etc. as appropriate. Any residual waste material will be disposed in a manner and at locations specified by the local government body. All work sites will have adequate sanitation facilities.	State Coordinator – Environment in the PMU. Division Level Multi-disciplinary Team. FPO/FPC
Energy Consumption	Equipment and machinery that is not efficient will lead to energy wastage and higher operating costs.	All procured equipment and machinery (e.g., pump sets, refrigeration units) will be BEE 4 or 5 star rated. Use of solar energy based equipment/machinery will be considered.	State Coordinator – Environment in the PMU. Division Level Multi-disciplinary Team FPO/FPC

Environmental Aspect	Impact	Mitigation Measure	Responsibility for Implementation
Human Resource Capacity	Poor capacity for environmental management.	Capacity building activities through orientation, training and use of IEC (information, education, communication) for farmers, FPO staff and board members, etc.	State Coordinator – Environment in the PMU. Division Level Multi-disciplinary Team. Board of Directors and CEO of the FPO.
Compliance Monitoring	Weak compliance of the environmental management plan will lead to aggravated impacts and undermine sustainability.	EMP monitoring as a part of project's over all Monitoring and Evaluation strategy	State Coordinator – Environment in the PMU Third party monitoring

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[1] Refer to:http://www.cgwb.gov.in/CGWA/Documents/Guidelines%20Supreme%20Court%20fatal%20Accident.pdf
[2] Refer to:http://www.moef.gov.in/sites/default/files/C%20&D%20rules%202016.pdf
[3] Refer to:http://www.moef.gov.in/sites/default/files/Final%20HWM%20Rules%202016%20(English)_0.pdf
[4] Refer to:http://wdra.nic.in/WAREHOUSEMANUAL30012013.pdf
[5] Refer to:http://www.cpcb.nic.in/Industry-Specific-Standards/Effluent/458-1.pdf
[6] Refer to:http://cpcb.nic.in/GeneralStandards.pdf

ANNEXURE 3

Project on Climate Resilient Agriculture (PoCRA)

Environmental Guidelines – (A)

To be used for Mini Watershed Plans

Part 1: General Environmental Guidelines (applicable to all activities)

Site Selection & Materials

·The site selected for the activity must not be in areas that are: wildlife conflict areas, waste dumpsites, highly polluted/contaminated land or water areas, areas prone to floods.

·Ensure that material required for construction of bunds, nala bunds, water harvesting structures, etc., is procured on-site or from authorized quarries.

Resource Conservation

·Adopt water conservation practices (e.g., use of efficient irrigation methods such as drip and sprinkler irrigation, mulching, alternate furrow irrigation, etc.).

·Avoid wastage and over-consumption of water (e.g., avoid over-extraction of groundwater).

·Adopt renewable energy alternatives where feasible (e.g., solar lights, solar water pumps, etc.).

·Adopt energy efficient agri-machinery (e.g., BEE 5 star rated pumps).

Pollution Control

·Ensure that all vehicles have a valid Pollution Under Control certification.

·Ensure that all generator sets (diesel, petrol, kerosene, LPG, CNG) meet the 'CPCB noise and emission control standards for Generator Sets'.

·Ensure that noise generating activities meet the CPCB prescribed 'Ambient Air Quality Standards in Respect of Noise'.

·Avoid release of wastewater into water bodies, streams, etc., without any treatment.

·Ensure that all waste water meets the 'CPCB General Standards' prior to disposal.

·Ensure that all machinery conforms to noise standards.

·Compost organic wastes.

·Dispose non-biodegradable wastes at locations specified by the local government body (e.g., proper disposal of waste plastic mulch).

·Avoid burning of wastes (crop residues, leaf litter, plastic wastes, etc.).

Biodiversity Conservation

·Avoid felling of existing trees.

·Avoid cultivation/rearing of exotic species of animals or plants.

Health and Safety

·Adopt prescribed safety practices, including use of personal protection equipment (PPE), for handling, storage, use and disposal of pesticides (refer to Pest Management Plan).

·Adopt prescribed safety practices, including use of personal protection equipment (PPE), for handling any machinery.

·Ensure that all pits, holes, water storage structures, etc., must be adequately secured to prevent accidental falls.

Environmental Guidelines – (A)

To be used for Mini Watershed Plans

Part 2: Activity Specific Environmental Guidelines

S. No.	*Activity*	*Environmental Management Guidelines*
1	Farmer Field Schools (FFS)	Emphasize on occupational health and safety (e.g., safe handling of pesticides) during FFS sessions.
2	Agro-forestry (Farm Periphery; Small Block of 100 plants)	·Avoid monoculture of alien tree species. ·Adopt integrated nutrient management based on soil testing results to avoid overuse of chemical fertilizers. ·Adopt integrated pest management (with permissible pesticides) to reduce reliance on chemical pesticides. ·Adopt efficient irrigation practices (drip irrigation, mulching, etc.).
3	Plantations– Mango, Citrus, Custard Apple/Guava/Amla, Pomegranate	·Adopt integrated nutrient management based on soil testing results to avoid overuse of chemical fertilizers. ·Adopt integrated pest management (with permissible pesticides) to reduce reliance on chemical pesticides. ·Adopt efficient irrigation practices (drip irrigation, mulching, etc.).
4	Improvement of saline and sodic lands through soil amendment application	Ensure that the soil amendments used meet the respective BIS standards (non-conformity to standards may lead to contamination): ·IS-10170-1982 for By-product Gypsum ·IS-6046-1982 for Gypsum for agricultural use ·IS 14403: 1996 for Agriculture Grade Iron Pyrites
5	Farm pond with inlet & outlet and grass cultivation	·Ensure adequate safety fencing around the farm pond to prevent accidental falls. ·Ensure safe side slopes (not steeper than 3:1).
6	Water pumps	·Procure energy efficient pumps (e.g., BEE 5 star rated).
7	Shadenet house (GI/MS pipes, Bamboo)	·Adopt integrated pest management (with permissible pesticides) to reduce reliance on chemical pesticides.
8	Polyhouse (open vent) & Poly tunnels	·Adopt integrated pest management (with permissible pesticides) to reduce reliance on chemical pesticides. ·Dispose plastic waste through selling to recyclers or at locations specified by the local government authority.
9	Small ruminants	·Livestock units located within 5 km of protected areas should ensure vaccination of animals to prevent spread of disease to wild animals. ·Avoid open grazing in or near forest areas. ·Avoid location of livestock units within living quarters to control spread of zoonotic diseases. ·Practice efficient feeding systems (stall feeding, rotational feeding, chaff cutter, etc.). ·Maintain hygiene in animal shelter (sloping floor, periodic cleaning and disinfection, etc.). ·Compost the manure and leftover feed. ·Transport of animals must be in accordance with the Prevention of Cruelty to Animals Act 1960. ·Dispose dead or diseased animals safely in accordance with the procedures prescribed by the Animal Husbandry Department. ·Ensure compliance with Maharashtra Pollution Control Board's guidelines for livestock farms[1].
10	Backyard poultry	·Avoid location of poultry units within living quarters to control spread of zoonotic diseases. ·Maintain hygiene in poultry shed shelter (periodic cleaning and

		disinfection, etc.). ·Compost the manure and leftover feed. ·Transport of birds must be in accordance with the Prevention of Cruelty to Animals Act 1960. ·Dispose dead or diseased birds safely in accordance with the procedures prescribed by the Animal Husbandry Department. ·Ensure compliance with Maharashtra Pollution Control Board's guidelines for poultry units[2].
11	Inland fisheries	·Avoid cultivation of alien species. ·Avoid over-fertilization/feeding to reduce organic nutrient load in the water body.
12	Vermi compost units	·Avoid alien species of earthworms (*E. foetida, E. euginiae*). ·Use native species of earthworms (*P. excavates, L. mauritii*). ·Adopt prescribed management practices to avoid infestation of flies and rodents.
13	Organic input production unit	·Ensure that there is no over-harvesting of local wild plant species for preparation of organic inputs. ·Ensure that all organic waste from the production unit is composted. ·Ensure adoption of safety practices by workers (e.g., while grinding using high speed electric motors).
14	Drainage Line Treatment - Construction of Earthen/Cement Nala Bunds	·Ensure that the Nala Bund allows adequate downstream flow. ·Ensure that no sand mining takes place close to the Nala Bund.
15	Construction of new water harvesting structures - Farm ponds (community and individual, with and without lining)	·Ensure that the open dug well is properly secured with a wall/fence and cover to avoid accidental falls. ·Ensure adequate safety fencing around the farm pond to prevent accidental falls. ·Make provision for safe disposal of farm pond lining material at the end of its service life.
17	Desilting of old water storage structure	·Ensure safe disposal of desilted material (e.g., use on farm land). ·Avoid leaving desilted material close to the water storage structure. ·Ensure that the desilting activity does not damage side slopes or leave deep pits. ·Ensure provision of protective fencing around the structure to prevent accidental falls.
18	Construction of groundwater recharge structures for open dug wells/bore wells	·Ensure that the recharge structure is located at a safe distance (at least 15 metres) for possible sources of contamination (e.g., manure heaps, leach pit latrines, etc.). ·Ensure that the design of the recharge structure includes silt trap and filter media to prevent contamination of the well.
19	Water pumps for protective irrigation	Procure energy efficient pumps (e.g., BEE 5 star rated).
20	Water carrying pipes for protective irrigation	Avoid use of AC (asbestos-cement) pipes.

[1] Refer to:http://mpcb.gov.in/images/tabelacircular.pdf

[2] Refer to:http://mpcb.gov.in/consentmgt/pdf/guidelines4GrantingConsent2poultryfarm.pdf