

**Environmental Assessment and Environmental Management
Framework for**

Jharkhand Opportunities for Harnessing Rural Growth (JOHAR)

Final Report

Jharkhand State Livelihoods Promotion Society (JSLPS)

Department of Rural Development, Government of Jharkhand

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List of Acronyms

AKM	Ajeevika Krishi Mitra
AMM	Ajeevika Matsya Mitra
APS	Ajeevika Pasu Sakhi
AVM	Ajeevika Vanopaj Mitra
BDC	Business Development Cell
CP	Community Professional
CSC	Cluster Service Centres
EA	Environmental Assessment
EMF	Environmental Management Framework
EMP	Environment Management Plan
GoI	Government of India
GoJ	Government of Jharkhand
HVA	High Value Agriculture
INM	Integrated Nutrient Management
IPM	Integrated Pest Management
JOHAR	Jharkhand Opportunities for Harnessing Rural Growth
JSLPS	Jharkhand State Livelihood Promotion Society
KVK	Krishi Vigyan Kendra
MIS	Management Information System
NP	National Park
NRLM	National Rural Livelihoods Mission
NRLP	National Rural Livelihoods Project
NTFP	Non Timber Forest Produce
PCB	Pollution Control Board
PDO	Project Development Objective
PG	Producer Group
PMP	Pest Management Plan
PO	Producer Organization
SHG	Self Help Groups
TSA	Technical Support Agency
TSP	Technical Service Provider
WB	World Bank
WHO	World Health Organization
WLS	Wild Life Sanctuary
WUG	Water User Group

Executive Summary

The Project Development Objective (PDO) of Jharkhand Opportunities for Harnessing Rural Growth (JOHAR) project is “to enhance and diversify household income in select farm and non-farm sectors for targeted beneficiaries in project areas”. The primary project beneficiaries are the rural households, including women and men from scheduled castes and scheduled tribes, smallholder and landless households in selected blocks of rural Jharkhand.

The project would achieve the PDO by: a) mobilizing and aggregating rural producers including women and men from SC/ST and smallholder households into producer groups and organizations, with focus on diversification and/or intensification of their current production system, and, improving their participation higher up in the value chain; b) strengthening the competitive advantage of target rural producers by transfer of climate resilient production techniques, enhanced opportunities for value addition and effective market linkages; c) improving access to financing, including innovative financial products, through the community institution platform and through commercial banks; d) establishing partnerships with the private sector, including rural entrepreneurs, for effective forward and backward linkages with producers; e) supporting skill development and financing modalities to facilitate jobs and entrepreneurship with a focus on the value chain and agri-business.

The project components are as follows:

Component 1: Diversified and Resilient Production and Value Addition

This component will support small producer collectives and interventions for diversification, intensification and value-addition in the selected sub-sectors of High Value Agriculture, livestock, NTFP, fisheries and irrigation.

Component 2: Promoting Market Access, Skill Development and Pro-poor Finance

This component will involve support for promoting market access and private sector participation, fostering skill development and entrepreneurship in focus value chains, and, facilitating the development of pro-poor agricultural finance systems.

Component 3: Project and Knowledge Management

The objective of this component is to establish effective project management and facilitate strong knowledge management.

The project is not likely to have any significant, irreversible impacts, however the project is classified as Category ‘B’ as the project interventions in diversified production and value addition could have site specific adverse environmental impacts if not executed and managed appropriately. Consequently, environmental safeguard policies on Environmental Assessment (OP 4.01) and Pest Management (OP 4.09) are triggered.

The Jharkhand State Livelihood Promotion Society (JSLPS) has conducted an Environment Assessment (EA) study based on which an Environment Management Framework (EMF) is developed to guide the project teams in avoidance and mitigation of negative impacts from the

project interventions. The environment assessment study identified the following key potential environmental issues related to the project interventions.

- Promotion of hybrid/high yielding varieties, increased irrigation inputs and increased use of agro chemicals may have negative impacts on local biodiversity, soil and water resources
- Introduction of new species and increase in chemical inputs in fishery may threaten aquatic biodiversity and lead to eutrophication; unsustainable water resource management etc.
- Poor livestock management practices may affect local fodder resources, improper manure management may lead to pollution
- Environmental issues related to value addition include excessive resource use (energy and water) and release of wastes into the environment
- Environmental issues related to value chain infrastructure include improper site selection and issues related to construction, operation and management.

Based on the EA and Environment Management Framework (EMF) is developed. The objective of EMF is to ensure the environmental sustainability of the project interventions under the component 'diversified and resilient production and value addition'. The EMF proposes the following strategy for environmental management in the project:

- Compliance of the project activities with legal and regulatory framework prepared for the project (presented in chapter IV) with respect to natural resource management and environmental protection
- Limited Environmental Appraisal of the business plans (community crop plans by Producer Groups (PGs), , micro irrigation plans by Water User Groups (WUG), agri business plans by Producer Organisations (POs),) for identification of potential issues and mitigations/environmental guidelines
- Detailed Environmental Appraisal, preparation and implementation of detailed Environment Management Plans (EMPs) for activities with potential adverse impacts such as irrigation system development.
- Managing the crop pests in concurrence with OP 4.09 through a Pest Management Plan (PMP)

The brief overview of the EMF implementation plan is as follows:

- Capacity Building of the Community Professionals (Ajeevika Krishi Mitra, Ajeevika Pasu Sakhi, Ajeevika Matsya Mitra, Ajeeviak Vanopaj Mitra, Micro Enterprise Consultants) on conducting environmental appraisal, developing the tools and formats in local language
- Capacity building for the project teams on integration of environmental safeguards
- Environmental Appraisal of the Agri business plans /Community Crop plans / Micro Irrigation Plans and integration of mitigation measures/ environmental guidelines
- Awareness generation among the project beneficiaries on mitigations, environmental guidelines and facilitating the implementation
- Monitoring of the implementation
 - Internal monitoring by project teams
 - External audit by external agency

- Allocation of budget and required resources for effective implementation
- Implementation arrangements for the Pest Management Plan

The overall responsibility of the EMF implementation will be with the JSLPS. The thematic leads at state level and thematic experts at district level will handle the responsibility of EMF implementation in the respective thematic areas. At State level the thematic lead on High Value Agriculture (HVA) will be designated as nodal person for environmental safeguards. An Environment consultant will be positioned at State level for supporting the EMF implementation throughout the project period. At district level the thematic expert on HVA will be designated as nodal person for safeguards. At the block levels, thematic cluster coordinators will handle the responsibility of EMF implementation and coordinate the Environmental Appraisal by CPs and service providers. The Community Professionals will handle the responsibility of conducting Limited Environmental Appraisals for community crop plans and agri business plans and the service providers will conduct detailed Environmental Appraisal for Micro Irrigation Plans. In addition to this provision will be made to acquire additional human resources to meet any specific technical and/or operational requirement that may arise from time to time.

Chapter I

Jharkhand State Livelihood Promotion Society (JSLPS)

1.1. About the Jharkhand State Livelihood Promotion Society (JSLPS)

The **Jharkhand State Livelihood Promotion Society (JSLPS)** was formed as an autonomous and independent society in the year 2009 under the aegis of Rural Development Department, Government of Jharkhand. The society was formed to serve as a special purpose vehicle for smooth implementation of poverty reduction strategies, pro-poor schemes and programs in Jharkhand especially for disadvantaged groups. The society works as a nodal agency for livelihood promotion strategies and interventions in the state and collaborates with various government departments, NGOs/CBOs, technical institutions and private sector partners. It functions democratically through its Executive Council (EC) and General Body (GB), which is represented by Secretaries from different Government Departments, policy makers, NABARD, bankers, social workers and representatives of NGOs.

Objectives of JSLPS

The specific objectives of the Society are to:

- i. Alleviate the poverty in the state, especially among the disadvantaged groups by bringing in convergence among various poverty reduction and empowerment programs or schemes.
- ii. Contribute to the lives of the rural poor throughout the state through empowerment and fostering strong self-managed grass root institutions and support investments for the groups of the poor.
- iii. Build support and service structures for providing social and technical guidance to the poor in their overall social progress and livelihood development and in doing so forging partnership and collaboration with relevant Govt. departments and NGOs.
- iv. Establish models for participatory social and economic development of the rural poor in conformity with all these objectives and prove their relevance, sustainability and suitability of replication.
- v. Facilitate knowledge and experience sharing among stakeholders including –government departments, technical institutions, relevant autonomous agencies of the government, civil society organizations, non-governmental organizations, private sectors, community based organization and research agencies.

1.1.1. Programs of JSLPS

National Rural Livelihood Mission (NRLM), National Rural Livelihood Project (NRLP)

JSLPS anchors the National Rural Livelihood Mission (NRLM/P) in Jharkhand and the state chapter of the project was entrusted to society named as State Rural Livelihood Mission (SRLM). The JSLPS has initiated the SRLM's activity in the financial year 2012-13. The state level State Mission Management Unit (SMMU) was established within the society. The society is headed by a full-time Chief Executive Officer (CEO) who is supported by a Chief Operating Officer (COO) to look after the operational issues. A team of senior level professionals and thematic experts have been inducted in the team. The SMMU has unveiled its independent vertical at district and blocks as DMMU and BMMU respectively.

NRLM implementation is in a Mission Mode. This enables (a) shift from the present allocation based strategy to a demand driven strategy enabling the states to formulate their own livelihoods-based poverty reduction action plans, (b) focus on targets, outcomes and time bound delivery, (c) continuous capacity building, imparting requisite skills and creating linkages with livelihoods opportunities for the poor, including those emerging in the organized sector, and (d) monitoring against targets of poverty outcomes. As NRLM follows a demand driven strategy, the States have the flexibility to develop their livelihoods-based perspective plans and annual action plans for poverty reduction. The activities to be supported under the NRLP intend to achieve the following key outcomes:

- Enhance effectiveness of public expenditure on NRLM
- Leverage resources for the poor
- Increase access to other government programs

Mahila Kisan Sashaktikaran Pariyojna (MKSP)

To improve the status of women in Agriculture, and to enhance the opportunities for her empowerment, Government of India has announced “Mahila Kisan Sashaktikaran Pariyojana” (MKSP), as a sub component of the National Rural Livelihood Mission (NRLM) which is also implemented by JSLPS.

The primary objective of the MKSP is to empower women in agriculture by making systematic investments to enhance their participation and productivity, as also create and sustain agriculture based livelihoods of rural women. By establishing efficient local resource based agriculture, wherein women in agriculture gain more control over the production resources and manage the support systems, the project seeks to enable them to gain better access to the inputs and services provided by the government and other agencies. Once the production capacities of women in agriculture improve, food security ensues for their families and communities. Specific objectives of MKSP are as following.

- To enhance the productive participation of women in agriculture;
- To create sustainable agricultural livelihood opportunities for women in agriculture;
- To improve the skills and capabilities of women in agriculture to support farm and non-farm-based activities;
- To ensure food and nutrition security at the household and the community level;
- To enable women to have better access to inputs and services of the government and other agencies;
- To enhance the managerial capacities of women in agriculture for better management of bio-diversity;
- To improve the capacities of women in agriculture to access the resources of other institutions and schemes within a convergence framework.

Sanjivani

Women in every household play a role of central pillar and it has been seen that improvement of status of women in family results in overall improvement of family. Women centred SHG movement is a tried and tested model for fighting against poverty. The State has developed cadre of trained and motivated rural women who have overcome poverty themselves and who are now able to can train other rural local women to be successful like them. With this vision Sanjivani

project is initiated by State government in 29 blocks of 13 Districts of Jharkhand under the banner of Jharkhand State Livelihood Promotion Society. The objectives of Snajeevani are as follows:

- In selected villages ensure universal coverage of families under SHG fold.
- Capacity Building of SHGs in the program villages with the help of Community Resource Person.
- To cover all SHG members under existing social security net.
- Supporting SHG to undertake livelihood activities of their choice to enhance their current income.

Adarsh Gram Yojna

Considering the potential of the state to grow and achieve the development indicators at par with any developed states, the Rural Development Department (RDD), Government of Jharkhand initiated a Model Village Project (Adarsh Gram Yojana) which aims at enhancing quality of life of rural households by adopting integrated development approach in collaboration all line departments of the State Government as well as partner agencies. To this end the RDD endeavors to prepare the village level perspective plans integrating all the sectors and subsectors which can contribute to the all round development of the villages in converting the villages as model village. The model village development plan will be initially initiated in few selected villages 100 villages to begin with as a pilot and as experience gained, it may be replicated in the entire state in phased manner.

The ultimate object of the Adarsh Gram Pariyojana is to ensure that each household will be able to earn a minimum of Rs. 60,000/- a year by availing them appropriate opportunities in education and skill development, infrastructural development, creating new job opportunities for youths, agriculture and horticulture, dairy, fisheries, non timber forest produce, non- farm based micro enterprise, promotion innovative and environment friendly livelihoods ,setting common facility centres, housing, water and sanitation, health and various other civic facilities, strengthening Gram Panchyats and other village level institutions, decentralization and devolution of power at grassroots.

State-level Support to Livelihood Strategies in Jharkhand

The project aimed to strengthen the State Government's capacity to effectively deliver livelihood schemes and programs by enhancing coordination between various government departments responsible for implementing national and state livelihood support programs. In addition the project also aimed to actively mobilize disadvantaged groups to generate greater awareness and access entitlements and economic opportunities. The project was implemented during 2009-2012. The Project Partners were Department of Rural Development, Government of Jharkhand, and JSLPS. Funding support was provided by the UNDP. Major achievements of the program are as follows:

- A drip irrigation prototype for individual small and marginal land holdings, demonstrated in five districts with more than 300 farmers, has now been up-scaled by the Rural Development Department across the state
- Prototypes are available for up-scaling to generate incremental income for disadvantaged communities engaged in non-timber forest production, lac and paddy cultivation
- Participatory micro plans have benefited 500 villages through identifying available

livelihood options

- Support to self-help groups in establishing and managing a poly nursery for growing improved varieties of vegetable seedlings has enabled women members to generate an additional revenue stream
- Housing plan developed for people living Below the Poverty Line
- A curriculum designed to train local village development committees to enable better utilization of Backward Region Grant Funds

Chapter II

Jharkhand Opportunities for Harnessing Rural Growth Project (JOHAR)

2.1. Background

Since 2012, the World Bank has been engaged with JSLPS through its support to the NRLM's National Rural Livelihoods Project (NRLP). NRLP has demonstrated that the institutions of the poor can function as efficient partners for livelihood enhancement interventions. The proposed JOHAR project will build upon this institutional platform, targeting a subset of households that are ready to move towards intensification, diversification and enhanced market orientation of production systems. The project will tap opportunities to influence the broader policy/enabling environment in the state to facilitate strategic shifts in the sector.

2.1. Project Development Objective

The Project Development Objective is 'to enhance and diversify household income in select farm and non-farm sectors for targeted beneficiaries in project areas'

2.3. Project Outreach

The JOHAR project is planned for implementation in 65 selected blocks spread across 17 districts (covered by JSLPS under the NRLP) in the state in three agro-climatic zones. The blocks in the state were ranked based on a set of criteria that take into consideration the existing production base, the potential for future growth, and the following factors: the presence of mature community institutions; intensity of production in selected sub-sectors (high value agriculture, fisheries, livestock, non-timber forest produce); proximity to markets; access to public infrastructure such as irrigation, water bodies and roads; presence of Community Professionals (CPs), etc.

2.4. Project Beneficiaries

The primary project beneficiaries are the rural households, including women and men from scheduled castes and scheduled tribes, smallholder and landless households in selected blocks of rural Jharkhand. The project will benefit about 2,00,000 households.

2.5. Project Approach

The proposed project builds on the existing organizational and social capital developed in NRLP districts focusing on both SHG and non-SHG households. This arrangement will be leveraged to develop producer groups and producer organizations in select sectoral clusters. The project will identify rural households that have actual and potential marketable surplus in developing the clusters in order to ensure marketability of produce. Inclusion of marginalized groups in cluster settings will be addressed through a variety of pathways that built into the project.

2.6. Project Indicators

The key result indicators for the project are following:

- Percent increase in average annual household income (real) of at least 60% of the

- targeted households
- Percent increase in the proportion of income (real) from select productive livelihoods sources
- Number of farmers reached with agricultural assets or services
Percent of female farmers
- Percent of project beneficiaries that belong to SC/ST categories.
Percent of female beneficiaries

2.7. Project Components

2.7.1. Component 1: Diversified and Resilient Production and Value Addition

This component will support collectives of small producers and interventions for diversification, intensification and value-addition in the selected sub-sectors of HVA, livestock, NTFP, fisheries and irrigation. The following are sub-components under this.

Sub-component 1.1 Rural Producer Collectives

The objective of this sub-component is to promote collectives of small producers with significant participation of women producers from SHGs. The key strategy adopted will be to build on the work of the existing NRLP where the mobilized households have developed first-level of assets/resources and are significant economic actors in specific sub-sectors/commodities. Close alignment with the institutional structure of SHGs, whose membership base is women from poor households, will ensure that the producer collectives are socially inclusive.

The key activities under the sub-component are: (a) Formation of PGs (about 3400) focusing on production, aggregation and first level of value addition in specific sub-sectors/commodities across HVA, livestock, fisheries and NTFP. (b) Formation of about 30 higher-level POs that will function as business enterprises engaged in aggregation, higher order value addition, branding and marketing. (c) Development of a cadre of community professionals (CPs) who will form and groom the PGs and POs, provide grassroots level extension services, facilitate linkages with markets and financial institutions, and assist in data management. The CPs include Ajeevika Krishi Mitra (AKM) for HVA, Ajeevika Pashu Sakhi (APS) for livestock, Ajeevika Matsya Mitra (AMM) for fisheries, Ajeevika Vanopaj Mitra (AVM) for NTFP, as well as PG facilitators and book-keepers. (d) Garnering financial support in the form of startup capital to PGs and POs, and part-financing of the PO business plan to supplement funding mobilized through convergence or from formal financial institutions (FFIs). (e) Technical support to JSLPS on promotion and strengthening of PGs and POs through a Technical Support Agency (TSA). Capacity building of CPs is described under Component 2. A large number of women from SHGs will be mobilized under this sub-component as members and leaders of the PGs and POs, and as CPs. Through ongoing and new partnerships with resource agencies on implementing more engendered production and agribusiness models, the project will focus on providing greater visibility and formal recognition to women producers.

Sub-component 1.2 High-Value Agriculture Development

The objective of this sub-component is to promote the adoption of market-led HVA systems by the targeted households. HVA will mainly focus on year-round cultivation of vegetables in the midland. In addition, to help provide better food security to households, it will also demonstrate technologies for improving productivity and reducing climate risk in paddy. In the uplands it will demonstrate new high-yielding varieties of pulses, oilseeds and millets. Thus, in combination, while vegetable cultivation will provide a quantum jump in income, other measures will enhance food security and help reduce risk by diversifying the cropping portfolio. Also, innovations piloted under the Bank supported Sustainable Livelihoods and Adaptation to Climate Change (SLACC) project, such as community based soil testing, increasing organic content of soils, ICT-based crop extension and weather forecasting will be scaled up through this sub-component.

The key activities under this sub-component are: (a) Facilitation of participatory HVA crop selection by farmers through training on utilization of multiple information inputs (including market information, feedback from crop trials, nutrition and food security status, etc.) in selecting HVA crops. Crops chosen would help households earn an income of Rs 25,000–100,000 and bring at least 0.3 acres of land under HVA (examples include tomato, chilli, capsicum, watermelon, cucurbits, cole crops). Most households will be able to set aside this parcel of land as the average landholding is about 1.17 ha. (b) Facilitation of community-based planning such that each PG will undertake coordinated cultivation of 1–2 crops in a season and achieve sufficient production volume for effective technology transfer and efficient input–output marketing. A one-time grant support limited to 30 percent of the cost of inputs for HVA crop cultivation will be provided to the producers through PGs. (c) Training of farmers through CPs (AKMs and senior AKMs) on aspects including production of high quality planting materials through nurseries, soil-testing based crop fertilizer management, pest surveillance, integrated pest management, etc. In addition to training, handholding will be provided through information and communications technology (ICT)-based on time crop advisory services for selected HVA crops to the CPs/PGs/POs through smart phones. The ICT-based crop advisory service will also provide information to POs on crop status that can help in planning for marketing. (d) Establishment of village resource centers that will provide need-based services/products such as nurseries to produce quality planting material, soil testing laboratories, agri machinery hiring centers, etc. (e) Establishment of cluster service centers to enable value addition through facilities for cleaning, sorting, grading, packing, cooling, drying and storage facilities as per the crop requirement and market demand. (f) Partnerships with technical service providers (such as World Vegetable Center, Professional Assistance for Development Action (PRADAN), Transforming Rural India Foundation (TRIF), Mobile Agriculture School and Services (MAAS)) to develop standardized package of practices for chosen HVA crops, deliver training and provide ICT-based crop advisory services. Convergence with existing GoJ programs is envisaged for several activities in this sub-component including establishment of soil testing labs, nurseries, vermicompost units, agri-machinery banks, sorting & grading facilities, solar drying units, etc.

Sub-component 1.3 Livestock Development

The objective of this sub-component is to support the targeted households in asset creation, productivity enhancement and market access of selected livestock (broilers, layers, pigs, goats and dual purpose backyard poultry). Given the major role of women, especially from marginal

and landless households, in the small ruminant sector, this component will have a large number of women as beneficiaries as well as CPs.

The key activities are: (a) Establishment of breeding villages for pig and goat rearing including support for procurement of breeding stock and village sanitization. (b) Introduction of improved breeds through support for procurement of high quality boars, bucks, pullets, chicks, etc., from private sector enterprises and breeding villages. (c) Provision of working capital to PGs to meet health care and feed cost for one production cycle. (d) Support for establishment of composite feed mills. (e) Support for construction of scientific housing for livestock. (f) Support for vaccination programs for disease prevention. (g) Capacity building on productivity enhancement (improved breeding, health, feeding, housing and management) that will include skill training of producers as well as other need-based training through Farmer Field Schools and exposure visits. Continued extension support will be provided to producers through CPs (Pashu Sakhis). Services of TSAs will be hired to provide capacity building support. (h) Support for partnerships would be contracted with key NGOs and private sector agencies (for example, PRADAN, Jharkhand Womens' Poultry Self-Supporting Cooperative Federation, Heifer International, Tata Trusts, Kegg Farms) to implement the activities for specific sub-sectors. The Global Alliance for Livestock Veterinary Medicines (GALVmed) would be contracted to support supply chain management for vaccines and training Pashu Sakhis in maintaining records. Support through convergence with existing GoJ programs is envisaged for several activities in this sub-component including housing for livestock, introduction of improved breed animals, establishment of feed plants, etc.

Sub-component 1.4 Fishery Development

The objective of this sub-component is to enhance fish production and marketing by the targeted households. The sub-component will focus on farm pond production, fry production and reservoir/cage production.

The key activities to be supported are: (a) Demonstrations/pilots on improved technologies including short production cycle models involving fast growing fish varieties, cage culture of *Pangasius* in reservoirs, improved stocking, intensification of fish seed production in small ponds, improved fish culture in farm ponds/Dobhas, introduction of formulated fish feeds that use locally available ingredients, promotion of appropriate innovative technologies (e.g. lining in Dobhas), etc. (b) Financial support through grants to SHGs for on-ward lending to PGs for fisheries, as well as through direct grants to PGs for pond improvement and procuring basic equipment. (c) Training of fish farmers in PGs, SHGs and their federations through the Directorate of Fisheries of the GoJ, extension support institutions (Krishi Vignana Kendras) as well as NGOs with expertise in this area. Exposure visits will be organized to facilitate learning from best practitioners within and outside the state. (d) Establishment of technical advisory centers at the district level to cater to the needs of small fish farmers. (e) Augmentation of state hatchery infrastructure. (f) Studies on governance and policy reforms including leasing of water bodies for fisheries, aquaculture insurance, information management to support stocking programs and subsidy schemes. (g) Development and deployment of mobile applications that will enable Global Positioning System (GPS) tagging of production ponds, geographic information system (GIS)-based analysis, disseminate technical advice on production, record production, relay market information, etc. Convergence support is foreseen for several activities

in this sub-component including training, provision of aquaculture equipment, hatchery development, fish production, etc.

Sub-component 1.5 Non-Timber Forest Produce Development

The objective of this sub-component is to supplement household earnings through enhanced value addition of NTFPs for the targeted households, especially the particularly vulnerable tribal groups (PVTGs). NTFPs can be gathered from natural forests or in some cases (lac for example) through cultivation. For most NTFPs, production is viewed as a supplementary livelihood activity and therefore, the sub-component will focus on blocks with high potential for NTFP production as well as other primary income sources such as HVA and livestock. The NTFPs selected for the intervention are: lac production on semialata, ber and kusum trees; tamarind fruit; moringa leaves; lemon grass; chironji fruit; tulsi leaves; and honey. The sub-component will also explore potential value-addition of select NTFP through creation of artisanal crafts (for example, bamboo craft, lac jewelry, etc.).

The key activities under the sub-component are: (a) Analytical studies on value chains of selected NTFPs. (b) Investments to: improve timely supply of quality seed material for the selected NTFPs (brood lac, semialata saplings, etc.), provide necessary inputs to farmers (equipment, cultivation cost, etc.), and develop supportive products or services such as manufacture of apiary boxes. (c) Establish primary and advanced processing units at the cluster level for value addition. (d) Establish a state level center of excellence for research and development and quality control. (e) Training and exposure visits for producers on scientific production/collection, post-harvest management, processing and marketing. (f) innovative pilot interventions such as on artisanal products. Convergence with existing GoJ programs is foreseen for activities including input supply, establishment of processing units and support services.

Sub-component 1.6 Irrigation System Development

The objective of this sub-component is to provide improved access to water through development of irrigation structures and introduction of water management practices. This will be provided to the targeted households practicing HVA cropping system through a community-based approach. The new irrigation structures would include construction of farm ponds, lift irrigation schemes, and shallow wells. Water management practices would focus on piped distribution system, micro-irrigation schemes (drip irrigation kits, sprinkler irrigation system) and mulching, etc. These irrigations would be critical and life saving during Kharif and Rabi season for HVA.

Given the smallholdings of farmers and their relative inability to make large investments individually, the project will support micro-irrigation schemes that are community owned, operated and maintained.

The activities supported under the sub-component are: (a) Preparation of irrigation plans through a TSP who will carry out site survey, design and plan preparation. The plan will include details of existing water sources, proposed structures for development including lifting devices, distribution systems, command area and irrigation schedule. It will also provide detailed specifications of materials, their costs and an implementation schedule. (b) Creation of the micro-irrigation infrastructure that will involve: gravity-based diversion of hill streams to lower

areas; solar-, electric- and diesel-based lifting devices with GPRS-enabled starter connected to a mobile application that will help track usage of micro-irrigation sub-projects; distribution systems that enable operation of drip irrigation systems; small irrigation pump sets for use with farm ponds, wells, etc. (c) Demonstration of low-cost drip irrigation, alternate row flooding, etc., to reduce water usage. (d) Formation of water user groups under the technical supervision of the TSP with membership of all HVA farmers in the command area for participating in planning, development, operation and maintenance of the micro-irrigation infrastructure. The user group members will pay user charges to cover costs of operation and maintenance. The micro-irrigation infrastructure will be part-financed through convergence with existing schemes of the GoJ that support seepage tanks, solar powered pumps, drip irrigation, etc.

2.7.2. Component 2: Promoting Market Access, Skill Development and Pro-poor Finance

This component will involve support for promoting market access and private sector participation, fostering skill development relevant to the focus value chains, and, facilitating the development of pro-poor agricultural finance systems.

Sub-component 2.1 Market Access and Private Sector Participation

The objective of this sub-component is to strengthen forward and backward market linkages for rural producers in the HVA, livestock, fisheries and NTFP sectors.

In order to achieve the objective, the project will support the following activities: (a) Market intelligence and information: Product-based market assessment studies will be supported, that will identify opportunities to increase participation in value chains, identify constraints to market access and information, and provide a better understanding of market prices, volumes and channels. The studies will also cover the role and contribution of women across the value chains, and provide better understanding of the constraints and opportunities for strengthening women's participation in selected commodities. A technology-based market information platform will be supported for providing producers with real-time market price information to facilitate informed market decisions, transparency and reduce the role of intermediaries. The platform will equip the women producers with the tools to engage and negotiate with the local and regional markets more profitably. Training will be provided to subscribers to enable full adoption of this technology. (b) Forward market linkages: Partnerships will be built with selected agencies for turnkey projects on scaling up existing models that successfully link markets with producers through various market-led strategies. Senior AKMs will be capacitated to function at the cluster level as market champions to match market information with local capabilities to effectively promote linkages of PGs and POs with the markets. (c) Business Development Cell (BDC) of public-private-community partnerships (PPCPs) will be established in JSLPS and will facilitate partnerships with private sector companies, industry associations, government departments, etc. on forward and backward value-chain linkages across the various sub-sectors. The BDC will identify opportunities for investment based on up-to-date cluster and district-level information. The Cell will also support innovation and entrepreneurship through provision of technical and incubation support to emerging entrepreneurs and micro-enterprises. The assistance will cover establishment of linkages with financial institutions, e-marketing platforms and private companies (for back-end operations, extension services, processing facilities, marketing, etc.).

Sub-component 2.2 Skill Development in Focus Value Chains

The objective of this sub-component is to upgrade skills of individual entrepreneurs, CPs and service providers in agriculture and allied sectors in order to build their capacity for entrepreneurship and for training/technical service delivery to producers.

The specific activities financed will include: (a) participatory technical evaluations of focus value chains across HVA, livestock, fisheries and NTFP sub-sectors to identify skill gaps and opportunities for skills up-gradation; (b) hiring technical partner organizations and resource people to develop curricula for training to address these gaps; (c) developing training delivery systems (including pre- and post-training services) through partnerships with support organizations and developing a pool of master trainers within the state; (d) holding training programs for community professionals including AKM for HVA, para-vets and APS for livestock, AMM for fisheries, AVM for NTFP, and micro-enterprise consultants (MEC) for entrepreneurship; (e) provision of training programs for service providers including soil sample collectors, soil testing analysts, nursery entrepreneurs and assistants, irrigation operators and repairers, agriculture machinery operators and repairers, hatchery entrepreneurs and workers, feed plant operators, etc.; (f) holding training for entrepreneurs; (g) liaising with the National Skills Development Corporation and the relevant Sector Skills Council for accreditation of training providers and certification of trainees; (h) establishing an innovation marketplace program that will help to identify promising innovations in the agriculture and allied sectors that can be supported for scaling up into enterprises through the BDC described under sub-component 2.1.

Sub-component 2.3 Pro-poor Agricultural Finance Systems

The objective of this sub-component is to support producer collectives (PGs and POs) and their enterprises in accessing financial services, especially credit and insurance, to support production and resilience. In doing so the sub-component will reduce the gender gap in access to credit. The project shall follow three major pathways for channelizing credit: (a) credit from VOs/FFIs to the SHGs, and/or, from FFIs to Joint Liability Groups (b) partnerships with FFIs for credit targeted at individual producers (c) credit from FFIs for POs by leveraging their equity capital base.

The sub-component will work on both the demand side and supply side for enabling effective and sustainable linkages between providers and users of financial services. The major activities proposed on the demand side are: (i) needs assessment; (ii) customer segmentation; and (iii) financial education of the producers covered by the project. The major activities proposed on the supply side are: (a) landscape mapping; (b) risk profiling; (c) technical assistance to build capacities and enable partnerships with formal financial institutions; (d) demand-driven design of credit and insurance products; and (e) financial services delivery. This sub-component shall be steered by a Financial Inclusion and Mainstreaming team in the Project Management Unit (PMU). The team will be responsible for expanding access to financial services through multiple pathways outlined above and supporting risk management on both the supply side and demand side through measures such as financial education; coverage of individual producers under credit bureau; and effective management of data related to financial services to individual producers covered under the project.

2.7.3. Component 3: Project and Knowledge Management

The objective of this component is to establish effective project management and facilitate strong knowledge management. The project will support the following activities: (a) Project management: This sub-component will support project coordination, implementation, financial management, environmental and social safeguards management, and monitoring at the state and district levels. It will include establishment of state- and district-level PMUs in JSLPS, staff and consultant expenses, procurement of resource/support agencies and service providers, office infrastructure, logistics support, management information system (MIS), GIS, ICT-mediated citizen engagement systems, and other operational expenses. Project monitoring, learning and evaluation systems will be supported through this sub-component. The sub-component will also invest in capacity building of human resources in the JSLPS. (b) Knowledge management: This sub-component will support research and innovation by national and state institutions, agriculture universities, NGOs, etc. to bridge key knowledge and technology gaps. Knowledge products in the form of policy papers and experience sharing seminars will be organized. An ‘innovation fund’ will also be ear-marked to support exploration and piloting of innovations in production, technology and marketing systems, social inclusion approaches, etc.

2.8. Applicability of Environmental Safeguards

The interventions under different project components and the environmental implications are listed in the table below:

Table 1: Component wise interventions and Environmental Implications

Components	Interventions/Activities	Environmental Implications
Diversified and Resilient Production <i>Sub Component – Rural Producer Collectives</i>	<ul style="list-style-type: none"> • Promotion and capacity building of Producer Groups and Farmer Producer Organizations • Developing a cadre of Community Professionals 	<ul style="list-style-type: none"> • PGs and POs are required to follow certain norms while procuring the inputs and during crop cultivation • Community professionals need to be trained on integrating environmental aspects
<i>Sub Component – High Value Agriculture Development</i>	<ul style="list-style-type: none"> • Promotion of HVA Crops • Capacity Building on Production technologies • Establishment of Village Resource Centres • Establishment of Cluster Service Centres • Partnerships with Technical Service Providers 	<ul style="list-style-type: none"> • Need for promotion of climate tolerant and pest resistant varieties. • Integration of safeguards into capacity building programs • Scope for integration of environment guidelines and environment friendly features into cluster service centres

<p><i>Sub Component – Livestock Development</i></p>	<ul style="list-style-type: none"> • Establishment of Breeding villages • Introduction of improved breeds • Provision of working capital for PGs • Support for establishment of composite feed mills • Support for scientific housing • Vaccination • Capacity building on productivity enhancement • Support for partnerships 	<ul style="list-style-type: none"> • Promotion of good indigenous breeds, care to separate with other herds • Efficient resource management is needed in case of improved breeds • Compliance requirements for establishment of feed mills. • Need for integration of fodder, water and manure management aspects
<p><i>Sub Component – Fishery Development</i></p>	<ul style="list-style-type: none"> • Demonstration and pilots on improved technologies • Financial support for inputs and pond improvement • Capacity Building/training • Establishing Technical Advisory Centres at district level • Augmentation of state hatchery infrastructure • Studies • Mobile applications 	<ul style="list-style-type: none"> • Scope for integration of environmental best practices and promotion of native fish species with good market demand. • Introduction of new species may have a negative impact on local fish diversity. • Increased use of chemical inputs for production enhancement leading to water quality deterioration
<p><i>Sub Component – Non Timber Forest Produce Development</i></p>	<ul style="list-style-type: none"> • Value Chain analysis of selected NTFPs • Supply of quality seed material • Primary advanced processing units • Centre of excellence establishment • Training and exposure visits 	<ul style="list-style-type: none"> • Need for promotion of sustainable harvesting methods and regeneration. • Compliance requirements for processing units.
<p><i>Sub Component – Irrigation System Development</i></p>	<ul style="list-style-type: none"> • Development of Micro – Irrigation Plans • Creation of Micro-irrigation Infrastructure 	<ul style="list-style-type: none"> • Disturbance to the local environment due to creation of irrigation infrastructure • Improved irrigation is likely to trigger increase in chemical

	<ul style="list-style-type: none"> • Demonstration of Low-cost Drip Irrigation and other efficient methods • Formation of Water User Groups 	<p>inputs</p> <ul style="list-style-type: none"> • Wastage of water if not planned properly, or if flood method of irrigation is followed.
<p>Promoting Market Access, Skill Development and Pro-poor Finance <i>Sub Component - Market Access and Private Sector Participation</i></p> <p><i>Sub Component - Skill Development and Entrepreneurship in Focus Value Chains</i></p> <p><i>Sub Component - Pro-poor Agricultural Finance Systems</i></p>	<ul style="list-style-type: none"> • Market Intelligence and Information • Forward market linkages • Business Development Cell • Evaluation of value chains for skill up gradation • Technical partnerships for curricula development and delivery system • Trainings for CPs, service providers and entrepreneurs • Innovation market place • Landscape mapping • Risk profiling • Technical assistance to build capacities and enable partnerships with formal financial institutions; • Demand-driven design of credit and insurance products; • Financial services delivery. 	
Project Management Support	<ul style="list-style-type: none"> • Project Management • Knowledge Management 	<ul style="list-style-type: none"> • Implementation arrangements for safeguards

2.9. Environmental Assessment and Environmental Management Framework (EMF)

Based on the environmental implications, the project is classified as Category ‘B’ and the environmental safeguard policies on Environmental Assessment (OP 4.01) and Pest Management

(OP 4.09) are triggered. JSLPS has undertaken an Environmental Assessment (EA) study and developed an Environment Management Framework (EMF) and a Pest Management Plan (PMP) to guide the project teams on integrating environment management into the project interventions.

The purpose of EMF is to ensure that the project interventions are environmentally sustainable and are in compliance with applicable laws and regulations and policies of the Government of India, the Government of Jharkhand and triggered safeguard policies of the World Bank.

The EA, EMF report discusses the following:

- Overview of the objectives and components of JOHAR and environmental implications
- Overview of environmental baseline of the state (with specific reference to project area) with respect to project interventions
- Legal and regulatory framework that is applicable to the project activities
- Key environmental risks and mitigation/environmental guidelines
- Environmental Appraisal of crop plans, micro irrigation plans and agri business plans
- Environment Management Framework (EMF) for the project – key procedures, implementation arrangements, budget etc.
- Pest Management Plan

The relevant details under each chapter are attached as Annexures.

Chapter III

Environmental Baseline

3.1. Profile of the State

The State of Jharkhand constitutes 2.42 percent of the geographical area of the country. The state has varying relief because of its physiography comprising of four series of plateaus of different heights. The highest plateau lies in the west known as Western or Higher Ranchi Plateau or locally known as the Pat region located at 2500 to 3600 feet above sea level covering northern part of the old Ranchi district and the southern edge of the old Palamu district. The second plateau is known as Ranchi Plateau having a height of 2000 feet composed of gneisses and granites. It is separated by the Damodar trough from the Hazaribagh Plateau. The next plateau is Lower Chotanagpur Plateau consisting mainly of gneisses and granite and partly of schists and other Dharwar rocks. The other plateaus are the Rajmahal Hills and the Kaimur Plateau.

In the state, there exist wide variations in respect of natural resources base include rainfall and temperature conditions that determine the agricultural operations and productivity of different crops. In view of these variations, agro-climatic zones are the base of EIA study.

3.2. Agro-Climatic Regions of the State

The state is divided into the following three agro-climatic regions.

i) Central North-eastern Plateau: The region constitutes around 37 per cent of the total geographical area. It is urbanized and the most densely populated part of Jharkhand. The percentage of urban to total population is around 45 and the density of population is 433 persons per sq. km.

ii) Western Plateau: The region constitutes around 40 per cent of the total geographical area. It is the least urbanized and the least densely populated part of Jharkhand. The percentage of total population is around 35 and the density of population is 246 persons per sq. km.

iii) South-eastern Plateau: The region constitutes around 17 per cent of the total geographical area. It is the most urbanized part of Jharkhand but the density of population is much less than in the Central North-eastern Plateau. The percentage of total population is around 20 and the density of population is 299 persons per sq. km.

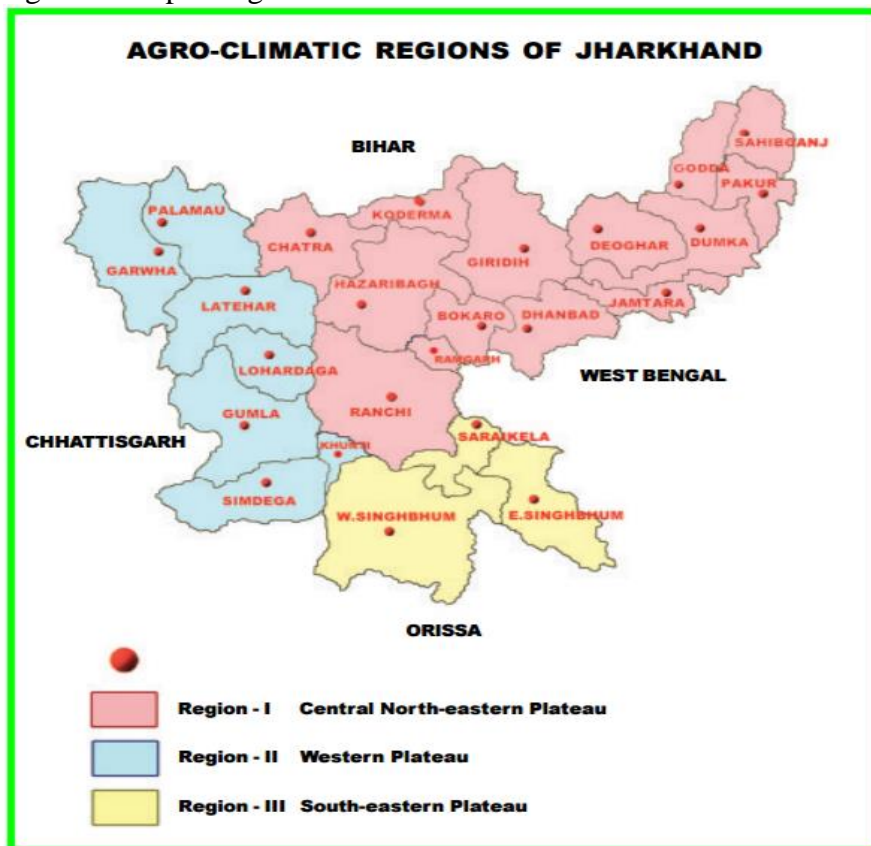
The salient features of the districts in different Agro-Climatic regions are presented below:

Table 2: Features of Agro-climatic zones of Jharkhand (project area)

Agro Climatic Zones	Districts Covered	Annual Average Rainfall (mm)	Proportion of				Main Features
			Geographical Area	Cropped Area	Net Area Sown	Irrigated Area	
Region-I Central North-eastern	Dumka, Pakur, Giridih, Bokaro, Dhanbad, Hazaribagh,	1320.0	37	40.63	27	53	Erratic and uneven distribution of average rainfall. Coarse textured soils.

Plateau	Chatra, Ramgarh and part of Ranchi						Crust formation on the soil surface. Low water retention capacity of the soils.
Region-II Western Plateau	Palamu, Garhwa, Lohardaga, Gumla, Latehar, Khunti, Simdega & part of Ranchi	1246.0	40	35.64	48	42	Erratic and uneven distribution of rainfall. Low water retention Capacity of the soils.
Region-III South-eastern Plateau	East Singhbhum, Saraikella Kharsawa and West Singhbhum	1400.0	23	23.73	25	5	Uneven distribution of rainfall. Low water holding capacity, eroded soils. Shallow soil depth. Poor soil fertility.

Figure 1: Map of Agro-climatic Zones in Jharkhand State



(Source: Agricultural Technology Modules for Jharkhand, Birsa Agriculture University, Ranchi and ICAR, Kolkata)

Almost all the regions of the state are characterized by erratic rainfall, low water retentive capacity of the soils. The project interventions will address the issues through water conservation measures and soil nutrient management as part of HVA and irrigation interventions.

3.3. Climate and Rainfall

The state falls under tropical monsoon climatic region.

Rainfall:

Out of 13 districts in region I, district Pakur receives the highest rainfall of 1730 mm followed by Ranchi (1388.6 mm). The districts like Giridih, Koderma, Bokaro and Hazaribag receive less than 1300 mm rainfall and are prone to prolonged dry spells in July/August compared to other districts of this region, even in good rainfall years.

In Region-II, districts like Latehar, Gumla and Simdega receive fairly good amount of rainfall in normal monsoon years. However, in aberrant monsoon years this region becomes rain shadow area and dry spells of longer duration (more than 20 days) affect the cropping systems very adversely, particularly in Palamu district.

The South-eastern part of the state (Region-III) districts also receive good amount of annual rainfall and its distribution over the months is in the similar pattern.

Water harvesting and efficient use of irrigation water will be given priority as part of agricultural interventions

3.4. Forest coverage

The state has 28.5% of its area under forest. The district forest coverage in project districts is as follows:

Table 3: District wise Forest Coverage in Jharkhand (project districts)

District	Geographical Area	Forest Coverage		
		Very Dense	Moderately Dense	Open Forest
Bokaro	1929	61	231	273
Chatra	3732	250	869	662
Dhanbad	2996	0	14	190
Dumka	6112	0	277	383
Garhwa	4092	124	409	859
Giridih	4963	76	337	465
Gumla	9077	323	921	1472
Hazaribagh	5998	271	632	1190
Lohardaga	1491	173	217	109

Pakur	1571	3	173	111
Palamu	8657	533	1824	1237
Pashchimi Singhbhum	9907	483	1558	1871
Purbi Singhbum	3533	52	589	429
Ranchi	7698	138	172	1226
Total	71756	2487	8223	10477

(Source IFSR, 2015)

The important tree species in different agro climatic zones is listed in the table below:

Table 4: Status of Forest resources in the State

Agro-climatic Zones	Density of Trees Per Hectare	Per-Hectare Average Volume (Cubic Metre)	Status of Major tree Species		Classification of Major Vegetation			
			Density Per hectare	Average Volume (Cubic Metre)	Timber, Fuel and Fodder	Fruit	Medicinal Herbs	Other Livelihood purpose
Zone-I	401	20.72	224	11.66	Sal, Aasan, Dhotha, Mahua, Sidha, Karam, Akleshia, Chukundi, Shisham, Kusum Ber, Arjun, Gamhar,	Piyar, Bhelwa, Kaju, Mahua, Mango	Harar Baheda, Palas, Padan,	Simbal, Bamboo, kusum, Kendu
Zone-II	462	44.27	259	17.37				
Zone-III	232	26.02	100	10.41				

(Source: Compiled from the <http://forest.jharkhand.gov.in/Management/frs.aspx>)

Table 5: National Parks and Wild Life Sanctuaries in the project districts

Sl. No.	Name of the Wild Life Sanctuary (WLS)/National Park (NP)	Area (Sq km)	District	Legal status
1	Betla National Park	231.67	Palamu	NP
2	Palamau Sanctuary	794.33	Palamu	WLS
3	Lawalong Sanctuary	207.00	Chatra	WLS

4	Dalma Sanctuary	193.22	East Singhbhum	WLS
5	Hazaribagh Sanctuary	186.25	Hazaribagh	WLS
6	Palkot Sanctuary	183.18	Gumla	WLS
7	Mahuaradanr Wolf Sanctuary	63.25	Palamau	WLS
8	Parasnath Sanctuary	49.33	Giridih	WLS
9	Topchanchi Sanctuary	8.75	Dhanbad	WLS

Activities related to NTFP collection are limited under the project (as the interventions are largely to do with cultivation of lac, lemon grass etc.); in cases where there is collection it will not include collection from NP and WLSs. The project will plan for capacity building the community on sustainable harvesting and regeneration methods. Similarly grazing of small ruminants will not be encouraged near NPs and WLSs. All necessary permissions will be taken from the Forest Department wherever needed.

3.5. Land Use Pattern

The land use pattern in the state is as follows:

Table 6: Zone-wise Land Use Pattern in JOHAR Project Area

Zone District	Total reporting area (ha.)	Area under different uses					Cropping intensity
		Forest (%)	Area Not Available for Agri (%)	Pasture and Other Uncultivated land (%)	Fallow land (%)	Net area Sown (%)	
Bokaro	288992	25.67	24.66	7.20	30.92	11.55	111
Chatra	382050	56.78	7.59	1.84	30.63	3.17	142
Dhanbad	204161	9.27	39.02	6.86	37.87	6.98	104
Dumka	377523	12.95	15.33	12.32	42.14	17.27	132
Giridih	493248	32.14	14.42	9.00	32.84	11.60	168
Hazaribagh	431315	47.22	10.24	3.78	27.61	11.14	103
Pakur	180557	8.13	15.32	12.05	47.91	16.59	117
Ramgarh	139998	30.20	22.08	3.55	38.03	6.14	182
Ranchi	497306	20.02	13.98	5.04	36.39	24.56	118
Zone I	2995150	29.30	16.07	6.71	34.87	13.05	127
Garhwa	428826	29.30	16.07	6.71	34.87	13.05	150
Gumla	534318	25.33	11.26	6.54	33.97	22.90	105
Khunti	261088	17.44	14.50	5.60	36.44	26.02	126
Latehar	383490	50.85	9.68	4.69	20.73	14.04	106
Lohardaga	153621	28.87	12.91	6.14	25.74	26.34	131
Palamu	460431	36.88	12.69	2.50	24.52	23.41	113
Simdega	379434	27.32	11.84	9.91	27.10	23.83	103
Zone II	2601208	34.02	11.92	5.46	27.95	20.65	115

E Singbhum	556697	22.43	33.31	8.59	21.88	13.80	104
Saraikela	237231	27.39	16.03	7.55	18.39	30.64	103
W Singhbhum	567769	25.07	17.82	8.14	28.96	20.02	125
Zone III	2607719	24.39	23.84	8.22	24.22	19.32	113

(Source: <http://aps.dac.gov.in/LUS/Public/Reports.aspx>)

The key observations from land use pattern are:

- Fallow land: Across the zones, there is considerable proportion of fallow land i.e. about 30 percent (about 35, 28 and 24 percent in case of zones I, II and II respectively). In certain districts the proportion of fallow land is considerably higher that ranges from one-fifth to one-third across the districts and zones that need due attention.
- Area Not Available for Cultivation: Overall, about 16 percent of the total reporting area is categorized as area not available for cultivation. Across the zones, almost similar proportion can be noticed with slight difference.
- Permanent Pastures and Other Uncultivated land: This category of land includes land under miscellaneous tree and culturable waste land that can be used for animal grazing as well. This is one of the most important categories of land use. The availability of permanent pasture and grazing land determines the status of livestock economy in the regions. It constituted about 6 percent of the reporting area in project area.

Degradation of Land Resources

The present section deals with the status of land degradation in the JOHAR project area. There are five of categories of land degradation in the state such as sheet erosion, gully erosion, ravines, mining surface and stone waste. The major causes of the degradation are overgrazing, over-cultivation, water logging, deforestation and pollution and industrial cause. The analysis shows that about 19 percent area in the project area is degraded.

Table 7: Degradation of Land Resources in the state

Particulars	Region-I (Central Northern- Eastern Plateau)	Region-II (Western Plateau)	Region-III (South- eastern Plateau)	Overall
Categories of Land Degradation	Proportion of Degradation of Land			
Sheet Erosion	87.42	60.71	88.58	81.71
Gully Erosion	10.13	27.01	6.38	13.62
Ravines	0.57	0.75	0.14	0.59
Mining Surface	0.90	0.70	0.75	0.85
Barren Rocky/ Stony Waste	0.98	10.83	4.16	3.22
Total Area Degraded (Ha.)	807253	233138	42037	1082428
Total Geographical (Ha.)	2110413	2290254	1361697	5762364

Proportion of Degraded (%)	38.25	10.18	3.09	18.78
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(Source: Compiled from JSLPS document on Land Degradation)

In districts where the HVA and livestock activities are promoted, it is important to integrate soil conservation measures as part of crop and livestock management practices.

3.6. Agriculture

Cropping Pattern:

Agriculture is largely rainfed in Jharkhand state. Rice crop occupies the prime portion in the cropping pattern with a share of about 68% in total cropped area. It may be because of the favourable environmental condition that suit to such crop. About 14% of the land is under vegetable and fruit cultivation, followed by maize and wheat which is about 8%. Remaining crops like millets, pulses and oil seeds are grown in limited proportion of land.

Table 8: Agro-climatic zone wise Cropping Pattern in Project districts

Zone/ District	Proportionate Distribution of Area Under Different Crops (%)									Total Cropped Area (Ha.)
	Rice	Millet	Maize	Ragi	Wheat	Gram	Thur	Fruit & Vegetables	Oil seeds	
Bokaro	76.81	0.29	6.16	0.31	0.94	0.04	0.15	14.59	0.70	37083
Chatra	65.01	0.88	8.90	1.05	3.92	1.15	4.29	8.91	5.89	17225
Dhanbad	85.08	0	2.35	1.40	1.70	0	0.36	8.51	0.24	14864
Dumka	74.30	0.03	10.41	0.01	3.32	0.80	0.71	8.63	1.79	86274
Giridih	83.14	0.08	0.39	1.44	3.39	0.49	0.09	10.58	0.40	95872
Hazaribagh	53.71	0.01	9.00	1.48	6.89	2.00	0.83	22.76	3.32	49634
Pakur	77.54	0.77	4.24	0.00	4.02	1.51	0.76	8.46	2.71	34966
Ramgarh	46.97	0.00	6.67	0.29	6.20	10.10	0.95	28.22	0.60	15671
Ranchi	73.98	0.01	1.76	2.53	1.63	0.34	0.78	17.62	1.36	143669
Zone I	72.63	0.17	4.48	1.16	3.54	1.41	0.60	14.14	1.87	507600
Garhwa	23.90	0.40	14.63	1.35	16.05	1.08	24.71	5.85	11.93	81336
Gumla	65.60	0.29	1.54	5.09	0.65	0.29	0.64	20.20	5.70	127923
Khunti	73.64	0.25	0.61	3.81	0.48	0.28	0.71	16.67	3.55	85327
Latehar	37.11	0.16	19.62	0.63	2.92	2.08	3.19	24.91	9.37	56897
Lohardaga	53.34	0.00	6.01	1.87	4.47	0.68	1.16	29.65	2.82	53047
Palamu	14.69	0.11	10.19	0.19	11.71	7.87	21.48	16.94	16.83	122044
Simdega	79.75	1.30	0.62	2.58	1.58	1.16	6.20	5.48	1.33	92948
Zone II	48.09	0.18	6.58	2.55	4.39	2.64	6.75	20.36	8.46	445238
E Singhbhum	94.15	0.01	0.58	0.00	0.53	0.12	0.07	4.36	0.19	79722
Saraikela	91.62	0.00	0.78	0.00	0.50	0.78	0.12	5.53	0.69	74665
WSinghbhum	87.65	0.26	1.23	0.28	0.52	0.68	0.45	6.35	2.58	141849
Zone III	90.40	0.13	0.94	0.13	0.52	0.55	0.26	5.61	1.46	296236
Overall	68.10	0.16	4.39	1.41	3.13	1.64	2.71	14.33	4.12	1249074

(Source: <http://aps.dac.gov.in/LUS/Public/Reports.aspx>)

As the cropping pattern is dominated by paddy, the crop diversification will consider the less water intensive crops (or efficient irrigation methods), keeping in view the soil characteristics and nutrient status. Crop rotation with pulse crops should be promoted to the extent possible.

Crop Productivity:

An attempt has been made to understand the productivity of certain crops across the agro-climatic zones. The analysis shows that there are variations in agricultural production across the regions. In the region (Central Northern-Eastern Plateau), there substantial proportion of land in term of total geographical area, land put to use for agriculture production. But it is lagging behind in meeting the desire level of production as well as per hectare productivity of agricultural output.

Table 9: Zone wise Cropping and Productivity

Particulars	Region-I (Central Northern-Eastern Plateau)		Region-II (Western Plateau)		Region-III (South-eastern Plateau)	
	Area (000 ha.)	Productivity (Qtls/ha.)	Area (000 ha.)	Productivity (Qtls/ha.)	Area (000 ha.)	Productivity (Qtls/ha.)
Rice	836	11.28	328	6.9	330	4.5
Ragi	43.7	7.66	0	0	1.0	3.6
Maize	117	13.11	41.6	8.0	6.7	8.1
Wheat	92	16.00	14.0	6.5	1.9	6.6
Gram	8.6	11.41	17.0	7.5	0.6	7.4

(Source: http://www.sameti.org/default1_1sprof.htm)

The productivity enhancement interventions in the areas with low productivity would follow sustainable agricultural practices.

3.7. Water Resources

Present Scenario of water resource in Jharkhand shows that both surface and ground water play crucial role. The state is also considered as water endowed state keeping in view the average rainfall conditions.

Groundwater Scenario

The availability of groundwater in the state is substantial against the demand for water. The groundwater development status is well under control in the state. In overall, it is about 28 percent and it varies from about from about 14 percent in zone III to 31 percent in zone I.

Table 10: Status of Groundwater Resources in the JOHAR Project Districts (Ham)

Districts	Natural Recharge	Natural Discharge During Monsoon	Net Groundwater Availability	Annual Ground Water Draft			Allocation for Domestic & Industrial Uses	Net Water Availability for future Use	Stages of Groundwater Development %
				Irrigation	Domestic	Total			
Bokaro	27599	2190	25408	5204	2752	7956	4121	16083	31
Chatra	27290	2527	24762	7363	1299	8662	2197	15202	35
Dhanbad	14945	1453	13492	3232	3807	7039	5780	4480	52
Dumka	30056	3006	27051	5578	1804	7382	2455	19018	27
Pakur	14094	1409	12685	582	1131	1714	1582	10521	14
Giridih	36960	3696	33264	8859	3109	11968	5099	19305	36
Hazaribagh	33438	3250	30188	9480	2264	11744	3392	17316	39
Ramgarh	11323	965	10358	2908	1135	4043	1633	5816	39
Ranchi	37973	2900	35072	10036	3919	13954	5080	19957	40
Zone I	204325	18684	185640	43771	17597	61368	25338	116530	33
Gharwa	33912	2839	31073	9257	1710	10967	2510	19306	35
Gumla	40578	4058	36520	8170	1370	9541	1670	26680	26
Khunti	15955	1596	14360	3350	709	4059	963	10047	28
Latehar	27779	2523	25256	5762	924	6686	1288	18206	26
Lohardaga	10418	1042	9376	3143	575	3718	812	5421	40
Palamu	39472	3392	36080	9182	2510	11692	3761	23137	32
Simdega	29783	2825	26958	6358	839	7197	1118	19482	27
Zone II	381192	35388	345804	80860	26007	106868	36926	228017	33
Saraikela	20759	1900	18859	912	1298	2210	1731	16217	12
E-Singhbhum	29863	2708	27156	2346	3287	5633	4966	19844	21
W-Singhbhum	36786	3678	33108	964	1921	2885	2562	29582	9
Zone III	87408	8286	79123	4222	6506	10728	9259	65643	14

The status of groundwater development is found satisfactory in the region. There are no semi-critical, critical or over exploited blocks in the state.

The project will not support ground water extraction; however it is important to promote surface water harvesting measures in districts with low rain fall and areas where the HVA interventions are taken up.

Irrigation

Irrigation facilities are limited in the state i.e. only 12%. The source wise access to irrigation facilities across the regions is presented in the table below.

Table 11: Irrigation pattern across the different Agro Climatic Zones in Jharkhand

Features	Region-I (Central Northern-Eastern Plateau)	Region-II (Western Plateau)	Region-III (South-eastern Plateau)	Overall
Total Area Irrigated	282629	514539	263146	1060314
Canal %	16.80	17.00	65	32.93
Tank%	30.55	3.65	13.90	16.03
Tube well%	4.75	14.70	2.64	7.36
Tubewell & other	47.90	64.65	17.62	43.39

The project will support only community based on farm irrigation under sub component - irrigation system development. Efficient methods of irrigation will be promoted under this.

Drought:

Majority of the production happens in kharif as 82% of rainfall is from monsoon. Despite of good amount of rainfall, the surface water is not available for irrigation in crucial periods due to inadequate storage facilities. The rainfall in the state also has witnessed significant changes in last decade. Late arrival and early cessation of monsoon is a common phenomenon in the state. Monsoon breaks occur in mid June. Dry spells of 2-3 weeks and even more usually occur in July-August. Failure of Hathia rain (late September-early October) is observed once in four years, which adversely affects grain growth of standing crops and also affects the establishments of second crop in winter season. As a general practice in the state, paddy being the most preferred crop, its sowing season during kharif keeps on extending even to late August /early September depending on the rainfall factors there by affecting the yield of the crop. The drought prone districts in the state include Ranchi, Dumka, Dhanbad. The districts declared as drought hit in the year 2016 are - Ranchi, Khunti, Lohardaga, Gumla, Simdega, West Singhbhum, Saraikela, East Singhbhum, Palamu, Garhwa, Latehar, Hazaribagh, Ramgarh, Koderma, Dhanbad, Bokaro, Chatra, Dumka, Deoghar, Giridih which includes all the project districts.

The project should prepare and implement drought proof measures as part of HVA and Irrigation interventions. The package of practices should include drought proof and drought mitigation measures in tune with the crop contingency plans developed by the Department of Agriculture, Research Institutions and under the program National Initiative on Climate Resilient Agriculture (NICRA).

3.8. Livestock

The cattle population constituted more than half of the share in total livestock population and share of goat population is one-third. The share of buffalo population is less than one-ten i.e. 8% percent only. Size and composition of livestock population are determined by the agro-climatic conditions, agricultural operations availability of fodder resources and so on. Animals are also used for draught purpose in the state. The piggery is emerging as most profitable enterprises and farmers prefer to rear pigs for enhancing their household income.

Table 12: Livestock Composition in the Project Districts and Land Available for Grazing

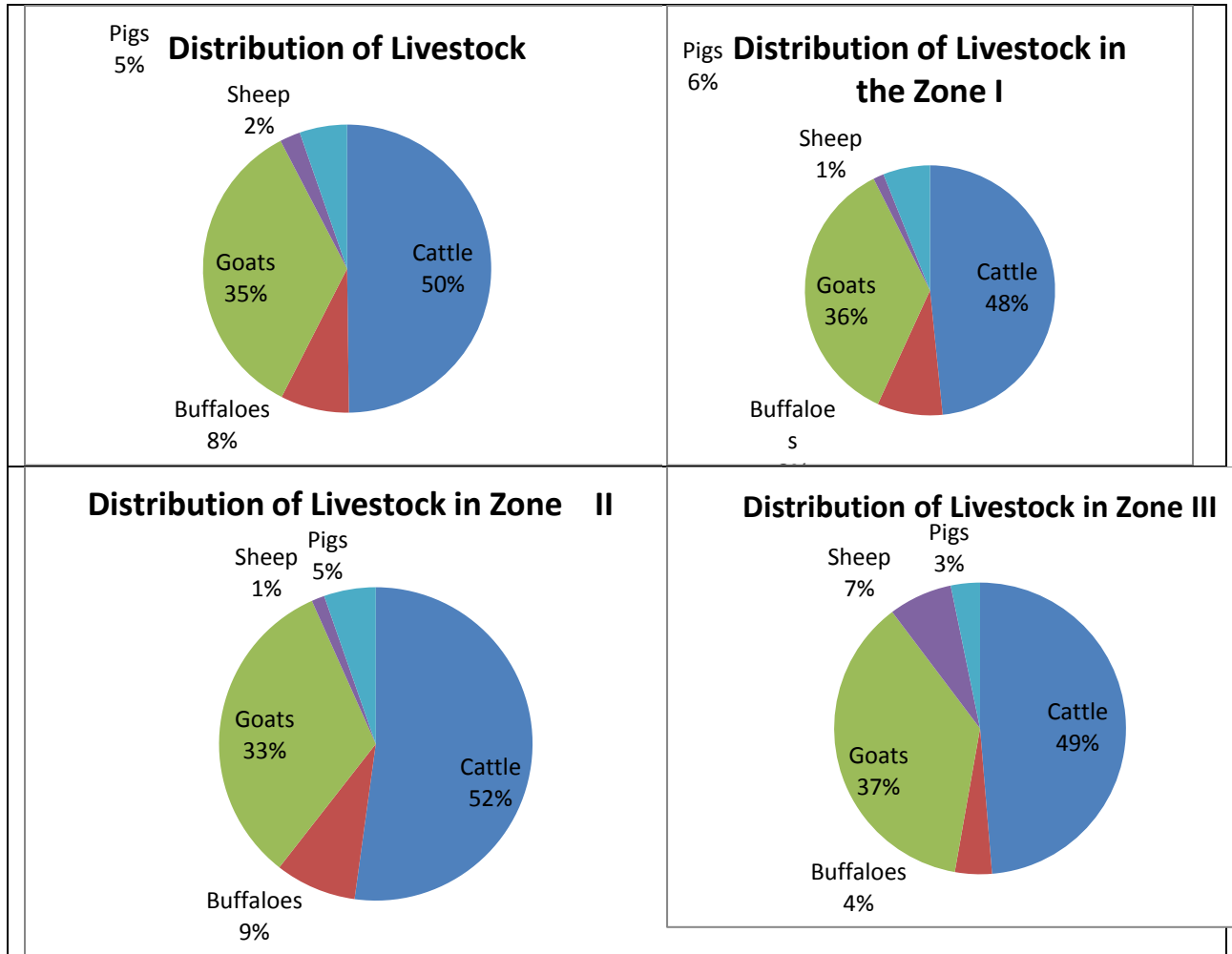
State / Zones	Proportionate Distribution of Animals					Total	Density (per ha)
	Cattle	Buffaloes	Goats	Sheep	Pigs		
Bokaro	52.09	6.75	36.11	1.82	3.23	194264	1.42
Chatra	49.59	12.63	31.17	0.03	6.57	236526	1.56
Dhanbad	50.19	4.56	39.36	2.44	3.45	195619	0.75
Dumka	52.70	4.13	30.42	2.69	10.06	323149	1.60
Giridih	51.17	8.42	37.92	0.75	1.74	403519	0.45
Hazaribagh	46.98	12.93	36.63	0.21	3.26	296162	0.50
Pakur	45.27	7.01	33.71	3.23	10.79	193318	2.56
Ramgarh	36.16	14.55	40.63	0.96	7.69	102312	2.06
Ranchi	44.75	11.38	37.88	1.44	4.54	313198	1.25
Zone I	48.59	8.93	35.70	1.44	5.34	2258067	1.38
Garhwa	58.60	9.43	28.72	0.42	2.82	189204	1.82
Gumla	52.40	8.35	33.72	0.32	5.21	206310	2.49
Khunti	50.00	6.03	31.97	6.71	5.29	113725	2.11
Latehar	54.24	7.25	30.38	0.04	8.09	160458	2.63
Lohardaga	52.76	6.53	37.09	1.04	2.58	107261	1.29
Palamu	59.27	10.09	26.10	0.99	3.55	296098	1.32
Simdega	52.35	3.05	33.95	0.73	9.92	147120	1.75
Zone II	55.07	7.78	30.82	1.17	5.16	1220176	1.98
Saraikeela	46.51	4.83	39.22	6.40	3.04	156099	1.33
Singhbhum	48.79	4.28	36.48	8.13	2.31	252702	2.24
Purbi Singhbhum	50.18	3.31	35.78	6.24	4.48	210748	2.85
Zone III	48.69	4.09	36.93	7.05	3.23	619549	2.18
Overall	50.54	7.85	34.43	2.21	4.97	4097792	1.92

Note: Forest, Forest land, unculturable wasteland, permanent grazing lands, culturable wasteland and total fallows have been included to estimate land available for grazing.

Adult Cattle Unit = 1 cattle = 1 buffalo = 0.2 sheep or goat

The estimates show that in zone III, there is pressure on grazing resources is higher as compared to the other zones. In overall, there are 1-3 ACU feeding on each hectare of land available for grazing. In zone I, there very limited ACUs are depending on feeding resource. It can be inferred that these is scope expansion in the livestock population.

Figure 2: Distribution of Livestock in the state and in AC Zones



There is scope for developing the grazing lands as part of the livestock development interventions.

The livestock development interventions would consider the available fodder resources and plan for management and enhancing of the resources.

Chapter - IV

Legal and Regulatory Framework

4. Introduction

There are various policies and acts framed by the Government of India (GoI) as well as Government of Jharkhand (GoJ) that deal with environment concerns, natural resource management and agricultural activities. This section provides overview of the policy framework at national and state levels relevant to the JOHAR project. In addition, the World Bank (WB) Safeguard policies are reviewed from their context of applicability. This chapter discusses the policies, rules and regulations that are applicable to the JOHAR project.

4.1. Environmental Acts and Rules of Government of India and Government of Jharkhand

To maintain the environmental balance in the process of development, both national and state governments have framed certain environment acts and rules that are analysed in the following table.

Table 13: Applicability of National Environmental Acts and Rules

Acts/ Rules	Aims	Provisions	Enforcing Authority	Relevance to JOHAR Project
Environment and Pollution				
The air (prevention and control of pollution) act, 1981	To provide for prevention, control and abatement of air pollution in India.	Setting air quality standards, procedures for consent to operate enterprises, penalties etc. Consent should be taken to establish and operate.	Ministry of Environment Forests and Climate Change , GoI and Jharkhand State Pollution Control Board, GoJ	Applicable to, processing activities (dal mills, rice mills fish/poultry feed manufacture etc.
The Water (Prevention and Control of Pollution) Act <i>Amended:</i> 1988	Provision for prevention and control of water pollution and maintaining or restoring of wholesomeness of water in the country	Laying down the permissible limits/ standards of pollutants likely to be emitted, collection of samples of effluent and analysis and	Jharkhand State Pollution Control Board	Applicable to any activities that release wastes into water bodies (eg: processing units, high chemical use in fisheries etc.)

Acts/ Rules	Aims	Provisions	Enforcing Authority	Relevance to JOHAR Project
		provisions for penalties.		
Wildlife, Biodiversity and Forest				
The Biological Diversity Act, 2002 G.S.R.261 (E), [15/04/2004] - Biological Diversity Rules, 2004	Conservation of biological diversity and its sustainable use, equitable sharing of benefits arising out of the use of biological resources.	Regulation of access to biological diversity, empower National Biodiversity Authority and State Biodiversity Board to restrict certain activities that affect bio-diversity adversely. Provision of appropriate legislation for declaration of Biodiversity Heritage sites at local level.	Ministry of Environment Forests and Climate Change , Government of India and Jharkhand State Biodiversity Board	Relevant to the project. The project envisages maintaining the biodiversity. At the same time the project will enhance crop productivity through sustainable natural resource management.
Scheduled Tribes and other Traditional Forest Dwellers (Recognition Forest Rights) Act, 2006	To recognise and vest the forest rights and occupation in forest land in forest dwellers and other traditional forest dwellers who have been residing there for generations but whose rights couldn't be recorded.	Recognition of rights and responsibilities and authority for sustainable use, maintenance of ecological balance of ecological balance and strengthening the conservation regimen of forest while ensuring	Ministry of Environment Forests and Climate Change, Government of Jharkhand.	Relevant to the project. The Act determines the use rights for the collection NTFP, agricultural operation, animal rearing and construction of common facilities.

Acts/ Rules	Aims	Provisions	Enforcing Authority	Relevance to JOHAR Project
		livelihood and food security.		
<p>Forest (Conservation) Act, 1980 (With Amendments made in 1988)</p> <p>Forest (Conservation) Rules, 2003 (With Amendments made in 2004)</p>	<p>The Act is an interface between conservation and development.</p>	<p>The act permits judicious and regulated use of forest land for non-forestry purposes. According to the act: Any forest land or any portion of it should not be used for any non-forest purposes. While the forest policy has recorded rights, concessions and privileges of the local people, activities like felling of trees or breaking up the forest floor so as to procure stones, minerals, or take up constructions, etc is not permitted. In the districts affected with Left Wing Extremism diversion of forest land not more than 5 ha by Government Department for creation of critical public</p>	<p>Ministry of Environment Forests and Climate Change Government of Jharkhand.</p>	<p>Relevant to the project.</p> <p>Applicable to the project where agriculture or any construction of common facilities are promoted near forest in tribal areas.</p>

Acts/ Rules	Aims	Provisions	Enforcing Authority	Relevance to JOHAR Project
		utility infrastructure is permitted.		
The Wild Life (Protection) Act, 1972	Protection of wild animals, birds and plants for matters connected therewith or ancillary or incidental thereto.	Destruction, exploitation or removal of any wild life including forest produce from a sanctuary of the destruction or diversification of habitat of any wild animal, or the diversion, stoppage or enhancement of the flow of water into or outside the sanctuary is prohibited without a permit granted by the Chief Wildlife Warden.	Department of Forest and Environment, Government of Jharkhand.	Relevant to the project. Applicable to the activities like livestock development where grazing is involved in forest areas, collection of NTFP and construction of common facilities near forest areas.
Agriculture				
The Insecticides Act. 1968 <i>Amendment:</i> Insecticides (Amendment) Act, 1977	Regulate the import, manufacture, sale, transport, distribution and use of insecticides with a view to prevent risk to human beings or animals, and for matters connected therewith.	Registration, license and other rules & safeguards for handling insecticides by users. Safe packing, storage while transportation, prohibition of sale, etc. of certain insecticides for	Department of Agriculture, Government of India and Government of Jharkhand	Relevant to project, applicable to agricultural activities. Mitigation measures taken care in Pest Management Plan (Annexure 5).

Acts/ Rules	Aims	Provisions	Enforcing Authority	Relevance to JOHAR Project
		reasons of public safety.		
The Fertilizer (Control) Order, 1985	Registration is required for selling fertilizer at any place as wholesale dealer or retail dealer.			Applicable to POs in cases where stocking and sale of fertilisers may happen
The Seeds Act 1966, The Seeds Rules 1968	The Seeds Act regulates the quality of certain seeds for sale.	Regulation of sale of seeds of notified kinds or varieties. Determine the responsibilities for making and labelling. Certification agency and grant/voke of certificate, provision of penalties.	Department of Agriculture, GoJ	Relevant to the project. The project does not envisage seed production yet, but will take cognizance of the act if promoted.
Livestock Development				
Bio-Medical Waste (Management & Handling) Rules, 1998	Control the indiscriminate disposal of hospital waste/ bio medical waste to restrict the environmental	It shall be the duty of the every occupier of an institution generating bio medical waste which includes Veterinary	State Pollution Control Board, Government of Jharkhand	Relevant to the project. Rules will help in managing the waste generated by AI or at the

Acts/ Rules	Aims	Provisions	Enforcing Authority	Relevance to JOHAR Project
	hazard in the area.	institution and animal house to ensure-that such waste is handled without any adverse effect to the human health and the environment.		veterinary health centres that may have adverse environment affects.
Indian Fisheries Act 1897	Protection of fishery in waters bodies by rules of State.	Use of dynamites or explosives or poison for fishing is an offence.	Department of Animal Husbandry and Fishery	Relevant to the project. Applicable to the project where capturing of fisheries is involved.

Table 14: Applicability of State Environmental Acts and Rules

Acts/ Rules	Aims	Provisions	Enforcing Authority	Relevance to JOHAR Project
Jharkhand Panchayati 2001, Amendment (Bill) 2010	To conserve vegetative cover and protect the village grazing lands	It shall be duty of Panchayats to take all steps for development of grasses, shrubs and plants in grazing ground and prevent encroachments. Control over land in each village to five-person committee headed by the ward Panch of the village concerned and four members to be elected by	Department of Panchayati Raj, Government of Jharkhand	Relevant to the project. The provisions will help in developing village common land on which bulk of marginalized households depends for their livelihood.

		Gram Sabha.		
Jharkhand Public Land Encroachment Act, 2016	To restrict the illegal privatisation of public land that available for community	If any individual found guilty in encroachment on public land, shall be punished with imprisonment or with financial penalty or with both.	Department of Revenue.	Relevant to the project This will restrict encroachment on common land and make it available for grazing animals in general and goat in particularly
Jharkhand Participatory Irrigation Management Rules' (2014).	Promotion of WUAs for Operation, future maintenance of irrigation infrastructures. Preparation of crop plans keeping in view of water requirement for the entire command area and implement the same	Provision of three tier WUAs, provides guidance and strategic support for implementation of PIM and Command Area Development work. Recognition of this water institution.	Department of Water Resources, GoJ	Relevant to the project. Applicable to the agriculture and irrigation interventions. The project focuses on efficient and judicious use of water for irrigation.
Jharkhand NTFP Transit Rules, 2004	To control the transit of NTFP defined in the provisions by road, rail and airways.	No person other than the Government shall purchase or transport or import or export such specified forest produce in and from such area. Provision of procurement price of the NTFP and smooth monitoring and trading.	Department of Forest Environment, GoJ	Relevant to the project. Applicable to the transit of NTFP and linking with markets.

4.2. Environmental Policies framed by the Government of India and Government of Jharkhand

The Article 48-A of the Constitution of India states that the State shall endeavour to conserve and regenerate the environment resource base of the country. At the same time, Indian Constitution explains under Article 51-A (g) that it shall be the fundamental duty of every citizen to protect and improve the natural environment and to have compassion for living creatures. The policies that are applicable to the project are analysed in the following table.

Table 15: National Policies Environmental Policies and their relevance to JOHAR Project

Policies	Provisions	Relevance to JOHAR
National Policies		
National Environment Policy 2006	To protect and conserve critical ecological system and resources and to ensure equitable access to these resources for communities which are dependent on these resources for their livelihood.	Applicable The project promotes conservation and sustainable use of land, water and biomass which is one of the major challenges in agriculture sector. The project addresses the issue of awareness generation and mitigation measures
National Forest Policy (NFP), 1988 & revised NFP, 2016	Improve the health and vitality of forest ecosystems to meet the present and future needs of ecological security and biodiversity conservation with empowered and enabled communities.	Applicable The project activities focusing on NTFP and needs to integrate principles of sustainable harvesting and regeneration.
National Agriculture Policy 2000	National Agriculture Policy seeks to actualize vast untapped growth potential of Indian Agriculture, strengthen rural infrastructure to support faster agricultural development, promote value addition, accelerate the growth of agro-business create employment in rural areas, secure a fair standard of living for farmers and agricultural workers and their families, discourage migration to urban areas and face the challenges arising out of economic liberalization and globalization.	Applicable. The project aims to improve agricultural productivity and farm incomes by integrating technology, institutions and market innovations.
National	To improve economic viability of	Applicable.

Policies	Provisions	Relevance to JOHAR
National Policies		
Policy for Farmers 2007	<p>farming by substantial increase in net income of the farmers, to conserve and regenerate land, water and genetic resources for sustainable improvement in productivity, profitability and stability of major farming system.</p> <p>To develop support services including provisions of timely input supply and agriculture credit at affordable interest rates to the farmers. Provide suitable risk management measures for adequate and timely compensation to the farmers.</p>	The project envisages improvement of the land productivity and income of farmers in a sustainable manner.

Table16: Jharkhand State Policies and their Relevance to the Project

Policies	Provisions	Relevance to JOHAR Project
State Policies		
Agriculture Policy 2011, Government of Jharkhand	<p>The main aims of the policy is (i) to provide sustainable livelihood opportunities to the people for overall economic, social and human development with the national priorities and State priorities i.e. ensuring food, nutrition and economic security through development of agriculture and allied sectors. (ii) Efficient and sustainable use of soil, water and biodiversity including forest natural resources. (iii) Provide sustainable income generation activities to the farm families through integrated different farming systems. (iv) Linking food production with agro-based industries like lac, silk and post-harvest technologies for employment generation and market linkages.</p>	<p>Applicable</p> <p>The project aims to increase income from agriculture through integrating natural resources and strengthening value chains (especially in cash and high value crops) in an environmentally sustainable manner.</p>
Jharkhand Livestock Breeding Policy, 2011	<p>Increase the productivity of animal products like milk, egg and meat and their reproductive capacity by the breed improvement programme and conservational & development of</p>	<p>Applicable.</p> <p>Project activities focus of the productivity enhancement and value addition of livestock</p>

Policies	Provisions	Relevance to JOHAR Project
State Policies		
	different breed of animals and birds available in the state as well as to increase the income of the farmers.	products.

4.3. WB Safeguard Operational Policies

The following tabular presentation explains applicability of various environmental safeguard policies to the JOHAR project interventions. It also indicates the concerns that will need to be addressed in the EMF.

Table 17: World Bank Safeguard Policies and their Relevance to JOHAR Project

Environmental Safeguard Policy	Provisions	Relevance/ Applicability
Environmental Assessment (BP/OP 4.01)	It is an “umbrella policy” through which potential environmental impacts are identified and mitigation measures proposed. Assessment process determines whether other safeguard policies apply.	Triggered The present Environmental Assessment study involves development of an EMF for the JOHAR project.
Pest Management (OP 4.09)	Promotes the use of biological or environmental control methods and reduces reliance on synthetic chemical pesticides and sets conditions on the acquisition and use of pesticides. WB does not finance the pesticides that fall in the category of Class Ia, Ib, and II.	Triggered JOHAR project interventions supported through individual farmers/ producer organisations may involve technical input support for use of pesticide. The related safeguards/ provisions have been included in the EMF and a Pest Management Plan is prepared.

The Environment Management Framework designed for the project is responsive to the legal and regulatory framework given above. A ‘compliance list’ is prepared based on the framework (attached as Annexure 1) which will help in screening the business plans/sub project proposals for any activities that the project should not invest in. This will be duly integrated into the project operation manuals, IEC materials, business plan proposal formats etc.

Two environmental safeguard policies - Environmental Assessment (OP/BP 4.01) and Pest Management (OP 4.09) are triggered in the project and the EMF addresses the concerns arising out of the two applicable OP/BPs.

Applicability of OP/BP 7.50 Projects on International Waterways

The Project area includes administrative units (“blocks”) that are fully or partially within sub-catchments of the Ganges River basin (including for example, the Sone and Gandak sub-basins), which are considered part of an international waterway as defined in OP 7.50. In these areas, Project activities that involve water use or potential pollution (fisheries, and high-value agriculture) would be excluded. The remainder of the Project area is within coastal drainage basins including the Brahmani, Baitarani, Subernarekha and Damodar. These are not considered to be international waterways and thus no exclusion of water-using interventions would be required under the Project. The Damodar, while sometimes considered a part of the Ganges basin, joins the Hooghly River (a distributary of the Ganges that leaves the Ganges at Farakka, upstream of the Bangladesh Border) just upstream of the mouth at Haldia. The Damodar-Hooghly junction in the lower tidal estuarine reaches in the final few kilometers of the Hooghly’s ~560 km course to the sea from Farakka. There will be no consumptive use or prospective consumptive use of the estuarine water of the Hooghly under the Project given the salinity levels. OP 7.50 considerations do not therefore arise in the context of the Damodar. Given the above, OP 7.50 is therefore not applicable to the Project.

Chapter V

Assessment of Environmental Impacts

5. Introduction

The JOHAR project seeks to demonstrate at scale the feasibility of a range of distinct development approaches integrating technology, organization, institution, partnerships and market innovations that are capable for optimum use of available resources that further help in improving the level of household income. Thus, the desired outcome of the project is to increase the productivity of available resources and level of household income. While working towards the outcomes, it is important that the potential environmental impacts of the project interventions are identified and addressed through integration of appropriate mitigations so that the environmental sustainability is ensured. Of the project components the component 1 is likely to have adverse impacts and the environment if the interventions are not planned and executed properly.

5.1. Environment Impacts and Measures

The present section discusses the components wise possible impacts of project interventions.

Component 1: Diversified and Resilient Production and Value Addition:

This component will support collectives of small producers and interventions for diversification, intensification and value-addition in the selected sub-sectors of HVA, livestock, NTFP, fisheries and irrigation.

Sub component - High Value Agriculture:

The objective of this sub-component is to promote adoption of market-led High-Value Agriculture (HVA) systems by target households. HVA will mainly focus on year-round cultivation of vegetable and fruit crops in the midland. In addition, to help provide better food security to households, it will also demonstrate technologies for improving productivity and reducing climate risk in paddy. In the uplands it will demonstrate new high yielding varieties of pulses, oilseeds and millets.

The table below presents the potential impacts and mitigation measures of key interventions.

Table 18: HVA - Environment Impacts and Mitigation Measures.

Activity	Possible Environmental Impacts	Mitigation Measures/Environmental guidelines
Crop Selection	Selected crop may lead to consumption of more water. Selected cropping pattern may lead to nutrient depletion. Traditional and nutritious crops may be disappeared.	Crop selection must be matching with availability of water. Crop rotation should be followed to ensure that crops with different root zones, different demands on nutrients and different pests and diseases are

Activity	Possible Environmental Impacts	Mitigation Measures/Environmental guidelines
		cultivated alternatively.
Selection of the variety	Variety may not be suitable to the area or may threaten local biodiversity.	Well adapted and high-yielding varieties recommended to the region with resistance to biotic stresses and improved nutritional quality should be chosen.
Seed treatment	Sowing of untreated seed may lead to pest and disease infestation demanding use of chemicals for control	Use of treated seed preferably with botanicals.
Irrigation	<p>Excess use of water for intensive cropping depleting the surface water resource.</p> <p>Lack of information on weather updates may lead to untimely operations, especially irrigation leading to crop loss due to unexpected dry spells or rains.</p>	<p>Use water efficient methods of irrigation like drip especially for horticultural crops.</p> <p>ICT based regular weather updates on mobiles to plan the operations, especially irrigation (planned under the project).</p>
Pest Management	<p>Pest control measures without proper pest surveillance, without considering ETL levels and without proper advise may lead to high costs besides polluting the environment.</p> <p>Increased use of hazardous pesticides in more quantities than desired leading to runoff into water bodies and polluting them and polluting environment, leading to negative effects on biodiversity, health etc.</p> <p>Unscientific way of mixing, use of pesticides and disposal of pesticide containers or reuse may lead to health issues.</p>	<p>Pest control measures should be taken based on pest surveillance based advisory only.</p> <p>Restrict to non chemical methods of pest management.</p> <p>Avoid use of pesticides under the classes Ia, Ib and II as per the classification of World Health Organisation (WHO).</p> <p>Adopt the practices details in Pest Management Plan (Annexure-5). Follow the precautions in use and disposal of pesticides (Annexure 5).</p>
Soil Health & Nutrient Management	Soil degradation due to fertilizer use in more quantities and high uptake of nutrients due to high responding varieties.	Adopt organic manuring practices to the extent possible. Any chemical fertilizer application should be based on soil testing.

Activity	Possible Environmental Impacts	Mitigation Measures/Environmental guidelines
Drought proofing/mitigation	Given the fact that the droughts are a frequent phenomenon in the project districts the following drought proofing and mitigations strategies/measures need to be considered in the project in case of occurrence of drought.	<p>Drought proofing:</p> <ul style="list-style-type: none"> • Rain water harvesting, revival/repairs and maintenance (desilting) of ponds through convergence • Crop diversification and selection of less water intensive crops • Selection of drought resistant crop varieties in likelihood of drought • Mixed farming and crop rotation, inclusion of legumes in cropping system • Crop insurance • Watershed plan, promotion of agri-horti-silvi farming in tribal areas <p>Mitigation:</p> <ul style="list-style-type: none"> • Forecasting and early warning system, weather advisory for timely operations in crop production • Adopt micro irrigation methods and System of Rice Intensification (SRI) in rice • Judicious irrigation scheduling based on soil moisture deficit criterion • Measured supply of irrigation as per crop water demand • Practice mulching and other soil, moisture conservation techniques
Burning of crop residues (paddy)	The practice of burning crop residues will result in air pollution	Use of mowers should be demonstrated (pilot basis) to harvest the paddy straw and use it as dry fodder.

Activity	Possible Environmental Impacts	Mitigation Measures/Environmental guidelines
Storage and Handling of Agri-inputs	<p>Poor storage, handling can lead to spills and leaks of fertilizers and pesticides leading to contamination of soil, water and the surroundings.</p> <p>In case of seeds, poor storage may lead to pest and disease infestation of seeds.</p>	<p>Safety measures are required that in storing agriculture inputs like fertilizer and other chemicals that leads to infect other input.</p> <p>Clean the storage areas daily or after each use.</p>
Drying	<p>Storage of grains and products like turmeric, ginger etc. needs drying to attain prescribed moisture level to avoid pest and disease infestation which may call for chemical use for management.</p> <p>Drying on open grounds may contaminate the produce with dirt; microbes etc. which will reduce the quality of produce will have an impact on health.</p>	<p>Dry the product to attain prescribed moisture level in a clean environment.</p> <p>Drying on cement platforms, mats etc. will protect the produce from contamination. Use solar dries wherever possible.</p>
Milling	<p>Non compliance with norms of Pollution Control norms.</p> <p>Noise pollution to the workers and in the neighbourhood due to milling.</p> <p>Fine dust during milling will lead to health issues like allergy, asthma in long run.</p>	<p>Ensure consent from PCB wherever required.</p> <p>Noise protective equipment should be provided to the operator of the machines.</p> <p>Silencer should be attached to the equipment to reduce noise from the equipment to surrounding areas.</p> <p>Person using these machines must wear mask for preventing the problem related to inhalation.</p>
Processing and value addition	<p>Processing and value addition may require high amount of energy and water depleting local fuel and water resources and increasing emissions due to energy use.</p> <p>Accidents and health hazards are possible during processing involving machinery.</p> <p>Unhygienic environment or practices at processing will</p>	<p>Use energy efficient equipment for processing (such as steam boilers in turmeric)</p> <p>Take safety precautions and use safety gear during processing.</p> <p>The processing environment should be kept clean and personal hygiene is</p>

Activity	Possible Environmental Impacts	Mitigation Measures/Environmental guidelines
	contaminate the food products.	must among the workers.
Waste disposal	Disposal of wastes openly after milling or waste (water, seed coats, peels, etc.) after processing may create unhygienic environment due to decomposition.	Explore the alternate uses for the wastes (such as composting); in cases where they cannot be put to alternate use dispose the wastes as per the prescribed procedures.
Custom Hiring Centres	<p>Spread of weeds and pathogens from one field to other field through uncleaned farm machinery and implements. This will further encourage use of fungicides and weedicides.</p> <p>Use of some of the machinery such as Power Weeders, Power sprayers and Power tillers will increase use of fuels and will cause emission of GHGs (Green House Gases). The exhaust fumes from this farm machinery pollute local environment quality.</p> <p>There can be some safety hazards owing to use of machinery.</p>	<p>Clean machinery and tools after every use to ensure no weed seed, pathogens etc. are carried over to next field.</p> <p>Ensure purchase of fuel efficient models of this equipment. Proper maintenance (regular cleaning and service) would lead to enhanced efficiency.</p> <p>Awareness on safe use and first aid requirements to be ensured.</p>
Hiring Vehicles for Transportation	Hiring transportation agency for aggregation and transportation.	Transportation agency with old and ill serviced vehicles may result in more emissions.
Cluster Service Centres	<p>Construction of a brick and mortar structures like platforms for sorting, grading and storage facilities may lead to following negative environmental impacts:</p> <ul style="list-style-type: none"> • Non compliance with any legal requirements related to construction • Possible clearing of vegetation or cutting of trees • Dust and noise pollution during construction. 	<ul style="list-style-type: none"> • Take required permissions as indicated in the ‘compliance list’(annexure 1) and legal and regulatory framework • Minimize the need for cutting the trees and damage to native vegetation. • Compensatory plantation if there is any vegetation loss. • Frequent water sprinkling to avoid excessive dust during

Activity	Possible Environmental Impacts	Mitigation Measures/Environmental guidelines
	<ul style="list-style-type: none"> • Open disposal of debris near the site or near drains etc. will cause inconvenience and block drains. Unfilled borrow pits are a hazard, leading to accidental falls, water stagnation etc. 	<p>construction.</p> <ul style="list-style-type: none"> • Dispose the debris away from the site preferably in landfills or use for activities like road construction. Fill all the borrow pits to avoid hazards like accidental falls, water stagnation etc.

Sub component – Irrigation System Development:

The objective of this sub-component is to provide access to community-based micro irrigation to targeted households practicing HVA cropping system. This will be achieved by creating/augmenting water sources (primarily surface and sub-surface flows in streams), providing water-lifting devices and establishing water distribution systems.

The activities supported under the sub-component are: (a) Preparation of micro-irrigation plans through a TSP who will carry out site survey, design and plan preparation. The plan will include details of water sources, lifting devices, distribution systems, command area and irrigation schedule. It will also provide detailed specifications of materials, their costs and an implementation schedule. (b) Creation of the micro-irrigation infrastructure that will involve: gravity-based diversion of hill streams to lower areas; solar-, electric- and diesel-based lifting devices with GPRS-enabled starter connected to a mobile application that will help track usage of micro-irrigation sub-projects; distribution systems that enable operation of drip irrigation systems; small irrigation pump sets for use with farm ponds, wells, etc. (c) Demonstration of low-cost drip irrigation, alternate row flooding, etc., to reduce water usage. (d) Formation of water user groups under the technical supervision of the TSP with membership of all HVA farmers in the command area for participating in planning, development, operation and maintenance of the micro-irrigation infrastructure.

Table 19: Environment Impacts and Mitigation Measures in Community based Micro-irrigation

Activity	Possible Environmental Impacts	Mitigation Measures/Environmental guidelines
Intake structures, Installation of pipelines	<p>Possibility of impacts during construction on soil, boulders vegetation etc.</p> <p>Open disposal of wastes, debris or into the water body</p> <p>Dust and noise pollution</p>	<p>Precautions to be taken to avoid the impacts. Avoid clearing of vegetation to the extent possible.</p> <p>Dispose the excavated wastes in proper manner at the borrow sites or landfills.</p> <p>Sprinkle water to control dust.</p>

Pumping of water	Over extraction from streams will deplete the flows which may affect the aquatic biodiversity and lead to fish mortality	Need to follow the regulator measures that do not support the over-exploitation of water resources. Promotion of water saving technologies like sprinkler and drip irrigation.
Provision of pumping devices - pumps (electricity pumps and diesel pumps)	Requirement of energy and emissions due to operation of diesel pumps.	Shift to solar pumps where feasible and regular maintenance of diesel and electric pumps.
Irrigating the field	Excess irrigation may lead to soil salinity and drainage problem besides wastage of precious resource. Drainage from the irrigated farms may contaminate the water resources nearby due to chemical runoff	Plan the schedule based on weather data and follow efficient methods of irrigation like alternate row, micro irrigation etc. Drainage should not be let into potable catchment area but channelled separately.
Increased input use	Access to irrigation may lead to increased input use, especially chemical inputs	Adoption of IPM, INM approaches as planned (Annexure 5).
Maintenance of channels	Siltation and weed growth in the channels may affect the efficiency. Leakages may lead to wastage of water.	Regular cleaning maintenance of the channels is important.

There intervention not only causes to adverse environmental implications but also positive environmental implications like optimum use of water resources through using PVC pipelines. The adoption of alternative energy (solar) is also a best practice.

Sub component: Livestock Development

The objective of this sub-component is to support the targeted households in asset creation, productivity enhancement and market access of selected livestock (broilers, layers, pigs, goats and dual purpose backyard poultry).

The key activities are: (a) Establishment of breeding villages for pig and goat rearing including support for procurement of breeding stock and village sanitization. (b) Introduction of improved breeds through support for procurement of high quality boars, bucks, pullets, chicks, etc., from private sector enterprises and breeding villages. (c) Provision of working capital to PGs to meet health care and feed cost for one production cycle. (d) Support for establishment of composite feed mills. (e) Support for construction of scientific housing for livestock. (f) Support for

vaccination programs for disease prevention. (g) Capacity building on productivity enhancement (improved breeding, health, feeding, housing and management) that will include skill training of producers as well as other need-based training through Farmer Field Schools and exposure visits. Continued extension support will be provided to producers through CPs (Pashu Sakhis). Services of TSAs will be hired to provide capacity building support. (h) Support for partnerships would be contracted with key NGOs and private sector agencies

Table 20: Environment Impacts and Mitigation Measures of Livestock interventions – Small Ruminants

Component	Possible Environmental Impacts	Mitigation Measures/Environmental guidelines
Breed selection	Selection of breeds that cannot adapt to the local climatic conditions will lead to loss of animals or results in low productivity and health issues.	Selection of breeds suitable to local climatic conditions and up gradation with the improved breeds suitable or acclimatized to local climate should be done under technical guidance. Eg: Jamnapari, Serohi, Black Bengal. Breeding villages should preferably be selected in breeding tracts of native species.
Grazing	Continuous over grazing will lead to degradation of grazing lands. In case of sheep as they graze close to the ground surface vegetation is removed exposing the soil for erosion. The herd should not be allowed to graze along with other animals in breeding villages.	Growing fodder trees, regulated grazing and stall feeding (partly or completely) will reduce pressure on grazing lands. Rotational grazing will be followed and pasture land development initiatives will be taken up in convergence with NREGS. To the extent possible staff feeding will be promoted in breeding villages and in case of grazing rotational grazing will be followed and the herd will be grazed in a separated patch preferably fenced.
Cutting large branches from trees.	Regeneration of the trees will be affected if lopping is done extensively.	Only small twigs should be extracted, fodder trees can be grown in house premises as well.
Shed spacing	Congested, less ventilated sheds will lead to quick spread of diseases and affects animal health due to less scope for movement.	The sheds must have sufficient space and well ventilated and offer protection from heat, rain etc.
Stall feeding	Stall feeding with green fodder without chopping may lead to wastage.	Fodder should be properly chopped before feeding.
Shed cleaning and waste	Open disposal of shed cleanings and feed waste create unhygienic	Wastes should be composted as pit, or heap covered with leaves and lined

management	conditions and leads to loss of manurial value	with bricks to avoid leaching or evaporation losses.
Measures during drought	Lack of drought management strategy may lead to loss of herds or poor performance.	<ul style="list-style-type: none"> • Management of commons and pasture lands, improved grazing practices like rotational grazing, protection of shrubs and trees • Fodder conservation through community fodder banks • Harvest and use the failed crop as fodder • Management of common pasture lands

Table 21: Environment Impacts and Mitigation Measures – Poultry

Component	Possible Issue	Mitigation Measures/Environmental guidelines
Selection of species	Selection of species that may not be suitable to the region resulting in disease attacks, low performance etc.	Selection of disease resistant and hardy species that are suitable to the regions in consultation with the Animal Husbandry department and KVKs.
Location of the Units	Location of the units near residential areas lead to noise pollution and offensive smell. Location of Units near highways causes stress and disturbance to the birds.	It is advisable to locate the units away (100 m) from the residential areas and highways.
Housing the birds	Over crowding the birds in less space will have an impact on health of the birds – leads to quick spread of diseases and less productivity.	Follow the recommended spacing and heating requirements.
Shed cleaning and disposal of waste	Open disposal of manure leads to contamination of surrounding s and affects the manure quality	Manure should be stored in a pit or heap lined with bricks to avoid runoff during rainy seasons.
Disposal of dead birds	Open disposal of dead birds leads to spread of diseases and attract dogs etc.	Dead bird should be disposed by burning/burying method. And it should be done at least 100 m away from the shed.

Sub component – Fisheries Development:

The objective of this sub-component is to enhance fish production and marketing by the targeted households. The sub-component will focus on farm pond production, fry production and reservoir/cage production.

The key activities to be supported are: (a) Demonstrations/pilots on improved technologies including short production cycle models involving fast growing fish varieties, cage culture of *Pangasius* in reservoirs, improved stocking, intensification of fish seed production in small ponds, improved fish culture in farm ponds/Dobhas, introduction of formulated fish feeds that use locally available ingredients, promotion of appropriate innovative technologies (e.g. lining in Dobhas), etc. (b) Financial support through grants to SHGs for on-ward lending to PGs for fisheries, as well as through direct grants to PGs for pond improvement and procuring basic equipment. (c) Training of fish farmers in PGs, SHGs and their federations (d) Establishment of technical advisory centers at the district level to cater to the needs of small fish farmers. (e) Augmentation of state hatchery infrastructure. (f) Studies on governance and policy reforms including leasing of water bodies for fisheries, aquaculture insurance, information management to support stocking programs and subsidy schemes. (g) Development and deployment of mobile applications that will enable Global Positioning System (GPS) tagging of production ponds, geographic information system (GIS)-based analysis, disseminate technical advice on production, record production, relay market information, etc.

Table 22: Environment Impacts and Mitigation Measures – Fisheries

Component	Possible Environmental Impacts	Mitigation Measures/Environmental guidelines
<i>Culture fisheries</i>		
Preparation of the tank	Culturing fish without soil and water testing decreases productivity and may lead to increased in puts, or decline in water quality thus harming environment.	Soil and water testing should be done prior to stocking the fingerlings and corrective measures to be taken.
Fertilizer application	Excess fertilizer application for high productivity will lead to algal blooms and loss of fish due to depleted oxygen.	Follow the recommended dosage for fertilizer application To the extent possible combine organic and synthetic chemicals or apply alternatively.
Stocking density	Effective space utilization will not be there if recommended stocking density is not followed.	Recommended stocking density should be followed.
Mono culture	Monoculture will not ensure effective space utilization and productivity per unit area	Poly culture of the 2-3 species in recommended ratios will ensure optimum space utilization and production.
<i>Cage Culture in Reservoirs</i>		
Selection of reservoir for cage culture	Suitability of reservoir for cage culture, possibility of impact on aquatic environment and public use due to use of feed and chemicals.	As the cage culture operations will tend to increase nutrient load, BOD and COD in the water bodies, care must be taken to pre-assess the water quality of the location. Excessive nutrient load from cage culture inputs, especially feeds can create eutrophic

		<p>conditions with disastrous consequences to the ecosystem. It needs to be ensured that the water body is either oligotrophic (low nutrient content) or mesotrophic (moderate nutrient content) before starting the cage culture.</p> <p>Areas of fish nursery and breeding grounds, sensitive areas like wildlife habitat including birds nesting, socio-culturally important areas like water bodies for public use like drinking water, cleaning, navigation, etc, and protected aquatic reserves, sanctuaries, etc. are also to be avoided.</p> <p>Cage culture shall be allowed in water bodies having a surface area 1,000 ha or more at Full Reservoir Level and average depth of 10 m (Average depth is calculated as: Area in hectares divided by water holding capacity in m³).</p> <p>Water quality, weed infestation etc. to be considered. Cage culture should not be attempted in any water body having total phosphorous and total nitrogen concentration in the water in excess of 0.02 mg/L and 1.2 mg/L, respectively.</p>
Cage size	Number of cages, and size may influence the operation and maintenance	Size of a cage for fish culture in reservoirs can depend on number of cages installed. However, from operational and planning purposes, a cage with the dimensions: 6m (length) x 4m (width) x 4m (height) is considered as a standard unit.
Cage material	Use of material which is not environment friendly	A cage comprises hard frames as support and nylon nettings as cage body. It is desirable to have environment friendly, HACCP (Hazard Analysis and Critical Control Points) protocol compliant, rust-free materials for cage fabrication.
Net Size	Escape of the fish especially the cat fish species may threaten fish	The net mesh size recommended for rearing fry of Cat fish is 10 to 12 mm

	diversity.	and that for fingerling to marketable size is 20 to 30 mm. In case of Indian Major Carps (Catla, Rohu and Mirgal), the mesh size should be 5 mm for fry and 10 mm for fingerling. Protective net may be put above the cage
Health management	Disease outbreaks affecting wild species	Preventive measures to be taken to the extent possible.
Tilapia culture	Cage culture of Tilapia without guidelines may result in over breeding which have an impact on diversity of native fish species	The farmers/PGs planning for Tilapia culture should register with fisheries department for necessary guidance on Tilapia culture. The prescribed guidelines ¹ for Tilapia culture should be followed without fail.
<i>Fish Feed Manufacture</i>		
Raw materials	Raw material with high moisture content than desired levels, infested with fungus, pest etc, will lead to health problems when fed to fish.	The raw material should be of good quality and every batch of feed should be sent for testing for aflotoxins etc. and in case of presence of aflotoxins corrective measures to be taken as per the test recommendations.
Milling	Noise pollution to the workers and in the neighborhood due to milling. Fine dust during milling will lead to health issues like allergy, asthma in long run. Consumption on non renewable energy leading to emissions.	Noise protective equipment should be provided to the operator of the machines. Silencer should be attached to the equipment to reduce noise from the equipment to surrounding areas. Person using these machines must wear mask for preventing the problem related to inhalation. Use solar energy to the extent possible.

Table 23: Environment Impacts and Mitigation Measures – Piggery

Component	Possible Environmental Impacts	Mitigation Measures/Environmental guidelines
Breed selection	Selection of breeds that cannot adapt to the local climatic	Selection of suitable species in order to have increased adaptability.

¹ Guidelines for Responsible Farming of Tilapia in India - (<http://seai.in/seaidatafiles/uploads/2012/12/June-2012.pdf>) and <http://nfdb.gov.in/PDF/GUIDELINES/1.%20Guidelines%20for%20Responsible%20Farming%20of%20Tilapia%20in%20India.pdf>

	conditions will lead to loss of livestock or results in low productivity and might have health issues.	Indigenous species should be promoted to the extent possible.
Use of growth promoters	Use of growth promoters for gaining weight may have implications on health	Prohibition of use of hormones for gaining mass, farmers should be made aware of the ill effects.
Shed construction and maintenance	Congested, less ventilated shed results in disease outbreaks.	Sheds should be well ventilated and spacious enough to provide healthy environment. Sheds should be cleaned every day and the liquid waste should not be let into any water bodies.
Feed and manure management	Over feeding results in wastage. Pig manure could be an environmental hazard when it is not disposed/stored in proper manner (storing it openly)	Recommended dosages of feed to be followed. Feed waste to be collected and disposed properly. The manure should be stored in a lined pit to avoid any leachates and properly covered (to be opened and stirred once in a while allow the heat to escape). Integrated farming practices (with fisheries) should be encouraged so as to promote effective use of feed waste and manure.
Disease outbreaks	Improper disposal of manure, carcasses may result in quick spread of diseases and will lead heavy losses.	An awareness program to farmer on precaution measures that needs to be adopted during epidemic/ spreading of infectious diseases in pig should be made available. Knowledge on the possible diseases that could be transmitted from pig to humans should be provided.

Sub Component - Non Timber Forest Produce (NTFP) Development:

The objective of this sub-component is to supplement household earnings through enhanced value addition of NTFPs. The NTFPs selected for the intervention are: lac production on semialata, ber and kusum trees; tamarind fruit; moringa leaves; lemon grass; chironji fruit; tulsi leaves; and honey. The sub-component will also explore potential value-addition of select NTFP through creation of artisanal crafts (for example, bamboo craft, lac jewelry, etc.).

The key activities under the sub-component are: (a) Analytical studies on value chains of selected NTFPs. (b) Investments to: improve timely supply of quality seed material for the selected NTFPs (brood lac, semialata saplings, etc.), provide necessary inputs to farmers (equipment, cultivation cost, etc.), and develop supportive products or services such as

manufacture of apiary boxes. (c) Establish primary and advanced processing units at the cluster level for value addition. (d) Establish a state level center of excellence for research and development and quality control. (e) Training and exposure visits for producers on scientific production/collection, post-harvest management, processing and marketing. (f) innovative pilot interventions such as on artisanal products.

Table 24: Environment Impacts and Mitigation Measures – NTFP

Activity in the value chain or steps in the process	Possible Environmental Impacts	Interventions, Best practices
Permissions for collection of NTFP, or cultivation near forest areas	Issues regarding use of forest land, ownership rights, regulations from forest departments.	Required permission should be taken from Forest Department (differs from produce to produce) for collection and cultivation near forest areas (wherever applicable)
Harvesting of NTFP	NTFP are precious resources and unsustainable harvesting lead to loss of biodiversity.	<p>Training on sustainable harvesting will check the loss of biodiversity.</p> <ul style="list-style-type: none"> • For seed and pod collection, pods should be allowed to ripen on the tree until the outer shell is dry and can be separated from the pulp easily • Pods should be harvested by shaking the branches or climbing the tree or using sickles. They should not be beaten down with sticks as this injures the blossoms and buds of future leaves • All the pods/seeds should not be harvested, at least 25% should be left for natural regeneration
Method of Collection of Raw material.	Destructive methods of collection such as cutting the branches, uprooting the plants, etc. damages the resource. Unscientific methods of collection may affect the quality of product there by leading to less revenue and thus over exploitation. Each forest	Collection period and season of harvesting and tools used for collection should be as per standards prescribed. Trainings on these will help the communities to follow sustainable harvesting methods.

	product has some prescribed norms for collection.	
Processing of forest produce, preparation of herbal products.	<p>Improper drying (drying on bare earth) and storage may contaminate the produce.</p> <p>Processing using machinery for grinding, mixing, boiling etc. may lead to injuries.</p> <p>Energy use in boiling, drying etc. will required fuel wood.</p> <p>Sometimes due to lack of knowledge on mixing of different ingredient led to health issues.</p> <p>Wastes from processing should not be let into open.</p>	<p>Drying of produce should be done on cemented platform.</p> <p>Care to be taken while processing using machinery to avoid injuries and members to be trained on use of machinery. Energy efficient devices should be promoted.</p> <p>The members should be trained in preparation and use (to offer guidance to retailers or consumers).</p> <p>Date of processing and use and precautions of final products should be mentioned on the packets.</p> <p>Homeopathy doctor or Ayurvedic should be consulted for training and guidance at processing units.</p> <p>Waste disposal should be as per the prescribed methods.</p>

Best Practice Guidelines for Lac cultivation:

- Use of superior, healthy breed of lac insects.
- Use of good quality brood lac in appropriate quantity.
- Post harvest management of lac crop, host plant management and lac pest management.
- Quality brood lac ensures high fecundity of insects and fewer requirements of inoculums.
- Timely harvesting of crops and proper inoculation may reduce the risk of loss of lac insect to a large extent
- Avoiding continuous cultivation for several years on the same tree.

Best Practice Guidelines for Apiculture/honey collection:

- Selection of good apiary site and good quality bees
- Frequent inspection of colonies for hygiene
- The frames and boards should be cleaned regularly with hot water
- Use of antibiotics to be avoided

- Spraying of pesticides on bee flora/foraging areas to be avoided. In unavoidable circumstances, bees should be confined to the cages during pesticide spray
- Fumigation to be avoided except for honey extraction
- Safety gear like mask, helmet, gloves to be used while handling the colonies and harvesting

Best Practice Guidelines for Lemon grass cultivation:

- Select the variety suitable to the climate and soil type.
- Use of chemical fertilizers and pesticides to be avoided to the extent possible, shift to organic manures to the extent possible. Follow soil test based nutrient application
- As the crop is usually grown in less rainfall areas, follow soil, moisture conservation measures
- Chose well drained soils, ensure proper drainage, avoid water logging

5.2. Climate Resilience and Measures for Drought Proofing /Drought mitigation

The district wise agriculture contingency plans developed by National Initiative on Climate Resilient Agriculture (NICRA) should be referred for developing crop specific package of practices to integrate climate resilient practices and drought mitigation measures. The pest management aspects are to be referred from the Pest Management Plan (PMP) prepared for the project (annexure 5).

5.3. Classification of JOHAR Interventions based on Environmental Impacts

On the basis of the discussion that held in the preceding sections, JOHAR interventions may be classified as follows with respect to environmental impacts:

Table 25: Classification of Project interventions on the basis Environmental Impacts

Impact Category	Criteria	Project interventions	Application of EMF
Low	These projects may have limited and/or short term adverse impact on the environment and on health. However, these impacts can be mitigated by implementing	Millet production, Dairy, NTFP collection, Fisheries	Simple Environmental Guidelines applied through the use of checklists to ensure compliance. Environmental Appraisal by CPs.
Medium	These projects may have longer term adverse impact on environment, especially at the cumulative level. However, these impacts can be mitigated by implementing	High Value Agriculture, Goat rearing, Cluster service centres	Environmental Guidelines applied through the use of checklists to ensure compliance. Environmental Appraisal by CPs.
High	These projects have long term deteriorating impact on environment and high level of technical intervention is required to identify specific mitigation measures to address the environmental	Irrigation infrastructure	Environment Management Plan. Detailed Environmental Appraisal and EMP by Technical Service providers.

Chapter VI

Environmental Management Framework (EMF)

6.1. Environmental Management Framework (EMF) for JOHAR

Based on the understanding of the project implications on the environment, applicable legal and regulatory framework for the project, key issues and mitigation identified for different sectors; an Environmental Management Framework (EMF) is developed which is presented in this chapter. The EMF discusses the (i) the strategy for environment management of the project interventions (ii) institutional arrangements effective implementation of EMF (iii) capacity building plan for the staff and project beneficiaries (iv) monitoring arrangements.

6.2. Approach to Development of EMF

EMF is designed in consultation with various stakeholders – the target beneficiaries, project teams, concerned Government Department, Non Governmental Organisations (NGOs), through field consultations. The key observations from the field consultations are attached as Annexure 6. Desk reviews are conducted to understand the state of environment in the state and applicable legal and regulatory requirements, best practices and mitigations etc. Comments on the draft report are obtained from the World Bank team. A disclosure workshop was organised for sharing the findings with the stakeholders before finalising the document. A brief report on disclosure workshop is attached as Annexure 7.

6.3. EMF Objective and Strategy

The objective of the EMF is to ensure the environmental sustainability of the project interventions under the component ‘diversified and resilient production and value addition’.

The strategy is to conduct environmental appraisal for the Agri Business Plans of POs, Community Corp Plans of PGs and Micro Irrigation Plans of WUGs) which is a 2 step process:

1. screening the business plan activities for compliance with legal and regulatory framework (Compliance List, provided in Annexure 1)
2. appraisal of the business plans for identifying the potential impacts and mitigation measures

6.4. EMF Implementation Plan

The overview of the EMF implementation plan is as below:

- Institutional Arrangements
- Environmental Appraisal (limited) of the Agri Business Plans/Community Crop Plans/Micro irrigation plans and integration of mitigation measures/ Environmental guidelines
- Environmental Appraisal (detailed) of the Micro Irrigation Infrastructure plans
- Pest Management Plan (PMP)
- Capacity building of the project staff, CPs and beneficiaries
- Monitoring of the implementation
 - Internal monitoring by Environment Specialist

- External audit by external agency
- Budget and timeline for implementation.

6.4.1. Implementation Arrangements

State Level: At State level the thematic lead on HVA will act as nodal person for environmental safeguards and the respective thematic leads (livestock, fisheries, NTFP and irrigation) will handle the responsibility of integrating environmental safeguards into the respective sub components. An environment consultant will be hired at the State level on part time basis to support in implementation. The person will work in coordination with the thematic specialist (HVA, Irrigation, Livestock, Fisheries and NTFP) for effective integration of safeguards into the interventions. The person will plan and oversee the integration of safeguards into the training modules of project staff at District and Block levels, CPs and PGs/FPOs and monitors the implementation through sample field visits.

District Level: At district level safeguards will be anchored by HVA expert and the experts in other thematic areas- irrigation, livestock, fishery and NTFP will be responsible for coordinating the EA of agri business plans/community crop plans/micro irrigation plans and coordinating the integration of EMF into trainings. The state consultant will provide capacity building and monitoring support for the district experts.

Block level: At the block level the thematic cluster coordinators will be responsible for anchoring safeguards. They will be responsible for coordinating the functioning of CPs, coordinating the integration of safeguards into their trainings. The person will also be responsible for monitoring the implementation at block level through monitoring visits.

PG/PO level: The CPs working sector wise are responsible for conducting the EA for business plans and supporting implementation of mitigations and training the PGs/POs.

6.4.2. Environmental Appraisal (EA) of the Business Plans

The EA will be conducted by Community Professionals. The agri business plans of POs, community crop plans of PGs and micro-irrigation plans of WUGs will undergo a process of Environmental Appraisal (EA). During EA the plans will be screened for compliance (of all the proposed activities) with Legal and Regulatory framework and the potential issues are identified along with suitable mitigation measures/environmental guidelines. The screening will be done to verify the adherence to the ‘compliance list’ of activities (annexure 1) which is developed based on legal and regulatory framework. The issues and mitigations in chapter 5 will provide guidance for the appraisal.

The EA for the business plans will be done by the Community Professionals of respective sectors as indicated below:

Table 26: Responsibility of conducting EA for the Business plan

Business Plan	EA Responsibility
Community Crop Plans under HVA	Ajeevika Krishi Mitra (AKM)
Micro Irrigation Plans	Experts identified by SPMU
Business Plans by Livestock PG	Ajeevika Pasu Sakhi (APS)
Business Plans by Fisheries PG	Ajeevika Matsya Mitra (AMM)
Business Plans by NTFP PGs	Ajeeviak Vanopaj Mitra (AVM)
Micro Enterprises	Micro Enterprise Consultants (MECs)

The agri business plans, crop plans will be appraised by the respective CPs with the support of Block level Thematic Cluster Coordinators who are the nodal person for ‘environmental safeguards’ and the key mitigation measures and suggestions identified will be recorded in the EA format (attached as Annexure 2). The EA will also identify the support required for implementation of mitigation measures such as training, financial, convergence etc. The compliance list (Annexure 1) provided under the legal and regulatory framework and the environmental guidelines will serve as reference material for the CPs for conducting the EA. The EA is conducted in discussion with the beneficiaries and it may involve field visit as per the need. The district level HVA expert will verify a sample of proposals for compliance with the process of screening and EA. The other thematic experts will also verify the business plans in their respective thematic areas.

6.4.3. Environmental Appraisal of Micro Irrigation Plans (Infrastructure creation)

The EA of the Micro Irrigation Plans (infrastructure creation) will be conducted by the Technical Service Provider (TSP) given the higher level impacts on the water resources and impacts during the process of installation of lifting devices, irrigation distribution system etc. The TSP will integrate the mitigation measures into the designs/plan. The ‘compliance list’ and the environmental guidelines will be referred during the process of the EA. The format for EA of Micro Irrigation Plans is attached as Annexure 3. The state consultant will provide support and monitor the implementation.

6.4.4. Pest Management Plan (PMP)

The policy 4.09 is triggered for the project in view of potential use/increase of pesticide consumption followed by HVA and irrigation interventions. A Pest Management Plan (PMP) is developed to ensure the compliance of the project with the safeguard policy OP 4.09. The PMP is attached as Annexure 5.

The Package of Practices (PoP) developed for the HVA crops by the Technical Support Agency (TSA) will integrate the PMP principles. This will be verified by the thematic lead, HVA with the support of state consultant. All the IEC material, training modules etc. will be in compliance with the PMP. Safeguards clearance is required for all PoP/IEC materials developed for crops and livestock management which will be issued by HVA thematic lead with support of the consultant. The PoP should essentially include:

- Drought proof and mitigation measures, climate resilience practices
- Pest Management Practices as per the PMP
- Integrated nutrient management practices guidelines by soil testing

6.4.4. Capacity Building Plan

Capacity Building of the Project Team:

The EMF content will be integrated into the respective training modules of different sectors (HVA, Irrigation, Livestock, Fisheries, NTFP etc.) and ready to refer handbooks in local language will be made available for the staff will include the legal and regulatory requirements as well as mitigation measures.

The key content will include:

- Environment, livelihood linkages
- Natural Resource Management for Sustainable Livelihoods

- Impacts of Climate Change on Livelihoods and Climate Resilience , drought proof and mitigation
- Legal and Regulatory requirements in different sectors, compliance list
- Key Issues and mitigation measures, best practices – HVA, Livestock, Fisheries, NTFP
- Pest Management Plan
- Supervision and monitoring
Capacity building plan for CPs
-

Capacity Building of the Community Professionals:

The EMF content will be integrated into the respective capacity building modules of the CPs and the IEC material (small booklets with key issues and mitigations along with pictorial depictions) will be provided to CPs as ready reference materials in local language.

The key content will include:

- Environment, livelihood linkages
- Natural Resource Management for Sustainable Livelihoods
- Impacts of Climate Change on Livelihoods and Climate Resilience , drought proofing and mitigation
- Legal and Regulatory requirements in different sectors, compliance list
- Key Issues and mitigation measures, best practices – HVA, Livestock, Fisheries, NTFP
- Pest Management Plan
- Convergence for best practices
- Process of conducting Environmental Appraisal
- Monitoring indicators

6.4.5. Monitoring

Internal Monitoring:

The EMF implementation needs to be monitored during the project period at different levels. The table below present the key monitoring indicators, monitoring responsibility and frequency of monitoring.

Table 27: Monitoring Plan

Activity/Sub Component	Monitoring indicators	Responsibility	Frequency of monitoring
High Value Agriculture	<u>PG/PO level</u> <ul style="list-style-type: none"> • License for stocking and sale of pesticides, fertilizers by the FPOs • Non use of pesticides under class 1a, 1b and II <u>Farmer level:</u> <ul style="list-style-type: none"> • Non use of pesticides, especially class 1a, 1b and II • Integration of NPM/PMP (minimum of 3 principles) • Soil test based fertilizer application 	Ajeevika Krishi Mitra (AKM)	Once in 6 months
Irrigation	<ul style="list-style-type: none"> • Adoption of micro irrigation 	Technical	Once in a year

	methods	Service Provider	
Livestock/Poultry	<ul style="list-style-type: none"> • Spacious, clean shed/cage etc. • Manure management through composting • Permissions for grazing 	Ajeevika Pasu Sakhi (APS)	Once in 6 months
Fisheries	<ul style="list-style-type: none"> • Recommended ratio of fingerlings • Recommended feed • Responsible Tilapia farming as per guidelines 	Ajeevika Matsya Mitra (AMM)	Once in 6 months
NTFP	<ul style="list-style-type: none"> • Permissions for harvesting where applicable • Percent of beneficiaries trained is sustainable methods of cultivation and harvesting 	Ajeeviak Vanopaj Mitra (AVM)	Once in 6 months
Enterprises	<ul style="list-style-type: none"> • Required permissions/consent taken 	Micro Enterprise Consultants (MECs)	Once in 6 months

The CPs will cover a sample of minimum 10 activities in each sector and will submit a monitoring report to Thematic cluster Coordinator once every 6 months.

In addition to this, the state consultant will do yearly monitoring to (including field visits to districts) to understand the status of implementation.

External Audit:

An external audit will be conducted in 4th year of the project implementation by hiring an external agency to understand the effectiveness of implementation of EMF and the impact.

6.4.6. Budget (tentative)

EMF implementation will require dedicated budget. A tentative budget estimate is presented below:

Table 28: Budget Estimate (tentative)

Task	Unit Cost	Total Budget
Training of CPs	10,00,000	Integrated into overall project costs
Training of Project staff	5,00,000	Integrated into overall project costs
Training on PMP	10,00,000	Integrated into overall project costs
IEC materials	10,00,000 (lumpsum)	10,00,000
Monitoring costs – internal monitoring by consultant	10,00,000	10,00,000
External Audit	25,00,000	25,00,000
Total		45,00,000

Annexure 1: Compliance List

Agriculture:

- Purchase, stock, sale, distribution or exhibition of the following pesticides will not be supported:
 - pesticides classified in Class Ia, Ib and II of WHO classification; (appendix 2 of annexure 5)
 - pesticides banned by the Government of India; (appendix 2 of annexure 5)
- Purchase, stock, sale, distribution or exhibition of pesticides and chemical fertilizers will require license as per The Fertilizer (Control) Order, 1985

Processing:

- Consent for establishment and consent for operation is required from State Pollution Control Board for the following value addition/processing interventions falling under green and orange category industries:

<i>Examples for Orange category industries</i>	<i>Examples for Green category industries</i>
Poultry, hatchery, steeping and processing of grain, flour mills, handloom weaving and power looms (without dyeing and bleaching), organic manure	Rice mills, dal mills, fish/poultry fed manufacture, food processing (fruit and vegetable), spice grinding.

Livestock:

- Grazing of livestock in forest areas require permission from the Forest Department. However traditional forest dwellers have access to grazing areas, pastoralist routes as per the Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006.
- Livestock taken for grazing in forest areas need to be vaccinated

Fisheries

- Fishing is not allowed during ban or closed season from 1st July to 31st August for inland fisheries (reservoirs) during breeding season in order to conserve fish stocks and biodiversity.
- Culturing of banned fish (*Clarias gariepinus* (Thailand Magur), *Aristichthys nobilis* (Bighead carp) will not be supported
- Farming of *Oreochromis sp.* (Tilapia) should follow the specified guidelines²

Forests and Wildlife

- Activities that involve use of forest land for non-forest purposes needs permission from the Forest Department
- Extraction, transport, processing, sale of forest produce including non timber forest produce require permission from the Forest Department. However traditional forest

²Refer:

<http://nfdb.gov.in/PDF/GUIDELINES/1.%20Guidelines%20for%20Responsible%20Farming%20of%20Tilapia%20in%20India.pdf>

dwellers have access as per the Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006.

- Felling of trees without if required should be done only after permission from the Forest Department.
- Activities that involve destruction of wildlife or of wildlife habitat should not be done under the project (eg: clearing, kindling fire, damaging trees (*felling, girdling, lopping, topping, burning, stripping bark and leaves*), quarrying stone, etc., in reserved and protected forests will not be supported.

Any other Activities with Significant Adverse Environmental Impact:

Activities that are likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented, with impacts that may affect an area broader than the site of the activity are not to be supported (eg: slaughter houses, meat processing, use of asbestos for construction of sheds etc.).

Annexure 2: Format for Environmental Appraisal of Business Plans (Crop, Livestock, Fishery, NTFP)

Name of the Producer Group/Producer Organisation:

Village:

Block:

District:

Proposed Activity:

Key Interventions (list out)	Compliance with Legal and Regulatory Framework (Yes/No/Permission required)	Key Environmental Issues	Mitigation Measures	Support required for Mitigation Measures

Signature of the CP:

Signature of the Thematic Cluster Coordinator:

Date:

Annexure 3: Format for Environmental Appraisal of Micro Irrigation Plans (infrastructure)

Name of the Water User Group:

Village:

Block:

District:

Water Source:

Number of Farmers who will be benefited:

Area to be brought under irrigation (acres):

Soil type:

Crop:

Key Interventions (list out)	Compliance with Legal and Regulatory Framework (Yes/No/Permission required)	Key Environmental Issues	Mitigation Measures	Support required for Mitigation Measures

Signature of the TSP:

Date:

Signature of the Thematic Cluster Coordinator:

Annexure 4: Monitoring Format

Name of the CP

Village:

Block:

District:

Activity monitored:

Monitoring indicators	Compliance (Yes, No, Partial)	Remarks

Signature of the CP

Date:

Annexure 5: Pest Management Plan

The primary aim of Pest Management Plan (PMP) is to manage pests and diseases that may negatively affect production of crops so that they remain at a level that is under an economically damaging threshold. Pesticides should be managed to reduce human exposure and health hazards, to avoid their migration into off-site land or water environments and to avoid ecological impacts such as destruction of beneficial species and the development of pesticide resistance. PMP consists of the judicious use of both chemical and nonchemical control techniques to achieve effective and economically efficient pest management with minimal environmental contamination. PMP therefore may include the use of:

- Mechanical and Physical Control;
- Cultural Control;
- Biological Control, and
- Rational Chemical Control

Non Chemical Pest Management:

The pest management will be restricted the methods of mechanical, physical, biological methods unless chemical methods are highly desired. The key methods to be followed are:

- Selection of pest resistant varieties recommended for the state
- Crop rotation to reduce the presence of insects, disease, or weeds in the soil or crop ecosystems
- Support beneficial bio-control organisms—such as insects, birds, mites, and microbial agents—to perform biological control of pests (e.g., by providing a favorable habitat, such as bushes for nesting sites and other original vegetation that can house pest predators and parasites)
- Favor manual, mechanical weed control and/or selective weeding
- Using mechanical controls—such as traps, barriers, light, and sound—to kill, relocate, or repel pests.

The non chemical methods will also include the promotion of the following plant and animal based preparations as pesticides and growth promoters which are proven to be effective.

1. Seed treatment with *Beejamrutha* to offer protection from pathogens, pests and promote good germination (a mixture of cow dung, cow urine, water, lime and handful of soil)
2. Application of *GhanJeevamrutha* – culture of micro organisms to improve nutrient availability to the crop (a mixture of cow dung, cow urine, jaggery, gram flour and soil - preferably from forest)
3. Plant protection by natural pesticides like *Agni Astra*, *Brahma Astra*, *Neem Astra*
 - a. *Agni Astra*: prepared by boiling and fermenting chillies, garlic, tobacco and neem leaves in cow urine.
 - b. *Brahma Astra*: prepared by boiling and fermenting leaves of neem, milk weed, datura, arjun, gilory, karanj and guava in cow urine.
 - c. *Neem Astra*: prepared by adding neem leaf extract in cow dung and urine.

Integrated Pest Management:

IPM is the combined use of multiple methods mentioned above to prevent or suppress pests in a given situation. Although IPM emphasizes the use of nonchemical strategies, chemical control may be an option used in conjunction with other methods. In cases where chemical methods are adopted, it will be in compliance with the OP 4.09, i.e. the pesticides falling under classes 1a, 1b and II will be excluded (appendix 2). Integrated pest management strategies will depend on surveillance to establish the need for control and to monitor the effectiveness of management efforts. Pest surveillance is an effective tool as an information system, which renders pest control methods more effective. It aims at monitoring and forewarning of likely buildup of pests in order to facilitate planning and adoption of suitable control strategy based on ETL. The project will make the necessary arrangements and will provide the trainings for the Agriculture CPs on the same.

The following precautions will be ensured under IPM practices:

Pesticide Application

In cases where the pesticide application is justified, then the beneficiaries will be oriented on the following actions:

- The personnel will be trained to apply pesticides with all necessary precautions during mixing, applications, washing of the sprayers, disposal of spray equipment etc.
- Review and follow the manufacturer's directions on maximum recommended dosage or treatment as well as published reports on using the reduced rate of pesticide application without loss of effect, and apply the minimum effective dose
- Avoid routine "calendar-based" application, and apply pesticides only when needed and useful based on criteria such as field observations, weather data (e.g. appropriate temperature, low wind, etc.),
- Avoid the use of highly hazardous pesticides, particularly by uncertified, untrained or inadequately equipped users. This includes:
 - Pesticides that fall under the World Health Organization Recommended Classification of Pesticides by Hazard Classes 1a, 1b and II should be avoided in all cases and class III to be used only when no practical alternatives are available and where the handling and use of the products will be done in careful manner to avoid affects on health and environment
 - Use only pesticides that are approved by the WHO, that are slightly hazardous (Class III) and are unlikely to present acute hazards (Class IV) Appendix 2, Annexure 5. Use only pesticides that are manufactured under license and registered and approved by the appropriate authority and in accordance with the Food and Agriculture Organization's (FAO's) International Code of Conduct on the Distribution and Use of Pesticides;
 - Use only pesticides that are labelled in accordance with the national and international standards and norms
 - Avoid use of pesticides that have been linked to localized environmental problems and threats
- Maintain and calibrate pesticide application equipment in accordance with manufacturer's recommendations. Use application equipment that is registered in the country of use

- Establish untreated buffer zones or strips along water sources, rivers, streams, ponds, lakes, and ditches to help protect water resources

Pesticide Handling and Storage

Improper pesticides handling and storage may lead to contamination of soils, groundwater, or surface water resources, due to accidental spills during transfer, mixing etc. The following measures will be taken to avoid the issues. The PGs, sPO will be trained in handling and storage of pesticides especially on the following:

- Storage of pesticides in their original packaging, in a dedicated, dry, cool and well aerated location that can be locked and properly identified with signs, with access limited to authorized people. No human or animal food may be stored in this location. The store room should also be designed with spill containment measures and sited in consideration of potential for contamination of soil and water resources
- Purchase and store, no more pesticide than needed and rotate stock using a “first-in, first-out” principle so that pesticides do not become obsolete. Additionally, the use of obsolete pesticides should be avoided under all circumstances; a management plan that includes measures for the containment, storage and ultimate destruction of all obsolete stocks to be prepared by the PGs /POs (in accordance to guidelines by FAO and consistent with country commitments under the Stockholm, Rotterdam and Basel Conventions).
- Operators must read, understand, and follow product label directions for safe mixing, application, and disposal; farmers/labours applying pesticides to be trained on critical operations (e.g., mixing, transfers, filling tanks, and application).
- Mixing and transfer of pesticides should be undertaken in ventilated and well-lit areas, using containers designed and dedicated for this purpose
- Use of Personal Protective Equipment (PPE) such as gloves, overalls, eye protection worn at all times when handling and applying pesticides.
- Mixing and filling the pesticides should be done away from watercourses and drains.
- Spray operation should be done in early mornings and evenings, avoid spraying on cloudy day or a windy day/direction of wind.
- Rinsed water should be collected in a separate tank and disposed of as a hazardous waste, spills should be cleared. The spray equipment and containers should not be washed in water courses and drains
- Collect rinse water from equipment cleaning for reuse (such as for the dilution of identical pesticides to concentrations used for application);
- Empty pesticide containers should not be used for any other purpose (e.g. storing food, water containers). Contaminated containers should be handled as hazardous waste, and should be disposed safely
- Expired chemicals should be disposed off immediately
- Maintain records of pesticide use and effectiveness
- Shower or bath at the end of every day’s work and wear new clean clothes.
- 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. If the insecticide touches the skin, wash off immediately with soap and water.
- Change clothes immediately if they become contaminated with pesticides. Inform the supervisor immediately if one feels unwell.

- In case of accidental swallow or exposure to the spray or pesticides the first aid should be administered immediately and medical help should be sought immediately

Use of antibiotics/growth promoters in livestock rearing (piggery, poultry, fishery):

Use of antibiotics as growth promoters (eg: tylosin, quinolone, tetracycline, gentamicin, amantadine) is one of the issues in livestock rearing especially in intensive farming. These antibiotics are used in low doses which are believed to improve the quality of the meat with low fat and high protein content. However there are ill effects associated with this and one of them is imposing selection pressure for bacterial strains that are resistant to antibiotics (eg: *Escherichia coli*, *Salmonella spp*). Over time the residues of antibiotics in the meat also affects human health leading to side effects. There are also chances of resistance build up in human pathogens. The project will create awareness among the beneficiaries on the side effects of using antibiotics along with food and water for growth promotion. The PGs and POs guidelines will include ban on using the antibiotics for growth promotion.

Implementation Arrangements for PMP:

The PMP will be implemented in all HVA and irrigation system development activities. The implementation will be supported by capacity building of project teams including CPs and monitoring.

Capacity Building:

As part of PMP, the project teams especially the HVA experts and the Agriculture Community Professionals will be trained on PMP in the first year and refresher trainings will be conducted once every year.

- Training the HVA experts and the Agriculture Community Professionals (CPs) on
 - Importance and need for pest management
 - Pest Management Plan for the project
 - Technical aspects in Pest management:
 - Identification of pests and beneficial insects in the field
 - Determining the economic threshold levels (the density at which they begin to cause economically significant losses).of different pests in different crops
 - Designing and supporting the implementation of a pest management strategy giving preference to alternative pest management strategies, with the use of synthetic chemical pesticides as the last option. The indicative list of pest management practices for different crops is provided in the appendix 1.
 - Precautions to be taken during the purchase, store and use of pesticides and disposal of the wastes and containers.
- Information Education and Communication (IEC) materials will be developed targeting the PGs and FPOs which will include – posters, films, hand books etc.

Monitoring:

MIS on agriculture will capture the progress on PMP. Review of PMP will be done as part of regular review meetings on agriculture. The state consultant will provide yearly update on the PMP status based on the field visits and progress reports on PMP. The external audit will also capture the impact of PMP.

Appendix 1: Pest Management Practices for the common Crops

Rice:

Pest/disease/crop stage	Pest Management Practices
Nursery stage Leaf blast	<ul style="list-style-type: none"> Varieties: Rasi, Vikas, Krishna Hamsa, Tulasi, IR 64, Aditya, Swarnadhan, Himalaya 1, Himalaya 2, Himalaya 2216, Pant dhan 10, HKR 228 and PNR 519. Seed selection by putting in plain water and stirring well. Select the sunken seeds and reject the floating ones. Pre-sowing seed treatment by wet method: Soak the selected seeds in a container containing fungicidal solution of mancozeb Seed treatment for eliminating seed borne pathogens can be carried out by dry seed treatment method.
Stem borer	<ul style="list-style-type: none"> Apply neem cake or mustard oil cake (500 g/m²) in soil 15 days prior to sowing in root –knot nematode and stem borer endemic areas.
Main Field	
Stem borer	<ul style="list-style-type: none"> Deep ploughing to expose the soil harbouring insect pests Field sanitation to prevent pest multiplication .Clean cultivation with line sowing Placement of branches of <i>Chromoleana odoratum</i>, <i>Schima wallihii</i>, <i>Artimisia vulgaris</i> in the field for repellent of insect and it also act as perch for predatory birds. Or use wooden bar or bamboo made Birds perch @ 6 no/bigha Clipping of leaf tip of rice seedlings in nursery after uprooting to prevent the spread of insect infestation from nursery to the main field. Installation of pheromone traps @ 16-20/ha in a triangular patter at 60 m distance for trapping the adult male. 6-8 release of egg parasitoides, <i>Trichogramma japonicum</i> and <i>T. chilonis</i> @ 50,000/ha/week starting from 30 days after transplanting. “Trichocard” should be put over the entire infested area throughout the egg laying period of pests. Cut each Trichocard by scissor into 6-12 pieces and distribute over the entire field by fixing them to the plant by using a stapler or adhesive. Spraying of Neem oil 0.03% @ 3 ml/l at 10 DAT followed by second spray after 20 day interval.
Leaf folder	<ul style="list-style-type: none"> Varieties: Vikramarya, Nidhi, IR 24, Radha, Mahananda and Kunti. Deep ploughing to expose the soil harbouring insect pests Clean cultivation with line sowing For bio-control of leaf folder: 6-8 release of egg parasitoides, <i>Trichogramma japonicum</i> and <i>T. chilonis</i>@ 50,000/ha/week starting from 30 days after transplanting. “Trichocard” should be put over the entire infested area throughout the egg laying period of pests. Cut each Trichocard by scissor into 6-12 pieces and distribute over the entire field by fixing them to the plant by using a stapler or adhesive. Spraying of Neem oil 0.03% @ 3 ml/l at 10 DAT followed by second spray after 20 day interval
Brown Plant Hopper	<ul style="list-style-type: none"> Varieties: Vijetha, Chaitanay, Krishnaveni, Pratibha, Vajram, Makom, Pavizham, Mansarovar, CO 42, Jyoti, Chandana, Nagarjuna, Sonasali, Rasmi, Neela, Annanga, Daya, Bhadra, Karthika, Aruna, Remya, Kanakam, Bharathidasan, Remya, Triguna, IET 8116, Rajendra Mahsuri-1, Pant dhan, 11, Rajshree, Bhudeb and Hanseshwari . Sensible use of fertilizer by splitting nitrogen applications can also reduce chances of plant hopper outbreaks. Draining rice fields can be effective in reducing initial infestation levels. The

	<p>field should be drained for 3 - 4 days when heavy infestations occur.</p> <ul style="list-style-type: none"> • Growing no more than two crops per year and using early-maturing varieties reduces plant hopper abundance and damage. • Synchronous planting (planting neighboring fields within 3 weeks) and maintaining a rice-free period may be effective.
Green Leaf Hopper	<ul style="list-style-type: none"> • Transplanting older seedlings (>3 weeks) also reduces viral disease susceptibility transmitted by leafhoppers. • Avoid planting at peak activity (shown by historical records) period to avoid infestation. • Early planting within a given planting period, particularly in the dry season, reduces the risk of insect-vector disease. • Nitrogen should be applied at an optimal level to discourage population build-up and influence plant recovery. • Good weed control in the field and on the bunds removes the preferred grassy hosts and promotes crop vigor. • Crop rotation with a non-rice crop during the dry season decreases disease reservoirs. • Upland rice intercropped with soybean reduces the incidence of leafhoppers on rice compared to rice alone.
Sheath Blight	<ul style="list-style-type: none"> • Varieties: Rasi, Vikas, Krishna Hamsa, Tulasi, IR 64, Aditya, Swarnadhan, Himalaya 1, Himalaya 2, Himalaya 2216, Pant dhan 10, HKR 228 and PNR 519. • Destruction of crop residue • Spray talc based formulation of <i>Trichoderma harzianum</i> along with CMC (Carboxyl Methyl Cellulose) @ 8 g/l • Spraying of Botanicals viz., Cymbopogon 20 EC (Wanis) (5 ml/l) and Neemazal (neemoil) (3 ml/l) at 10 days interval, starting the first spray at symptom appearance.. • Soil amendment with saw dust and FYM at the rate of 1% and application of carbendazim (0.1%) followed by spraying of <i>Trichoderma viride</i> (0.5%).
Rice Blast	<ul style="list-style-type: none"> • Adjust planting time. Sow seeds early, when possible, after the onset of the rainy season. • Split nitrogen fertilizer application in two or more treatments. Excessive use of fertilizer can increase blast intensity.
Bacterial Leaf Blight	<ul style="list-style-type: none"> • Grow tolerant variety: Govinda, IR-36 • Avoid top dressing with nitrogenous fertilizers at panicle initiation stage, instead, top dressing with K₂O (@ 10 kg/ha or application of K₂O @ 5 kg/ha in the form of foliar spray of 3 % solution. • Combine application of <i>Pseudomonas fluorescence</i> and <i>Trichoderma harzianum</i> (0.5%).
<p>Application of natural pesticides/microbial cultures like <i>Beejamrutha</i> for seed treatment, <i>GhanJeevamrutha</i> as microbial culture and <i>Agni Astra</i>, <i>Bharma Astra</i>, <i>Neem Astra</i> for pest control will be promoted through training.</p>	

Maize:

Pest/disease/crop stage	Pest Management Practices
Measures at Pre sowing state – resting stages of insects, pathogens	<ul style="list-style-type: none"> • Adoption of crop rotation • Clean plow down of crop debris • Destruction of crop residue • Selection of tolerant varieties

	<ul style="list-style-type: none"> • Collection and destruction of white grub stages • Deep summer ploughing
Stem borers, Aphids, Thrips, Termites, Turcicum leaf blight (TLB), Maydis leaf blight (MLB), Common rust, Polysora rust, Brown spot, Curvularia leaf spot, etc.	<ul style="list-style-type: none"> • Varieties: HM 10, PAU 352, MALVIYA HYBRID MAKKA 2, PEMH 1, HQPM 7, HQPM 5, HQPM1, SHAKTIMAN 3, SHAKTIMAN 4, PEMH 5, HQPM4 and HSC 1 • Removal and destruction of dead hearts • Release of <i>Trichogramma chilonis</i> @ 1,60,000/ha. on 7 and 15 days old crop onwards at weekly interval
Banded leaf & sheath blight	<ul style="list-style-type: none"> • Varieties: PRATAP KANCHAN 2, PRATAP MAKKA 3, PRATAP MAKKA 5, SHAKTIMAN 1 and SHAKTIMAN 3 • Stripping of 2 lower leaves along with leaf sheath • Seed treatment with <i>Trichoderma harzianum</i> 2.0% WP @ 20 g/kg of seeds
Pythium stalk rot	<ul style="list-style-type: none"> • Plant population should not to exceed 50,000 ha • Good field drainage • Removal of previous crop debris/wheat straw
Bacterial stalk rot	<ul style="list-style-type: none"> • Varieties: PAU 352, PEMH 5, DKI 9202, DKI 9304 • Avoidance of water logging • Field should have proper drainage • Planting of the crop on ridges rather than flat soil • Avoid use of sewage water for irrigation
Fusarium stalk rot	<ul style="list-style-type: none"> • Varieties: PEMH 1, PEMH 2, PRATAP KANCHAN 2, PRATAP MAKKA 3, PRATAP MAKKA 5, SHEETAL, JH 6805, X 1280 • Sanitation and removal of previous crop debris • Lower plant population • Balanced soil fertility, avoid high level of N and low level of K • Use crop rotation with non host crop like soybean
Charcoal rot	<ul style="list-style-type: none"> • Varieties: JHMH 1701, JH 6805 and BIO 9639 • Sanitation and removal of previous crop debris • Deep ploughing • Avoiding water stress at flowering time reduces disease incidence • Balanced soil fertility, avoid high level of N and low level of K • Add <i>Trichoderma harzianum</i> formulation 2.0% WP in furrows at the time of sowing prior mixing with FYM @ 10 g/kg FYM & incubated for 10 days in moist condition for Charcoal rot
Application of natural pesticides/microbial cultures like <i>Beejamrutha</i> for seed treatment, <i>GhanJeevamrutha</i> as microbial culture and <i>Agni Astra</i> , <i>Bharma Astra</i> , <i>Neem Astra</i> for pest control will be promoted through training.	

Red Gram:

Pest/disease/crop stage	Pest Management Practices
Pre sowing measures	<ul style="list-style-type: none"> • Field sanitation, roguing • Deep summer ploughing to control juveniles and adults of nematodes, and resting stages of insect pests. • Sow/plant sorghum/maize/bajra in 4 rows all around cumin crop as a guard/barrier crop • Destroy the alternate host plants • Follow crop rotation with non host crops such as rice, maize, sorghum, tobacco or castor

Soil borne pathogens nematodes and resting stages of insects	<p>Cultural control:</p> <ul style="list-style-type: none"> • Deep ploughing of fields during summer to control nematodes and <i>Helicoverpa</i>. • Three summer ploughings at 10 days interval reduce juvenile population of pests. • For anthracnose and BLB hot water treatment of seeds at 52° C for 10 min. • Growing intercrops such as Pigeon pea, marigold and castor for the control of blister beetle, whitefly and leaf hoppers. <p>Biological control:</p> <ul style="list-style-type: none"> • Seed treatment with <i>Trichoderma viride</i> 1% WP @ 4g per Kg seeds.
Seed sowing/seedling	<ul style="list-style-type: none"> • Use resistant/tolerant varieties • Select seeds from disease free fields • Grow pigeon pea intercropped or mixed with cereal crops like sorghum. • Use certified and weed free seeds.
Leaf webber	<ul style="list-style-type: none"> • Growing intercrops such as marigold, castor etc.
Pigeon pea sterility mosaic (PSM), Mung Bean Yellow Disease (MBYD)	<ul style="list-style-type: none"> • Varieties: ICPL 157, NP(WR)15, Bahar • Destroy sources of sterility mosaic inoculum. • Use yellow sticky traps for the control of whitefly insect vector of MBYD.
Gram pod borer, spotted pod borer	<p>Cultural control:</p> <ul style="list-style-type: none"> • Growing trap crop like marigold on the borders and in between rows as intercrop. • Their flowers shall attract oviposition which can be plucked and disposed off • Follow ridge planting + cover crops like soybean, cowpea, blackgram, greengram, moth bean. • Raise one row of sunflower as intercrop for every 9 rows of pigeon pea. • Field sanitation <p>Biological control:</p> <ul style="list-style-type: none"> • <i>Bacillus thuringiensis sero var kurstaki</i> (3a, 3b, 3c) 5% w WP @ 400-500 g/acre in 200- 400 l of water or <i>Bacillus thuringiensis var. kurstaki</i>, serotype h-CA, 3b, strain z-52 @ 200-300 g/acre or NPV of <i>Helicoverpa armigera</i> 2.0% AS @ 100-200 ml/acre in 200-300 l of water or NPV of <i>Helicoverpa armigera</i> 2.0% AS strain no. GBS/HNPV-01 @ 100-200 ml/acre in 200-300 l of water or Bio-tech international strain no. IBH/HV-9 @ 100-200 ml/acre in 200-300 l of water or Indore bio-tech input & research strain no. IBL-17268 @ 100-200 ml/acre in 200-300 l of water. • Azadiractin 0.03% (300 ppm) neem oil based WSP @ 1000-2000 g in 200-300 l of water/acre. <p>Mechanical control:</p> <ul style="list-style-type: none"> • Setting up light traps @ 1/acre for adults • Erecting of bird perches @ 40/acre for encouraging predatory birds such as King crow, mynah etc. • Use of ovipositional trap crops such as marigold @ 100 plants/acre and collection of larvae from flowers • Installing pheromone traps @ 4-5/acre for monitoring and mass trapping the pests. • Handpick and kill caterpillars or feed them to poultry. This helps when their numbers are low and in small fields. • However, if possible wear gloves when handling hairy caterpillars. Some of them have urticating hairs, which may cause skin irritation.
<p>Application of natural pesticides/microbial cultures like <i>Beejamrutha</i> for seed treatment, <i>GhanJeevamrutha</i> as microbial culture and <i>Agni Astra</i>, <i>Bharma Astra</i>, <i>Neem Astra</i> for pest control will be promoted through training.</p>	

Bhendi/Okra:

Pest/disease/crop stage	Pest Management Practices
Okra shoot and fruit borer	<p>Cultural control:</p> <ul style="list-style-type: none"> • Collect and destroy affected fruits. • Avoid growing Malvaceous crops in sequence. • Remove and destroy affected shoots, fruits by clipping/ nipping off the shoots below the entrance hole. • Set up pheromone traps @ 4-5/acre for monitoring purpose. <p>Biological control:</p> <ul style="list-style-type: none"> • Spray azadirachtin 0.03% (300 ppm) neem oil based WSP @ 1000-2000 ml in 200-400 l of water/acre or azadirachtin 5% W/W neem extract concentrate @ 80 ml in 160 l of water/acre • Spray <i>B. t. var gallariae</i> @ 400-600 g in 200 l of water/acre • Release egg parasitoid, <i>Trichogramma chilonis</i> @ 40,000/acre. • Release first instar larvae of predator, <i>Chrysoperla carnea</i> @ 4,000/acre. • Spray <i>Beauveria bassiana</i> 1% WP @ 1500-2000 g in 160-200 l of water/acre
Whitefly/Yellow vein mosaic virus	<ul style="list-style-type: none"> • Varieties: Pusa Sawani, Pusa A 4, Arka Abhay, Arka Anamika, Varsha Uphar, Hisar Unnat, Hisar Naveen, HBH-142 (F1hybrid), Gujarat Anand Okra-5, CO 1, CO 3, COBH 1, Azad Bhindi -1, Azad Bhindi-3 <p>Cultural control:</p> <ul style="list-style-type: none"> • Field sanitation, roguing • Plant tall border crops like maize, sorghum or pearl millet to reduce whitefly infestations (4 rows). • Install yellow sticky traps @ 2/acre for monitoring purpose • Peppermint plants act as repellent for whitefly. • French bean acts as an attractant plant for predatory thrips. • Grow tolerant varieties • Rain bird type of irrigation <p>Biological control:</p> <ul style="list-style-type: none"> • Conserve predators such as coccinellids, lacewings, spiders, predatory bugs (<i>Dicyphus hesperus</i>), wasps etc. • Conserve parasitoids such as <i>Encarsia</i> sp, <i>Eretmocerus</i> spp. (nymphal and pupal), <i>Chrysocharis pentheus</i> (nymphal) etc. • Release <i>Chrysoperla carnea</i> @ 8,000 larvae/ acre • Spray NSKE 5% or azadirachtin 0.03% (300 ppm) neem oil based WSP @ 1000-2000 ml in 200-400 l of water/acre or azadirachtin 5% W/W neem extract concentrate @ 80 ml in 160 l of water/acre
Leafhoppers	<p>Cultural control:</p> <ul style="list-style-type: none"> • Destroy the alternate host plants. • Use resistant varieties • Okra intercropped with baby corn <p>Biological control:</p> <ul style="list-style-type: none"> • Conserve predators such as <i>Distina albino</i> and <i>Chrysoperla</i> spp. • Conserve parasitoids such as <i>Lymaenon empoascae</i> (egg) • Spray NSKE 5% or azadirachtin 0.03% (300 ppm) neem oil based WSP @ 1000-2000 ml in 200-400 l of water/acre or azadirachtin 5% W/W neem extract concentrate @ 80 ml in 160 l of water/acre
Whitefly	<ul style="list-style-type: none"> • Spray neem seed kernel extract (NSKE) 5% or azadirachtin 5% W/W neem extract concentrate @ 80 g in 160 l of water/acre
<p>Application of natural pesticides/microbial cultures like <i>Beejamrutha</i> for seed treatment, <i>GhanJeevamrutha</i> as microbial culture and <i>Agni Astra</i>, <i>Bharma Astra</i>, <i>Neem Astra</i> for pest control will be promoted through training.</p>	

Potato:

Pest/disease/crop stage	Pest Management Practices
Cultural and Mechanical methods at vegetative stage	<ul style="list-style-type: none"> • Collect and destroy crop debris • Judicious use of fertilizers • Provide irrigation at critical stages of the crop • Avoid water logging • Avoid any stress to the crop as much as possible • Enhance biocontrol activity by avoiding chemical spray, when 1-2 natural enemies are observed. • Collect and destroy disease infected and insect infested plant parts • Collect and destroy eggs and early stage larvae • Handpick the older larvae during early stages of crop • Use yellow and blue sticky traps @ 4-5 trap/acre • Use light trap @ 1/acre and operate between 6 pm and 10 pm • Install pheromone traps @ 4-5/acre for monitoring adult moths activity (replace the lures with fresh lures after every 2-3 weeks) • Erect bird perches @ 20/acre for encouraging predatory birds such as King crow, common mynah etc. • Set up bonfire during evening hours at 7-8 pm
Bacterial wilt	<ul style="list-style-type: none"> • Cultural control: • Use pathogen free tubers. • Disinfect the cutting knife using 1% sodium hypochlorite solution. • Apply lime (dolomite) in the soil as acidic or alkaline soil is not conducive to the bacterial wilt pathogen. • Biological control: • Apply neem cake @ 80 Kg/acre
Late blight	<ul style="list-style-type: none"> • Cultural control: • Use short-duration varieties.
Leaf curl diseases	<ul style="list-style-type: none"> • Cultural control: • Use peppermint repellent plant for whitefly (vector). • Show attractant plant like French bean to attract predatory thrips.
Tobacco caterpillar	<ul style="list-style-type: none"> • Cultural control: • Grow castor as ovipositional trap crop. • Biological control: • Release egg parasitoid, <i>Trichogramma pretiosum</i> @ 20,000/acre/week four times. • Spray NSKE 5% against eggs and first instar larva. • Apply entomopathogenic nematodes (EPNs) @ 2,50,000 infective juveniles of <i>Steinernema feltiae</i>/sq mt area.
Leaf eating caterpillar	<ul style="list-style-type: none"> • Release egg parasitoid <i>Trichogramma pretiosum</i> @ 20,000/ acre/week four times. • Spray NSKE 5% against eggs and first instar larva .
Aphid, thrips and leaf hopper (aphid's transmit potato virus Y (PVY) and potato leaf roll virus (PLRV), whitefly	<ul style="list-style-type: none"> • Varieties: Kufrianand • Use healthy seed, hot and cold weather cultivation, green manuring, irrigation, fertilizer application. • Plant early bulking and/or maturing cultivars to help seed production programme in areas having short aphid-free periods so that the seed crop may escape the population pressure of aphid vectors. • Spray NSKE 5%.
Potato wart	<ul style="list-style-type: none"> • Varieties: Kufrichipsona- 2, Kufrifrysona • Adopt intercropping potato with maize or rotational crops such as bean and radish (reduce population of viable resting spores in soil)
Potato scab	<ul style="list-style-type: none"> • Use healthy tubers and treat the seed tubers with boric acid (3% for 30 minutes)

	<p>before or after cold storage.</p> <ul style="list-style-type: none"> • Maintain optimum soil moisture from tuber initiation. • Practice crop rotation with wheat, peas, oats, barley, lupin, soybean, sorghum, bajra and green manures crops.
Bacterial diseases, black surf / canker	<ul style="list-style-type: none"> • Soak seed tubers in a solution of trisodium phosphate (90 g/l of water) one day before sowing. The tubers should be thoroughly rinsed and dried in shade.
Potato tuber moth	<p>Cultural control:</p> <ul style="list-style-type: none"> • After harvesting, potatoes should be kept in heaps in cool places for another 10-15 days for drying and further curing of skin. Heaps 3-4 meter long, wide at the base and about 1 meter wide at the top are the best. • In hills the harvested potatoes are spread in well-ventilated rooms for drying. • Fresh market potatoes should be stored between 5 to 6 °C. Potatoes that are used for making chips should be stored between 7 and 10 °C. • Collection of left over tubers in the field after harvesting • Storage of healthy tubers in moth proof structures
Bacterial soft rot	<p>Cultural control:</p> <ul style="list-style-type: none"> • Physical damage must be avoided as it encourages post-harvest rots. • Before storage curing is effective and non-chemical control method can be done by • Exposing tubers for 5 days at 15 – 20 °C and 90 - 95% RH.
<p>Application of natural pesticides/microbial cultures like <i>Beejamrutha</i> for seed treatment, <i>GhanJeevamrutha</i> as microbial culture and <i>Agni Astra</i>, <i>Bharma Astra</i>, <i>Neem Astra</i> for pest control will be promoted through training.</p>	

Cabbage/Cauliflower:

Pest/disease/crop stage	Pest Management Practices
Diamond Back Moth	<ul style="list-style-type: none"> • Varieties: Pusa Hybrid-2, Pusa Kartik Sankar, <p>Cultural control:</p> <ul style="list-style-type: none"> • Removal and destruction of plant remnants, stubbles, debris after harvest and ploughing the field. • Trap crop: Sowing 2 rows of bold seeded mustard as a trap crop for every 25 rows of cabbage to attract moths to mustard. Plant the first row 12 days before transplanting and the second row 25 days after transplanting • Grow intercrops such as tomato, garlic, coriander and carrot in alternate rows with cabbage <p>Biological control:</p> <ul style="list-style-type: none"> • Release egg parasitoid, <i>T. chilonis/pretiosum</i> @ 20,000/acre 4-6 times at weekly interval. • Release larval parasitoids, <i>Diadegma semiclausa</i> @ 1,00,000/acre (Hills – below 25 –27°C) or <i>Cotesia plutellae</i> (plains) @ 20,000/acre from 20 days after planting • Conserve other parasitoids such as <i>Brachymeria</i> spp., <i>Eriborus</i> spp. etc. • Fungal pathogens, for example, <i>Paecilomyces</i> spp. and <i>Zoophthora radican</i> are effective. • Foliar spray with 5% NSKE or azadirachtin 0.03% (300 ppm) neem oil based WSP @ 1000-2000 ml in 200-400 l of water/acre
Black rot	<ul style="list-style-type: none"> • Varieties: Pusa Shubra, Pusa Snowball K-1, Pusa Snowball Kt-25 <p>Cultural control</p> <ul style="list-style-type: none"> • Crop sanitation • Resistant varieties • Crop rotation for 2-3 years with non-cruciferous crops
Damping off	<p>Cultural control</p> <ul style="list-style-type: none"> • Quality seed and a chemical or heat pasteurized planting medium should be used.

	<ul style="list-style-type: none"> Excessive watering and poorly drained areas of field should be avoided Use raised beds: more than 15cm height is better for water drainage or use pro trays for raising seedlings
Alternaria leaf spot	<p>Cultural control:</p> <ul style="list-style-type: none"> Long rotations (3 years) without crucifer crops or cruciferous weeds such as wild mustard. Plant later plantings upwind of earlier plantings. Allow for good air circulation (i.e. wide spacings, rows parallel to prevailing winds, not close to hedgerows).
Cabbage Aphid	<p>Cultural Control:</p> <ul style="list-style-type: none"> Install yellow sticky traps, yellow water pan traps @ 12/acre <p>Biological control:</p> <ul style="list-style-type: none"> Conserve parasitoids such as <i>Aphidius colemani</i> (adult and nymph), <i>Diaeretiella</i> spp. (adult and nymph), <i>Aphelinus</i> spp. (adult and nymph) etc. Conserve predators such wasps, green lacewings, earwigs, ground beetles, rove beetles, spiders etc.
Tobacco caterpillar	<p>Cultural control:</p> <ul style="list-style-type: none"> Field sanitation and rouging Repellant plants: Ocimum/Basil Setting up light traps for adults @ 1/acre. Erecting of bird perches for encouraging predatory birds such as mynah, drongo etc. Use of ovipositional trap crops such as castor @ 250 plants/acre and collection of larvae from flowers Installing pheromone traps @ 4-5/acre for monitoring insect activity <p>Biological control:</p> <ul style="list-style-type: none"> Spray NSKE 5% against eggs and first instar larvae. Spray NPV @ 40LE/ac in combination with jaggery 1 kg, sandovit 100 ml or Robin Blue 50 g thrice at 10-15 days interval on observing the eggs or first instar larvae in the evening hours. Conserve parasitoids such as <i>Trichogramma chilonis</i> (egg), <i>Tetrastichus</i> spp. (egg), <i>Telenomus</i> spp. (egg), <i>Carcelia</i> spp. (larval-pupal), <i>Campoletis chlorideae</i> (larval) etc. Conserve predators such as lacewings (<i>Chrysoperla carnea</i>), coccinellids, king crow, dragonfly, spider, robber fly, reduviid bug, praying mantis, fire ants etc.
Cabbage butterfly	<p>Cultural control:</p> <ul style="list-style-type: none"> Fine-mesh netting in nursery will stop butterflies from reaching the crop and lay eggs. Collect and destroy eggs or caterpillars mechanically by hand- usually on the underside of the leaves. Intercropping cabbages with <i>Nasturtium</i> results in fewer eggs laid on cabbage by the butterflies. <p>Biological control:</p> <ul style="list-style-type: none"> Release <i>Trichogramma</i> spp. Erect bird perches Conserve parasitoids such as <i>Cotesia glomeratus</i> (larval), <i>Pteromalus puparum</i> (larval) etc.
Application of natural pesticides/microbial cultures like <i>Beejamrutha</i> for seed treatment, <i>GhanJeevamrutha</i> as microbial culture and <i>Agni Astra</i> , <i>Bharma Astra</i> , <i>Neem Astra</i> for pest control will be promoted through training.	

Brinjal:

Pest/disease/crop stage	Pest Management Practices
Damping off, wilt, root rot in nursery and main field	<ul style="list-style-type: none"> • Varieties: Pusa Purple Cluster, Pusa Anupama, Arka Anand, Arka Keshav, Arka Nidhi, Arka Neelkanths, JC-1, JC-2, Pant Samrat, Pant Brinjal Hybrid 1 <p>Cultural control</p> <ul style="list-style-type: none"> • Raised nursery bed. • Avoid excess dose of nitrogenous and phosphorous fertilizers. • Use of plug tray method and sterilized potting mixture <p>Biological control:</p> <ul style="list-style-type: none"> • Seed treatment with <i>Trichoderma viride</i> 1% WP @ 5 g/kg of seed. Make a thin paste of required quantity of <i>Trichoderma viride</i> 1% WP with minimum volume of water and coat the seeds uniformly, shade dry the seeds just before sowing. • Seedling root dip treatment: Mix 10 g of <i>Trichoderma viride</i> 1% WP in one l of water and dip the brinjal seedling root for 15 minutes • Soil treatment (main field): Mix 1.0 kg of <i>Trichoderma viride</i> 1% WP with 25 kg FYM and broadcast uniformly over an acre of land and irrigate the field immediately
Cultural/mechanical/biological measures at vegetative stage	<p>Common cultural practices:</p> <ul style="list-style-type: none"> • Collect and destroy diseased and insect infected plant parts. • Provide irrigation at critical stages of the crop • Avoid water stress and water stagnation conditions. • Enhance parasitic activity by avoiding chemical spray, when 1-2 larval parasitoids are observed <p>Common mechanical practices:</p> <ul style="list-style-type: none"> • Collection and destruction of eggs and early stage larvae • Handpick the older larvae during early stages • The infested shoots may be collected and destroyed • Handpick the gregarious caterpillars and the cocoons which are found on stem and destroy them in kerosene mixed water. • Use yellow sticky traps for aphids and whitefly @ 4-5 trap/acre. • Use light trap @ 1/acre and operate between 6 pm and 10 pm • Install pheromone traps @ 4-5/acre for monitoring adult moths activity (replace the lures with fresh lures after every 2-3 weeks) • Erecting of bird perches @ 20/acre for encouraging predatory birds such as King crow, common mynah etc. • Set up bonfire during evening hours at 7-8 pm • Collection and destruction of eggs and early stage larvae • Handpick the older larvae during early stages • The infested shoots may be collected and destroyed • Handpick the gregarious caterpillars and the cocoons which are found on stem and destroy them in kerosene mixed water. • Use yellow sticky traps for aphids and whitefly @ 4-5 trap/acre. • Use light trap @ 1/acre and operate between 6 pm and 10 pm
Shoot and fruit borer	<ul style="list-style-type: none"> • Varieties: HLB-12, JC-1, GBH-1, JC-2, Pant Brinjal Hybrid 1, PPI 1 <p>Cultural control:</p> <ul style="list-style-type: none"> • Continuous cropping of brinjal and potato in the same area encourages the pest activity and hence proper rotation should be followed. • Use resistant varieties • Intercropping of brinjal (2 rows) with coriander (one row) or fennel (1 row). • Install pheromone traps @ 4-5/acre for monitoring and 10/acre for mass trapping at 10 m distance from 20 DAT, the pheromone septa should be

	<p>changed at regular interval. Place the traps either at canopy level or at slightly above the canopy level for effective attraction</p> <ul style="list-style-type: none"> • Promptly remove and destroy infested shoots and fruit at regular intervals until final harvest. <p>Biological control:</p> <ul style="list-style-type: none"> • Release <i>Trichogramma chilonis</i> at 20,000/acre/week commencing from 21 days after transplanting (based on adult activity) till end of the crop. Trichocards should be tied to sticks placed at 4-5 m apart in the field in the evening prior to 1 day of parasitoid adult emergence • Conserve predators such as <i>Campyloneura</i> sp (a bug), <i>Cheilomenes sexmaculata</i> (a ladybird beetle), <i>Coccinella septempunctata</i> (seven spotted ladybird beetle), <i>Brumoides suturalis</i> (three striped ladybird), <i>C. carnea</i> (lacewing) • Conserve parasitoids such as <i>Pseudoperichaeta</i> sp (tachinid fly) <i>Phanerotoma</i> sp, <i>Itamoplex</i> sp, <i>Eriborus argenteopilosus</i>, <i>Diadegma apostate</i>, <i>Pristomerus testaceus</i>, <i>Trathala flavor-orbitalis</i>, <i>Bracon greeni</i> • Spray azadirachtin 1% EC (10000 ppm) nee based EC @ 400-600 ml in 400 l of water/acre or azadirachtin 0.03% (300 ppm) nee oil based WSP @ 1000-2000 ml in 200-400 l of water/acre • Spray NSKE 5%
Bacterial wilt	<ul style="list-style-type: none"> • Varieties: Pusa Purple Cluster, Pusa Anupama, Arka Anand, Arka Keshav, Arka Nidhi, Arka Neelkanths, JC-1, JC-2, Pant Samrat, Pant Brinjal Hybrid <p>Cultural control:</p> <ul style="list-style-type: none"> • Growing resistant varieties • Crop rotation with non-solanaceous hosts. Since pathogen is soil born, a rotation with inclusion of maize, soybean, wheat, rice, gingelly and green manuring has been found effective in reducing the disease in infested soil. • Green manuring with <i>Brassica</i> sp (biofumigation) • Soil solarization with a transparent polyethylene sheet (125 µm thick) for 8-10 weeks during March-June in nurseries <p>Biological control:</p> <ul style="list-style-type: none"> • Use neem cake. • Mix 1 kg of <i>Trichoderma viride</i> 1% WP with 25 kg FYM and broadcast uniformly over an acre of land and irrigate the field immediately.
Mealybugs	<p>Cultural control:</p> <ul style="list-style-type: none"> • Removal of weeds and alternate host plants like hibiscus, bhindi, custard apple, guava etc in and nearby vineyards throughout the year. <p>Biological control:</p> <ul style="list-style-type: none"> • Conserve the natural enemies.
Aphids	<p>Cultural control:</p> <ul style="list-style-type: none"> • Check transplants for aphids before planting. • Reflective mulches such as silver colored plastic can deter aphids from feeding on plants. • Sturdy plants can be sprayed with a strong jet of water to knock aphids from leaves. <p>Biological control:</p> <ul style="list-style-type: none"> • Release 1st instar larvae of green lacewing bug (<i>Chrysoperla zastrowi sillemi carnea</i>) @ 4,000 larvae/acre. • Spraying with tobacco decoction (1 Kg tobacco boiled in 10 l of water for 30 minutes and making up to 30 l + 100 g soap).
Whitefly	<p>Cultural control:</p> <ul style="list-style-type: none"> • Water sprays may also be useful in dislodging adults. • A small, hand-held, battery-operated vacuum cleaner has also been recommended for vacuuming adults off leaves. Vacuum in the early morning

	<p>or other times when it is cool and whiteflies are sluggish. Kill insects by placing the vacuum bag in a plastic bag and freezing it overnight. Contents may be disposed of the next day. Fumigating with a small petrol soaked cotton ball.</p> <ul style="list-style-type: none"> • For biological control follow common practices.
<p>Application of natural pesticides/microbial cultures like <i>Beejamrutha</i> for seed treatment, <i>GhanJeevamrutha</i> as microbial culture and <i>Agni Astra</i>, <i>Bharma Astra</i>, <i>Neem Astra</i> for pest control will be promoted through training.</p>	

Chilli:

Pest/disease/crop stage	Pest Management Practices
Aphids	<ul style="list-style-type: none"> • Varieties: Pusa Sadabahar, Arka Harita, Arka Meghana, Arka Sweta, Hisar Shakti, Hisar Vijay, Pant C-1 <p>Biological control:</p> <ul style="list-style-type: none"> • Conserve parasitoids such as <i>Aphidius colemani</i>, <i>Diaeretiella</i> spp. <i>Aphelinus</i> spp. etc. • Conserve predators such as anthocorid bugs/pirate bugs (<i>Orius</i> spp.), mirid bugs, syrphid/hover flies, green lacewings (<i>Mallada basalis</i> and <i>Chrysoperla carnea</i>), predatory coccinellids (<i>Stethorus punctillum</i>), staphylinid beetle (<i>Oligota</i> spp.), predatory cecidomyiid fly (<i>Aphidoletis aphidimyza</i>) and predatory gall midge, (<i>Feltiella minuta</i>), earwigs, ground beetles, rove beetles, spiders, wasps etc.
Yellow mite/other mites	<ul style="list-style-type: none"> • Varieties: Phule Jyoti, Phule Mukta <p>Cultural control:</p> <ul style="list-style-type: none"> • Chilli crop bordered by two rows of maize at every 0.5 acre area (31.2 x 60 sqm). <p>Biological control:</p> <ul style="list-style-type: none"> • Conserve the predators such as predatory mite (<i>Amblyseius ovalis</i>), predatory bug (<i>Orius</i> spp.), spiders etc. • If the incidence of mites is low, spray neem seed powder extract 4% at 10 days interval
Tobacco caterpillar	<p>Cultural control:</p> <ul style="list-style-type: none"> • Field sanitation and rouging • Castor can be grown as a trap crop along the field border to attract the egg laying female adult moths (collect and destroy the laid egg masses and gregarious neonates) • Pest repellent plants: Ocimum/Basil • Setting up light traps for collecting adults @ 1/acre • Erecting of bird perches for encouraging predatory birds such as king crow, mynah etc. • Install pheromone traps @ 4-5/acre for monitoring adult moth activity. Replace the lures with fresh lures after every 2-3 weeks <p>Biological control:</p> <ul style="list-style-type: none"> • Spray NSKE 5 % against eggs and first instar larva. • Spray B. t. var gallariae @ 600-800 g in 400 l of water/acre • Conserve parasitoids such as <i>Trichogramma chilonis</i> (egg), <i>Tetrastichus</i> spp. (egg), <i>Telenomus</i> spp. (egg), <i>Chelonus blackburni</i> (egg-larval), <i>Carcelia</i> spp. (larval-pupal), <i>Campoletis chlorideae</i> (larval), <i>Eriborus argentiopilosus</i> (larval), <i>Microplitis</i> sp etc. • Conserve predators such as <i>Chrysoperla carnea</i>, coccinellids, King crow, common mynah, wasp, dragonfly, spider, robber fly, reduviid bug, praying mantis, fire ants, big eyed bugs (<i>Geocoris</i> sp), pentatomid bug (<i>Eocanthecona furcellata</i>), earwigs, ground beetles, rove beetles etc.
Gram pod borer	<p>Cultural control:</p> <ul style="list-style-type: none"> • Field sanitation and rouging

	<ul style="list-style-type: none"> • Erecting suitable physical barriers such as nylon nets. • Growing intercrops such as cowpea, onion, maize, coriander, urdbean in 5 or 4:1 ratio • Guard crop sorghum or maize in 4 rows all around cotton crop as guard crop. • Rotate the chilli crop with a non-host cereal crop, cucurbit, or cruciferous vegetable. • Repellant plants: Ocimum/Basil • Erecting of bird perches for encouraging predatory birds such as king crow, mynah, and drongo etc. • Install pheromone traps @ 4-5/acre for monitoring adult moths activity. Replace the lures with fresh lures after every 2-3 weeks. • Use of ovipositional trap crops such as marigold @ 100 plants/acre 1 row of marigold for every 18 rows of chilli and collection of larvae from flowers (marigold seedling of 45 days should be planted along with chilli transplanting) <p>Biological control:</p> <ul style="list-style-type: none"> • Release of egg parasitoid <i>Trichogramma pretiosum</i> @ 50,000 adults (in the form of parasitized card)/acre/week commenced right from the start of flower initiation to till end of the crop, tie the egg cards on the stick placed through out the field at 4-5 m apart, in the evening, a day prior to the emergence of adult. • Conserve parasitoids such as <i>Tetrastichus</i> spp. (egg), <i>Telenomus</i> spp. (egg), <i>Campoletis chlorideae</i> (larval) etc. • Conserve predators such as <i>Chrysoperla carnea</i>, coccinellids, King crow, common mynah, wasp, dragonfly, spider, robber fly, reduviid bug, praying mantis, fire ants, big eyed bugs (<i>Geocoris</i> sp), pentatomid bug (<i>Eocanthecona furcellata</i>), earwigs, ground beetles, rove beetles etc.
Die back and fruit rot	<ul style="list-style-type: none"> • Varieties: Hisar Shakti, Hisar Vijay, TNAU Chilli Hybrid Co 1 <p>Cultural control:</p> <ul style="list-style-type: none"> • Production of pathogen-free planting materials is the key control measure used to manage the disease. • Use healthy pathogen-free chilli seed • Early removal of affected plants will control the spread of the diseases. • Transplants should be kept clean by controlling weeds and solanaceous volunteers in the vicinity of the transplant houses • Stagnation of water should not be allowed in nursery beds and fields in order to avoid fungal infection. The field should have good drainage and be free from infected plant debris.
Mosaic	<ul style="list-style-type: none"> • Varieties: Arka Suphal, Arka Harita, Arka Meghana, Hisar Shakti, Hisar Vijay, Phule Mukta <p>Cultural control:</p> <ul style="list-style-type: none"> • Select healthy seed for planting. • Crop rotation with non-hosts. • Control perennial weed hosts. • Rogue out and destroy infected plants in early stages of infection. • Grow disease tolerant varieties. • Raise 4 rows of maize or sorghum as border crop to restrict the spread of aphid vectors. • Cover the seed bed with nylon net or paddy straw.
<p>Application of natural pesticides/microbial cultures like <i>Beejamrutha</i> for seed treatment, <i>GhanJeevamrutha</i> as microbial culture and <i>Agni Astra</i>, <i>Bharma Astra</i>, <i>Neem Astra</i> for pest control will be promoted through training.</p>	

Tomato:

Pest/disease/crop stage	Pest Management Practices
Pre sowing	<p>Common cultural practices:</p> <ul style="list-style-type: none"> • Deep summer ploughing • Follow crop rotation with non-host crops • Destroy the alternate host plants • Sow sorghum/maize/ryegrass in 4 rows all around the main crop as guard/barrier crop
Measures at vegetative stage	<p>Common cultural practices:</p> <ul style="list-style-type: none"> • Collect and destroy crop debris • Provide irrigation at critical stages of the crop • Avoid water logging • Avoid water stress during flowering stage • Judicious use of fertilizers • Enhance parasitic activity by avoiding chemical spray, when 1-2 larval parasitoids are observed • Field sanitation • Ecological engineering of tomato with growing intercrops such as cowpea, onion, maize, coriander, urdbean etc. • Grow 4 rows of maize/sorghum/bajra around the field as a gourd guard/barrier crop. <p>Common mechanical practices:</p> <ul style="list-style-type: none"> • Collection and destruction of eggs and early stages of larvae • Collect and destroy disease infected and insect damaged plant parts • Handpick the older larvae during early stages of plant • The infested shoots and seed capsules may be collected and destroyed • Handpick the gregarious caterpillars and the cocoons which are found on stem and destroy them in kerosene mixed water. • Use yellow/blue pan water / sticky traps @ 4-5 trap/acre • Use light trap @ 1/acre and operate between 6 pm and 10 pm • Install pheromone traps @ 4-5/acre for monitoring adult moths activity (replace the lures with fresh lures after every 2-3 weeks) • Erecting of bird perches @ 20/acre for encouraging predatory birds such as king crow, common mynah etc. • Set up bonfire during evening hours at 7-8 pm
Damping off	<p>Cultural control:</p> <ul style="list-style-type: none"> • Excessive watering and poorly drained areas of field should be avoided • Use raised beds: 15 cm height is better for water drainage or use pro-trays for raising seedlings <p>Biological control:</p> <ul style="list-style-type: none"> • Seed treatment with <i>Trichoderma viride</i> 1 % WP@ 9 g/Kg of seed.
Early blight	<p>Cultural control:</p> <ul style="list-style-type: none"> • Change the nursery beds location every season, eradicate weeds and volunteer tomato plants, fertilize properly
Bacterial Wilt	<ul style="list-style-type: none"> • Varieties: Arka Ananya, Arka Abhijit, Arka Abha, Arka Alok <p>Cultural control:</p> <ul style="list-style-type: none"> • Rotate with non-host crops, particularly with paddy • Restriction of irrigation water flowing from affected field to healthy field <p>Biological control:</p> <ul style="list-style-type: none"> • Neem cake @ 100 Kg/acre
Fusarium wilt	<p>Biological control:</p> <ul style="list-style-type: none"> • Seed treatment with <i>Trichoderma viride</i> 1% WP @ 9 g/Kg seed

	<ul style="list-style-type: none"> • Root zone application: Mix thoroughly 2.5 Kg of the T. viride 1% WP in 150 Kg of compost or farmyard manure and apply this mixture in the field after sowing/transplanting of crop
Leaf curl	<ul style="list-style-type: none"> • Varieties: Arka Ananya, Kashi Vishesh, Kashi Amrit, COTH 2, TNAU Tomato Hybrid Co3 <p>Cultural control: Raising nursery in protected condition (with net of sufficient mesh size to prevent the entry of vector, whitefly)</p>
Gram Pod borer	<p>Biological control:</p> <ul style="list-style-type: none"> • Inundatively release T. pretiosum @ 40,000/acre 4-5 times from flower initiation stage at weekly intervals • Spray azadirachtin 1% (10000 ppm) neem based EC @ 400-600 ml in 200 l of water/acre or azadirachtin 5% W/W neem extract concentrate @ 80 g in 160 l of water/acre • Spray Ha NPV 0.43% AS @ 600 ml in 160-240 l of water/acre or Ha NPV 2% AS @ 100-200 ml in 200 l of water/acre in combination with jaggery @ 1 Kg in the evening hours at 10-15 days interval on observing the eggs or early instar larvae or Ha NPV 0.43% AS (Strain No. BIL/HV-9) @ 600 ml in 160-240 l of water/acre or NPV 2% AS Strain No. GBS/HNPV-01 (BIL/HV-9) @ 100-200 ml in 200 l of water/acre • Spray <i>Bacillus thuringiensis vargallariae</i> @ 400-600 g in 200 l of water/acre
Application of natural pesticides/microbial cultures like <i>Beejamrutha</i> for seed treatment, <i>GhanJeevamrutha</i> as microbial culture and <i>Agni Astra</i> , <i>Bharma Astra</i> , <i>Neem Astra</i> for pest control will be promoted through training.	

Papaya:

Pest/disease/crop stage	Pest Management Practices
Pre planting	<ul style="list-style-type: none"> • Deep ploughing of fields during summer to control nematodes population and weeds • Soil solarization • Timely sowing should be done. • Field sanitation, rogueing. • Apply manures and fertilizers as per soil test recommendations. • Plant tall border crops like maize, sorghum or millet to reduce white fly and aphids
Planting	<ul style="list-style-type: none"> • Planting to be done in pits already filled with top soil and farm yard manure. • Apply 20g each of Azospirillum and Phosphobacterium per plant at planting and again six months after planting
Main crop – soil borne pathogens	<p>Cultural control:</p> <ul style="list-style-type: none"> • Intercropping of marigold reduces nematode population • Nursery should be raised in nematode free sites or fumigated or solarized beds • Application of decomposed poultry manure @ 200 g / sq. m <p>Biological control:</p> <ul style="list-style-type: none"> • Apply neem cake @ 100 Kg/acre at the time of transplanting for reducing nematodes and borer damage.
Soil borne diseases	<p>Cultural control:</p> <ul style="list-style-type: none"> • Seedling raised in insect proof conditions. • Sow 4-5 seeds/bag then retain 3 seedlings. • 2 month old seedling is ready for transplanting • Papaya don't withstand water logging, hence well drained upland fields should be selected for cultivation.

	<ul style="list-style-type: none"> • Under drip, ring method should be followed. • Wind break: should be grown to protect from strong wind also save tree from cold damage <p>Mechanical control:</p> <ul style="list-style-type: none"> • Remove and destroy virus infected seedlings/plants. <p>Biological control</p> <ul style="list-style-type: none"> • Apply Neem seed kernel extract (NSKE) 5%/groundnut oil @ 1-2% on to the plants to manage the vector population.
Nematodes and insects	<p>Cultural control:</p> <ul style="list-style-type: none"> • Use resistant/tolerant varieties. • Sowing should be completed within recommended periods. • Intercropping with sunnhemp or marigold or daincha. <p>Biological control:</p> <ul style="list-style-type: none"> • Use mahua [<i>Madhuca longifolia</i>], castor, neem and karanj [<i>Pongamia pinnata</i>] cakes, biogas sludge applied at 1.0 t/acre during pit preparation. • Apply 2 tons of FYM enriched with <i>Pochonia chlamydosporia</i> and <i>Paecilomyces lilacinus</i>/acre before sowing, along with 100-200 Kg of neem or pongamia cake. • Apply neem based products (Neemagon, Bioneem, Neemraj etc.) for controlling this pest.
Mealy bugs	<p>Cultural control:</p> <ul style="list-style-type: none"> • Removal of weeds and alternate host plants like hibiscus, bhindi, custard apple, guava etc in and nearby vineyards throughout the year. <p>Biological control:</p> <ul style="list-style-type: none"> • Conserve the natural enemies.
Aphids	<p>Cultural control:</p> <ul style="list-style-type: none"> • Check transplants for aphids before planting. • Reflective mulches such as silver colored plastic can deter aphids from feeding on plants. • Sturdy plants can be sprayed with a strong jet of water to knock aphids from leaves. <p>Biological control:</p> <ul style="list-style-type: none"> • Release 1st instar larvae of green lacewing bug (<i>Chrysoperla zastrowi sillemi carnea</i>) @ 4,000 larvae/acre. • Spraying with tobacco decoction (1 Kg tobacco boiled in 10 l of water for 30 minutes and making up to 30 l + 100 g soap).
Whitefly	<p>Cultural control:</p> <ul style="list-style-type: none"> • Water sprays may also be useful in dislodging adults. • A small, hand-held, battery-operated vacuum cleaner has also been recommended for vacuuming adults off leaves. Vacuum in the early morning or other times when it is cool and whiteflies are sluggish. Kill insects by placing the vacuum bag in a plastic bag and freezing it overnight. Contents may be disposed of the next day. Fumigating with a small petrol soaked cotton ball. • For biological control follow common practices.
Stem borer	<p>Cultural control:</p> <ul style="list-style-type: none"> • Pierce the infested plants with a sharp needle or knife to kill the caterpillar in the stem. • For others see common practices.
Papaya hoppers	<ul style="list-style-type: none"> • Removal of weeds and alternate host plants such as Hibiscus, bhindi, custard apple, guava etc. • For other practices follow common practices.
Mite	<ul style="list-style-type: none"> • See common cultural practices • Spray NSKE(5%)
Foot Rot	<p>Cultural control :</p>

	<ul style="list-style-type: none"> • The crop should be irrigated by adopting the ring method of irrigation so that the water does not come in direct contact with the stem. • Avoid water logging.
Anthracnose	<p>Cultural control:</p> <ul style="list-style-type: none"> • Diseased leaves, twigs, gall midge infected leaves and fruits, should be collected and burnt. • Covering the fruits on trees, 15 days prior to harvest with news or brown paper bags.
Powdery mildews	<p>Mechanical control:</p> <ul style="list-style-type: none"> • Prune diseased leaves to reduce primary inoculum load. • Keep proper spacing during sowing.
Papaya mosaic virus	<p>Cultural control:</p> <ul style="list-style-type: none"> • Good field sanitation such as removal and destruction of affected plant reduce the spread of the disease. • Losses can be minimized controlling the population of aphid.
Papaya leaf curl virus	<p>Cultural control:</p> <ul style="list-style-type: none"> • Uproot the virus affected plants • Avoid growing tomato, tobacco near papaya. • Control whitefly vector. • Removal and destruction of the affected plants is the only control measure to reduce the spread of the disease. • The field should be kept weed free. Tobacco, tomato, sunnhemp, cape gooseberry, chilli, petunia, <i>Datura stramonium</i>, <i>Zinnia elegans</i> etc. should not be grown nearby papaya field.
Papaya ring spot virus	<p>Cultural control:</p> <ul style="list-style-type: none"> • Use of yellow sticky strap to control of aphid vector. • Use of resistant varieties. • Early detection of infected plants and prompt removal can check the spread of the disease. • Rogue out infected plants of papaya as early as possible to avoid further infection within the field. • Avoid taking mixed crop of tobacco, chilli, <i>Zinnea</i>, tomato and gooseberry in papaya field or nearby.
Fruit fly	<p>Cultural control:</p> <ul style="list-style-type: none"> • Prior to harvest, collect and dispose off infested and fallen fruits to prevent further, multiplication and carry-over of population. • Ploughing of orchard during November-December to expose pupae to sun's heat which kills them. • Managing fruit flies also reduces anthracnose disease and prevents late fruit fall. <p>Physical control:</p> <ul style="list-style-type: none"> • Hot water treatment of fruit at 48 ± 1 °C for 45 min. • Male annihilation technique: Set up fly trap using methyl eugenol. Prepare methyl eugenol 1 ml/L of water + 1 ml of malathion solution. Take 10 ml of this mixture per trap and keep them at 25 different places in one ha between 6 and 8 am. Collect and destroy the adult flies <p>Biological control:</p> <ul style="list-style-type: none"> • See common practices.
Scale insects	<p>Cultural control:</p> <ul style="list-style-type: none"> • Prune heavily infested plant parts to open the tree canopy and destroy' them immediately and preferably during summer. • These should be placed in a pit constructed on one corner of the orchard. Allow branches and twigs to dry until the parasites escape. • Burn the remaining debris. • Removal of attendant ants may permit natural enemies to control the insect.

Grey weevil	<p>Cultural control:</p> <ul style="list-style-type: none"> • Collection and destruction of infested and fallen fruits at weekly interval till harvest fruit. • Destroy all left over seeds in the orchard and also in the processing industries.
Aphids	<p>Cultural control:</p> <ul style="list-style-type: none"> • Check transplants for aphids before planting. • Reflective mulches such as silver colored plastic can deter aphids from feeding on plants. • Sturdy plants can be sprayed with a strong jet of water to knock aphids from leaves. <p>Biological control:</p> <ul style="list-style-type: none"> • Release 1st instar larvae of green lacewing bug (<i>Chrysoperla zastrowi sillemi carnea</i>) @ 4,000 larvae/acre. • Spraying with tobacco decoction (1 Kg tobacco boiled in 10 l of water for 30 minutes and making up to 30 l + 100 g soap).

Banana:

Pest/disease/crop stage	Pest Management Practices
<p>Pre planting Nematodes, banana corm weevil and diseases</p>	<ul style="list-style-type: none"> • Varieties: Poovan, Kadali, Kunnan, Poomkalli <p>Cultural control:</p> <ul style="list-style-type: none"> • Deep ploughing during summer. • Use of disease free planting material. • Storage of large corms in the sun for two weeks prior to planting. • Select healthy suckers. • Avoid growing Robusta, Karpooruvally, Malbhog, Champa and Adukkar. • Grow less susceptible varieties like Poovan, Kadali, Kunnan, Poomkalli. • Intercropping of banana with <i>Crotalaria juncea</i>, marigold reduces burrowing nematodes
Leaf eating caterpillar	<p>Cultural control:</p> <ul style="list-style-type: none"> • Collect and destroy egg masses and caterpillars • Use burning torch to kill the congregating larvae • Summer ploughing to expose to the pupae. • Grow repellent plants: Ocimum/basil • Attractant plants: Carrot family, sunflower family, buckwheat, alfalfa, corn • Nectar rich plants with small flowers i.e anise, caraway, dill, parsley, mustard, sunflower, buckwheat and cowpea (Braconid wasp) <p>Mechanical control:</p> <ul style="list-style-type: none"> • Hand pick and destroy the egg masses and caterpillars • Collect and destroy the damaged plant parts. • Use pheromone @ 4-5 traps/acre. • Use light trap to attract and kill the adults. <p>Biological control:</p> <ul style="list-style-type: none"> • Field release of egg parasitoids such as <i>Telenomus spodopterae</i>, <i>T. remus</i> • Encourage the activity of larval parasitoids <i>Ichneumon promissorius</i>, <i>Carceliaspp.</i>, <i>Campoletis chlorideae</i> • Pupal parasitoids such as <i>Ichneumon</i> sp etc. • Predators such as <i>Chrysoperla zastrowi sillemi</i>, Coccinellids, King crow, Braconid wasp, dragonfly, spider, robber fly, reduviid bug, praying mantis, red ants • Conserve nematode such as <i>Ovomermis albicans</i>
Banana rhizome weevil	<p>Cultural control:</p> <ul style="list-style-type: none"> • Removal of pseudostems below ground level

	<ul style="list-style-type: none"> • Trimming the rhizome • Prune the side suckers every month. <p>Mechanical control:</p> <ul style="list-style-type: none"> • Pheromone lure ('cosmolure') can be used for monitoring as well as trapping of banana rhizome weevil. Installing traps at low trap density 2/acre. • Initially placed in a line of 10 meters from a border and 20 meters apart.
Banana lacewing bug/ tingid bug	<p>Cultural control:</p> <ul style="list-style-type: none"> • Collect and destroy the damaged leaves, flowers and fruits along with life stages
Banana thrips	<p>Cultural control:</p> <ul style="list-style-type: none"> • Collect and destroy the damaged leaves, flowers and fruits along with life stages • Use blue pan water sticky trap @ 4-5/acre • Destroy all volunteer plants and old neglected plantations. Use healthy and pest free suckers for planting • Hot water treatment of suckers prior to planting. • Bunch covers (which cover the full length of the bunch) protection applied very early. • Regular checking of fruit under the bunch covers is essential to ensure that damage. • Conserve predators such as coccinellid and lacewings
Banana aphids	<p>Cultural control:</p> <ul style="list-style-type: none"> • Use yellow pan water sticky trap @ 4-5/acre • Ensure clean cultivation • Encourage activity of predator coccinellids such as <i>Scymnus</i>, <i>Chilomenes</i> • <i>sexmaculatus</i>, and lacewing, <i>Chrysoperla zastrowi sillemi</i>
Hard scale insect	<p>Cultural control:</p> <ul style="list-style-type: none"> • Collect and destroy the affected plant parts. <p>Biological control:</p> <p>Field release of coccinellid predators like <i>Chilocorus nigritus</i>, <i>Symnus coccivora</i></p>
Sigatoka disease	<p>Varieties: Ney Poovan, Pachanadan, Karpuravalli, Fhia 1 (Gold finger), Sannachenkadali</p> <p>Cultural control:</p> <ul style="list-style-type: none"> • Removal and destruction of the affected leaves. • Prevent water accumulation around the plant and go for periodical weeding. • Select tolerant varieties such as Ney Poovan, Pachanadan, Karpuravalli, Fhia 1 (Gold finger), Sannachenkadali
Bunchy top disease	<p>Cultural control:</p> <ul style="list-style-type: none"> • Select suckers from disease free areas. • Infected plants are destroyed using 4ml of 2, 4, D (50g in 400 ml of water). • Remove weeds which are attractant to aphids. • Select tolerant varieties such as Poovan, Pachanadan
Panama disease	<p>Varieties: Dwarf Cavendish, Robusta, Fhia 1 (Gold finger), Anai komban, Nivedya Kadali</p> <p>Cultural control:</p> <ul style="list-style-type: none"> • Avoid growing of susceptible cultivars viz., Rasthali, Monthan, Red banana and Virupakshi. • Grow resistant cultivar Poovan. • Removal and destruction of affected leaves followed by spraying with BM (1%) +linseed oil (2%). • Select tolerant varieties such as Dwarf Cavendish, robusta, Fhia 1 (Gold finger), Anai komban, Nivedya Kadali.
Bunchy top disease	<p>Varieties: Poovan, Pachanadan</p> <p>Cultural control:</p> <ul style="list-style-type: none"> • Select suckers from disease free areas.

	<ul style="list-style-type: none"> • Infected plants are destroyed using 4ml of 2, 4, D (50g in 400 ml of water). • Remove weeds which are attractant to aphids. • Select tolerant varieties such as Poovan, Pachanadan
Banana stem weevil	<p>Cultural control:</p> <ul style="list-style-type: none"> • Remove dried leaves periodically and keep the field clean • Prune the side suckers every month • Use healthy and pest free suckers to check the pest incidence • Do not dump infested materials into manure pit • Uproot infested trees, chop into pieces and burn • Use longitudinally split pseudostem trap at 26/acre. • 2m at 45 cm from ground level; another 2m at 150 cm from ground level. • Uproot infested trees, chop into pieces and burn.

(Source: Farmer Portal, Ministry of Agriculture, Government of India,-
<http://farmer.gov.in/IPMPackageofPractices.html>)

Appendix 2

Pesticides banned in India

Pesticides Banned for manufacture, import and use (25 No.s)

1. Aldrin
2. Benzene Hexachloride
3. Calcium Cyanide
4. Chlordane
5. Copper Acetoarsenite
6. Cibromochloropropane
7. Endrin
8. Ethyl Mercury Chloride
9. Ethyl Parathion
10. Heptachlor
11. Menazone
12. Nitrofen
13. Paraquat Dimethyl Sulphate
14. Pentachloro Nitrobenzene
15. Pentachlorophenol
16. Phenyl Mercury Acetate
17. Sodium Methane Arsonate
18. Tetradifon
19. Toxafen
20. Aldicarb
21. Chlorobenzilate
22. Dieldrine
23. Maleic Hydrazide
24. Ethylene Dibromide
25. TCA (Trichloro acetic acid)

Pesticide Withdrawn (7 No.s)

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

Pesticides restricted for use in India

1. Aluminium Phosphide
2. DDT
3. Lindane
4. Methyl Bromide
5. Methyl Parathion
6. Sodium Cyanide
7. Methoxy Ethyl Merciru Chloride (MEMC)
8. Monocrotophos (ban for use on vegetables)

WHO classification of chemical pesticides

List 1. Extremely hazardous (Class IA) technical grade active ingredients in pesticides

Aldicarb
Brodifacoum
Bromadiolone
Bromethalin
Calcium cyanide
Captafol
Chlorethoxyfos
Chlormephos
Chlorophacinone
Difenacoum
Difethialone
Diphacinone
Disulfoton
EPN
Ethoprophos
Flocoumafen
Hexachlorobenzene
Mercuric chloride
Mevinphos
Parathion
Parathion-methyl
Phenyl mercury acetate
Phorate
Phosphamidon
Sodium fluoroacetate
Sulfotep
Tebupirimfos
Terbufos

List 2. Highly hazardous (Class IB) technical grade active ingredients in pesticides

Acrolein
Allyl alcohol
Azinphos-ethyl
Azinphos-methyl
Blastidicin-S
Butocarboxim
Butoxycarboxim
Cadusafos
Calcium arsenate
Carbofuran
Chlorfenvinphos
3-Chloro-1, 2-propanediol
Coumaphos
Coumatetralyl
Zeta-cypermethrin
Demeton-S-methyl
Dichlorvos
Dicrotophos
Dinoterb
DNOC
Edifenphos

Ethiofencarb
Famphur
Fenamiphos
Flucythrinate
Fluoroacetamide
Formetanate
Furathiocarb
Heptenophos
Isoxathion
Lead arsenate
Mecarbam
Mercuric oxide
Methamidophos
Methidathion
Methiocarb
Methomyl
Monocrotophos
Nicotine
Omethoate
Oxamyl
Oxydemeton-methyl
Paris green
Pentachlorophenol
Propetamphos
Sodium arsenite
Sodium cyanide
Strychnine
Tefluthrin
Thallium sulfate
Thiofanox
Thiometon
Triazophos
Vamidothion
Warfarin
Zinc phosphide

List 3. Moderately hazardous (Class II) technical grade active ingredients in pesticides

Alanycarb
Anilofos
Azaconazole
Azocyclotin
Bendiocarb
Benfuracarb
Bensulide
Bifenthrin
Bilanafos
Bioallethrin
Bromoxynil
Bromuconazole
Bronopol
Butamifos
Butylamine
Carbaryl
Carbosulfan
Cartap

Chloralose
Chlordane
Chlorfenapyr
Chlorphonium chloride
Chlorpyrifos
Clomazone
Copper sulfate
Cuprous oxide
Cyanazine
Cyanophos
Cyfluthrin
Beta-cyfluthrin
Cyhalothrin
Cypermethrin
Alpha-cypermethrin
Cyphenothrin [(1R)-isomers]
2,4-D
DDT
Deltamethrin
Diazinon
Difenzoquat
Dimethoate
Dinobuton
Diquat
Endosulfan
Endothal-sodium
EPTC
Esfenvalerate
Ethion
Fenazaquin
Fenitrothion
Fenobucarb
Fenpropidin
Fenpropathrin
Fenthion
Fentin acetate
Fentin hydroxide
Fenvalerate
Fipronil
Fluxofenim
Fuberidazole
Gamma-HCH
Guazatine
Haloxfop
HCH
Imazalil
Imidacloprid
Iminoctadine
Ioxynil
Ioxynil octanoate
Isoprocarb
Lambda-cyhalothrin
Mercurous chloride
Metaldehyde
Metam-sodium
Methacrifos

Methasulfocarb
Methyl isothiocyanate
Metolcarb
Metribuzin
Molinate
Nabam
Naled
Paraquat
Pebulate
Permethrin
Phenthoate
Phosalone
Phosmet
Phoxim
Piperophos
Pirimicarb
Prallethrin
Profenofos
Propiconazole
Propoxur
Prosulfocarb
Prothiofos
Pyraclofos
Pyrazophos
Pyrethrins
Pyroquilon
Quinalphos
Quizalofop-p-tefuryl
Rotenone
Spiroxamine
TCA (acid)
Terbumeton
Tetraconazole
Thiacloprid
Thiobencarb
Thiocyclam
Thiodicarb
Tralomethrin
Triazamate
Trichlorfon
Tricyclazole
Tridemorph
Xylcarb

List 4. Slightly hazardous (Class III) technical grade active ingredients in pesticides

Acephate
Acetochlor
Acifluorfen
Alachlor
Allethrin
Ametryn
Amitraz
Azamethiphos
Bensultap
Bentazone

Butralin
Butroxydim
Chinomethionat
Chlormequat (chloride)
Chloroacetic acid
Copper hydroxide
Copper oxychloride
4-CPA
Cycloate
Cyhexatin
Cymoxanil
Cyproconazole
Dazomet
Dicamba
Dichlormid
Dichlorobenzene
Dichlorophen
Dichlorprop
Diclofop
Dicofol
Diethyltoluamide
Difenoconazole
Dimepiperate
Dimethachlor
Dimethametryn
Dimethipin
Dimethylarsinic acid
Diniconazole
Dinocap
Diphenamid
Dithianon
Dodine
Empenthrin [(1R) isomers]
Esprocarb
Etridiazole
Fenothiocarb
Ferimzone
Fluazifop-p-butyl
Fluchloralin
Flufenacet
Fluoroglycofen
Flurprimidol
Flusilazole
Flutriafol
Fomesafen
Furalaxyl
Glufosinate
Hexazinone
Hydramethylnon
Iprobenfos
Isoprothiolane
Isoproturon
Isouron
Malathion
MCPA
MCPA-thioethyl

MCPB
Mecoprop
Mecoprop-P
Mefluidide
Mepiquat
Metalaxyl
Metamitron
Metconazole
Methylarsonic acid
Metolachlor
Myclobutanil
2-Naphthyloxyacetic acid
Nitrapyrin
Nuairimol
Othilinone
N-octylbicycloheptene dicarboximide
Oxadixyl
Paclobutrazol
Pendimethalin
Pimaricin
Pirimiphos-methyl
Prochloraz
Propachlor
Propanil
Propargite
Pyrazoxyfen
Pyridaben
Pyridaphenthion
Pyridate
Pyrifenoxy
Quinoclamine
Quizalofop
Resmethrin
Sethoxydim
Simetryn
Sodium chlorate
Sulphur amide
2,3,6-TBA
Tebuconazole
Tebufenpyrad
Tebuthiuron
Thiram
Tralkoxydim
Triadimefon
Triadimenol
Tri-allate
Triclopyr
Triflumizole
Undecan-2-one
Uniconazole
XMC
Ziram

List 5. Technical grade active ingredients of pesticides unlikely to present acute hazard in normal use

Aclonifen
Acrinathrin
Alloxydim
Amitrole
Ammonium sulphamate
Ancymidol
Anthraquinone
Asulam
Atrazine
Azimsulfuron
Azoxystrobine
Bacillus thuringiensis
Benalaxyl
Benazolin
Benfluralin
Benfuresate
Benomyl
Benoxacor
Bensulfuron-methy
Bifenox
Bioresmethrin
Bipheny
Bispyribac
Bitertanol
Borax
Bromacil
Bromobutide
Bromopropyl
Bupirimate
Buprofezin
Butachlor
Butylate
Captan
Carbendazim
Carbetamide
Carboxin
Carpropamid
Chloransulam methy
Chlorfluazur
Chloridazon
Chlorimuron
Chlorothaloni
Chlorotoluron
Chlorpropham
Chlorpyrifos methyl
Chlorsulfuron
Chlorthal-dimethyl
Chlozolate
Cinmethylin
Cinosulfuron
Clofentezine
Clomeprop
Clopyralid

Cloxyfonac
Cryolite
Cycloprothrin
Cyclosulfamuron
Cycloxydim
Cyhalofop
Cyromazine
Daimuron
Dalapon
Daminozide
Desmedipham
Diafenthiuron
Dichlobenil
Dichlofluanid
Diclomezine
Dicloran
Diclosulam
Diethofencarb
Diflubenzuron
Diflufenican
Dikegulac
Dimefuron
Dimethirimol
Dimethomorph
Dimethyl phthalate
Dinitramine
Dipropyl isocinchomerate
Dithiopyr
Diuron
Dodemorph
Ethalfluralin
Ethephon
Ethirimol
Ethofumesate
Ethyl
Etofenprox
Famoxadone
Fenarimo
Fenbuconazole
Fenbutatin oxide
Fenchlorazole
Fenclorim
Fenfuram
Fenhexamide
Fenoxycarb
Fenpiclonil
Fenpropimorph
Ferbam
Flamprop-M
Florasulam
Flucarbazone-sodium
Flucycloxuron
Flufenoxuron
Flumetralin
Flumetsulam
Fluometuron

Flupropanate
Flupyrulfuron
Flurenol
Fluridone
Flurochloridone
Fluroxypy
Fluthiacet
Flutolanil
Tau-Fluvalinate
Folpet
Fosamine
Fosety
Gibberellic acid
Glyphosate
Halofenozide
Hexaconazole
Hexaflumuron
Hexythiazox
Hydroprene
2-Hydroxyethyl
Hymexazo
Imazametha benzmethyl
Imazapyr
Imazaquin
Imazethapyr
Imibenconazole
Inabenfide
Iprodione
Iprovalicarb
Isoxaben
Kasugamycin
Lenacil
Linuron
Maleic hydrazide
Mancozeb
Maneb
Mefenacet
Mepanipyrim
Mepronil
Metazachlor
Methabenzthiazuron
Methoprene
Methoxychlor
Methoxyfenozide
Methyldymron
Metiram
Metobromuron
Metosulam
Metoxuron
Metsulfuron methyl
Monolinuron
2-(1-Naphthyl) acetamide
1-Naphthylacetic acid
Napropamide
Naptalam
Neburon

Niclosamide
Nicosulfuron
Nitrothal-isopropyl
Norflurazon
Noviflumuron
Ofurace
Oryzalin
Oxabetrini
Oxadiazon
Oxine-copper
Oxycarboxin
Oxyfluorfen
Penconazole
Pencycuron
Penoxsulam
Pentanochlor
Phenmedipham
Phenothrin
2-Phenylpheno
Phosphorus acid
Phthalide
Picloram
Piperony
Pretilachlor
Primisulfuron
Probenazole
Procymidone
Prodiamine
Prometon
Prometryn
Propamocarb
Propaquizafop
Propazine
Propham
Propineb
Propyzamide
Pyrazolynate
Pyrazosulfuron
Pyrimethanil
Pyriminobac
Pyriproxyfen
Pyriproxyfen sodium
Quinclorac
Quinmerac
Quinoxifen
Quintozene
Rimsulfuron
Siduron
Simazine
Spinosad
Sulfometuron
Sulphur
See note
TCA
Tebufenozide
Tebutam

Tecnazene
Teflubenzuron
Temephos
Terbacil
Terbutylazine
Terbutryn
Tetrachlorvinphos
Tetradifon
Tetramethrin
Thiabendazole
Thidiazuron
Thifensulfuron-methy
Thifluzamide
Thiophanate-
Tiocarbazil
Tolclofos
Tolyfluanid
Transfluthrin
Triasulfuron
Tribenuron
Trietazine
Triflumuron
Trifluralin
Triflusulfuron-methyl
Triforine
Triticonazole
Validamycin
Vinclozolin
Zineb

Annexure 6: Key Environmental Issues Noted During Stakeholder Consultations

Component/ Sub-component	Key issues/ Observations
1. Diversified and Resilient Production	<ul style="list-style-type: none"> • Shift in from less water consumptive (cereal crops) to water intensive (vegetables) cropping pattern. • Expansion in usage of chemical inputs for sustaining agricultural production. • This shift may result in disappearance of certain traditional/ nutrient varieties of certain crops. In other words, bio-diversity challenges are expected. • Expansion of cropping system especially horticultural crops resulted in conversion waste and uncultivated land under cultivated land. • The emergence of commercial cropping pattern resulted in encroachment of public land in certain cases. • Growing use of chemical fertilizer can be resulted in polluting the resources such as land and water that further led to health hazards. • There substantial scope for promotion of rain-fed crops like pulses to improve the condition of farmers and conserving thee water resources as well as to meet growing demand for pulses. • Integrated use of natural resource base for making the farm economy viable.
Sub Component– Livestock Development	<ul style="list-style-type: none"> • There is short supply of feed and fodder for animals in general and for resource poor households in particular. • Livestock management practices followed by the Goat Keepers in particular were found as effective. • The traditional practices followed by the households in fodder management help in sustaining the livestock economy. • Health issues relating to both animal and human are the major concerns. The animal health facilities were found inadequate. • Poultry farming and maintenance are the major concerns. The linkages between farming practices and availability of resources such water that is crucial factor are missing. It need due attention for making enterprise viable. • Disposal of waste and dead animal/ birds is the major environment concerns. • Piggery enterprise is also major environmental concerns especially in terms of management.
Sub Component – Irrigation System Development	<ul style="list-style-type: none"> • There limited access of farmers to irrigation water. It is because of the limited efforts made in water management practices. • Community based irrigation developed by the NGOs in their project are found affective and sustainable. • The role of water harvesting structure that is called locally as <i>dhobas</i> was crucial

	<ul style="list-style-type: none"> • Reliability of water bodies is dictated by the size, design and management practices of water bodies. • The role of informal irrigation committees that formed at project level was found crucial. • The social restriction on digging bore well yielded the desirable results in halting the groundwater exploitation. • Expansion in demand for energy used in irrigation. • Maintenance of canal network was found poor that restricted the access to irrigation water.
Sub Component – Fishery Development	<ul style="list-style-type: none"> • Fishing in big reservoir was found sustainable in prevailing institutional arrangement for releasing of water for irrigation purposes. • Fishing practices followed Fishermen such as cage culture and size of net also help in sustaining fishery. • Reliability of water determines the viability of fishing in small bodies.
Sub Component – Non Timber Forest Produce Development	<ul style="list-style-type: none"> • Collection of NTFPs is dictated by the use rights and ownership rights on forest lands granted to the right holders. • Unscientific and unsustainable harvesting of NTFP resources and lead to loss of biodiversity. • There is growing scarcity of hosting trees that required for lac based activities that adversely affect the forest resources and enterprise as well.
2. Sub Component - Skill Development and Entrepreneurship in Focus Value Chains	<ul style="list-style-type: none"> • Lack of awareness regarding the agricultural operations like selection of seed, input application affect adversely the viability of crop production. In such situation the farmers are deprived from benefits of value chains. • Productions of commercial crops in bulk lead the growing demand for storage facilities. Otherwise, intervention in HAV will not yield desirable results. • Capacity building of the farmers towards the farm operations, management of livestock enterprise, and preparation of farm inputs by using biotic items push them to value chain. • Installation of NTFPs processing units lead to environmental consequences by not following the proper procedure regarding the disposal of waste. • There are certain limitations to the accessibility to the pro-poor financial resource. • Need of strengthening village institutional setup for optimum use of resources.
3. Project and Knowledge Management	<ul style="list-style-type: none"> • Active participation of different stakeholders in general and target groups in particular. • Continuous assessment and sharing of benefits to make the project result oriented. • Training, exposure visit enable the target group to proceed further

	<p>towards result oriented activities.</p> <ul style="list-style-type: none">• Need of strengthening community based and village democratic institutions at micro and macro levels.• Follow the prevailing institutional arrangement at the implementation of the activities and distribution of benefits.
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Annexure 7: Report of the Disclosure Workshop

Disclosure Workshop on Environment and Social Assessment, 15th February, Hotel Capitol Hill, Ranchi

Mr. Bishnu Parida, Chief Operating Officer, JSLPS welcomed the participants and explained the purpose of the workshop. Mr. Srimanta Patra, JSLPS, gave the background of the environment and social assessment studies.

The workshop was attended by the Principle Secretary, Rural Development Department, CEO and COO JSLPS, representatives of Departments of Horticulture, KVK ATMA, Agriculture, Cooperatives, Planning cum Finance, Women and Child Development, State Biodiversity Board, and NGOs including Landesa, Pradan, TRIF Syngenta, CARE-India, Vikas Bazar Network, Trickle Up, Lok Prerna, SUPPORT, and Tata Steel Rural Development Society, representatives of Block and Cluster Federations, and JSLPS staff. A total of 46 participants attended the workshop including 18 female participants.

Dr. Alka Awasthi, Social Consultant, presented the highlights of the Social Assessment study covering the objectives of the study, methodology used, stakeholder consultation process, key social issues identified and strategies developed for social management. The Social Management Framework as well as the Tribal Development Framework was presented in detail.

Dr. Dalbir Singh, Environment Consultant, presented the major findings of the Environment Assessment Report including the rationale for EMF, methodology followed for Environment Assessment, Key findings, applicable regulations, potential environmental impacts and their mitigation measures and guidelines. Ms. Vanitha Kommu, Consultant World Bank summarized the findings of the study and described how the recommendations would be implemented in the project.

Mr. N.N Sinha, RDD, made observations on the reports. He stated that JOHAR builds on the social inclusion achievements of NRLP but JOHAR will target primarily producers with marketable surplus. In this context it is important to maintain a balance between achievements of project objectives with social imperative of inclusion. He appreciated the fact that for the first time climate resilience has been explicitly mentioned as a project component, and hoped that the environmental imperatives of GHG mitigation as well as drought proofing would be effectively addressed in the project.

A number of suggestions were made on the reports, these are as follows:

A. Social Assessment Report

- For ensuring social inclusion we should give target percentages in line with proportion of vulnerable groups in the local population
- PRIs and traditional leaders have to be consulted during land lease/transfer process
- There are families that have received land recently through FRA, the project should create models for agriculture development on these newly acquired lands. It was pointed out by

some participants that such lands are usually in remote forest locations and provision of irrigation and agricultural inputs may pose difficulty in such areas.

- The project should try for land transfer from Forest Department to landless households, thereafter, the Department of Agriculture can support agriculture development activities on such lands and Kisan Credit Cards can be facilitated for credit linkage.
- People with Disabilities (PWD) should also be targeted for social inclusion.
- The project would involve intensification of production systems, there is risk of involvement of children in production processes. The project should provide guidelines and should include awareness generation on the topic
- It will be difficult to include tribals, particularly PVTGs and build their skills at par with other beneficiaries within the project period. While other vulnerable groups can be targeted in throughout the project sectors, additional pilots may be executed for PVTG specific livelihoods to bring them up to surplus production level
- We should increase the grant component for inclusion of vulnerable groups
- JOHAR can take commitment from Line departments to provide resources for activities with vulnerable groups in JOHAR
- Tribal Development Plans already exist, the project needs to clarify which new activities would be taken up under the TDPs
- For land transfer processes Gram Sabha consultations should take place, but presently all people do not attend the GS. The project needs to make efforts for mobilization of GS as well as capacity building of PRIs so that these consultations may be carried out effectively. Project interventions may be listed specifically in the GS agenda.
- From same family one person may be member of SHG, another of particular Producer Group, and more than one member of the same family may draw bank loans. There should be guidelines for ownership and transparency for such situations.

B. Environment Assessment

- Regarding the regulations on pesticide use, the pesticides banned by Government of India are not available in the market, however some of the pesticides banned as per WHO classification (such as monocrotophos) are crucial in certain stages in select crops like mango. The alternate package of practices should be able to address the pest problems effectively in absence of these pesticides
- Training on sustainable harvesting of NTFPs is important
- The comprehensive set of package of practices that is environment friendly should be given for the select crop including drought proof measures, climate resilience, suitable varieties etc. This can be done for individual crops at the stage of crop plans/DPR preparation
- The EA report should also include the drought mitigation strategy given the climate variability being experienced. The strategy outlined in the state action plan on climate change can be referred to
- Promotion of solar energy may lead to over-exploitation of groundwater. Micro irrigation will be promoted for optimal use of water resource
- It is advisable to capture the potential contributions to the GHG emissions under High Value Agriculture for better integration of mitigations

- The issues relating to efficient use of water, minimising use of chemical fertilizer, Feed and fodder management, sustainable harvesting of NTFP and environmental auditing will be addressed in JOHAR project.

Mr. Paritosh Upadhyay, Chief Executive Officer, JSLPS summed up the discussions with a view to relevance for JOHAR implementation. Mr. Srimanta Patra gave the vote of thanks.

List of participants

S.No.	Name	Organization
1	N.N. Sinha	Department of Rural Development, GoJ
2	Paritosh Upadhaya	CEO JSLPS
3	Bishnu C Parida	COO JSLPS
4	Srimanta K Patra	SPM-SMIB, JSLPS
5	Vanitha Kommu	World Bank Consultant
6	Purnima Mukherjee	JSLPS
7	Alka Awasthi	Consultant JOHAR
8	Dalbir Singh	Consultant JOHAR
9	Bhishma Nath Mahto	Tata Steel Rural Development Services
10	Rajaul Arfin	Lok Prerna
11	Ajay Kumar Mahto	JSLPS
12	Priyanka Devi	Cadre JSLPS
13	Kuldip Ebba	SUPPORT
14	B.K. Mallick	Consultant Care India
15	Khudi Ram	JSLPS
16	Cecilia Kashyap	Cadre JSLPS
17	Jyoti Rani	JSLPS
18	Shanti	JSLPS
19	Anita	JSLPS
20	Mamta SAnaha	JSLPS
21	Madhumita Nath	Vikas Bazar Network
22	Anil Kumar	JSLPS
23	District Agriculture Officer	ATMA Ranchi
24	Dr. Om Prakash Singh	Consultant JOHAR
25	Shiba Demta	Consultant JOHAR
26	Ranjeet Gupta	JSLPS
27	Bauna Dutta	Landesa
28	B. Prabhakar	JSLPS
29	Dinesh Kumar	Member Secretary, Jharhand State Biodiveristy Board
30	Kalicharan Singh	Cooperative Services, GoJ
31	Rashmi Rani	Cooperative Services, GoJ
32	Dr. Ashish Das	Trickle Up
33	Deepak Upadhyay	JSLPS
34	Banshi Dhar Singh	Satyam Seva
35	P.S. Munda	Finance Department, GoJ
36	Kumar Sanjay	Finance Department, GoJ

37	Subhanshu Kr Debartar	TRI
38	Akhilesh Kumar	Planning cum Finance, GoJ
39	Randhir Kumar	Cluster Federation Murhu
40	Susum Kadir	Cluster Federation Murhu
41	Nanda Kadir	Cluster Federation Murhu
42	A.K. Mishra	WCD, GoJ
43	Shilwnti Lakra	Cluster Federation, Namkum
44	Rajni Lakra	Cluster Federation, Namkum
45	Anita Lakra	Cluster Federation, Namkum
46	Aparna Shilpi	JSLPS

