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ECOSYSTEM SERVICES IMPROVEMENT PROJECT

Project Completion Report




Indian Council of Forestry Research and Education

Ecosystem Services Improvement Project

PROJECT COMPLETION REPORT

2023

Indian Council of Forestry Research and Education
(An Autonomous Body of Ministry of Environment, Forest and Climate Change, Government of India)
P.O. New Forest, Dehradun - 248006 (INDIA)

Profile of the Project

Title of the Project: Ecosystem Services Improvement Project
Funding Agency: The World Bank (GEF Trust Fund)
Implementing Agency: Indian Council of Forestry Research and Education
Date of Commencement of the Project: 07 February 2018
Date of Completion of the project: 30 July 2023
Total Budget of the project: USD 5.24 million
Total Expenditure incurred in the Project: Rs. 41,35,77,896.83
Project Director: Ms. Kanchan Devi, Director (International Cooperation), ICFRE
Project Manager: Dr. R. S. Rawat, Scientist-E, ICFRE
Project Coordinator: Dr. Shilpa Gautam, Scientist-E, ICFRE
Individual Consultants:

1. Sh. N.P.S. Nain, Land Management Consultant
2. Sh. R. Bisen, NRM cum Biodiversity Consultant
3. Dr. Nivedita Mishra Thapliyal, Social Development and Community Mobilization Consultant
4. Dr. Sunil Prasad, M&E Consultant
5. Dr. Arun Kumar Thakur, Policy and Knowledge Management Consultant
6. Sh. Devendra Kumar Kurrey, State Coordinating Consultant
7. Dr. Md. Shahid, Carbon Sequestration Consultant
8. Dr. Nepolion Borah, Carbon Monitoring Consultant
9. Sh. Umang Thapa, Establishment and Secretarial Consultant
10. Sh. Subhash Godiyal, Financial Consultant
11. Dr. Girish Khanduri, Procurement Consultant

ESIP: Project Implementation Unit
Biodiversity and Climate Change Division
Directorate of International Cooperation
Indian Council of Forestry Research and Education
P.O. New Forest, Dehradun – 248 006 (INDIA)

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(पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार की स्वायत्त संस्था)
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INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION
(An Autonomous Body of Ministry of Environment, Forest and Climate Change, Government of India)
P.O. New Forest, Dehradun- 248006 (INDIA)

Overview of the Ecosystem Services Improvement Project

30 July 2023

The GEF/ World Bank funded Ecosystem Services Improvement Project (ESIP) supported the goals of the Green India Mission by demonstrating models for adaptation-based mitigation through sustainable land and ecosystem management and livelihood benefits. Objective of the project was to improve the forest quality, land management and non-timber forest produce benefits for forest dependent communities. The project consisted of three components viz. (i). Strengthen capacity of government institutions in forestry and land management programs, (ii). Investments for improving forest quality in selected landscapes and (iii). Scaling up sustainable land and ecosystem management in selected landscapes. ESIP introduced new tools, techniques and practices for sustainable management of natural resources, including biodiversity and carbon stocks. ESIP was implemented in the selected landscapes in Madhya Pradesh and Chhattisgarh by ICFRE and Madhya Pradesh and Chhattisgarh State Forest Departments under the overall direction of Ministry of Environment, Forest and Climate Change, Government of India.

Eddy covariance-based carbon flux towers were established by ICFRE under ESIP at Khatpura Forest Beat in Budhni Forest Range (Sehore Forest Division, Madhya Pradesh) and Sonhat Forest Beat in Raghunathnagar Forest Range (Balrampur Forest Division, Chhattisgarh) for measurement and monitoring of carbon fluxes between atmosphere and vegetation. Capacity of the State Forest Departments and Joint Forest Management Committees of Madhya Pradesh and Chhattisgarh were also built under the project. A portal on SLEM Knowledge Sharing and Reporting System was developed under the project for sharing of knowledge and learnings on SLEM and collection of data from various stakeholders for preparation of national report to UNCCD secretariat. Knowledge products (brochures, flyers, manuals, books and documentaries) on sustainable land and ecosystem management (SLEM) and forest carbon stocks measurement were also developed under the project and shared with project beneficiaries and other stakeholders. Networking of national and international institutions working in the fields of sustainable land management and forest carbon assessment was also done through organisation of national and international workshops.

Total area of about 25,000 ha was covered under scaling up of SLEM best practices in common property resource, private lands and Government lands. More than 25,000 people, comprising of forest dwellers, small landholders, marginal farmers etc. were the direct beneficiaries of the project at the community level in the states of Madhya Pradesh and Chhattisgarh. The indirect beneficiaries of the project comprised of larger population of these states which were benefitted from the improved forest quality and ecosystems services such as improved water flows, climate amelioration, and land productivity. At the Forest Division/ Range level, the Forest Development Agencies and JFMCs were the key beneficiaries of capacity enhancement and supporting tools. At the state level, the State Forest Departments were the main beneficiaries of strengthened institutional capacities, new technologies, and enhanced carbon measurement and monitoring systems.

(Dr. R. S. Rawat)
Project Manager, ESIP, ICFRE

(Kanchan Devi)
Project Director, ESIP, ICFRE

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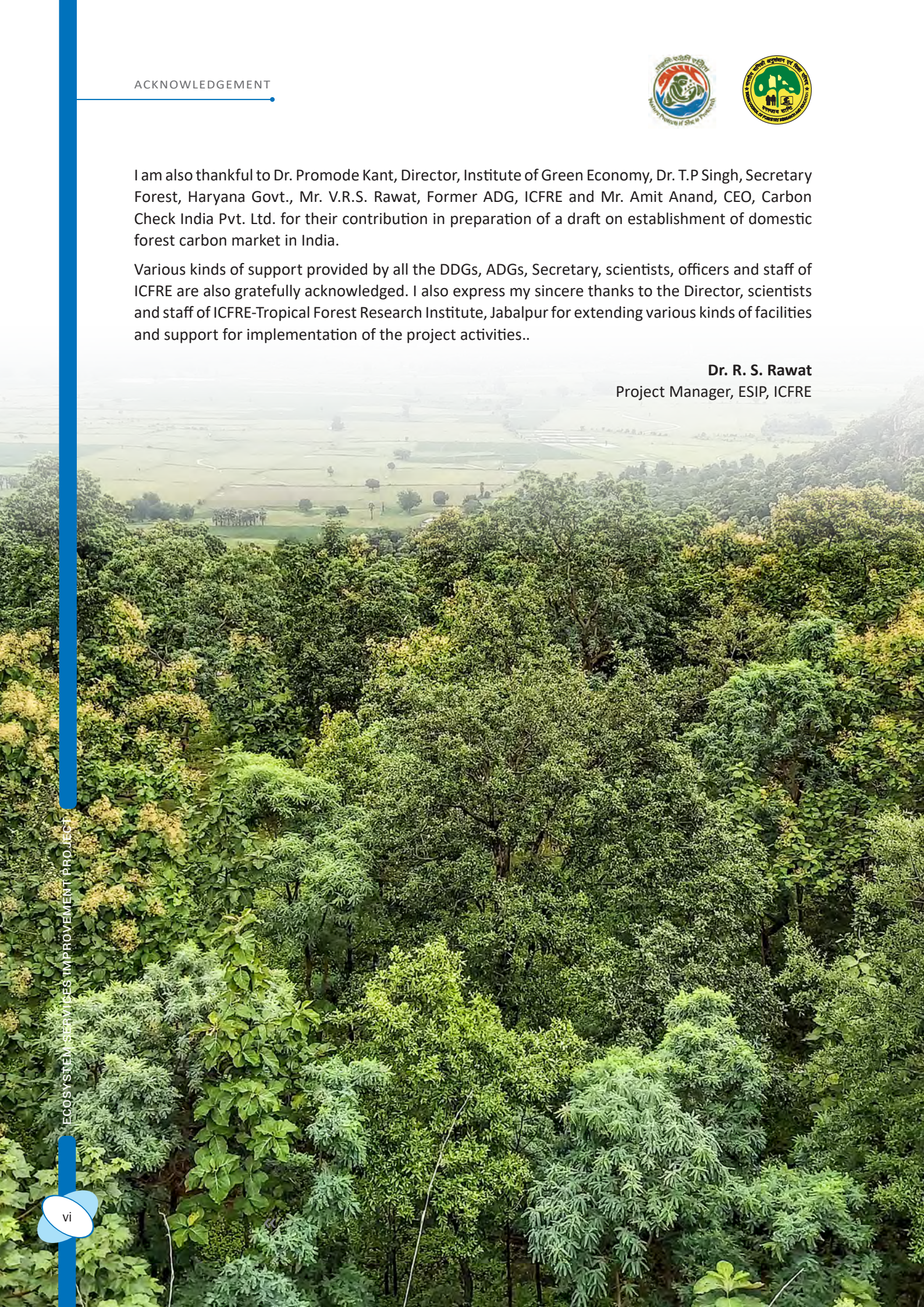
Dr. R. S. Rawat
Project Manager, ESIP, ICFRE



CONTENTS

ACRONYMS

BAU	Business as Usual
BMC	Biodiversity Management Committee
C	Carbon
CBD	Convention on Biological Diversity
CG	Chhattisgarh
CIFOR	Centre for International Forestry Research
CO_2	Carbon Dioxide
CPP	Country Partnership Programme
CPRs	Common Property Resources
CSR	Corporate Social Responsibility
EDC	Eco-Development Committee
EMP	Environmental Management Plan
ESIP	Ecosystem Services Improvement Project
FAO	Food and Agriculture Organization
FFV	Forest Fringe Village
FLE	Frontline Extension
FPO	Farmers Producer Organisation
FSI	Forest Survey of India
GBPNIHE	Govind Ballabh Pant National Institute of Himalayan Environment
GDP	Gross Domestic Product
GEF	Global Environment Facility
GIM	Green India Mission
GIS	Geographic Information System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (German Corporation for International Cooperation)
GPDP	Gram Panchayat Development Plan
GHG	Greenhouse Gas
GT	Giga Tonne
h	Hectare
HH	Household
ICAR	Indian Council of Agricultural Research
ICFRE	Indian Council of Forestry Research and Education
ICFRE-TFRI	ICFRE-Tropical Forest Research Institute
ICIMOD	International Centre for Integrated Mountain Development
ICRAF	International Council for Research in Agroforestry
IFS	Integrated Financial System
IIRS	Indian Institute of Remote Sensing
IIT	Indian Institute of Technology
IITM	Indian Institute of Tropical Meteorology
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature

JFM	Joint Forest Management
JFMC	Joint Forest Management Committee
Kg	Kilogram
KVK	Krishi Vigyan Kendra
LDN	Land Degradation Neutrality
LULUCF	Land Use, Land-Use Change and Forestry
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
Mha	Million hectare
MoEFCC	Ministry of Environment, Forest and Climate Change
MOU	Memorandum of Understanding
MP	Madhya Pradesh
MSP	Minimum Support Price
NDC	Nationally Determined Contributions
NEE	Net Ecosystem Exchange
NGO	Non-Government Organization
NIH	National Institute of Hydrology
NITI	National Institution for Transforming India
NRSC	National Remote Sensing Centre
NTFP	Non-Timber Forest Product
PA	Protected Area
PDO	Project Development Objective
PESA	Provisions of the Panchayats (Extension to Scheduled Areas) Act 1996
PME	Participatory Monitoring and Evaluation
PPP	Public–Private Partnership
QPM	Quality Planting Material
R&D	Research and Development
REDD+	Reducing emissions from deforestation and forest degradation, role of conservation, sustainable management of forests and enhancement of forest carbon stocks
ROAM	Restoration Opportunities Assessment Methodology
SAC	Space Applications Centre
SBB	State Biodiversity Board
SDGs	Sustainable Development Goals
SFDs	State Forest Departments
SLEM	Sustainable Land and Ecosystem Management
SLUB	State Land Use Board
t	Tonne
TGA	Total Geographic Area
TPA	Technical Partner Agency
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
VVK	Van Vigyan Kendra

EXECUTIVE SUMMARY

Deforestation, over-cultivation, soil erosion, and depletion of wetlands are the major causes of land degradation and desertification. The scale of land degradation and desertification has reached at alarming proportions and could pose significant challenges in maintaining land-based sustainable productivity on one hand and economic growth on the other. The scale and impact of land degradation and desertification are severe in India, and it is estimated that nearly 29% of its land area is under degradation. Managing land that is undergoing degradation and desertification, is therefore a significant priority in the context of achieving national targets and international commitments related to Nationally Determined Contribution, Land Degradation Neutrality and Sustainable Development Goals. The greatest prospect for turning degraded land into healthy land lies in sustainable management of natural resources. In this context, Ecosystem Services Improvement Project (ESIP) was executed to manage natural resources by improving forest quality and linked livelihood improvement, and the community involved in it through a combination of technical assistance and demonstrative investments in the selected landscapes of Chhattisgarh and Madhya Pradesh. One of the objectives of ESIP was to improve the quality and productivity of the existing forests so as to ensure sustained flow of ecosystem goods and services, and to ensure the sustainable harvesting and value addition of non-timber forest products (NTFPs) to provide economic benefits to forest dependent communities. ESIP includes four project components viz. (i). Strengthen capacity of government institutions in forestry and land management programs, (ii). Investments for improving forest quality in selected landscapes, (iii). Scaling up sustainable land and ecosystem management (SLEM) in selected landscapes and (iv). Project Management. Indian Council of Forestry Research and Education (ICFRE) and State Forest Departments of Madhya Pradesh and Chhattisgarh were the project implementing agencies. ICFRE was responsible for implementation of the Sub-component 1.2: Forest Carbon Stocks Measuring, Monitoring, and Capacity Building, Component 3: Scaling up of Sustainable Land and Ecosystem Management in Selected Landscapes, and Component 4: Project Management.

ESIP was implemented in the selected landscapes of Madhya Pradesh and Chhattisgarh which fall under central Indian highlands. The project activities were implemented in Banapura, Itarsi and Sukhtawa Forest Ranges in Hoshangabad Forest Division, Budhni Forest Range in Sehore Forest Division and Bhaura Forest Range in North Betul Forest Division of Madhya Pradesh, and Marwahi Forest Range in Marwahi Forest Division, Raghunathnagar Forest Range in Balrampur Forest Division, Pandaria West Forest Range in Kawardha Forest Division, Pali Forest Range in Katghora Forest Division and Narharpur Forest Range in Kanker Forest Division of Chhattisgarh.

ESIP was envisaged to support in the sequestration of additional carbon of about 10% in the forest areas of Madhya Pradesh and Chhattisgarh over the baseline through implementation of the project interventions/ activities. The total forest carbon stock in project areas of Madhya Pradesh for the year 2022-23 was estimated to be 1302477.11 tonnes over the baseline total forest carbon stock of 1172639.19 tonnes for the year 2018-19. Total forest carbon

stock was estimated to be increased by 11.25% in the project areas of Madhya Pradesh over the baseline forest carbon stock. The total forest carbon stock in project areas of Chhattisgarh for the year of 2022-23 was estimated to be 1312014.46 tonnes over the baseline total forest carbon stock of 1223310.56 tonnes for the year 2018-19. During the assessment period from 2018-19 to 2022-23, total forest carbon stock was estimated to be increased by 7.51% in the project areas of Chhattisgarh.

Two eddy covariance-based carbon flux towers established by ICFRE at Khatpura Forest Beat in Budhni Forest Range (Sehore Forest Division, Madhya Pradesh) and Sonhat Forest Beat in Raghunathnagar Forest Range (Balrampur Forest Division, Chhattisgarh) in March 2021 to monitor CO_2 flux and net ecosystem exchange at real time. Northern mixed deciduous forest of Madhya Pradesh and Southern mixed deciduous forest of Chhattisgarh act as net carbon sink with a net carbon uptake of 4.96 - 5.47 t C ha^{-1} y^{-1} in Madhya Pradesh and 4.15 - 4.66 t C ha^{-1} y^{-1} in Chhattisgarh. The highest sequestration of CO_2 was recorded in the month of August at Northern Mixed Deciduous Forest, Khatpura (Madhya Pradesh) and September at Southern Mixed Deciduous Forest, Sonhat (Chhattisgarh). In the month of April and May carbon was released into the atmosphere and forest act as source of carbon.

Resource manuals on Measurement of Forest Carbon Stocks for Capacity Building of State Forest Departments were developed for capacity building of the State Forest Departments and Joint Forest Management Committees (JFMCs), and research and academic institutions. Organised 20 trainings on Measurement of Forest Carbon Stock for capacity building of the State Forest Departments of Madhya Pradesh and Chhattisgarh. A total number of 825 officers/ officials from State Forest Departments of Madhya Pradesh and Chhattisgarh participated in the trainings. Trainings on Measurement of Forest Carbon Exchange through Eddy Covariance System were also organized and participants from State Forest Departments of Madhya Pradesh and Chhattisgarh, ICFRE Hqs., ICFRE institutes, SFDs of Madhya Pradesh and Chhattisgarh, Forest Survey of India, Indira Gandhi Krishi Vishwavidyalaya, Raipur and Sant Gahira Guru Vishwavidyalaya, Sarguja, Ambikapur and other organizations (NRSC, IIRS, GBPNIHE, IIT Madras, NIH Roorkee, Uttarakhand Watershed Management Directorate) participated in the trainings. Organised 45 hands-on trainings on Measurement of Forest Carbon Stock for capacity building of the JFMCs of Madhya Pradesh and Chhattisgarh. A total of 2915 members of JFMCs of Madhya Pradesh and Chhattisgarh participated in the hands-on trainings. Built the capacity of the Chhattisgarh State Forest and Climate Change Department for preparation of State REDD+ Action Plan.

Developed a Draft on Establishment of Domestic Forest Carbon Market in India for submission to the Ministry of Environment, Forest and Climate Change, Government of India for consideration. The draft highlighted introduction to carbon markets, role of forest sector in carbon market, objectives of domestic forest carbon market, scope of domestic forest carbon market, process flow: project cycle, organisational structure for domestic forest carbon market, eligible activities and types of carbon offsets, validation, verification and issuance procedures and national forest carbon registry.

Socio-economic surveys of the project areas of Madhya Pradesh and Chhattisgarh were conducted and developed baseline reports with the objective to establish baseline information on socio-economic status of project villages, household requirement for natural resources and to shortlist site specific SLEM best practices for scaling up.

Communication strategy is an integral part of the planning process for successful achievement of the key deliverables and is assumed to be capable of making required changes and multiplying the impacts of project. A communication strategy for sustainable land

and ecosystem management was developed to facilitate knowledge and experience sharing, dissemination of knowledge on best practices and success stories for scaling up of SLEM in the ESIP areas of Madhya Pradesh and Chhattisgarh.

Knowledge products in Hindi and English on SLEM best practices viz. lac cultivation for livelihood generation and biodiversity conservation, amla based agro-forestry, rehabilitation of degraded bamboo forests, eco-restoration and institution strengthening, Wadi system – A tree-based farming system, rain water harvesting and augmentation of water resources, integrated farm development for sustainable land productivity, system of rice intensification, climate proofing fish farming, chauka system- a water conservation practice, biopesticides and biofertilisers and vermicomposting were developed and published for capacity building of local communities of the project areas of Madhya Pradesh and Chhattisgarh for scaling up of SLEM practices. Knowledge products were disseminated to the stakeholders through ICFRE website and SLEM Knowledge Sharing and Reporting System, and during trainings and other learning and knowledge sharing events organised under the project.

Trainings on Scaling up of SLEM best practices for local communities of the project areas of Madhya Pradesh and Chhattisgarh were organised for building the capacity of local communities on scaling up of lac cultivation for livelihood generation and biodiversity conservation, amla based agro-forestry, rehabilitation of degraded bamboo forests, eco-restoration and institution strengthening, Wadi system – A tree-based farming system, rain water harvesting and augmentation of water resources, integrated farm development for sustainable land productivity, system of rice intensification, climate proofing fish farming, chauka system- a water conservation practice, biopesticides and biofertilizers, and vermicomposting. A total number of 18504 beneficiaries of the project areas of Madhya Pradesh and Chhattisgarh participated in 223 trainings.

Sustainable land and ecosystem management (SLEM) practices emerge as effective tools to address land degradation issues. SLEM best practices on rain water harvesting and augmentation of water resources, lac cultivation for livelihood generation and biodiversity conservation, crop diversification for sustainable land productivity, biopesticides and biofertilizers preparation for sustainable land productivity, vermicomposting, micro-irrigation techniques (gravity-based drip irrigation system and portable sprinkler irrigation system) for conservation of water resources and enhancing productivity, WADI system - a tree-based farming system, Azolla cultivation for integrated farm development, system of rice intensification and promotion of improved cook stoves for addressing the forest degradation were selected and scaled up in the project areas of Madhya Pradesh and Chhattisgarh through community driven participatory approach. These practices improved the ecosystem services and livelihoods of the local communities of project areas of Madhya Pradesh and Chhattisgarh. Land area of 25316 ha was covered under SLEM practices through intervention of ESIP and other schemes of the Governments. More than 66402 direct beneficiaries were benefitted from scaling up of SLEM practices under the project out of which 50% were women beneficiaries.

A roadmap for institutional and policy mainstreaming of SLEM in India was developed. The roadmap provided specific guidelines to different Ministries/ Departments/ Research Organizations/ Civil Society Originations involved in restoration of degraded lands and combating land degradation and desertification. A portal on SLEM Knowledge Sharing and Reporting System (https://nrdp.icfre.gov.in) was developed under ESIP for sharing the knowledge, learnings, practices and success stories related to scaling up of SLEM best practices for achieving land degradation neutrality (LDN) by 2030 and also

help in strengthening the national capacity for reporting to UNCCD Secretariat regarding progress made in implementation of the convention.

A study was conducted under ESIP to evaluate working/ effectiveness of Van Vigyan Kendras (VVKs) for fulfilling the objectives of forestry extension services to enable technologies from lab to land and make practicable suggestions to improve the working and effectiveness of VVKs in future. A brainstorming workshop on 'Strengthening of Forestry Extension System in India' was organised with a motive to share forestry extension experiences of ICFRE, Indian Council of Agricultural Research (ICAR), State Forest Departments and to get the views and ideas of experts for identification of suitable strategies and actions for strengthening of forestry extension system in India.

National database on SLEM practitioners was prepared for development of institutional and individual networks. National Workshop on 'Agroforestry and Farm Forestry for Sustainable Land and Ecosystem Management' and International Workshop on 'Enhancing Ecosystem Services by Improving Forest Quality and Productivity, and SLEM Knowledge Dissemination' were organised for sharing of knowledge and experiences as well as for developing institutional and individual networks.

Necessary mitigation actions were undertaken for addressing and respecting the environmental and social safeguards while implementing the activities for scaling up of SLEM practices in the project areas of Madhya Pradesh and Chhattisgarh.

ICFRE on behalf of the Directorate of Green India Mission (GIM), Ministry of Environment, Forest and Climate Change, Government of India conducted an independent evaluation of the overall impacts of the project activities in accordance with the project objectives and indicators set out in its Results Framework.

Total expenditures of Rs. 41,35,77,896.83 were incurred in implementation of the activities implemented by ICFRE under the project.

CHAPTER – 01

INTRODUCTION

Land is a finite resource and suffers from varying degree and types of degradation. Deforestation, over-cultivation, soil erosion, and depletion of wetlands are the major causes of land degradation and desertification. The scale of land degradation and desertification has reached alarming proportions and could pose significant challenges in maintaining land-based sustainable productivity on one hand and economic growth on the other. Considering the current rate of land degradation and desertification, decline in living standards and gross domestic product, and an extreme loss of biodiversity is expected. Intergovernmental Panel on Climate Change report on ''Climate Change and Land'' stated that sustainable land management is required to reverse the impacts of land degradation especially by climate change and other drivers (IPCC, 2019). The occurrence of recurrent droughts, storms, and irregular or intense rainfall patterns that are frequently evident worldwide can considerably affect various ecosystems and their productivities. These events are not only disrupting the ecosystem services produced from the healthy functioning of the ecosystem but also causing degradation and desertification.

In India, an estimated 300 million of its population is directly or indirectly dependent on forests, most of them are rural poor, with little land and limited livelihood options. Forests in India are a significant source of sustenance for tribal and vulnerable communities living inside and on the fringes of the forests. Forests also play a critical role in supporting biodiversity which constitutes a good part of income generation for the forest fringe communities. As a result of anthropogenic pressure on natural resources, the scale and impact of land degradation and desertification are severe in the country, and it is estimated that nearly 29% (96 mha) of its land area is under degradation (SAC, 2021). Degraded lands are more prone to invasion by invasive alien species, which compete with native species and lead to further land degradation, productivity reduction and biodiversity loss. Managing land that is undergoing degradation and desertification, is therefore a significant priority in the context of achieving national targets and international commitments related to Nationally Determined Contribution, Land Degradation Neutrality and Sustainable Development Goals.

The greatest prospect for turning degraded land into healthy land lies in sustainable management of natural resources. In this context, Ecosystem Services Improvement Project (ESIP) was executed to manage natural resources by improving forest quality and linked livelihood improvement, and the community involved in it through a combination of technical assistance and demonstrative investments in the selected landscapes of Chhattisgarh and Madhya Pradesh. One of the objectives of ESIP was to improve the quality and productivity of the existing forests so as to ensure sustained flow of ecosystem goods and services, and to ensure the sustainable harvesting and value addition of non-timber forest products (NTFPs) to provide economic benefits to forest dependent communities. ESIP included four project components viz. (i). Strengthen capacity of government institutions in forestry and land management programs, (ii). Investments for improving forest quality in selected landscapes, (iii). Scaling up sustainable land and ecosystem management in selected landscapes and (iv). Project Management.

Indian Council of Forestry Research and Education (ICFRE) and State Forest Departments of Madhya Pradesh and Chhattisgarh were the project implementing agencies. ICFRE was responsible for implementation of the Sub-component 1.2: Forest Carbon Stocks Measuring, Monitoring, and Capacity Building, Component 3: Scaling up of Sustainable Land and Ecosystem Management in Selected Landscapes, and Component 4: Project Management. Project component on scaling up of sustainable land and ecosystem management (SLEM) approaches was mainly focused on combating land degradation and desertification and on increasing above-ground forest carbon stock through a combination of investments to implement and scale-up tried and tested SLEM best practices, to increase national capacity for monitoring land degradation and track associated indicators, and to generate knowledge exchange on SLEM approaches. SLEM practices (planting tree species, sustainable harvesting and value addition of non-timber forest products, rainwater harvesting and augmentation of water resources, management of agricultural land by promoting organic practices, and introduction of high-productive climate-resilient varieties of seeds, promotion of integrated farm development activities, promotion of the use of water-saving technologies in irrigation, promotion of sustainable harvesting practices with non-timber forest produces, promotion of energy-efficient biomass-based cooking stoves, application of engineering measures in moisture retention activities) are the best approaches for strengthening ecosystem services at the local level. It also covered the capacity building of the stakeholders on SLEM practices and livelihood improvement activities, and carbon measurement and monitoring.

Direct project beneficiaries included about 25,000 people, comprising forest dwellers, small landholders, marginal farmers etc. at the community level in the selected landscapes of Madhya Pradesh and Chhattisgarh. The indirect beneficiaries included a larger population in these states who were benefitted from improved forest quality and ecosystem services such as improved water flows, climate amelioration and land productivity. At the Forest Division level, the Forest Ranges were the key beneficiaries of capacity enhancement and supporting tools. At the state level, the State Forest Departments of Madhya Pradesh and Chhattisgarh were the main beneficiaries of strengthened institutional capacities, new technologies, and enhanced carbon measurement and monitoring systems.

Green India Mission (GIM) of the Government of India recognized that climate change impact and alter the distribution, type and quality of natural resources of the country and the associated livelihoods of local communities. GIM also acknowledges the role of forests on environmental amelioration through climate change mitigation, biodiversity conservation, food security, water security and livelihood security of forest dependent communities. ESIP supported the goals of GIM by demonstrating models for adaptation-based mitigation through sustainable land and ecosystem management and livelihood benefits.

CHAPTER – 02

PROJECT DEVELOPMENT OBJECTIVE

The project development objective was to improve forest quality, land management and non-timber forest produce benefits for forest dependent communities in selected landscapes in Madhya Pradesh and Chhattisgarh. The project comprised of following four components:

Component 1: Strengthen capacity of government institutions in forestry and land management programs in Madhya Pradesh and Chhattisgarh: Objective of this component was to enhance the capacity and skills of the State Forest Departments, the Forest Development Agencies, and local communities for improving management of forest and land resources and ensuring the delivery of sustainable benefits to local communities that depend on these resources. This component provided technical assistance for building institutional capacity and capability for planning and efficient delivery of forest ecosystem quality improvement and land management programs, and developed, tested and piloted nation-wide systems for measuring and monitoring forest carbon stocks.

Role of ICFRE under this component was to measure and monitor forest carbon stocks and to build the capacity of State Forest Departments and Joint Forest Management Committees on measurement of forest carbon stocks.

Component 2: Investments for improving forest quality in selected landscapes: Objective of this component was to improve the quality and productivity of the existing forests so as to ensure sustained flows of ecosystem services and carbon sequestration, and to ensure the sustainable harvesting and value addition of NTFP to provide economic benefits to forest dependent communities that promote conservation and improve ecological connectivity between critical biodiversity areas.

Component 3: Scaling up sustainable land and ecosystem management in selected landscapes: Objectives of this component was to prevent land degradation and desertification and to increase above-ground forest carbon stock through a combination of activities to implement and scaleup tried-and-tested SLEM best practices, to increase national capacity for monitoring land degradation and to track associated indicators and generate knowledge exchange on SLEM approaches. This component was mostly implemented by ICFRE.

Component 4: Project Management: Objective of this component was to coordinate and monitor project implementation and progress.

CHAPTER – 03

REVIEW OF LITERATURE

Land degradation is the result of unsustainable use of land-based resources, deforestation, over grazing and other anthropogenic pressures. The rapid pace of land degradation and desertification has reached alarming proportions and posing significant challenges in maintaining land-based sustainable productivity on the one hand and economic growth on the other (ICFRE, 2014 a). Over exploitation of natural resources and unsustainable land use practices have made the life less resilient and more vulnerable to the climate change and leading towards land degradation and desertification. Among all the resources, land is the key resource which is facing highest pressure due to anthropogenic activities related to agriculture production and other developmental activities. Over exploitation has not only depleted the natural resources but also affected the livelihood and food security of the rural communities. If this situation prevails, it would be difficult to achieve the sustainable development goal of zero hunger by 2030. Moving towards scaling up of sustainable land management practices, innovative ways to produce food, focus on cultivation of improved and resilient crop varieties, sustainable water harvesting methods, soil conservation approaches and focus on reducing greenhouse gas emission could be the way out for addressing land degradation and desertification (Ranganathan *et al*., 2018).

India with 2.3% of the world's land area and less than 4% of the global fresh water, has to fulfil the food and water requirement of about 18% of the world's human and cattle population. It has been reported that about 29.77% (97.85 mha) of total geographical area (TGA) of the country was under land degradation during 2018-19 (SAC, 2021). Whereas, the area under land degradation during the timeframe of 2011-13 and 2003-05 was observed 29.32% of TGA (96.40 mha) and 28.76% of the TGA (94.53 mha), respectively. A cumulative increase of 1.45 mha area (0.44% of the TGA) under desertification and land degradation was observed for the timeframe of 2011-13 to 2018-19. Whereas, for the timeframe of 2003-05 to 2011-13, a cumulative increase of 1.87 mha area (0.57% of the TGA) was observed. The most significant process of desertification/ land degradation in the country was water erosion (11.01% in 2018-19, 10.98% in 2011-13 and 10.83% in 2003-05) followed by vegetation degradation (9.15% in 2018-19, 8.91% in 2011-13 and 8.60% in 2003-05) and wind erosion (5.46% in 2018-19, 5.55 % in 2011-13 and 5.58 % in 2003-05).

India, 26 States/Union Territories have shown an increase in the level of desertification/land degradation between 2003-2005- and 2011-13-time frame. Maximum contribution (23.95% during 2011-13 and 23.64% during 2003-05) in desertification/land degradation of the country was reported for nine States/Union Territory (Rajasthan, Maharashtra, Gujarat, Karnataka, Jharkhand, Odisha, Madhya Pradesh, Telangana and Jammu and Kashmir), while rest of the states contribute less than 1% of desertification/ land degradation. Nine states/UTs mentioned above contain more than 80% of country's degraded land. State-wise data of desertification/land degradation shows that states like Jharkhand, Rajasthan, Delhi, Gujarat and Goa have more the 50% area under desertification/ land degradation while states like Kerala, Assam, Mizoram, Haryana, Bihar, Uttar Pradesh, Punjab and Arunachal Pradesh showed the ray of hope with less than 10% area under desertification/ land degradation (SAC, 2016).

Land degradation and desertification adversely affected the life of millions of people and the biodiversity. Loss of soil productivity not only affected the lives but also led the mass migration and socio-economic conflicts. Land degradation in India highly affected the agriculture sector which has highest contribution in Gross Domestic Product (GDP) of the country. Thus, clear impact of land degradation on GDP of the country can be easily figured out. In the year 2014-15, the economic loss due to land degradation and change in land use pattern was 2.54% of the GDP, which was about 3,177.39 billion (TERI, 2019).

In India, an emphasis on poverty alleviation through enhanced productivity of dry as well irrigated ecosystems requires apt conservation measures for sustainable production. The genesis of sustainable land and ecosystem management (SLEM) was rooted in the rationale that food security through enhanced agricultural productivity cannot be achieved by further increasing the cultivated area. Sustainable and integrated management of the natural resources is vital to meet the challenges of land degradation and desertification, and to sustain the flow of ecosystem goods and services. Keeping sustainable land management approach in mind, SLEM-Country Partnership Programme (SLEM-CPP) was initiated in 2008 and overall development objective was to contribute to poverty alleviation in India by promoting enhanced efficiency of natural resource use, improved land and ecosystem productivity, and reduced vulnerability to extreme weather events. The SLEM-CPP supported by GEF was in itself an innovative programmatic operation specifically developed to become more inclusive in addressing the sustainable land and ecosystem management agenda by drawing upon GEF resources and setting objectives that include combating land degradation, conserving biodiversity and adaptation to climate change. In the Indian context, SLEM was innovative as it takes a multi-sectoral approach to land management relating to poverty reduction, watershed management and afforestation initiatives based on ecosystem approach that pays particular attention to safeguarding biodiversity and climate change. ICFRE implemented GEF/ the World Bank funded project titled 'Policy and Institutional Reform for Mainstreaming and Scaling-up of the Sustainable Land and Ecosystem Management' from 2009 to 2014 as a Technical Facilitation Organization under SLEM-CPP and documented some SLEM best practices (ICFRE, 2014 b). There are significant opportunities for scaling up of SLEM practices in order to improve land productivity and reduce land degradation. SLEM practices need to be adopted and scaled up to improve the health and productivity of land on a sustainable basis. Sanz *et al*. (2017) highlighted that the objective of SLEM was to harmonize the complimentary goals of providing environmental, economic, and social opportunities for the benefit of present and future generations while maintaining and enhancing the quality of natural resources. SLEM focused on a holistic approach for achieving long-term productive ecosystems by integrating biophysical, socio-cultural and economic needs and values (Holling, 2001 and Schwilch *et al*., 2009). Along with rehabilitation and restoration of degraded landscapes, SLEM practices form one of the main mechanisms to achieve land degradation neutrality (Orr *et al*., 2017) and Nationally Determined Contribution targets under the Paris Agreement. SLEM practices can also be seen as a vehicle to optimize the contributions of land use-based actions in line with the objectives of the United Nations Framework Convention on Climate Change (UNFCCC), United Nations Convention to Combat Desertification (UNCCD) and Convention on Biological Diversity (CBD), and broadly contribute in achieving the land-based targets of sustainable development goals.

About 100 million of India's population is directly dependent on forested landscape for their livelihoods. Moreover, forest degradation directly contributes to climate change resulting in vegetation loss thereby imposing

significant challenges to the local communities of the forest fringe villages in respect of their livelihoods. Increasing habitat fragmentation and diminishing forest quality are posing greater challenges to life of forest dependent communities and adverse impacts will keep on increasing unless significant efforts are made to improve the sustainable flow of ecosystem goods and services. The forest cover of the country was 7,13,789 sq km as per 2021 assessment (FSI, 2021) which was 7,12,249 sq km as per 2019 assessment (FSI, 2019), recording an increase of 1,540 sq km within two years. The total forest and tree cover of the country was 8,09,537 sq km which is 24.62% of its geographical area. India has been successful in enhancing forest carbon stock through sustainable management of forests. As per the India State of Forest Report 2021, total forest carbon stock was estimated to be 7,204 million tonnes with an increase of 79.4 million tonnes over the previous assessment of 2019 (FSI, 2021). The land use, land-use change and forestry (LULUCF) sector in India was the only sector that consistently absorbs carbon dioxide in the country. LULUCF sector was a net sink of carbon and offset 15% of total national greenhouse gas emissions (MoEFCC, 2021). The Government of India is executing the National Mission for a Green India, commonly referred to as the Green India Mission (GIM) under its National Action Plan on Climate Change which aims to improve the forest cover by integrating the issues of forest quality and ecosystem services. It aims at protecting, restoring and enhancing the diminishing forest cover, and responding to climate change by a combination of mitigation and adaptation measures. Baseline reports of the forest carbon stocks of project areas of Madhya Pradesh and Chhattisgarh were published by ICFRE for the year 2019-20 under ESIP (ICFRE, 2020 a and 2020 b).

CHAPTER – 04

MATERIALS AND METHODS

Project Areas of Madhya Pradesh: The Madhya Pradesh State Forest Department selected two L1 level landscapes (Satpura-Narmada and Vindhya Plateau) which comprise of three L2 level landscapes in Betul, Hoshangabad and Sehore Forest Divisions for implementation of the project activities under ESIP. Banapura, Itarsi and Sukhtawa Forest Ranges in Hoshangabad Forest Division, Budhni Forest Range in Sehore Forest Division and Bhaura Forest Range in North Betul Forest Division were selected for the implementation of the project activities under ESIP (Table 1).

Project Areas of Chhattisgarh: The Chhattisgarh State Forest and Climate Change Department initially selected four Forest Divisions viz. Marwahi, Balrampur, Kawardha and Katghora for implementation of the project activities under ESIP which fall under Gourela-Pendra-Marwahi, Balrampur, Kabirdham and Korba districts of Chhattisgarh. Kanker Forest Division was added in the later stage for implementation of the project activities under ESIP. Marwahi Forest Range in Marwahi Forest Division, Raghunathnagar Forest Range in Balrampur Forest Division, Pandria West Forest Range in Kawardha Forest Division, Pali Forest Range in Katghora Forest Division and Narharpur Forest Range in Kanker Forest Division were selected for the implementation of the project activities under ESIP (Table 2).

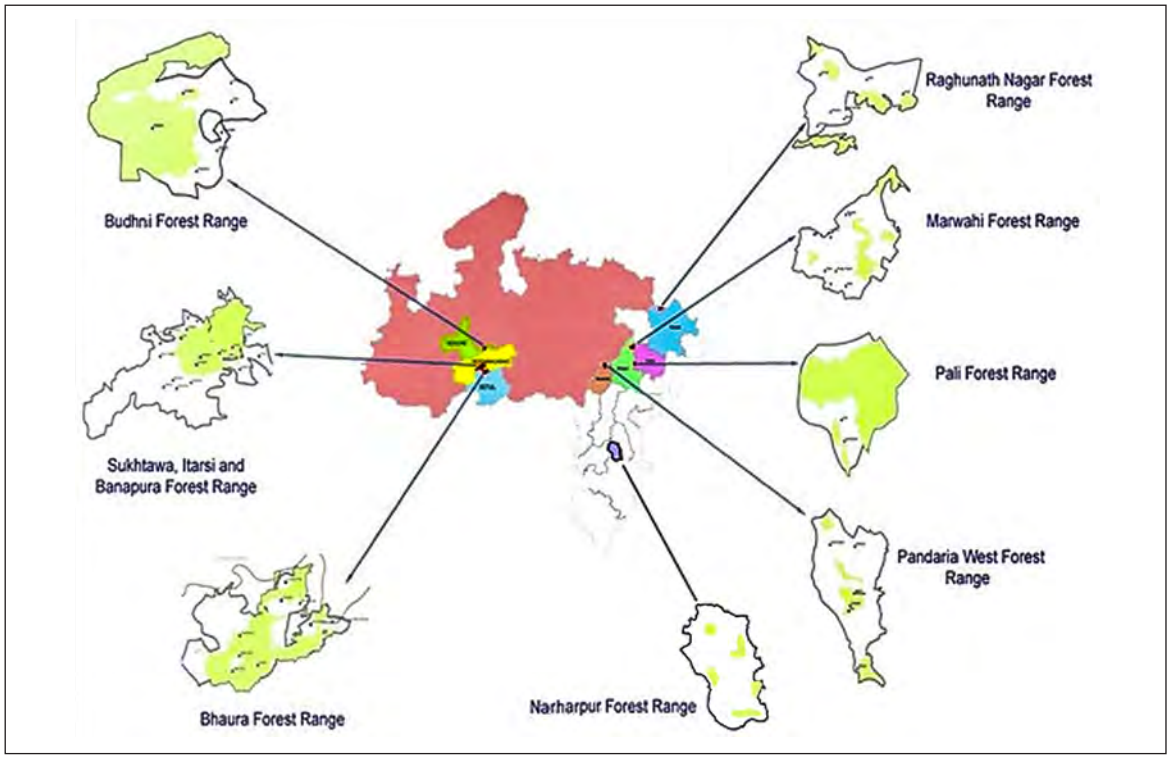


Figure 1: Project areas of Madhya Pradesh and Chhattisgarh

Table-1: Project areas of Madhya Pradesh

S.No.	Forest Range	Villages
1	Banapura	Pipalgota, Nayagaon, Bhawanda , Ghoghara, Nanderwada, Sota Chikhali, Jondhal, Salai, Narri, Chandakhad, Gotabarri, Keolajhir, Banspani, Banapura
2	Bhaura	Handipani, Kachhar, Koyal Buddi, Kuppa, Tetar Mal & Ryt, Koyalari, Banabehda, Bhaura Dhana
3	Itarsi	Khatama, Lalpani, Bhatna, Ranjhi
4	Sukhtawa	Khoda, Pipariya Khurd, Saradeh, Amrai, Baramahua, Manataker
5	Budhni	Hathlewa, Paraswada, Paharkhedi & Makodiya, Chacmau, Naganpur, Saidganj, Akola, Khatpura

Table-2: Project areas of Chhattisgarh

S.No.	Forest Range	Villages
1	Pali	Kodar, Hardikachhar, Parsapani, Jamnipani, Dumdumi, Nawadih, Chanwaripara, Karranawapara, Kanhaiyapara
2	Pandaria West	Neur, Rahidand, Amania, Taitirni, Rukhmidadar, Rokhni, Amilitola, Bhangitola
3	Raghunathnagar	Kesari, Shankarpur, Babhani, Nawgai, Rameshpur, Girwani, Raghunathnagar
4	Marwahi	Bansital, Danikundi, Naka, Boharijorki, Silphari, Kolbirra, Ameratikra, Moharitikra, Pathrra, Baghrra, Madai, Matiyadand, Rumga
5	Narharpur	Bhansuli, Devgaon, Surhi, Dabbipani, Mandradarha, Rajpur, Barethinbahara, Bhiroud, Dabena, Jhaliyamari, Mashulpani, Charbhatha, Badbani, Dudumbahara, Dhaurabhatha, Jaamgaon

Table-3: Details of the project areas of Madhya Pradesh and Chhattisgarh

ESIP Villages	TGA (in ha)	Total HH	Total Popul-ation	Forest Area (in ha)	Area under Non-Agri-cultural Uses (in ha)	Barren & Un-cultivable Land Area (in ha)	Permanent Pastures and Other Grazing Area (in ha)	Land Under Miscl. Tree Crops (in ha)	Culturable Waste Land (in ha)	Fallow Land other than Current Fallow (in ha)	Current Fallow Lands (in ha)	Net Area Sown (in ha)
MP (41 Villages)	26517.67	4818	23630	10607.73	756.38	332.73	896.57	85.1	1977.89	522.14	577.35	8504.81
CG (51 Villages)	36697	13036	54857	10950.13	1330.21	4963.04	4105.17	68.26	720.72	991.52	1258.89	12308.99
Total (92 Villages)	63214.67	17854	78487	21557.86	2086.59	5295.77	5001.74	153.36	2698.61	1513.66	1836.24	20813.8

Measurement and Monitoring of Forest Carbon Stocks: Measurement and monitoring of forest carbon stocks were done as per the standard procedures and methods (IPCC, 2003; IPCC, 2006; FSI, 1996; FSI, nd; MoEFCC, 2014 and ICFRE, 2020 c; Rajput *et. al.*, 1996; Walkley and Black, 1934 and Pearson *et al.*, 2007). Eddy covariance-based carbon flux towers were established at Khatpura Forest Beat in Budhni Forest Range (Sehore Forest Division, Madhya Pradesh) and Sonhat Forest Beat in Raghunathnagar Forest Range (Balrampur Forest Division, Chhattisgarh). Data on eddy fluxes were calculated and analysed as per standard methods (McMillen, 1988; Loescher *et al.*, 2006; McGloin *et al.*, 2018; Foken, 2008; Vickers and Mahrt, 1997; Moncrieff *et al.*, 1997, 2004; Webb *et al.*, 1980; Burba, 2013; Kaimal

et al., 1972; Baldocchi *et al*., 1988); Fei *et al*., 2018; Falge *et al*., 2002; Hutyra *et al.,* 2007; Zhang *et al*., 2006; Wang *et al*., 2008; Artigas *et al.,* 2015; Migliavacca *et al*., 2015; Reichstein and Beer, 2008).

Capacity Building on Measurement and Monitoring of Forest Carbon Stocks: Trainings for capacity building of the State Forest Departments were planned in such a way to cover class room sessions followed by hands-on sessions in the forest for laying out of sample plots, measurement of vegetation parameters and collection of soil and plant samples for estimation of forest carbon stocks and exercises on estimation of carbon. Following schedule was followed for organisation of the trainings for capacity building of State Forest Departments of Madhya Pradesh and Chhattisgarh:

Schedule of the Training	
Day 1	
Time	**Topic**
10:00 -10:30 AM	• Overview of ESIP and introduction to training • Introductory remarks by Representatives of State Forest Department
10:30 - 11:00 AM	**Tea break and Group Photo**
11:00 - 12:00 PM	Forest carbon stocks as an ecosystem service
12:00 - 1:00 PM	Forest Carbon Pools, Measuring and Monitoring of Forest Carbon Stocks
1:00 - 2:00 PM	**Lunch**
2:00 - 3:30 PM	Methodological aspects of forest carbon stocks measurement: Stratification, variability estimation, selection of appropriate number of sample plots and distribution of sample plots
3:30 - 3:45 PM	**Tea Break**
3:45 - 4:30 PM	Methodological aspects of forest carbon stocks measurement: Laying out of sample plots in forest, estimation of above ground biomass, litter, below ground biomass and soil organic carbon including field equipment handling and analysis of litter, vegetation and soil analysis
4:30 - 5:30 PM	Filling of the data in the field forms
	Day 2
9:00 - 5:00 PM	Key steps in 'On-site forest carbon stock assessment': Hands on in laying out of sample plots, measurement of trees, shrubs and herbaceous plants, collection of litter, ground vegetation and soil samples etc, including handling of equipment (Group field exercise)
	Day 3
9:30 - 10:30 AM	Wrap up of On-site forest carbon stocks assessment: Doubts and clarifications etc. on sampling process and methodologies etc.
10:30 - 10:45 AM	**Tea Break**
10:45 - 1:00 PM	Class room exercise on biomass carbon estimation for sample plot data: Application of relevant allometric equations Data Entry in excel sheet and analysis
1:00 - 2:00 PM	**Lunch**
1:00 - 4:00 PM	Class room exercise on biomass carbon estimation for sample plot data: Application of relevant allometric equations Data Entry in excel sheet and analysis
4:00 - 5:00 PM	Valedictory session and closing remarks Vote of Thanks

Trainings for capacity building of Joint Forest Management Committees were structured for half day class room session and half day hands-on session in the forest for laying out of sample plots, measurement of vegetation parameters and collection of soil and plant samples for estimation of forest carbon stocks.

Trainings on measurement of forest carbon exchange using eddy covariance techniques were structured for class room sessions followed by practical demonstration of the sensors installed on the carbon flux towers.

Scaling up of SLEM Best Practices: Participatory rural appraisal exercises and focus group discussions were conducted in the randomly selected villages (about 30%) of ESIP areas of Madhya Pradesh and Chhattisgarh for preparation of baseline reports of socio-economic status of project areas. ICFRE had documented 22 best practices for sustainable land and ecosystem management (SLEM) under the World Bank funded SLEM Project (ICFRE, 2014). Other organisations have also documented SLEM best practices. ICFRE envisaged to scale up tested and proven SLEM best practices in the common property resource lands, private lands and non-forest areas covering around 25,000 ha in the project areas of Chhattisgarh and Madhya Pradesh. Initially SLEM best practices viz. rain water harvesting and augmentation of water resources, Wadi - a tree based farming system, lac cultivation for livelihood generation and biodiversity conservation, *chauka* system for management of common property resources for sustainable livelihood and adaptation to climate change, amla based agroforestry, agarbatti preparation from degraded bamboo forests, mulberry cultivation: A diversification climate change adaptation practice for sustainable livelihood, system of rice intensification, climate-proofing fish farming and livelihood diversification through integrated crop production systems were shortlisted in consultation with the local communities of the project areas for scaling up. M/s Watershed Organization Trust was engaged as Technical Partner Agency (TPA) to support ICFRE in identification and scaling up of tested and proven SLEM best practices in the project areas of Madhya Pradesh Chhattisgarh. TPA conducted stakeholder consultations at the village level in the project areas and prepared village wise SLEM plans highlighting the details about identified SLEM best practices/ activities and list of the beneficiaries for scaling up of SLEM best practices/ activities through community driven participatory approach.

CHAPTER – 05

OUTCOME

Component wise outcomes of the project are highlighted as under:

5.1. Sub-component: Forest Carbon Stock Measuring and Monitoring - Capacity-building of Component 1: Strengthen capacity of government institutions in forestry and land management programs in Madhya Pradesh and Chhattisgarh

5.1.1. Measurement and Monitoring of Forest Carbon Stock

Forests store significant amount of carbon in its biomass, litter, dead wood and soil, and it has major role in climate change mitigation and adaptation. Forests are considered to provide a large climate change mitigation opportunity at relatively lower costs along with significant co-benefits. Forests and climate change are very intricately linked with each other and forests can be source or sink of carbon. The central Indian highlands are part of the 39% forest grids of India identified and mapped as 'vulnerable to climate change'. These grids also face threats of degradation due to unsustainable land use practices (MoEF, 2012). The World Bank funded Ecosystem Services Improvement Project (ESIP) was implemented in the selected landscapes of Madhya Pradesh and Chhattisgarh which fall under central Indian highlands. ESIP envisaged to support the goals of the GIM by demonstrating models for adaptation-based mitigation measures through sustainable land and ecosystem management (SLEM) and also to provide livelihood benefits to the local communities of the project areas. ESIP also envisaged to support in the sequestration of additional carbon of about 10% in the forest areas of Madhya Pradesh and Chhattisgarh over the baseline through implementation of the project interventions/ activities (World Bank, 2017). It also presents a good opportunity to improve the carbon sequestration potential of the entire target area of GIM through scaling up of successful demonstrative pilots of ESIP.

Five carbon pools viz., aboveground biomass, belowground biomass, litter, deadwood, soil organic matter were taken for measurement of forest carbon stocks. Baseline studies on the forest carbon stocks in the project areas of Madhya Pradesh and Chhattisgarh were conducted during the year 2018-19. Baseline reports were prepared (ICFRE, 2020 a and 2020 b) and shared with State Forest Departments of Madhya Pradesh and Chhattisgarh, Ministry of Environment, Forest and Climate Change, Government of India and the World Bank. Baseline reports were also uploaded on ICFRE website and on "SLEM knowledge sharing and reporting system" portal for wider dissemination. Baseline reports acted as a benchmark for assessing the impacts of the project intervention/ activities carried out by State Forest Departments of Madhya Pradesh and Chhattisgarh on forest carbon stocks in the project areas. Assessment of forest carbon stocks of the project areas of Madhya Pradesh and Chhattisgarh was done during the year 2022-23 to evaluate the impact of project intervention/ activities and findings of the study was published titled as ESIP: Assessment of Forest Carbon Stocks of Project Areas of Madhya Pradesh and Chhattisgarh (ICFRE, 2023 a).

Forest Carbon Stock in Project Areas of Madhya Pradesh: The total forest carbon stock in project areas of Madhya Pradesh for the year 2022-23 was estimated to be 1302477.11 tonnes over the baseline total forest carbon stock of 1172639.19 tonnes for the year 2018-19 (Table 4).

Table-4: Total forest carbon stock of project areas of Madhya Pradesh

Forest Range	Total forest carbon stock in 2018-19 (in Tonnes)	Total forest carbon stock in 2022-23 (in Tonnes)
Budhni Forest Range	237013.53	262445.08
Bhaura Forest Range	378629.12	429062.52
Banapura, Itarsi and Sukhtawa Forest Ranges	556996.54	610969.50
Total	**1172639.19**	**1302477.10**

Total forest carbon stock was estimated to be increased by 11.25% in the project areas of Madhya Pradesh over the baseline forest carbon stock. Total forest carbon stock was estimated to be increased by 13.32% in Bhaura Forest Range, 10.73% in Budhni Forest Range while total carbon stock was estimated to be increased by 9.69% in Banapura, Itarsi and Sukhtawa Forest Ranges (Table 5).

Table-5: Incremental changes in the total forest carbon stock in project areas of Madhya Pradesh

Forest Ranges	Total forest carbon stock (in Tonnes)		
	2018-19	2022-23	% Increment
Budhni Forest Range	237013.53	262445.08	10.73
Bhaura Forest Range	378629.12	429062.52	13.32
Banapura, Itarsi and Sukhtawa Forest Ranges	556996.54	610969.50	9.69

The average carbon stock density in Budhni, Bhaura and Banapura, Itarsi and Sukhtawa Forest Ranges were 59.82 tC/ha, 57.59 tC/ha and 62.24 tC/ha, respectively in 2018-19. This increased to 66.24 tC/ha, 65.26 tC/ha and 68.27 tC/ha in Budhni, Bhaura and Banapura, Itarsi, Sukhtawa Forest Ranges respectively in 2022-23. The aboveground components and soil have maximum share of the total forest carbon stock, whereas deadwood contribution was negligible. Incremetal changes in carbon stock density in project areas of Madhya Pradesh is given in the Table 6.

Table-6: Incremental changes in carbon stock density in project areas of Madhya Pradesh

Forest Ranges	Average carbon stock density (t/ha)		
	2018-19	2022-23	% Increment
Budhni Forest Range	59.82	66.24	10.73
Bhaura Forest Range	57.59	65.26	13.32
Banapura, Itarsi and Sukhtawa Forest Ranges	62.24	68.27	9.69
Average	**59.88**	**66.59**	**11.25**

Forest Carbon Stock in Project Areas of Chhattisgarh: The total forest carbon stock in project areas of Chhattisgarh for the year of 2022-23 was estimated to be 1312014.46 tonnes (Table 7) over the baseline total forest carbon stock of 1223310.56 tonnes for the year 2018-19.

Table-7: Total forest carbon stock of project areas of Chhattisgarh

Forest Ranges	Total forest carbon stock in 2018-19 (in Tonnes)	Total forest carbon stock in 2022-23 (in Tonnes)
Raghunathnagar Forest Range	126538.39	136572.88
Pali Forest Range	348362.24	373200.47
Marwahi Forest Range	261660.33	283901.46
Pandria West Forest Range	486749.60	518339.65
Total	**1223310.56**	**1312014.46**

During the assessment period from 2018-19 to 2022-23, total forest carbon stock was estimated to be increased by 7.51% in the project areas of Chhattisgarh. Total forest carbon stock of Marwahi Forest Range was estimated to be increased by 8.50% while total forest carbon stock in Pandria West Forest Range was estimated to be increased by 6.49%. Total forest carbon stock of Pali Forest Range and Raghunathnagar Forest Range were estimated to be increased by 7.13% and 7.93% as compared to baseline carbon stock for the year 2018-19 (Table 8).

Table-8: Incremental changes in the total forest carbon stock in project areas of Chhattisgarh

Forest Ranges	Total Forest carbon stock (in Tonnes)		
	2018-19	2022-23	% Increment
Raghunathnagar Forest Range	126538.39	136572.88	7.93
Pali Forest Range	348362.24	373200.47	7.13
Marwahi Forest Range	261660.33	283901.46	8.50
Pandria West Forest Range	486749.60	518339.65	6.49

The average carbon stock density in Raghunathnagar, Pali, Pandria West and Marwahi Forest Ranges were 60.07 t/ha, 96.73 t/ha, 80.91 t/ha and 58.73 t/ha, respectively in 2018-19. This increased to 64.83 tC/ha, 103.63 tC/h, 86.16 t/ha and 63.72 t/ha in Raghunathnagar, Pali, Pandria West and Marwahi Forest Ranges in 2022-23. The aboveground biomass and soil have maximum share of the total forest carbon stock, whereas deadwood contribution is nil. During the monitoring period (2019-2022), 7.93% carbon stock density was estimated to be increased in Raghunathnagar Forest Range while 7.13% carbon stock density was estimated to be increased in Pali Forest Range. 6.49% carbon stock density was estimated to be increased in Pandria West Forest Range while 6.49% carbon stock density was increased in Marwahi Forest Range as compared to baseline in 2018-19 (Table 9).

Table-9: Incremental changes in carbon stock density in project areas of Chhattisgarh

Forest Ranges	Average carbon stock density (t/ha)		
	2018-19	2022-23	% Increment
Raghunathnagar Forest Range	60.07	64.83	7.93
Pali Forest Range	96.73	103.63	7.13
Marwahi Forest Range	58.73	63.72	8.50
Pandria West Forest Range	80.91	86.16	6.49
Average	**74.11**	**79.58**	**7.51**

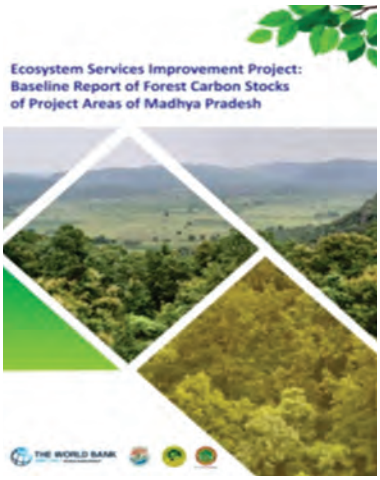
The total forest carbon stock in project areas of Madhya Pradesh was estimated to be 1302477.11 tonnes with the average carbon density of 66.59 t/ha over the baseline total forest carbon stock of 1172639.19 tonnes.

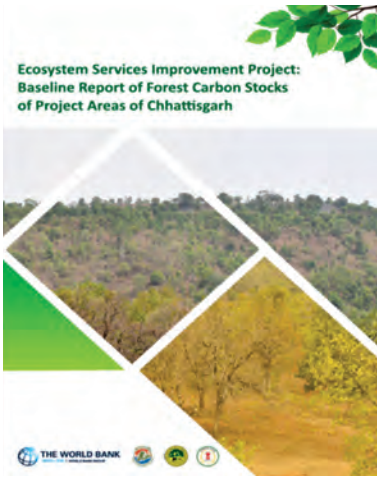
The total forest carbon stock in project areas of Chhattisgarh was estimated to be 1311347.53 tonnes with the average carbon density of 79.58 t/ha over the baseline.

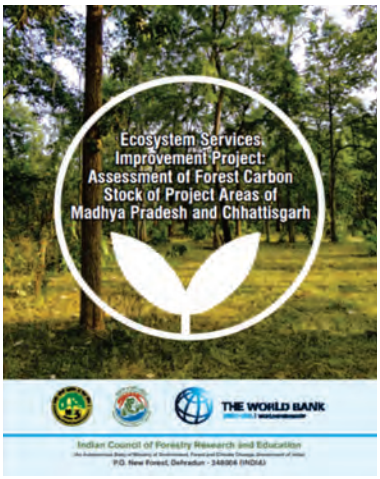
The forest carbon stock in the ESIP areas of the Madhya Pradesh was increased by 11.25% over the baseline forest carbon stock for the year 2018-19.

The forest carbon stock in the ESIP areas of Chhattisgarh was increased by 7.51% over the baseline forest carbon stock.

The total forest carbon stock of project areas of Madhya Pradesh and Chhattisgarh was increased by 9.38% over the baseline forest carbon stock.





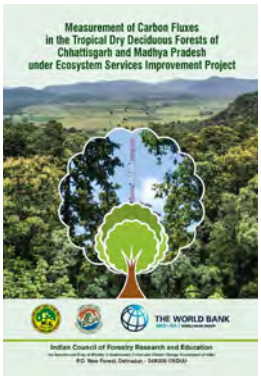


5.1.2. Develop, Test, and Pilot Systems for Measuring and Monitoring of Forest Carbon Stocks

Forests play key role in mitigating climate change through sequestrating atmospheric carbon dioxide. An accurate measurement of carbon fluxes of forest ecosystems across regions is needed to understand the interaction between terrestrial carbon and the atmosphere. The carbon flux tower directly measures the carbon, water, and heat flux in forest and atmosphere across spatial and temporal variability. Carbon flux towers are employed to study carbon cycling of forest ecosystem and are helpful in suggesting suitable strategies for sustainable management of forests by providing information on seasonal dynamics and inter-annual variation of net ecosystem exchange. Accordingly, two eddy covariance-based carbon flux towers with 42-meter height were installed in the states of Madhya Pradesh and Chhattisgarh for measuring the carbon fluxes of forests. The eddy covariance-based carbon flux towers are equipped with operational fast sensor Infrared gas analyzer with 3-D sonic anemometer which serves as components of eddy covariance flux tower. The other complementary meteorological sensors measuring air temperature and relative humidity, net radiation, photosynthetically active radiation, soil heat flux, soil moisture and temperature, wind speed and direction are also installed which helps in flux calculations and biogeochemical dynamics. Eddy covariance technique provides the continuous measurement of the exchange rate of CO_2 across the interface between the atmosphere

and vegetation by measuring the covariance between fluctuating vertical wind velocity and CO_2 mixing ratio. This technique directly measures the carbon, water, and heat flux in plant communities and atmosphere across a varied spectrum of time scales, ranging from half-hourly, daily to yearly scales. This is employed to study carbon cycling of the forest ecosystem and facilitate policy-oriented decisions and suggest strategies for sustainable forest management by providing information on seasonal dynamics and inter-annual variation of net ecosystem exchange.

Measurement of Carbon Fluxes in the Tropical Dry Deciduous Forests of Madhya Pradesh and Chhattisgarh: Eddy covariance-based carbon flux towers established by ICFRE at Khatpura Forest Beat in Budhni Forest Range (Sehore Forest Division, Madhya Pradesh) and Sonhat Forest Beat in Raghunathnagar Forest Range (Balrampur Forest Division, Chhattisgarh) in March 2021 to monitor CO_2 flux and net ecosystem exchange at real time. Data of eddy covariance-based carbon flux towers for the period from April 2021 to March 2023 were analysed and findings of the study were published titled as Measurement of Carbon Fluxes in the Tropical Dry Deciduous Forests of Chhattisgarh and Madhya Pradesh under ESIP (ICFRE 2023 b). Key findings of the study on measurement of carbon fluxes in the Northern Mixed Deciduous Forest, Khatpura (Madhya Pradesh) and Southern Mixed Deciduous Forest, Sonhat (Chhattisgarh) are highlighted as under:



- Photosynthetically Active Radiation, one of the crucial parameters in carbon cycle in terrestrial ecosystem and surface energy cycle, ranged from 392.71 to 890.90 $\mu molm^{-2}s^{-1}$ at Northern Mixed Deciduous Forest, Khatpura (Madhya Pradesh) and from 156.65 to 910.91 $\mu molm^{-2}s^{-1}$ at Southern Mixed Deciduous Forest, Sonhat (Chhattisgarh).
- The energy balance closure is used to assess the reliability and accuracy of surface flux measurement. The average monthly energy balance ranged from 145.05 to 305.98 Wm^{-2} at Northern Mixed Deciduous Forest, Khatpura (Madhya Pradesh) and from 132.39 to 264.45 Wm^{-2} at Southern Mixed Deciduous Forest, Sonhat (Chhattisgarh).
- The recorded annual mean net ecosystem exchange at both the sites indicate the net sink of carbon to the atmosphere over study period. The CO_2 uptake from the atmosphere was reported from the month of July to February continuously at both the forests. Forests are acting as source of carbon from March to June.
- The mean net ecosystem exchange was recorded lower in the wet seasons than dry season at Northern Mixed Deciduous Forest, Khatpura (Madhya Pradesh) and Southern Mixed Deciduous Forest, Sonhat (Chhattisgarh).
- The highest sequestration of CO_2 was recorded in the month of August at Northern Mixed Deciduous Forest, Khatpura (Madhya Pradesh) and September at Southern Mixed Deciduous Forest, Sonhat (Chhattisgarh).
- The cumulative net ecosystem exchange recorded for Northern Mixed Deciduous

Forest, Khatpura (Madhya Pradesh) was 5.47 and 4.96 t C ha^{-1}, respectively in 1st year and 2nd year and for Southern Mixed Deciduous Forest, Sonhat (Chhattisgarh) was 4.15 and 4.66 t C ha^{-1}.

- The carbon uptake reached peak before noon hours (1000–1100 hrs) in both wet season dry season, and then started to diminish at both forests. In the evening, net ecosystem exchange changed from a negative value to a positive value indicating carbon emission to the atmosphere.
- Environmental parameters such as air temperature, photosynthetically active radiation, vapour pressure deficit and soil temperature were significantly correlated with net ecosystem exchange at Northern Mixed Deciduous Forest, Khatpura (Madhya Pradesh) and Southern Mixed Deciduous Forest, Sonhat (Chhattisgarh).
- Some Government organizations such as NRSC, IIRS, IITM etc. also established carbon flux towers in different parts of the country. There is a need to develop a mechanism for networking of the already installed eddy covariance-based carbon flux towers in the form of Indo Flux for comprehensive observation, sharing of the data and results for further preparation of the country level report on the carbon fluxes of the forests. Subsequently, networking of carbon flux towers can also be done with Asia Flux.
- Long term measurements of carbon fluxes provide intense and detailed understanding of the carbon cycle processes. Continuation of ongoing measurements could help in predicting net carbon uptake in near future and also helpful in developing suitable mitigation and adaptation strategies for changing climate.

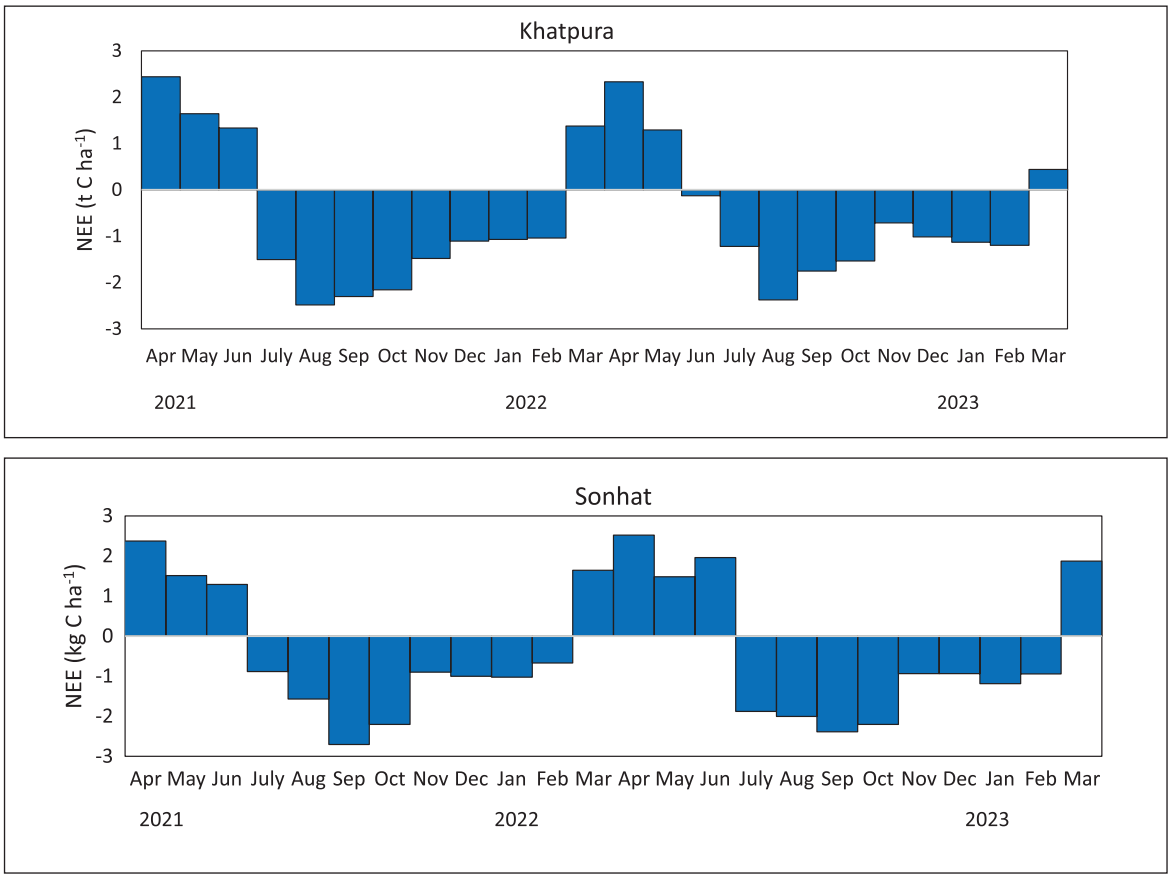


Figure 2: Monthly time series of mean Net Ecosystem CO_2 Exchange (NEE) at Northern Mixed Deciduous Forest, Khatpura (MP) and Southern Mixed Deciduous Forest, Sonhat (CG)

Northern mixed deciduous forest of Madya Pradesh and Southern mixed deciduous forest of Chhattisgarh act as net carbon sink with a net carbon uptake of 4.96 - 5.47 t C ha^{-1} y^{-1} in Madhya Pradesh and 4.15 - 4.66 t C ha^{-1} y^{-1} in Chhattisgarh.

The highest sequestration of CO_2 was recorded in the month of August at Northern Mixed Deciduous Forest, Khatpura (Madhya Pradesh) and September at Southern Mixed Deciduous Forest, Sonhat (Chhattisgarh).

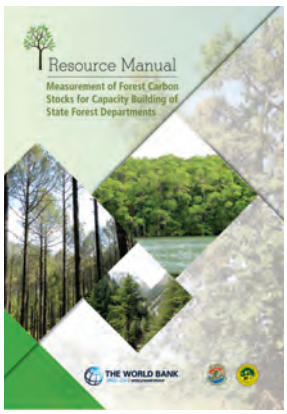
In the month of April to May carbon was released into the atmosphere and forest act as source of carbon.

5.1.3. Capacity Building of State Forest Departments and Joint Forest Management Committees for Measurement and Monitoring of Forest Carbon Stock

5.1.3.1. Development and Publication of Resource Manuals: Following resource manuals were developed and published under ESIP for capacity building of the State Forest Departments and Joint Forest Management Committees, and research and academic institutions:

(i) Resource Manual on Measurement of Forest Carbon Stocks: The resource manuals (in Hindi and English) on 'Measurement of Forest Carbon Stocks for Capacity Building of State Forest Departments' were developed in such a manner that a field forester can easily follow the manual and measure forest carbon stocks. Resource manual covers all aspects of carbon measurement right from determining the sample size, laying out of sample plots, measurement of various variables, analysis of plant and soil samples and finally analysis of different carbon pools in a forest ecosystem. Resource manuals were provided to all participants of the trainings organized under ESIP for capacity building of State Forest Departments of Madhya Pradesh and Chhattisgarh. Copies of the resource manuals were also provided to all State Forest Departments of the country.

(ii) Resource Manual on Application of Eddy Covariance Technique for Measurement of Forest Carbon: This resource manual covers all the aspects of sensors used, eddy covariance techniques, processing of data, calculation and analysis of flux data through software and integration of remote sensing and eddy covariance techniques. Resource manual was provided to all participants of the trainings organized under ESIP for capacity building of State Forest Departments of Madhya Pradesh and Chhattisgarh, and research and academic institutions.



(iii) **Brochure on Measurement of Forest Carbon Stocks:** A brochure in Hindi was developed and published for capacity building of Joint Forest Management Committees (JFMCs) of Madhya Pradesh and Chhattisgarh. The brochure highlighted in detail the importance of forest carbon measurement, laying out of sample plots, recording and collection of data, and collection of plant and soil samples for carbon estimation. Brochures were provided to the all participants of the trainings organized under ESIP for capacity building of JFMCs of Madhya Pradesh and Chhattisgarh.

5.1.3.2. Capacity Building of State Forest Departments

Organised 20 trainings on Measurement of Forest Carbon Stock for capacity building of the State Forest Departments (SFDs) of Madhya Pradesh and Chhattisgarh. The objective of trainings was to build the capacity of the State Forest Departments on detailed methodologies and procedures required for laying out of sample plots (for trees, shrubs and herbs), measurement and collection of data and samples from the field, and analysis of data for estimation of forest carbon stocks. Classroom training sessions were followed by the hands-on training in the field for laying out of the sample plots, collection of the data and collection of soil and forest floor samples for estimation of carbon stocks. Details of the trainings organised under the project are given in Table 10. A total number of 825 officers/ officials from State Forest Departments of Madhya Pradesh and Chhattisgarh participated in 20 trainings organised during the year 2018 to 2022 under ESIP.

Table-10: Trainings organised for SFDs on Measurement of Forest Carbon Stocks

S. No.	Training	Date	SFD	Location	Participants		Total
					Male	Female	
1	Biodiversity and Forest Carbon Stock Assessment	13 to 14 November 2018	MP	Hoshangabad	43	0	43
2	Measurement of Forest Carbon Stock	28 May 2019	MP	Hoshangabad	44	2	46
3	Measurement of Forest Carbon Stock	17 to 18 June 2019	MP	Itarsi	50	3	53
4	Measurement of Forest Carbon Stock	14 September 2019	MP	Budhni	30	0	30
5	Application of GIS and Remote Sensing in Forest Carbon Stock Assessment	11 to 13 February 2020	MP	Itarsi	52	2	54
6	Measurement of Forest Carbon Stock	04 to 06 February 2021	MP	Hoshangabad	29	01	30
7	Measurement of Forest Carbon Stock	07 to 09 February 2021	MP	Sehore	26	02	28
8	Measurement of Forest Carbon Stock	10 to 12 February 2021	MP	North Betul	28	0	28
9	Measurement of Forest Carbon Stocks (ToT)	28 to 30 September 2021	MP	Itarsi	25	3	28
10	Measurement of Forest Carbon Stock (ToT)	04 to 06 October 2021	MP	Itarsi	26	2	28

S. No.	Training	Date	SFD	Location	Participants		Total
					Male	Female	
11	Measurement of Forest Carbon Stock (ToT)	07 to 09 October 2021	MP	Itarsi	25	0	25
12	Measurement of Forest Carbon Stock (ToT)	19 to 23 September 2022	MP	Dehradun	30	0	30
Total participants of MP-SFD					**408**	**15**	**423**
13	Biodiversity and Forest Carbon Stock Assessment	11 to 12 September 2018	CG	Bilaspur	80	0	80
14	Measurement of Forest Carbon Stock	15 to 17 October 2019	CG	Bilaspur	48	0	48
15	Measurement of Forest Carbon Stock	23-27 November 2019	CG	Pali	36	0	36
16	Measurement of Forest Carbon Stock (ToT)	06 to 08 September 2021	CG	Kanker	70	3	73
17	Measurement of Forest Carbon Stock (ToT)	13 to 15 September 2021	CG	Ambikapur	39	2	41
18	Measurement of Forest Carbon Stock (ToT)	10 to 21 September 2021	CG	Chilfi, Kawardha	50	3	53
19	Measurement of Forest Carbon Stock (ToT)	23 to 25 September 2021	CG	Bilaspur	47	1	48
20	Measurement of Forest Carbon Stocks (ToT)	26 to 30 September 2021	CG	Dehradun	23	0	23
Total participants of CG-SFD					**393**	**9**	**402**
Total Participants					**801**	**24**	**825**

Three trainings on Measurement of Forest Carbon Exchange through Eddy Covariance System were also organized under ESIP. A total of 84 participants from ICFRE institutes, SFDs of MP and CG, Forest Survey of India, Indira Gandhi Krishi Vishwavidyalaya, Raipur and Sant Gahira Guru Vishwavidyalaya, Sarguja, Ambikapur participated in the trainings (Table 11).

Table-11: Trainings organised on Measurement of Forest Carbon Exchange through Eddy Covariance System

S. No.	Training	Date	SFD/ Organisation	Location	Participants		Total
					Male	Female	
1	Application of Eddy Covariance system for Forest Carbon measurement	03/09/2021	MP SFD, ICFRE, FSI	Itarsi and Budhni	19	5	24
2	Application of Eddy Covariance system for Forest Carbon measurement	12/09/2021	CG SFD, ICFRE, Universities	Ambikapur and Ragunathnagar	29	1	30
3	Measurement of Forest Carbon Exchange through Eddy Covariance System	31/10/2022 to 02/11/2022	MP SFD, CG SFD & ICFRE	Dehradun	27	3	30
Total					**75**	**9**	**84**

M/s Campbell Scientific India Pvt. Ltd. organized two training programmes on Measurement of Forest Carbon Exchange through Eddy Covariance-based Carbon Flux Towers on 06-07 February 2023 at Hyderabad and on 09-10 February 2023 at Dehradun. Scientists and researchers from ICFRE Hqs., ICFRE institutes and other organizations (NRSC, IIRS, GBPNIHE, IIT Madras, NIH Roorkee, Uttarakhand Watershed Management Directorate etc.) participated in these trainings.

Figure 3: Glimpses of trainings for SFDs on Measurement of Forest Carbon Stock

5.1.3.3. Capacity Building of Joint Forest Management Committees (JFMCs)

Organised 45 hands-on trainings on Measurement of Forest Carbon Stock for capacity building of the JFMCs of Madhya Pradesh and Chhattisgarh. Objective of the hands-on trainings was to build the capacity of JFMCs for laying out of sample plots (for trees, shrubs and herbs), measurement and collection of data, and collection of plant and soil samples from the field. Details of the hands-on trainings organised under the project are given in Table 12. A total of 2915 members of JFMCs of Madhya Pradesh and Chhattisgarh participated in the hands-on trainings organised during the year 2018 to 2023.

Table-12: Hands-on trainings organised for JFMCs on Measurement of Forest Carbon Stocks

S. No.	Hands-on Training	Date	State	Forest Range	Participants		Total
					Male	Female	
1	Measurement of Forest Carbon Stock	21 Nov. 2020	MP	Banapura Forest Range	31	1	32
2	Measurement of Forest Carbon Stock	22 Nov. 2020	MP	Budhni Forest Range	27	4	31
3	Measurement of Forest Carbon Stock	23 Nov. 2020	MP	Bhaura Forest Range	23	5	28
4	Measurement of Forest Carbon Stock	24 Nov. 2020	MP	Itarsi Forest Range	22	10	32
5	Measurement of Forest Carbon Stock	13/02/2021	MP	Sukhtawa Forest Range	26	11	37
6	Measurement of Forest Carbon Stock	17 Nov. 2021	MP	Budhni Forest Range	30	26	56
7	Measurement of Forest Carbon Stock	18 Nov. 2021	MP	Sukhtawa Forest Range	20	29	49
8	Measurement of Forest Carbon Stock	21 Nov. 2021	MP	Banapura Forest Range	33	18	51
9	Measurement of Forest Carbon Stock	10/03/2022	MP	Itarsi Forest Range	21	31	52
10	Measurement of Forest Carbon Stock	14/03/2022	MP	Bhaura Forest Range	31	16	47
11	Measurement of Forest Carbon Stock	18 /03/ 2023	MP	Bhaura Forest Range (Tetar Mal/ Rayyat, Kuppa, Handipani Villages)	49	34	83
12	Measurement of Forest Carbon Stock	19 /03/2023	MP	Bhaura Forest Range (Banabehda, Bhaura dhana Villages)	36	28	64
13	Measurement of Forest Carbon Stock	20 /03/2023	MP	Bhaura Forest Range (Koyalbuddi, Kachhar, Koylari Villages)	34	40	74
14	Measurement of Forest Carbon Stock	21 /03/2023	MP	Sukhtwa Forest Range (Pipariya Khurd Billage)	50	29	79
15	Measurement of Forest Carbon Stock	22 /03/ 2023	MP	Sukhtwa Forest Range (Kohda Village)	36	30	66
16	Measurement of Forest Carbon Stock	23 /03/2023	MP	Itarsi Forest Range (Lalpaani, Khatama, Bhatna and Ranjhi viallges)	39	56	95
17	Measurement of Forest Carbon Stock	14 /03/2023	MP	Banapura Forest Range (Ghoghra, Bhawanda and Banspani Villages)	41	33	74
18	Measurement of Forest Carbon Stock	15 /03/ 2023	MP	Banapura Forest Range (Peepalgota and Nayagaon Villages)	52	36	88
19	Measurement of Forest Carbon Stock	16 /03/ 2023	MP	Banapura Forest Range (Narri, Gotabarri, Keolajhir, Chandakhad and Salai Villages)	45	59	104
20	Measurement of Forest Carbon Stock	17/03/2023	MP	Banapura Forest Range (Sotachikli, Jondhal and Nanderwada Villages)	38	46	84
21	Measurement of Forest Carbon Stock	14 /03/2023	MP	Budhni Forest Range (Akola and Naganpur Villages)	29	27	56

S. No.	Hands-on Training	Date	State	Forest Range	Participants		Total
					Male	Female	
22	Measurement of Forest Carbon Stock	15 /03/2023	MP	Budhni Forest Range (Paharkhedi and Paraswada Villages)	23	37	60
23	Measurement of Forest Carbon Stock	16 /03/2023	MP	Budhni Forest Range (Chachmau and Hathlewa Villages)	21	32	53
24	Measurement of Forest Carbon Stock	17 /03/ 2023	MP	Budhni Forest Range (Khatpura and Saidganj Villages)	6	57	63
				Total	**763**	**695**	**1458**
25	Measurement of Forest Carbon Stock	18/12/2020	CG	Pandria West Forest Range	27	6	33
26	Measurement of Forest Carbon Stock	21/12/2020	CG	Raghunathnagar Forest Range	59	31	90
27	Measurement of Forest Carbon Stock	24/12/2020	CG	Marwahi Forest Range	46	28	74
28	Measurement of Forest Carbon Stock	26/12/2020	CG	Pali Forest Range	40	5	45
29	Measurement of Forest Carbon Stock	28 Nov. 2021	CG	Pali Forest Range	52	4	56
30	Measurement of Forest Carbon Stock	01/12/2021	CG	Pandria West Forest Range	58	6	64
31	Measurement of Forest Carbon Stock	04/12/2021	CG	Marwahi Forest Range	53	5	58
32	Measurement of Forest Carbon Stock	07/12/2021	CG	Raghunathnagar Forest Range	20	41	61
33	Measurement of Forest Carbon Stock	14/03/2023	CG	Marwahi Forest Range (Naka, Bahri Jhorki, Bansital, Danikundi villages)	40	10	50
34	Measurement of Forest Carbon Stock	15 /03/2023	CG	Marwahi Forest Range (Matiyadand, Ameritikra, Moharitola Villages)	44	08	52
35	Measurement of Forest Carbon Stock	16 /03/2023	CG	Marwahi Forest Range (Silpahari, Bagharra, Kolbira Villages)	42	09	51
36	Measurement of Forest Carbon Stock	17 /03/ 2023	CG	Marwahi Forest Range (Madai, Rumga, Pathrra Villages)	40	10	50
37	Measurement of Forest Carbon Stock	19 /03/2023	CG	Raghunathnagar Forest Range, Chhattisgarh (Nawgai Village)	72	26	98
38	Measurement of Forest Carbon Stock	20 /03/2023	CG	Raghunathnagar Forest Range, Chhattisgarh (Shankarpur Village)	78	13	91
39	Measurement of Forest Carbon Stock	21 /03/2023	CG	Raghunathnagar Forest Range, Chhattisgarh (Girwani Village)	78	24	102
40	Measurement of Forest Carbon Stock	14 /03/2023	CG	Pali Forest Range (Hardikachhar Village)	31	39	70
41	Measurement of Forest Carbon Stock	15 /03/2023	CG	Pali Forest Range (Kodar Village)	51	56	107
42	Measurement of Forest Carbon Stock	16 /03/2023	CG	Pali Forest Range (Kanhaiyapara Village)	43	52	95
43	Measurement of Forest Carbon Stock	14 /03/ 2023	CG	Pandria West Forest Range (Rahidand, Amania, Amilitola Villages)	34	25	59

S. No.	Hands-on Training	Date	State	Forest Range	Participants		Total
					Male	Female	
44	Measurement of Forest Carbon Stock	15 /03/ 2023	CG	Pandria West Forest Range (Rukhmidadar Village)	25	40	65
45	Measurement of Forest Carbon Stock	16 /03/2023	CG	Pandria West Forest Range (Neur, Rokhni, Taitirni, Bhangitola Villages)	26	60	86
				Total	**959**	**498**	**1457**
				Total Participants	**1722**	**1193**	**2915**

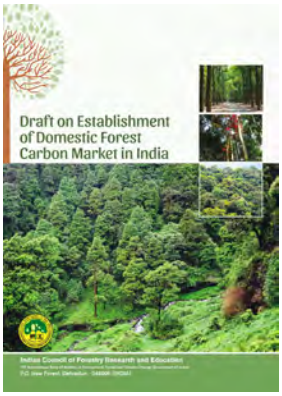
Figure 4: Glimpses of trainings for JFMCs on Measurement of Forest Carbon Stock

5.1.3.4. Capacity Building of the Chhattisgarh State Forest and Climate Change Department for preparation of State REDD+ Action Plan: Organized Stakeholders and Expert Consultation Workshops from 17-20 February 2020 at Raipur (Chhattisgarh) for building the capacity of Chhattisgarh State Forest and Climate Change Department for preparation of State REDD+ Action Plan. The main objective of the workshops was to build capacity of State Forest and Climate Change Department for developing a State REDD+ Action Plan for the State of Chhattisgarh. A total of 70 participants participated in the workshop.

Figure 5: Capacity Building Workshop for Preparation of State REDD+ Action Plan

5.1.3.5. Draft on Establishment of Domestic Forest Carbon Market in India

Currently, India does not have any domestic forest carbon market but it has the potential of becoming a leading player in forest carbon market. Establishment of forest carbon market may promote forest carbon trading at domestic level which may ultimately contribute in sustainable management of forests. An Expert Committee was constituted under ESIP for developing a draft on Establishment of Domestic Forest Carbon Market in India for submission to Ministry of Environment, Forest and Climate Change, Government of India for consideration. The Draft on Establishment of Domestic Forest Carbon Market in India was published which highlighted introduction to carbon markets, role of forest sector in carbon market, objectives of domestic forest carbon market, scope of domestic forest carbon market, process flow: project cycle, organisational structure for domestic forest carbon market, eligible activities and types of carbon offsets, validation, verification and issuance procedures and national forest carbon registry (ICFRE, 2023 c).



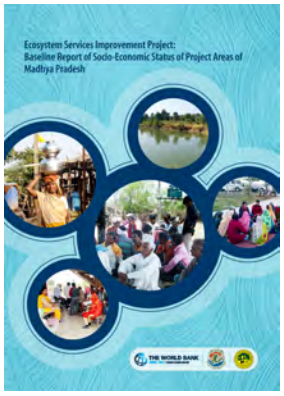
5.2. Component 3: Scaling up Sustainable Land and Ecosystem Management in selected landscapes: This component consists of following three sub-components:

- Scaling-up of SLEM Best Practices
- Building National Capacity for Land Degradation and Desertification Monitoring
- Development and Implementation of a National Knowledge Network

5.2.1. Scaling-up of SLEM Best Practices

5.2.1.1. Preparation of Baseline Reports of the Socio-economic Status of the Project Areas

Socio-economic surveys of the project areas of Madhya Pradesh and Chhattisgarh were conducted with the objective to establish baseline information on socio-economic status of project villages, household requirement for natural resources and to shortlist site specific SLEM best practices for scaling up. It was reported that local communities of the project areas were depending on the forests for meeting their fuel wood, fodder and other livelihood



requirements. Shortage of water for irrigation was one of the key issues highlighted by the villagers and also observed during the surveys and focus group discussion. It was observed that main priority of the local communities of the project areas was rain water harvesting through deepening of existing ponds for augmentation of water resources and ground water recharge. Other SLEM best practices prioritized by the local communities were Wadi - a tree-based farming system model, lac cultivation for livelihood generation and biodiversity conservation and system of rice intensification and integrated farm development. Baseline reports of socio-economic status of project areas of Madhya Pradesh and Chhattisgarh were published (ICFRE, 2020 d and 2020 e) and shared with State Forest Departments.

5.2.1.2. Communication Strategy for Sustainable Land and Ecosystem Management

Communication strategy is an integral part of the planning process for successful achievement of the key deliverables and is assumed to be capable of making required changes and multiplying the impacts of project. Generally, the messages do not always reach up to the intended beneficiaries in a way they were desired to. In such cases proper designing of communication strategy helps to reach out to the intended project beneficiaries with application of proper approaches and methods of communication. One of the main components of the project was scaling up sustainable land and ecosystem management (SLEM) practices in selected landscapes. For achieving the targets pertaining to scaling up of SLEM practices, constant flow of information, communication and education were required. Accordingly, a communication strategy for sustainable land and ecosystem management was developed to facilitate knowledge and experience sharing, dissemination of knowledge on best practices and success stories for scaling up of SLEM in the ESIP areas of Madhya Pradesh and Chhattisgarh (ICFRE, 2021). Communication strategy helped in involving local communities, developing a sense of belongingness, behavioural change, resource planning and mobilization, participatory monitoring and evaluation for scaling up of SLEM practices. Communication modes *viz.* demonstrations, wall paintings, posters, hoardings; capacity building programmes and workshops; preparation and printing of pamphlets, flyers, brochures and success stories etc.; media outreach, folk media,

use of audio-visuals, door-to-door contact campaigns were suggested to communicate the SLEM messages to the target beneficiaries and other stakeholders. It was also suggested to use some effective communication tools such as interpersonal or face-to-face interaction, group meetings or discussion, print media, mass media and folk media for transmitting the messages for scaling up SLEM practices.

5.2.1.3. SLEM Awareness Generation

Twenty six awareness generation programmes and exposure visits on sustainable land and ecosystem management practices were organized for local communities of project areas of Madhya Pradesh and Chhattisgarh. A total of 1035 members of the local communities participated in the awareness generation programmes (Table 13 and 14).

Table-13: Awareness generation programme and exposure visits organized for local communities of the project areas of Madhya Pradesh

S. No.	Awareness Generation Programme/ Exposure Visit	Date	No. of Participants
1	Awareness Programme on SLEM for Chachmau, Paharkhedi, Haltlewa and Naganpur villages of Budhni Forest Range, MP	13 Nov. 2019	63
2	Awareness Programme on SLEM for Saidganj and Khatpura villages of Budhni Forest Range, MP	14 Nov. 2019	34
3	Awareness Programme on SLEM for Handipani and Kuppa villages of Bhaura Forest Range, MP	14 Nov. 2019	100
4	Awareness Programme on SLEM Awareness Programme on SLEM for Koyalbuddi and Tetarmal villages of Bhaura Forest Range, MP	19 Nov. 2019	80
5	Awareness Programme on SLEM for Keolajhir, Chandakhad and Salai villages of Banapura Forest Range, MP	23 Nov. 2019	135
6	Awareness Programme on SLEM for Baspani and Ghoghara villages of Banapura Forest Range, MP	24 Nov. 2019	68
7	Awareness Programme on SLEM for Lalpani and Ranjhi villages of Itarshi Forest Range, MP	25 Nov. 2019	54
8	Awareness Programme on SLEM for Khatama village of Itarshi Forest Range, MP	26 Nov. 2019	46
9	Awareness Programme on SLEM for Pipriyakhurd village of Sukhtawa Forest Range, MP	27 Nov. 2019	28
10	Exposure visit for local communities of Bhaura Forest Range, North Betul Forest Division on integrated Farm Development and Crop Diversification	22 Nov. 2019	29
11	Exposure visit for local communities of Banapura Forest Range on rain water harvesting and augmentation of water resources at Watershed Organisation Trust, Chhindwara Centre, MP	7- 8 Feb. 2020	30
12	Exposure visit for local communities of Banapura Forest Range on rain water harvesting and augmentation of water resources at Watershed Organisation Trust, Chhindwara Centre, MP	10 - 11 Feb. 2020	32
13	Exposure visit for local communities of Banapura Forest Range on rain water harvesting and augmentation of water resources at Watershed Organisation Trust, Chhindwara Centre, MP	13 - 14 Feb. 2020	31
		Total Participants	**730**

Table-14: Awareness generation programme organized for local communities of the project areas of Chhattisgarh

S. No.	Awareness generation programme	Date	No. of Participants
1	Awareness Programme on SLEM at Girwani Village of Raghunathnagar Forest Range	05 Nov. 2019	27
2	Awareness Programme on SLEM at Navgai Village of Raghunathnagar Forest Range	06 Nov. 2019	27
3	Awareness Programme on SLEM at Rameshpur Village of Raghunathnagar Forest Range	06 Nov. 2019	24
4	Awareness Programme on SLEM at Kesari Village of Raghunathnagar Forest Range Forest Range	07 Nov. 2019	27
5	Awareness Programme on SLEM at Shankarpur Village of Raghunathnagar Forest Range	07 Nov. 2019	40
6	Awareness Programme on SLEM at Bhabni Village of Raghunathnagar Forest Range	09 Nov. 2019	17
7	Awareness Programme on SLEM at Naka, Baharijhrki Village of Marwahi Forest Range	12 Nov. 2019	13
8	Awareness Programme on SLEM at Pathrra & Baghara Villages of Marwahi Forest Range	13 Nov. 2019	16
9	Awareness Programme on SLEM at Silpahari Village of Marwahi Forest Range	14 Nov. 2019	17
10	Awareness Programme on SLEM at Chanwaripara Village of Pali Forest Range	16 Nov. 2019	27
11	Awareness Programme on SLEM at Parsapani & Haldukachhar Village of Pali Forest Range	17 Nov. 2019	32
12	Awareness Programme on SLEM at Karranavapara Village of Pali Forest Range	17 Nov. 2019	22
13	Awareness Programme on SLEM at Kanahiyapara Village of Pali Forest Range	18 Nov. 2019	16
		Total Participants	**305**

Figure 6: Glimpses of exposure visits of local communities of project areas of MP

5.2.1.4. SLEM Knowledge Products

Knowledge products in Hindi and English on SLEM best practices viz. lac cultivation for livelihood generation and biodiversity conservation, amla based agro-forestry, rehabilitation of degraded bamboo forests, eco-restoration and institution strengthening, Wadi system – A tree-based farming system, rain water harvesting and augmentation of water resources, integrated farm development for sustainable land productivity, system of rice intensification, climate proofing fish farming, chauka system- a water conservation practice, biopesticides (नीमास्त्र, ब्रह्मास्त्र, दसपर्णी अर्क) and biofertilisers (अमृत पानी, बीजामृत, जीवामृत) and vermicomposting (केंचुआ खाद, नाडेप खाद) were developed and published for capacity building of local communities of the project areas of Madhya Pradesh and Chhattisgarh for scaling up of SLEM practices.

5.2.1.5. Capacity Building of Local Communities on Scaling Up of SLEM Best Practices

Organised 223 trainings on scaling up of SLEM best practices for local communities of the project areas of Madhya Pradesh and Chhattisgarh. The objective of trainings was to build the capacity of local communities on scaling up of lac cultivation for livelihood generation and biodiversity conservation, amla based agro-forestry, rehabilitation of degraded bamboo forests, eco-restoration and institution strengthening, wadi system – a tree-based farming system, rain water harvesting and augmentation of water resources, integrated farm development for sustainable land productivity, system of rice intensification, climate proofing fish farming, chauka system- a water conservation practice, biopesticides and biofertilizers, and vermicomposting. A total of 18504 beneficiaries of the project areas of Madhya Pradesh and Chhattisgarh participated in 223 trainings organised during the year 2019-20 to 2023-24. Participation of women in the trainings was 49.58% (Figure 7). Details of the trainings organised under the project are given in Table 15, 16 and 17.

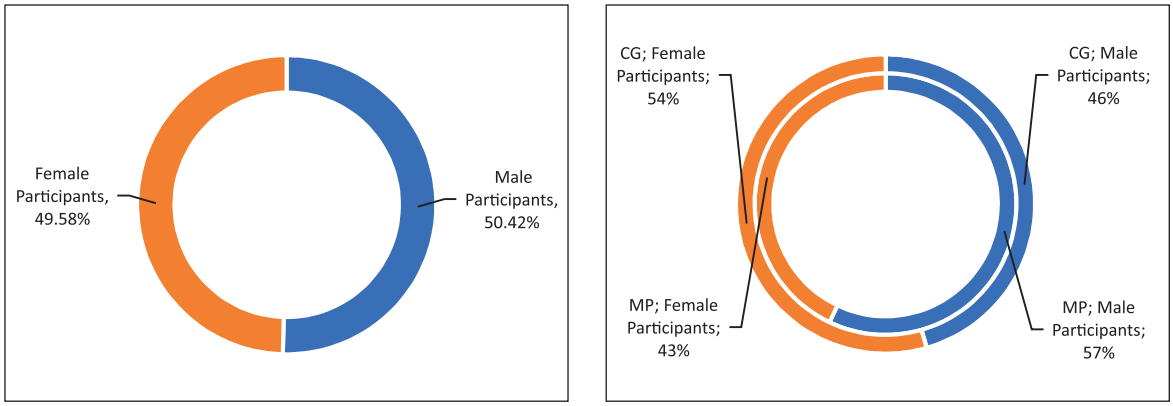


Figure 7: Gender participation in trainings

Table-15: Abstract of the trainings organised for local communities on scaling up of SLEM best practices in the project areas of Madhya Pradesh and Chhattisgarh

S.No.	Year	No. of trainings organized	Beneficiaries		
			Male	Female	Total
1	2019-20	8	277	193	470
2	2020-21	66	2879	1820	4699
3	2021-22	68	3199	2064	5263
4	2022-23	65	2674	3665	6339
5	2023-24	16	301	1432	1733
Total		**223**	**9330**	**9174**	**18504**

Table-16: Trainings organised for local communities on scaling up of SLEM best practices in the project areas of Madhya Pradesh

S. No.	Training	Date	Location	Beneficiaries		
				Male	Female	Total
1	Integrated farm development for sustainable land productivity	21-22 Oct. 2019	Budhni Forest Range, Sehore Forest Division	14	0	14

S. No.	Training	Date	Location	Beneficiaries		
				Male	Female	Total
2	Integrated Farm Development for Sustainable Land Productivity	21 Jan. 2021	Banapura, Banapura Forest Range, Hoshangabad Forest Division	47	25	72
3	Integrated Farm Development for Sustainable Land Productivity	22 Jan. 2021	Banspani, Banapura Forest Range, Hoshangabad Forest Division	34	22	56
4	Integrated Farm Development for Sustainable Land Productivity	23 Jan. 2021	Bhawanda, Banapura Forest Range, Hoshangabad Forest Division	45	19	64
5	Integrated Farm Development for Sustainable Land Productivity	24 Jan. 2021	Ghoghara, Banapura Forest Range, Hoshangabad Forest Division	31	26	57
6	Integrated Farm Development for Sustainable Land Productivity	25 Jan. 2021	Peepalgota, Banapura Forest Range, Hoshangabad Forest Division	35	41	76
7	Integrated Farm Development for Sustainable Land Productivity	26 Jan. 2021	Nayagaon, Banapura Forest Range, Hoshangabad Forest Division	44	41	85
8	Integrated Farm Development for Sustainable Land Productivity	27 Jan. 2021	Jondhal, Banapura Forest Range, Hoshangabad Forest Division	43	41	84
9	Integrated Farm Development for Sustainable Land Productivity	27 Jan. 2021	Handipani, Bhaura Forest Range, North Betul Forest Division	18	49	67
10	Integrated Farm Development for Sustainable Land Productivity	27 Jan. 2021	Koyalhari, Bhaura Forest Range, North Betul Forest Division	35	28	63
11	Integrated Farm Development for Sustainable Land Productivity	28 Jan. 2021	Kuppa, Bhaura Forest Range, North Betul Forest Division	26	28	54
12	Integrated Farm Development for Sustainable Land Productivity	29 Jan. 2021	Teter Mal, Bhaura Forest Range, North Betul Forest Division	36	17	53
13	Integrated Farm Development for Sustainable Land Productivity	30 Jan. 2021	Banahebada, Bhaura Forest Range, North Betul Forest Division	22	32	54
14	Integrated Farm Development for Sustainable Land Productivity	01 Feb. 2021	Kachhar, Bhaura Forest Range, North Betul Forest Division	40	23	63
15	Integrated Farm Development for Sustainable Land Productivity	02 Feb. 2021	Koyal Buddi, Bhaura Forest Range, North Betul Forest Division	32	23	55
16	Integrated Farm Development for Sustainable Land Productivity	03 Mar. 2021	Keolajhir, Banapura Forest Range, Hoshangabad Forest Division	49	27	76
17	Integrated Farm Development for Sustainable Land Productivity	04 Mar. 2021	Narri, Banapura Forest Range, Hoshangabad Forest Division	51	13	64

S. No.	Training	Date	Location	Beneficiaries		
				Male	Female	Total
18	Integrated Farm Development for Sustainable Land Productivity	05 Mar. 2021	Chandakhad, Banapura Forest Range, Hoshangabad Forest Division	48	23	71
19	Integrated Farm Development for Sustainable Land Productivity	06 Mar. 2021	Gotabarri, Banapura Forest Range, Hoshangabad Forest Division	38	14	52
20	Integrated Farm Development for Sustainable Land Productivity	07 Mar. 2021	Salai, Banapura Forest Range, Hoshangabad Forest Division	45	13	58
21	Integrated Farm Development for Sustainable Land Productivity	08 Mar. 2021	Sothchikli, Banapura Forest Range, Hoshangabad Forest Division	48	44	92
22	Integrated Farm Development for Sustainable Land Productivity	09 Mar. 2021	Nanderwada, Banapura Forest Range, Hoshangabad Forest Division	51	9	60
23	Integrated Farm Development for Sustainable Land Productivity	12 Mar. 2021	Kohda, Sukhtawa Forest Range, Hoshangabad Forest Division	61	12	73
24	Integrated Farm Development for Sustainable Land Productivity	12 Mar. 2021	Khatpura, Budhni Forest Range, Sehore Forest Division	61	13	74
25	Integrated Farm Development for Sustainable Land Productivity	13 Mar. 2021	Pipariya Khurd, Sukhtawa Forest Range, Hoshangabad Forest Division	85	26	111
26	Integrated Farm Development for Sustainable Land Productivity	14 Mar. 2021	Bhatna, Itarsi Forest Range, Hoshangabad Forest Division	17	22	39
27	Integrated Farm Development for Sustainable Land Productivity	15 Mar. 2021	Khatama, Itarsi Forest Range, Hoshangabad Forest Division	38	29	67
28	Integrated Farm Development for Sustainable Land Productivity	16 Mar. 2021	Lalpani, Itarsi Forest Range, Hoshangabad Forest Division	31	24	55
29	Integrated Farm Development for Sustainable Land Productivity	17 Mar. 2021	Ranjhi, Itarsi Forest Range, Hoshangabad Forest Division	30	22	52
30	Integrated Farm Development for Sustainable Land Productivity	12 Mar. 2021	Khatpura, Budhni Forest Range, Sehore Forest Division	61	13	74
31	Integrated Farm Development for Sustainable Land Productivity	13 Mar. 2021	Saidganj, Budhni Forest Range, Sehore Forest Division	50	31	81
32	Integrated Farm Development for Sustainable Land Productivity	14 Mar. 2021	Paraswada, Budhni Forest Range, Sehore Forest Division	49	22	71
33	Integrated Farm Development for Sustainable Land Productivity	15 Mar. 2021	Akola, Budhni Forest Range Sehore Forest Division	77	2	79

S. No.	Training	Date	Location	Beneficiaries		
				Male	Female	Total
34	Integrated Farm Development for Sustainable Land Productivity	16 Mar. 2021	Paharkedi, Budhni Forest Range Sehore Forest Division	68	5	75
35	Integrated Farm Development for Sustainable Land Productivity	17 Mar. 2021	Naganpur, Budhni Forest Range Sehore Forest Division	42	22	62
36	Integrated Farm Development for Sustainable Land Productivity	18 Mar. 2021	Chachmau, Budhni Forest Range Sehore Forest Division	29	26	55
37	Integrated Farm Development for Sustainable Land Productivity	19 Mar. 2021	Hathlewa, Budhni Forest Range Sehore Forest Division	56	11	67
38	Scaling up of SLEM best practices	23 Sept. 2021	Keolajhir, Banapura Forest Range	37	43	80
39	Scaling up of SLEM best practices	24 Sept. 2021	Narri, Banapura Forest Range, Hoshangabad Forest Division	50	35	85
40	Scaling up of SLEM best practices	25 Sept. 2021	Chandakhad, Banapura Forest Range, Hoshangabad Forest Division	55	26	81
41	Scaling up of SLEM best practices	27 Sept. 2021	Gotabarri, Banapura Forest Range, Hoshangabad Forest Division	44	20	64
42	Scaling up of SLEM best practices	28 Sept. 2021	Salai, Banapura Forest Range, Hoshangabad Forest Division	40	24	64
43	Scaling up of SLEM best practices	29 Sept. 2021	Sotachikli, Banapura Forest Range, Hoshangabad Forest Division	54	31	85
44	Scaling up of SLEM best practices	01 Oct. 2021	Jondhal, Banapura Forest Range, Hoshangabad Forest Division	31	32	63
45	Scaling up of SLEM best practices	03 Oct. 2021	Banapura, Banapura Forest Range	54	22	76
46	Scaling up of SLEM best practices	04 Oct. 2021	Nanderwada, Banapura Forest Range, Hoshangabad Forest Division	82	38	120
47	Scaling up of SLEM best practices	04 Oct. 2021	Khatpura, Budhni Forest Range, Sehore Forest Division	32	47	79
48	Scaling up of SLEM best practices	05 Oct. 2021	Khatama, Itarsi Forest Range, Sehore Forest Division	42	50	92
49	Scaling up of SLEM best practices	05 Oct. 2021	Saiydganj, Budhni Forest Range, Sehore Forest Division	32	53	85
50	Scaling up of SLEM best practices	06 Oct. 2021	Paraswada, Budhni Forest Range, Sehore Forest Division	29	40	69

S. No.	Training	Date	Location	Beneficiaries		
				Male	Female	Total
51	Scaling up of SLEM best practices	08 Oct. 2021	Akola, Budhni Forest Range, Sehore Forest Division	63	12	75
52	Scaling up of SLEM best practices	09 Oct. 2021	Paharkhedi, Budhni Forest Range, Sehore Forest Division	43	34	77
53	Scaling up of SLEM best practices	10 Oct. 2021	Naganpur, Budhni Forest Range, Sehore Forest Division	28	18	46
54	Scaling up of SLEM best practices	11 Oct. 2021	Chachmau, Budhni Forest Range, Sehore Forest Division	27	25	52
55	Scaling up of SLEM best practices	12 Oct. 2021	Hathlewa, Budhni Forest Range, Sehore Forest Division	41	25	66
56	Scaling up of SLEM best practices	13 Oct. 2021	Handipani, Bhaura Forest Range, North Betul Forest Division	46	34	80
57	Scaling up of SLEM best practices	14 Oct. 2021	Kuppa, Bhaura Forest Range, North Betul Forest Division	74	29	103
58	Scaling up of SLEM best practices	15 Oct. 2021	Tetermal, Bhaura Forest Range, North Betul Forest Division	51	15	66
59	Scaling up of SLEM best practices	16 Oct. 2021	Banabaheda, Bhaura Forest Range, North Betul Forest Division	51	19	70
60	Scaling up of SLEM best practices	17 Oct. 2021	Koyalbuddi, Bhaura Forest Range, North Betul Forest Division	43	27	70
61	Scaling up of SLEM best practices	18 Oct. 2021	Kachhar, Bhaura Forest Range, North Betul Forest Division	51	34	85
62	Scaling up of SLEM best practices	19 Oct. 2021	Koylari, North Betul Forest Division	32	41	73
63	Scaling up of SLEM best practices	27 Oct. 2021	Ghoghara, Banapura Forest Range, Hoshangabad Forest Division	44	23	67
64	Scaling up of SLEM best practices	28 Oct. 2021	Bhawanda, Banapura Forest Range, Hoshangabad Forest Division	36	26	62
65	Scaling up of SLEM best practices	29 Oct. 2021	Peepalgota, Banapura Forest Range	46	20	66
66	Scaling up of SLEM best practices	30 Oct. 2021	Pipariya Khurd, Suktawa Forest Range, Hoshangabad Forest Division	68	38	106
67	Scaling up of SLEM best practices	31 Oct. 2021	Kohda, Suktawa Forest Range, Hoshangabad Forest Division	63	23	86
68	Scaling up of SLEM best practices	01 Nov. 2021	Lalpani, Itarsi Forest Range, Hoshangabad Forest Division	32	21	53

S. No.	Training	Date	Location	Beneficiaries		
				Male	Female	Total
69	Scaling up of SLEM best practices	12 Nov. 2021	Ranjhi, Itarsi Forest Range, Hoshangabad Forest Division	31	23	54
70	Scaling up of SLEM best practices	13 Nov. 2021	Bhatna, Itarsi Forest Range, Hoshangabad Forest Division	22	27	49
71	Scaling up of SLEM best practices	14 Nov. 2021	Banspani, Banapura Forest Range, Hoshangabad Forest Division	25	20	45
72	Scaling up of SLEM best practices	16 Nov. 2021	Nayagaon, Banapura Forest Range, Hoshangabad Forest Division	48	41	89
73	Scaling up of SLEM best practices	02 Nov. 2022	Khatpura, Budhni Forest Range, Sehore Forest Division	04	83	87
74	Scaling up of SLEM best practices	02 Nov. 2022	Saidganj, Budhni Forest Range, Sehore Forest Division	19	69	88
75	Scaling up of SLEM best practices	03 Nov. 2022	Akola, Budhni Forest Range, Sehore Forest Division	1	89	90
76	Scaling up of SLEM best practices	04 Nov. 2022	Pahadkhedi & Naganpur, Budhni Forest Range, Sehore Forest Division	35	55	90
77	Scaling up of SLEM best practices	05 Nov. 2022	Chachmau & Paraswada, Budhni Forest Range, Sehore Forest Division	27	53	80
78	Scaling up of SLEM best practices	06 Nov. 2022	Hathlewa, Budhni Forest Range, Sehore Forest Division	23	69	92
79	Scaling up of SLEM best practices	07 Nov. 2022	Tetar Mal/Rayyat, Bhaura Forest Range, North Betul Forest Division	31	49	80
80	Scaling up of SLEM best practices	08 Nov. 2022	Kuppa, Bhaura Forest Range, North Betul Forest Division	27	54	81
81	Scaling up of SLEM best practices	09 Nov. 2022	Banabehda, Bhaura Forest Range, North Betul Forest Division	47	33	80
82	Scaling up of SLEM best practices	10 Nov. 2022	Koyalbuddi, Bhaura Forest Range, North Betul Forest Division	40	40	80
83	Scaling up of SLEM best practices	11 Nov. 2022	Kachhar, Bhaura Forest Range, North Betul Forest Division	61	49	110
84	Scaling up of SLEM best practices	12 Nov. 2022	Haandipani, Bhaura Forest Range, North Betul Forest Division	73	39	112
85	Scaling up of SLEM best practices	13 Nov. 2022	Koylari, Bhaura Forest Range, North Betul Forest Division	66	14	80
86	Scaling up of SLEM best practices	14 Nov. 2022	Pipariya Khurd, Sukhtwa Forest Range, Hoshangabad Forest Division	64	55	119

S. No.	Training	Date	Location	Beneficiaries		
				Male	Female	Total
87	Scaling up of SLEM best practices	15 Nov. 2022	Kohda, Sukhtwa Forest Range, Hoshangabad Forest Division	73	40	113
88	Scaling up of SLEM best practices	16 Nov. 2022	Lalpaani, Itarsi Forest Range, Hoshangabad Forest Division	55	32	87
89	Scaling up of SLEM best practices	17 Nov. 2022	Bhatnaa & Ranjhi, Itarsi Forest Range, Hoshangabad Forest Division	55	27	82
90	Scaling up of SLEM best practices	18 Nov. 2022	Khatama Itarsi Forest Range, Hoshangabad Forest Division	74	27	101
91	Scaling up of SLEM best practices	01 Nov. 2022	Bhawanda, Banapura Forest Range, Hoshangabad Forest Division	62	38	100
92	Scaling up of SLEM best practices	02 Nov. 2022	Ghogara and Banspani, Banapura Forest Range, Hoshangabad Forest Division	41	53	94
93	Scaling up of SLEM best practices	03 Nov. 2022	Nanderwada, Banapura Forest Range, Hoshangabad Forest Division	83	71	154
94	Scaling up of SLEM best practices	04 Nov. 2022	Nayagaon, Banapura Forest Range, Hoshangabad Forest Division	58	22	80
95	Scaling up of SLEM best practices	05 Nov. 2022	Keolajhir, Banapura Forest Range, Hoshangabad Forest Division	23	70	93
96	Scaling up of SLEM best practices	06 Nov. 2022	Chandakhad, Banapura Forest Range, Hoshangabad Forest Division	48	40	88
97	Scaling up of SLEM best practices	07 Nov. 2022	Salai, Banapura Forest Range, Hoshangabad Forest Division	35	44	79
98	Scaling up of SLEM best practices	08 Nov. 2022	Narri, Banapura Forest Range, Hoshangabad Forest Division	46	53	99
99	Scaling up of SLEM best practices	09 Nov. 2022	Gotabarri, Banapura Forest Range, Hoshangabad Forest Division	52	33	85
100	Scaling up of SLEM best practices	10 Nov. 2022	Jondal, Banapura Forest Range, Hoshangabad Forest Division	36	47	83
101	Scaling up of SLEM best practices	11 Nov. 2022	Sotachikli, Banapura Forest Range, Hoshangabad Forest Division	34	77	111
102	Scaling up of SLEM best practices	12 Nov. 2022	Pipalgota, Banapura Forest Range, Hoshangabad Forest Division	42	66	108
			Total	**4469**	**3365**	**7834**

Table-17: Trainings organised for local communities on scaling up of SLEM best practices in the project areas of Chhattisgarh

S. No.	Training	Date	Location	Beneficiaries		
				Male	Female	Total
1	System of Rice Intensification	02 July 2019	Bilaspur, Marwahi Forest Range, Marwahi Forest Division	20	7	27
2	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	14 Oct. 2019	Danikundi, Marwahi Forest Range, Marwahi Forest Division	26	10	36
3	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	15 Oct. 2019	Matiyadand, Marwahi Forest Range, Marwahi Forest Division	36	27	63
4	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	16 Oct. 2019	Ameratikra, Marwahi Forest Range, Marwahi Forest Division	28	27	55
5	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	18 Oct. 2019	Kodar, Pali Forest Range, Katghora Forest Division	20	70	90
6	Integrated Farm Development for Sustainable Land Productivity	15 Nov. 2019	Danikundi, Marwahi Forest Range, Marwahi Forest Division	71	14	85
7	Integrated Farm Development for Sustainable Land Productivity	19 Nov. 2019	Kodar, Pali Forest Range, Katghora Forest Division	62	38	100
8	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	29 Nov. 2020	Madai, Marwahi Forest Range, Marwahi Forest Division	29	6	35
9	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	29 Nov. 2020	Matiyadand, Marwahi Forest Range, Marwahi Forest Division	32	8	40
10	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	30 Nov. 2020	Patharra and Kolbira, Marwahi Forest Range, Marwahi Forest Division	17	19	36
11	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	30 Nov. 2020	Rumga, Marwahi Forest Range, Marwahi Forest Division	36	6	42
12	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	1 Dec. 2020	Banshital and Danikundi, Marwahi Forest Range, Marwahi Forest Division	21	20	41
13	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	1 Dec. 2020	Naka, Marwahi Forest Range, Marwahi Forest Division	19	27	46
14	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	2 Dec. 2020	Silpahari, Marwahi Forest Range, Marwahi Forest Division	24	18	42
15	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	2 Dec. 2020	Bagharra, Marwahi Forest Range, Marwahi Forest Division	18	17	35

16	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	3 Dec. 2020	Amera Mohri (Tohla) and Amera Tikra, Marwahi Forest Range, Marwahi Forest Division	34	25	59
17	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	21 Jan. 2021	Amlitola, Pandria West Forest Range, Kawardha Forest Division	39	42	81
18	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	22 Jan. 2021	Neur, Pandria West Forest Range, Kawardha Forest Division	36	22	58
19	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	23 Jan. 2021	Rukmidadar,Pandria West Forest Range, Kawardha Forest Division	54	50	104
20	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	24 Jan. 2021	Taiterni, Pandria West Forest Range, Kawardha Forest Division	53	32	85
21	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	25 Jan. 2021	Rokhani, Pandria West Forest Range, Kawardha Forest Division	36	53	89
22	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	27 Jan. 2021	Bangitola, Pandria West Forest Range, Kawardha Forest Division	44	22	66
23	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	28 Jan. 2021	Rahidand, Pandria West Forest Range, Kawardha Forest Division	54	28	82
24	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	29 Jan. 2021	Amania, Pandria West Forest Range, Kawardha Forest Division	39	40	79
25	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	30 Jan. 2021	Kukdur, Pandria West Forest Range, Kawardha Forest Division	66	30	96
26	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	02 Feb. 2021	Karanawadih, Pali Forest Range, Katghora Forest Division	26	34	60
27	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	03 Feb. 2021	Karra Nawapara, Pali Forest Range, Katghora Forest Division	36	81	117
28	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	04 Feb. 2021	Parsapani, Pali Forest Range, Katghora Forest Division	22	23	45
29	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	05 Feb. 2021	Kanhaiya Para, Pali Forest Range, Katghora Forest Division	35	62	97
30	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	06 Feb. 2021	Kodar, Pali Forest Range, Katghora Forest Division	60	52	112
31	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	12 Mar. 2021	Rameshpur, Raghunathnagar Forest Range, Balrampur Forest Division	57	45	102
32	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	12 Mar. 2021	Shankarpur, Raghunathnagar Forest Range, Balrampur Forest Division	73	41	114

33	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	13 Mar. 2021	Kesari, Raghunathnagar Forest Range, Balrampur Forest Division	66	42	108
34	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	13 Mar. 2021	Girwani, Raghunathnagar Forest Range, Balrampur Forest Division	78	34	112
35	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	14 Mar. 2021	Raghunathnagar, Raghunathnagar Forest Range, Balrampur Forest Division	83	29	112
36	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	14 Mar. 2021	Nawgai, Raghunathnagar Forest Range, Balrampur Forest Division	57	35	92
37	Lac Cultivation for Livelihood Generation and Biodiversity Conservation	15 Mar. 2021	Babhani, Raghunathnagar Forest Range, Balrampur Forest Division	62	39	101
38	Scaling up of SLEM best practices	22 Sept. 2021	Amlitola, Pandria West Forest Range, Kawardha Forest Division	34	41	75
39	Scaling up of SLEM best practices	23 Sept. 2021	Neur, Pandria West Forest Range, Kawardha Forest Division	46	24	70
40	Scaling up of SLEM best practices	24 Sept. 2021	Taiterni, Pandria West Forest Range, Kawardha Forest Division	51	32	83
41	Scaling up of SLEM best practices	25 Sept. 2021	Rokhni, Pandria West Forest Range, Kawardha Forest Division	60	81	141
42	Scaling up of SLEM best practices	26 Sept. 2021	Bhangitola, Pandria West Forest Range, Kawardha Forest Division	43	28	71
43	Scaling up of SLEM best practices	27 Sept. 2021	Rahidand, Pandria West Forest Range, Kawardha Forest Division	60	39	99
44	Scaling up of SLEM best practices	28 Sept. 2021	Amania, Pandria West Forest Range, Kawardha Forest Division	61	40	101
45	Scaling up of SLEM best practices	29 Sept. 2021	Rukmidadar, Pandria West Forest Range, Kawardha Forest Division	70	48	118
46	Scaling up of SLEM best practices	09 Oct. 2021	Madai, Marwahi Forest Range, Marwahi Forest Division	20	45	65
47	Scaling up of SLEM best practices	10 Oct. 2021	Rumga Village, Marwahi Forest Range, Marwahi Forest Division	58	18	76
48	Scaling up of SLEM best practices	11 Oct. 2021	Patharra Village, Marwahi Forest Range, Marwahi Forest Division	38	27	65
49	Scaling up of SLEM best practices	12 Oct. 2021	Kolbira, Marwahi Forest Range	39	24	63
50	Scaling up of SLEM best practices	13 Oct. 2021	Matiyadand Village, Marwahi Forest Range, Marwahi Forest Division	53	7	60
51	Scaling up of SLEM best practices	14 Oct. 2021	Naka, Marwahi Forest Range, Marwahi Forest Division	47	20	67
52	Scaling up of SLEM best practices	16 Oct. 2021	Bansital, Marwahi Forest Range, Marwahi Forest Division	29	38	67
53	Scaling up of SLEM best practices	17 Oct. 2021	Danikundi, Marwahi Forest Range, Marwahi Forest Division	26	44	70
54	Scaling up of SLEM best practices	18 Oct. 2021	Ameratikra village, Marwahi Forest Range, Marwahi Forest Division	52	40	92

55	Scaling up of SLEM best practices	19 Oct. 2021	Bagharra village, Marwahi Forest Range, Marwahi Forest Division	22	45	67
56	Scaling up of SLEM best practices	20 Oct. 2021	Silpahri village, Marwahi Forest Range, Marwahi Forest Division	40	28	68
57	Scaling up of SLEM best practices	28 Oct. 2021	Raghunathnagar, Raghunathnagar Forest Range, Raghunathnagar Forest Division	54	6	60
58	Scaling up of SLEM best practices	29 Oct. 2021	Rameshpur, Raghunathnagar Forest Range, Raghunathnagar Forest Division	96	11	107
59	Scaling up of SLEM best practices	30 Oct. 2021	Babhani, Raghunathnagar Forest Range, Raghunathnagar Forest Division	74	20	94
60	Scaling up of SLEM best practices	31 Oct. 2021	Naugai, Raghunathnagar Forest Range, Raghunathnagar Forest Division	75	25	100
61	Scaling up of SLEM best practices	01 Nov. 2021	Shankarpur, Raghunathnagar Forest Range, Raghunathnagar Forest Division	108	28	136
62	Scaling up of SLEM best practices	14 Nov. 2021	Kesari, Raghunathnagar Forest Range, Raghunathnagar Forest Division	79	25	104
63	Scaling up of SLEM best practices	15 Nov. 2021	Girwani, Raghunathnagar Forest Range, Raghunathnagar Forest Division	73	23	96
64	Scaling up of SLEM best practices	17 Nov. 2021	Kanhaiyapara, Pali Forest Range, Katghora Forest Division	34	27	61
65	Scaling up of SLEM best practices	18 Nov. 2021	Karanawapara, Pali Forest Range, Katghora Forest Division	30	60	90
66	Scaling up of SLEM best practices	19 Nov. 2021	Chanwaripara, Pali Forest Range, Katghora Forest Division	25	47	72
67	Scaling up of SLEM best practices	20 Nov. 2021	Karanawadhi, Pali Forest Range, Katghora Forest Division	32	33	65
68	Scaling up of SLEM best practices	21 Nov. 2021	Kodar, Pali Forest Range, Katghora Forest Division	62	19	81
69	Scaling up of SLEM best practices	22 Nov. 2021	Parsapani, Pali Forest Range, Katghora Forest Division	41	20	61
70	Scaling up of SLEM best practices	23 Nov. 2021	Jamnipani, Pali Forest Range, Katghora Forest Division	20	15	35
71	Scaling up of SLEM best practices	17 Nov. 2022	Matiyadand, Marwahi Forest Range, Marwahi Forest Division	62	27	89
72	Scaling up of SLEM best practices	18 Nov. 2022	Danikundi, Marwahi Forest Range, Marwahi Forest Division	50	30	80
73	Scaling up of SLEM best practices	19 Nov. 2022	Bansital, Marwahi Forest Range, Marwahi Forest Division	50	31	81
74	Scaling up of SLEM best practices	20 Nov. 2022	Ameratikrra, Marwahi Forest Range, Marwahi Forest Division	63	17	80

75	Scaling up of SLEM best practices	21 Nov. 2022	Moharitola, Marwahi Forest Range, Marwahi Forest Division	52	30	82
76	Scaling up of SLEM best practices	22 Nov. 2022	Kolbirra, Marwahi Forest Range, Marwahi Forest Division	41	44	85
77	Scaling up of SLEM best practices	23 Nov. 2022	Naka, Marwahi Forest Range, Marwahi Forest Division	58	25	83
78	Scaling up of SLEM best practices	24 Nov. 2022	Silphari, Marwahi Forest Range, Marwahi Forest Division	76	60	136
79	Scaling up of SLEM best practices	25 Nov. 2022	Baghrra & Boharijorki, Marwahi Forest Range, Marwahi Forest Division	40	40	80
80	Scaling up of SLEM best practices	26 Nov. 2022	Pathrra, Marwahi Forest Range, Marwahi Forest Division	53	27	80
81	Scaling up of SLEM best practices	27 Nov. 2022	Madai, Marwahi Forest Range, Marwahi Forest Division	53	28	81
82	Scaling up of SLEM best practices	28 Nov. 2022	Rumga, Marwahi Forest Range, Marwahi Forest Division	95	73	168
83	Scaling up of SLEM best practices	28 Nov. 2022	Raghunathnagar, Raghunathnagar Forest Range, Ambikapur Forest Division	10	114	124
84	Scaling up of SLEM best practices	29 Nov. 2022	Keshari, Raghunathnagar Forest Range, Ambikapur Forest Division	31	103	134
85	Scaling up of SLEM best practices	30 Nov. 2022	Girwani, Raghunathnagar Forest Range, Ambikapur Forest Division	9	173	182
86	Scaling up of SLEM best practices	01 Dec. 2022	Shankarpur, Raghunathnagar Forest Range, Ambikapur Forest Division	35	100	135
87	Scaling up of SLEM best practices	02 Dec. 2022	Nawgai, Raghunathnagar Forest Range, Ambikapur Forest Division	32	81	113
88	Scaling up of SLEM best practices	05 Dec. 2022	Babhani, Raghunathnagar Forest Range, Ambikapur Forest Division	33	104	137
89	Scaling up of SLEM best practices	03 Dec. 2022	Rameshpur, Raghunathnagar Forest Range, Ambikapur Forest Division	12	99	111
90	Scaling up of SLEM best practices	17 Nov. 2022	Hardikachhar, Pali Forest Range, Katghora Forest Division	23	63	86
91	Scaling up of SLEM best practices	18 Nov. 2022	Nawadih, Pali Forest Range, Katghora Forest Division	39	44	83
92	Scaling up of SLEM best practices	19 Nov. 2022	Chanwaripara, Pali Forest Range, Katghora Forest Division	31	51	82
93	Scaling up of SLEM best practices	20 Nov. 2022	Karranawapara, Pali Forest Range, Katghora Forest Division	35	81	116
94	Scaling up of SLEM best practices	21 Nov. 2022	Kanhaiyapara, Pali Forest Range, Katghora Forest Division	28	52	80

95	Scaling up of SLEM best practices	22 Nov. 2022	Parsapani, Pali Forest Range, Katghora Forest Division	23	21	44
96	Scaling up of SLEM best practices	23 Nov. 2022	Kodar, Pali Forest Range, Katghora Forest Division	30	137	167
97	Scaling up of SLEM best practices	24 Nov. 2022	Jamnipani, Pali Forest Range, Katghora Forest Division	25	49	74
98	Scaling up of SLEM best practices	25 Nov. 2022	Neur, West Pandriya Forest Range, Kawardha Forest Division	9	91	100
99	Scaling up of SLEM best practices	26 Nov. 2022	Rokhni, West Pandriya Forest Range, Kawardha Forest Division	32	52	84
100	Scaling up of SLEM best practices	27 Nov. 2022	Bangitola, West Pandriya Forest Range, Kawardha Forest Division	33	53	86
101	Scaling up of SLEM best practices	28 Nov. 2022	Taiterni, West Pandriya Forest Range, Kawardha Forest Division	30	67	97
102	Scaling up of SLEM best practices	29 Nov. 2022	Amlitota, West Pandriya Forest Range, Kawardha Forest Division	41	44	85
103	Scaling up of SLEM best practices	30 Nov. 2022	Rahidand, West Pandriya Forest Range, Marwahi Forest Division	40	41	81
104	Scaling up of SLEM best practices	01 Dec. 2022	Amania, West Pandriya Forest Range, Kawardha Forest Division	29	57	86
105	Scaling up of SLEM best practices	02 Dec. 2022	Rukmidadar, West Pandriya Forest Range, Kawardha Forest Division	36	65	101
106	Scaling up of SLEM best practices	09 June 2023	Bhirod, Narharpur Forest Range, Kanker Forest Division	10	93	103
107	Scaling up of SLEM best practices	10 June 2023	Dhorabhata, Narharpur Forest Range, Kanker Forest Division	20	83	103
108	Scaling up of SLEM best practices	11 June 2023	Dudumbahara, Narharpur Forest Range, Kanker Forest Division	46	58	104
109	Scaling up of SLEM best practices	12 June 2023	Masulpani, Narharpur Forest Range, Kanker Forest Division	41	61	102
110	Scaling up of SLEM best practices	14 June 2023	Charbhata, Narharpur Forest Range, Kanker Forest Division	30	75	105
111	Scaling up of SLEM best practices	13 June 2023	Manhradarha, Narharpur Forest Range, Kanker Forest Division	21	79	100
112	Scaling up of SLEM best practices	15 June 2023	Devgaon, Narharpur Forest Range, Kanker Forest Division	4	107	111
113	Scaling up of SLEM best practices	17 June 2023	Dabbaipani, Narharpur Forest Range, Kanker Forest Division	1	101	102
114	Scaling up of SLEM best practices	10 June 2023	Barethinbahara, Narharpur Forest Range, Kanker Forest Division	12	93	105
115	Scaling up of SLEM best practices	11 June 2023	Bhansuli, Narharpur Forest Range, Kanker Forest Division	24	77	101
116	Scaling up of SLEM best practices	15 June 2023	Jhaliyamari, Narharpur Forest Range, Kanker Forest Division	28	81	109
117	Scaling up of SLEM best practices	12 June 2023	Surahi, Narharpur Forest Range, Kanker Forest Division	13	129	142
118	Scaling up of SLEM best practices	14 June 2023	Dabena, Narharpur Forest Range, Kanker Forest Division	22	101	123

119	Scaling up of SLEM best practices	16 June 2023	Jamgaon, Narharpur Forest Range, Kanker Forest Division	3	127	130
120	Scaling up of SLEM best practices	17 June 2023	Rajpur Narharpur Forest Range, Kanker Forest Division	7	107	114
121	Scaling up of SLEM best practices	13 June 2023	Batbani, Narharpur Forest Range, Kanker Forest Division	19	60	79
Total				**4861**	**5809**	**10670**

Figure 8: Glimpses of trainings on scaling up of SLEM best practices

5.2.1.6. Scaling up of SLEM Best Practices in the Project Areas of Madhya Pradesh and Chhattisgarh

Land degradation and desertification have adversely affected the life of millions of people and biodiversity. Unsustainable use of land resource, loss of vegetation through deforestation and forest degradation, unsustainable fuelwood and fodder collection, forest fires and overgrazing etc. are key drivers that lead to desertification and land degradation. Besides these, unsustainable land use practices such as inappropriate crop rotation, inadequate adoption of soil conservation measure, excessive use of chemical fertilizers and pesticides, and excess extraction of ground water are also identified as other drivers of land degradation. Sustainable land and ecosystem management (SLEM) practices emerge as effective tools to address land degradation issues. SLEM practices are based on principles of adoption and income generation at the local level, land-user-driven and participatory approaches, integrated use of natural resources on farms and at the ecosystem level and stakeholder's involvement. Combating land degradation and desertification and meeting national targets and international commitments related to land degradation neutrality, climate change and sustainable development goals can be achieved through scaling up of tested and proven SLEM best practices.

SLEM best practices on rain water harvesting and augmentation of water resources, lac cultivation for livelihood generation and biodiversity conservation, crop diversification for sustainable land productivity, biopesticides and biofertilizers preparation for sustainable land productivity, vermicomposting, micro-irrigation techniques (gravity-based drip irrigation system and portable sprinkler irrigation system) for conservation of water resources and enhancing productivity, WADI system - a tree-based farming system, Azolla cultivation for integrated farm development, system of rice intensification and promotion of improved cook stoves for addressing the forest degradation were selected for scaling up in the project areas of Madhya Pradesh and Chhattisgarh through community driven participatory approach. Details of the SLEM best practices scaled up in the project areas are as under:

(1) SLEM Practice: Rain Water Harvesting and Augmentation of Water Resources

The main source of water in India consists of precipitation, apart from it, various inland water resources include rivers, canals, reservoirs, tanks, ponds, etc. Water resources in India are limited and therefore, it is important to harness the available water and store it for long duration. Ponds are effective means for harvesting rainwater which subsequently fulfil the drinking water supply to livestock and agricultural needs. Rain water harvesting and storage are an effective strategy to address the issue of land degradation and drought.

In rainfed areas, agriculture depends substantially on ground water hence, various water conservation and storage practices have been employed traditionally. Locally constructed reservoirs/ farm ponds/ village ponds known as *talab, pokhar, johad, dhabri* etc. are playing an important role in

conservation of ground water for replenishing soil moisture and sub-surface water. Rain water harvesting practices have played an indispensable role in fulfilling the water requirements for crops in dry season, thereby increasing the productivity. These practices have immense importance in the states of Chhattisgarh and Madhya Pradesh, where agriculture is mainly rainfed. The major benefits of rainwater harvesting practices includes lifesaving/ supplemental irrigation to crops and plantations, improve moisture status of the soil and augment groundwater recharge, reduce soil erosion and help in flood retardation and to meet water demand for domestic, animal and other uses.

With the objective to increase the ground water level, soil moisture and support floral and faunal diversity, the existing ponds were deepened for rain water harvesting in the project areas of Madhya Pradesh (Banabaheda, Koyalbuddi, Tetarmal, Kachhar villages of Bhaura Forest Range; Banspani, Peepalgota, Nayagaon villages of Banapura Forest Range; Pipriya Khurd village of Sukhtawa Forest Range; Lalpani village of Itarasi Forest Range and Chachmau village of Budhni Forest Range) and Chhattisgarh (Bansital, Rumga (Thaitola), Matiyadand, Amaratikra villages of Marwahi Forest Range and Shankarpur, Rameshpur, Babhani villages of Raghunathnagar Forest Range). Environmental and social safeguards were followed during deepening of ponds such as safe disposal of excavated soil, deepening works done in dry season to avoid any impact on aquatic fauna, and levelling and compaction of muck piles were done in a proper way. The selection of pond sites and identification of silt disposal sites were done prior to the excavation work with the consent of all sections of the society. Knowledge products in the form of flyers and pamphlets prepared on rain water harvesting were distributed to the local communities of the project areas for creating awareness and enhancing the knowledge base. Trainings were also provided to the local communities of the project villages of Madhya Pradesh and Chhattisgarh to generate awareness on soil and water conservation and to motivate the local community to maintain the ponds for rain water harvesting.

Table-18: Scaling up of SLEM best practice: Rain water harvesting and augmentation of water resources

State	No. of Villages	No. of HH targeted	No. of direct beneficiaries	Area coverage (ha)
MP	10	140	420	288
CG	07	101	303	128
Total	**17**	**241**	**723**	**416**

Impact of SLEM Practice: Deepening of ponds increased 40-60% water holding capacity of the ponds and resulted in utilization of available water for agricultural purpose by a greater number of farmers (Table 19). Drinking water availability for local livestock also increased. Rain water harvesting ponds also increased the ground water recharge as evident from the increase in the water level (1-1.5 metre) of the nearby wells and round the year water supply from nearby hand pumps.

Table-19: Details of ponds excavated for rain water harvesting and augmentation of water resources in the project areas

S.No.	Name of Village	Length (m)	Width (m)	Depth (m)	Volume Excavated (Cum)	Water Holding Capacity Increased (Kilo liter)
Rain water harvesting pond sites in the project areas of Madhya Pradesh						
1	Baspani (Pond 1)	46.6	40	1	1864	1864.00
2	Baspani (Pond 2)	54	32.65	1	1763.1	1763.10
3	Pipalgota (Pond 1)	50	28	1.5	2100	2100.00
4	Pipalgota (Pond 2)	60	40.3	1.2	2901.6	2901.60
5	Nayagaon	88	39.7	0.6	2096.16	2096.16
6	Lalpani (Pond 1)	50	23.6	2	2360	2360.00
7	Lalpani (Pond 2)	35	24.25	1.3	1103.375	1103.38
8	Piparya Khurd	80	50	1	4000	4000.00
9	Kachhar	45.1	14.85	3	2009.205	2009.21
10	Koyalbuddi (Pond 1)	33.35	30	3	3001.5	3001.50
11	Koyalbuddi (Pond 2)	47	34.5	2.4	3891.6	3891.60
12	Banahabeda (Pond 1)	23.35	22	2	1027.4	1027.40
13	Banahabeda (Pond 2)	46	26.7	2	2456.4	2456.40
14	Banahabeda (Pond 3)	47	9.85	1.5	694.425	694.43
15	Tatarmal	25.4	23	2	1168.4	1168.40
16	Chachmau* Part I	43.35	51.55	2.00	4469.39	4469.39
	Chachmau* Part II	50.75	42.50	2.00	4313.75	4313.75
					Total	**41220.32**
Rain water harvesting pond sites in the Project areas of Chhattisgarh						
17	Bansital*	30	30	2	1800.00	1800.00
18	Rumga	45	36	2	3240.00	3240.00
19	Matiyadand	52	42	1.60	3494.40	3494.40
20	Ameritikra (Pond 1)	55	60	1.40	4620.00	4620.00
21	Ameritikra (Pond 2)	75	70	1.40	7350.00	7350.00
22	Shankarpur	35	35	0.45	551.25	551.25
23	Rameshpur	60	50	0.50	1500.00	1500.00
24	Babhani	73	69	0.50	2518.50	2518.50
					Total	**25074.15**
					Grand Total	**66294.47**

** Ponds are also used for climate proofing fish farming*

Rain water harvesting increased the crop productivity (100-200 kg/acre) and also increased the population of the floral and faunal species in the nearby areas.

Figure 9: Scaling up of rain water harvesting and augmentation of water resources

(2) SLEM Practice: Lac Cultivation for Livelihood Generation and Biodiversity Conservation

India is the leading lac producer in the world in terms of production of raw lac. Major lac producing states in India are Jharkhand, Chhattisgarh, Madhya Pradesh, West Bengal, Odisha, Andhra Pradesh, Maharashtra and Uttar Pradesh. Lac is a type of natural resin that is formed as a result of secretion by the female lac insect. Lac is used in manufacturing of bangles, glazed paper, printing and water proofing inks, dye, dental plates, optical frames, and used in coating of insulator, spark plugs, medicines and also used in automobile

paint, cosmetic and leather industries. Lac dye is widely used in India as a dye for wool and silk. Lac cultivation provides the subsidiary source of income for farmers and forest dwellers. Scaling up of lac cultivation indirectly conserve associated faunal and floral biodiversity. Kusum (*Schleichera oleosa*), Palash (*Butea monosperma*) and Ber (*Ziziphus mauritiana*) are the major host plants for lac insect. Systematic and scientific approach in lac cultivation ensures sustainable production and better yield of lac.

Trainings were organised for capacity building of the local communities of the project areas of Chhattisgarh on scaling up of lac cultivation for livelihood generation and biodiversity conservation. Brood lac insect (@10 kg/ beneficiary) and necessary accessories along with technical support for inoculation of brood lac insect on host trees (*Butea monosperma*/ Palash) were provided to the local communities of project areas of Chhattisgarh (Bansital, Danikundi, Naka, Bahri Jhorki, Silphari, Kolbirra, Ameratikra, Moharitikra, Pathrra, Baghrra, Madai, Matiyadand and Rumga villages of Marwahi Forest Range; Kodar, Nawadih, Chanwaripara and Kanhaiyapara villages of Pali Forest Range and Kesari, Shankarpur, Babhani, Nawgai, Rameshpur and Girwani villages of Raghunathnagar Forest Ranges) for scaling up of lac cultivation. Total 2612 households adopted and scaled up the SLEM best practice on lac cultivation for livelihood generation and biodiversity conservation.

Table-19: Scaling up of SLEM best practice: Lac cultivation for livelihood generation and biodiversity conservation

State	No. of Villages	No. of HH targeted	No. of direct beneficiaries	Area coverage (ha)
CG	25	2612	7836	1138

Impact of SLEM Practice: On an average 20-25 kilograms of broodlac was harvested by each beneficiary of Pali Forest Range and Marwahi Forest Range, and earned an additional income of about Rs. 8000/- per beneficiary from lac cultivation. Result of the brood lac was not encouraging in the Ragunathnagar Forest Range may be due to some adverse weather conditions during the year 2021. Local communities of the project areas were conserving the brood lac for further scaling up of lac cultivation.

Figure 10: Scaling up of lac cultivation for livelihood generation and biodiversity conservation

(3) SLEM Practice: Biopesticides and Biofertilizers Preparation for Sustainable Land Productivity

Biopesticides and biofertilizers aim to enhance the land productivity along with improving the soil health and maintaining the ecological balance. It promotes the utilization of locally available natural resources for the preparation of biopesticides and biofertilizers without the use of chemical fertilizers and pesticides. It aims to enhance the sustainable land productivity and promote organic farming. *Neemastra* is a natural insecticide/ pesticide mixture to control the dangers of nymph-sucking insects and mealybugs. It is prepared with neem leaves, cow urine and cow dung, the fermentation of which yields an organic bioproduct that can be used as foliar spray over the crop. *Jeevaamrit* is a liquid organic manure and an excellent source of natural carbon and biomass that contains macro and micro nutrients required by crops. Its main constituents are cow dung, cow urine, jaggery, pulses flour, soil and water. *Dashparni* is a completely natural and organic plant-based product effective in controlling all kinds of insect pests and diseases. It is prepared using all-natural ingredients consisting of ten types of plant leaves that are not consumed by livestock, cow dung and cow urine.

Capacity of the local communities of the project areas was built for preparation and application of biopesticides and biofertilisers namely *Neemastra, Amrit Pani, Bijamrit, Brahmastra, Dasaparni* extract and *Jeevamrit* through organising trainings at village level. Live demonstrations on preparation of biofertilizer and biopesticides were also given to the local communities in all the ESIP villages. Knowledge products in the form of flyers and pamphlets, highlighting details about the methods for preparation *of Neemastra, Amrit Pani, Bijamrit, Brahmastra, Dasaparni* extract, *Jeevamrit* and its application were distributed to the local communities of the project villages for creating awareness and enhancing their knowledge base.

Scaling up of biopesticides and biofertilizers preparation and application for sustainable land productivity was done in all the project villages of Madhya Pradesh and Chhattisgarh by formation of 2691 clusters and each cluster consisted of at least 6 households. A set of three open top drums of 200 Litre capacity was provided to each cluster along with necessary technical support in the form of capacity building and technical know-how for preparation and application of biopesticides and biofertilizers (Table 20).

Table-20: Scaling up of SLEM best practice: Biopesticides and biofertilizers preparation for sustainable land productivity

State	No. of Villages targeted	No. of Clusters formed	No. of HHs targeted	No. of direct beneficiaries	Area coverage (ha)
MP	34	677	5460	16380	8504.81
CG	51	2014	16310	48930	12308.99
Total	**85**	**2691**	**21770**	**65310**	**20813.80**

Impact of SLEM Practice: Before the scaling up of this practice, local communities of the project areas were using chemical pesticides for protecting their crops from pest and diseases and investing about Rs. 1000/- per crop/ beneficiary for procurement of pesticides. Now, they have started preparation and application of biopesticides and biofertilizers in their agricultural fields for enhancing sustainable land productivity, and saved a sum of Rs. 1000/- per crop/beneficiary.

Figure 11: Scaling up of biopesticides and biofertilizers preparation for sustainable land productivity

(4) SLEM Practice: WADI System - A Tree-based Farming System

WADI is a tree-based farming system to promote agroforestry and has been practiced traditionally in India. The concept of WADI includes an integrated approach of agriculture, horticulture and forestry systems. WADI aims to promote socio-economic empowerment of the communities as well as conservation of soil and water resources. WADI system promotes comprehensive economic development through enhancing agricultural productivity and efficient management of natural resources. It also enhances financial security of the small and marginal farmers through integrated concepts of agriculture, horticulture and silviculture at village level. Tall seedlings of grafted mango, guava, custard apple, lemon, amla, drum sticks/ jack fruit (two plants of each species) were provided to the local communities of ESIP areas of Madhya Pradesh and Chhattisgarh for scaling up of WADI system in the project areas. A total of 16071 households in the project areas of Chhattisgarh and Madhya Pradesh were provided with the bunch of tall seedlings of fruit trees (Table 21). Technical support in the form of capacity building and technical know-how on planting techniques were provided to the beneficiaries of the project areas of Madhya Pradesh and Chhattisgarh.

Table-21: Scaling up of SLEM best practice: WADI System - A tree-based farming system

State	No. of Villages targeted	No. of tall seedlings provided	No. of HHs targeted	No. of direct beneficiaries	Area coverage (ha)
MP	34	51288	4276	12828	51.28
CG	51	141564	11795	35385	141.56
Total	**45**	**192852**	**16071**	**48213**	**192.84**

Impact of SLEM Practice: A bunch of tall seedlings containing 6 seedlings (of fruit trees of highly productive varieties of mango (grafted), lemon, amla, custard apple, guava and drums bicks/jack fruit with the height > 3 feet and age > 2 years) were provide to each of the beneficiaries. About 192852 tall plants were distributed and planted in the project areas. The survival rate of these plants was about 80-90%. Due to improved varieties, flowering,

and fruiting were observed in mango and guava in some villages. In long run, fruit trees would contribute in providing food security and nutritional requirement and also contribute in sequestration of additional carbon from the atmosphere.

Figure 12: Scaling up of WADI System - A tree-based farming system

(5) SLEM Practice: Vermicomposting for Sustainable Land Productivity

In order to ensure sustainable land productivity, vermicomposting activity was selected for integrated farm development as one of the SLEM activities for scaling up in the ESIP areas. Sustainable land productivity can be ensured through use of vermicompost instead of chemical fertilizers. Vermicomposting aims to enhance the land productivity along with maintaining the ecological balance. Vermicomposting promotes the utilization of locally available resources and is one of the processes of preparation of organic manure in which earthworms convert waste materials into compost. Vermicompost creates a favourable environment for beneficial microorganisms; permanently improves soil quality; prevent soil erosion; increases water-holding capacity of soil, and ultimately increase the crop productivity.

Vermicomposting has good potential for its scaling up in the states of Madhya Pradesh and Chhattisgarh as they are agrarian economy. Both these states were reported to have high consumption of chemical fertilizer, the use of vermicompost seems to have great potential in reducing dependency on chemical fertilizers and enhancing the sustainable land productivity. Vermicomposting unit consist of vermibed along with shade net, outlet pipe for collecting vermiwash, bamboo sticks for installation and earthworms (3 kg/unit) along with necessary technical support in the form of capacity building and technical know-how for preparation and

application of vermicompost were provided to the beneficiaries of the project areas of Madhya Pradesh and Chhattisgarh. Capacity of the local communities of the project areas was built in vermicomposting through organization of the trainings at village level. Live demonstrations of the preparation of vermicomposting was also given to the local communities of the project areas. Knowledge products in the form of flyers and brochures on vermicomposting were also provided to the local communities of the project areas for creating awareness and enhancing their knowledge base. Total number of 5022 vermicomposting units were established for scaling up of vermicomposting in the project areas of Madhya Pradesh and Chhattisgarh (Table 22).

Table-22: Scaling of SLEM best practice: Vermicomposting for sustainable land productivity

State	No. of Villages targeted	No. of Vermicomposting units established	No. of HHs targeted	No. of direct beneficiaries	Area coverage (ha)
MP	34	2562	2562	7686	1296
CG	35	2460	2460	7380	1213
Total	**69**	**5022**	**5022**	**15066**	**2509**

Impact of SLEM Practice: Farmers especially women beneficiaries were actively involved in vermicomposting activity and using it in their agriculture fields. Some of the beneficiaries have informed that their crop production increased as a result of use of vermicompost. Average saving @ Rs. 3035/- per household per year was observed due to cut down of the cost of chemical inputs on application of vermicompost in the farming.

Figure 13: Scaling up of vermicomposting for sustainable land productivity

(6) SLEM Practice: Micro Irrigation System for Enhancing Water Use Efficiency and Productivity

More than 80% of the available water resource in the country is used in agricultural sector for the purpose of irrigation. The country has been able to cover just 50% of the net sown area under irrigation. Water being the most critical input for agriculture, its judicious use is important to ensure sustainable productivity and food security. There is a need for adopting optimum cropping pattern and efficient water

application, that utilises available water resources in an efficient manner. The saving of water will not only help in improving soil health, enhancing productivity and providing environmental advantage, but also in supporting irrigation with extended coverage for a longer duration from the same source of water. The water-use efficiency of protective irrigation source through small water harvesting structures in rainfed areas can be enhanced by integrating them to micro-irrigation systems, and provide live saving irrigation to the standing crop. The Government of India is promoting micro irrigation with the objective to enhance water use efficiency in the agriculture sector by promoting appropriate technological interventions like drip and sprinkler irrigation technologies and encourage the farmers to use water saving and conservation technologies.

Micro irrigation techniques not only help in water saving, but also in reducing fertilizer usage, labour expenses, and other input costs, besides sustaining soil health. Micro- irrigation systems deliver water savings of up to 40% over conventional flood irrigation methods, along with considerable crop productivity and income enhancement. Hence, efficient use of the available water through micro irrigation like drip and sprinkler system helps in judicious use of water for conservation and enhancing productivity.

To avoid overuse of water during irrigation, enhancing productivity and to promote conservation of water resources, gravity-based drip irrigation system for vegetable crops covering 0.01 ha area of each project beneficiary were provided for scaling up in the project areas of Chhattisgarh and Madhya Pradesh. To avoid overuse of water during irrigation, portable sprinkler irrigation system for covering 0.4 ha area were provided to the beneficiaries of project areas of Madhya Pradesh. Micro irrigation systems comprised of gravity-based drip irrigation system (2394 units in Chhattisgarh and 1672 units in Madhya Pradesh) and portable sprinkler irrigation system (1198 units in Madhya Pradesh) were installed for scaling up of micro irrigation systems in the ESIP areas for enhancing water use efficiency and productivity (Table 23).

Technical support in the form of capacity building and technical know-how on operation and maintenance of micro irrigation systems were provided to the beneficiaries of the project areas of Madhya Pradesh and Chhattisgarh.

Table-23: Scaling up of SLEM best practice: Gravity-based drip irrigation system and portable sprinkler irrigation system for enhancing water use efficiency and productivity

State	No. of Villages targeted	No. of Drip Irrigation Unit units established	No. of HHs targeted	No. of direct beneficiaries	Area coverage (ha)
MP	35	1672	1672	5016	16.72
CG	48	2394	2394	7182	23.94
Total	**83**	**4066**	**4066**	**12198**	**40.66**

State	No. of Villages targeted	No. of Sprinkler Irrigation Unit units established	No. of HHs targeted	No. of direct beneficiaries	Area coverage (ha)
MP	35	1198	1198	3594	479.20

Impact of SLEM Practice: Local communities of the project areas showed interest in low-cost micro-irrigation (drip and sprinkler) to produce vegetables and other crops for increasing income and improving household nutrition. Sprinkler irrigation became very popular in the project areas of Madhya Pradesh and beneficiaries used this irrigation system, especially in high water demanding crop such as Moong (*Vigna radiata*). Drip irrigation reduced the overuse of water for irrigation.

Figure 14: Scaling up of micro irrigation system

(7) SLEM Practice: Crop Diversification for Sustainable Land Productivity

Improved varieties of seeds of vegetable crops comprising of tomato, radish, carrot, cauliflower, green pea, spinach, coriander, mustard green, fenugreek and amaranthus (14320 seed kits) for Rabi season were distributed to the beneficiaries of the project areas of Madhya Pradesh and Chhattisgarh. Improved varieties of seeds of vegetable crops comprising of brinjal, chili, french beans, lady finger, cucumber, pumpkin, bottle gourd (13100 seed kits) for Kharif season were distributed to the beneficiaries of the project areas of Madhya

Pradesh and Chhattisgarh (Table 24). Technical support in the form of capacity building and technical know-how on seed sowing and planting techniques were provided to the beneficiaries of the project areas of Madhya Pradesh and Chhattisgarh.

Table-24: Scaling of SLEM best practice: Crop diversification for sustainable land productivity

State	No. of Villages targeted	No. of Vegetable seed kits of Rabi crop provided	No. of HHs targeted	No. of direct beneficiaries	Area coverage (ha)
MP	35	4464	4464	13392	44.64
CG	35	9856	9856	29568	98.56
Total	**70**	**14320**	**14320**	**42960**	**143.20**

State	No. of Villages targeted	No. of Vegetable seed kits of Kharif crop provided	No. of HHs targeted	No. of direct beneficiaries	Area coverage (ha)
MP	34	4382	4382	13146	43.83
CG	35	8718	8718	26154	87.17
Total	**69**	**13100**	**13100**	**39300**	**131.00**

Impact of SLEM Practice: Local communities of the project areas cultivated the vegetable crops in the Kharif and Rabi seasons, which they used for self-consumption and seed collection, also reduced their reliance on purchasing vegetable seeds from the market. Some of the beneficiaries sold the extra vegetables in the local market and earned on an average Rs. 4000/- additional income in a season. Crop biodiversity was also improved in the project areas.

Figure 15: Scaling up of crop diversification

(8) SLEM Practice: Azolla Cultivation for Integrated Farm Development

The practice of Azolla cultivation is widely popular in the countries of south-east Asia like India, China, Philippines, Indonesia etc. Azolla is an aquatic floating fern and fixes atmospheric nitrogen with the help of blue green algae (*Anabaena azollae*) present as a symbiont. The rate of nitrogen fixation was reported to be about 25 kg/ha. Azolla will take the shape of a thick mat within seven days of inoculation. Azolla is very rich in protein (25-35%), calcium (67 mg/100g) and iron (7.3 mg/100g). Ideally, it will give 10 kg of Azolla within seven days of inoculation. After the seventh day, 1.5 kg of Azolla could be harvested every day. Harvested Azolla need to be washed in freshwater before it is fed to the cattle. Washing is necessary to remove the smell of cow dung. Azolla can be used as a bio-fertilizer/ green manure, a mosquito repellent, and above all as a bio-scavenger as it takes away all heavy metals. Azolla is suitable for paddy cultivation and increases the rice production by 20%. Azolla is used as food supplement for variety of animals like cattle, goat, pigs, rabbits, chickens, ducks and fish.

Azolla cultivation units (with accessories and mother seeds) for 7000 beneficiaries were established in project areas of Madhya Pradesh and Chhattisgarh for scaling up of Azolla cultivation for integrated farm development (Table 25). Technical support in the form of capacity building and technical know-how for cultivation and uses were provided to the beneficiaries of the project areas of Madhya Pradesh and Chhattisgarh.

Table-25: Scaling of SLEM best practice: Azolla cultivation for integrated farm development

State	No. of Villages targeted	No. of Azolla cultivation units established	No. of HHs targeted	No. of direct beneficiaries
MP	40	2467	2467	7401
CG	51	4533	4533	13599
Total	**91**	**7000**	**7000**	**21000**

Impact of SLEM Practice: Some of the beneficiaries of the project areas acknowledged Azolla as a healthy and nutritional cattle feed after feeding goats and cows. Some beneficiaries were also using Azolla as a feed for poultry. Azolla fodder is an excellent alternate feed supplement for livestock, poultry and fish. This practice reduces the feed cost and results in increased milk yield.

Figure 16: Scaling up of Azolla cultivation

(9) SLEM Practice: System of Rice Intensification

System of Rice Intensification (SRI) is a method of rice cultivation for increasing rice yield with reduced seed and water demand. SRI involves cultivating rice with as much organic manure as possible, starting with young seedlings planted singly at wider spacing in a square pattern; and with intermittent irrigation that keeps the soil moist but not flooded, and frequent inter-cultivation with a weeder that actively aerates the soil. Traditional paddy growers can adopt SRI practice where water is scarcely available and as such has an immense potential in the paddy growing areas of Chhattisgarh and Madhya Pradesh. A training for the local communities (beneficiary/farmers) of Marwahi Forest Range was provided on SRI covered nursery preparation, handling and transplanting of seedlings, water management and weed control for proper adoption of this SLEM best practice. Improved variety of paddy seeds and conoweeder were provided to the beneficiaries of Matiadand, Bansital, Amaratikra and Rumga villages of Marwahi Forest Range and scaled up the SRI. Besides this, local communities of project areas of Ragunathnagar Forest Range also scaled up the SRI and also broadcasted Azolla in their paddy fields with technical support from the project.

Table-26: Scaling of SLEM best practice: System of rice intensification

State	No. of Villages targeted	No. of HHs targeted	No. of direct beneficiaries	Area coverage (ha)
CG	11	14	42	9

Impact of SLEM Practice: Paddy production was increased in comparison to the traditional paddy cultivation. Seeds as well as water requirement for irrigation was also low.

Figure 17: Scaling up of system of rice intensification

(10) SLEM Practice: Promotion of Improved Cook Stoves for Addressing the Forest Degradation

About 72% rural population in the state of Madhya Pradesh and about 76% rural population in the state of Chhattisgarh are dependent on agriculture and natural resources for sustenance. As per the baseline reports of project areas of Madhya Pradesh and Chhattisgarh, local communities of the project areas were mainly depending on fuelwood as a primary source of energy for cooking and heating. Local communities of the project areas were mainly using traditional three stone chulah. On an average 17 to 20 kg of fuelwood was collected on daily basis by each household from the nearby forest areas. Maximum distance travelled by the local communities for fuel wood collection in the forest areas varies from 2 to 5 km and time spent varies from 5 to 8 hours depending upon the availability of fuel wood in forests. Women play major role in fuelwood collection in the states of Madhya Pradesh and Chhattisgarh and their maximum time is consumed in fuel wood collection. Fuelwood collection is one of the major drivers of forest degradation in the project areas of Madhya Pradesh and Chhattisgarh. Furthermore, the open fires and traditional chullah consume more fuelwoods and release significant amount of carbon and causes respiratory diseases such as bronchitis and pneumonia. Therefore, 13055 Improved Cook Stoves were provided to the local communities of the project areas of Madhya Pradesh and Chhattisgarh for addressing this driver of land degradation and to improve the ecosystem services. Improved cook stoves distributed to the local communities met all the standards prescribed by the Ministry of New and Renewable Energy, Govt. of India. Technical know-how was also provided in the trainings to the local communities on usage of improved cook stoves. Distribution of improved cook stoves benefitted 39165 direct beneficiaries of the project areas (Table 27).

Table-27: Scaling of SLEM best practice: Promotion of improved cook stoves for addressing the forest degradation

State	No. of Villages targeted	No. of Improved Cook Stoves provided	No. of HHs targeted	No. of direct beneficiaries
MP	35	4245	4245	12735
CG	35	8810	8810	26430
Total	**70**	**13055**	**13055**	**39165**

Impact of SLEM Practice: Uses of improved cookstoves are providing multiple benefits to the local communities of the project areas and contributing in improvement of the ecosystem services through addressing the forest degradation. Improved cook stoves were more energy and thermal efficient and consume less fuel wood and emit less carbon than the traditional *chulah*. As per the data recorded from the project areas, fuel wood consumption was reduced to about 35 to 45% after using improved cook stoves by the local communities, and also reduced the smoke emission. Uses of improved cook stoves in the project areas of Madhya Pradesh and Chhattisgarh contribute in achieving the nationally determined contribution targets under the Paris Agreement.

5.2.1.7. Beneficiaries of SLEM Practices

Forest Range wise details of beneficiaries of SLEM best practices scaled up in the project areas of Madhya Pradesh and Chhattisgarh are given in the Table 28. Total beneficiaries of 66402 were targeted in the scaling up of SLEM practices in the project areas of Madhya

Figure 18: Promotion of improved cook stoves

Pradesh and Chhattisgarh. Village wise details of the SLEM practices scaled up in the selected landscapes of Madhya Pradesh and Chhattisgarh are annexed as Annexure 1 and Annexure 2. SLEM practices viz. pond deepening, construction of ponds, crop diversification, WADI system, land levelling and pasture land management scaled up in the project areas of Madhya Pradesh and Chhattisgarh under other schemes of the Governments from 2018 to 2023. Total area of 2417.42 ha of CPR, private land and Government lands were brought under the SLEM practices (Table 29). These can also be attributed the impact of the ESIP interventions in the project areas.

Table-28: Details of beneficiaries (households) of SLEM best practices scaled up in the project areas of Madhya Pradesh and Chhattisgarh

S. No.	Name of Forest Range	House-holds targeted	Beneficiaries of SLEM Best Practices											
			Rain water harvesting	Lac cul-tivation	Vermi composting for sustainable land productivity	Biopesticides and biofertilizers for sustainable land productivity	Crop diversification for sustainable land productivity		Micro Irrigation System for Enhancing Water Use Efficiency and Productivity		WADI-System	System of Rice Intensi-fication	Azolla cultivation integrated farm develop-ment	Improved Cook Stoves for addressing forest degradation
							Vegetable seeds (Rabi Crop)	Vegetable seeds (Kharif Crop)	Drip system	Sprinkler system				
SLEM best practices scaled up in the project areas of Madhya Pradesh														
1.	Bhaura	1283	57	-	696	1242	1154	949	274	190	949	-	615	1171
2.	Banapura	2384	54	-	867	2204	1602	1602	693	450	1520	-	1167	1396
3.	Itarsi	339	11	-	186	339	246	301	185	129	301	-	100	281
4.	Sukhtawa	569	17	-	249	464	351	419	145	147	419	-	285	406
5.	Budhni	1249	01	-	564	1211	1111	1111	375	282	1087	-	300	991
	Total	**5824**	**140**	**-**	**2562**	**5460**	**4464**	**4382**	**1672**	**1198**	**4276**	**-**	**2467**	**4245**
SLEM best practices scaled up in the project areas of Chhattisgarh														
6.	Marwahi	6436	71	821	981	6436	3851	3851	664	-	3851	5	2000	4081
7.	Pali	770	-	338	144	770	765	763	299	-	764	-	217	731
8.	Pandaria West	1381	-	-	401	1381	1224	1224	355	-	1224	-	403	559
9.	Raghunath nagar	4016	30	1453	934	4016	4016	2888	460	-	2894	9	737	3439
10	Narharpur	3707	-	-	-	3707	-	-	616	-	3062	-	1176	-
	Total	**16310**	**101**	**2612**	**2460**	**16310**	**9856**	**8718**	**2394**	**-**	**11795**	**14**	**4533**	**8810**
	Grand Total	**22134**	**241**	**2612**	**5022**	**21770**	**14301**	**13100**	**4066**	**1198**	**16071**	**14**	**7000**	**13055**

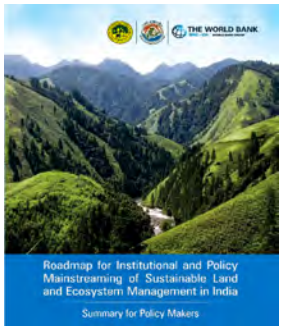
Table-29: SLEM practices scaled up in the project areas of Madhya Pradesh and Chhattisgarh under other schemes of the Governments

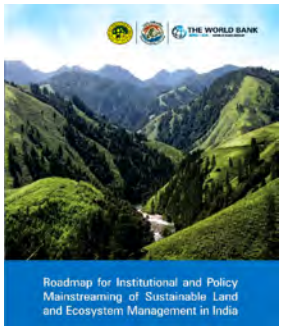
S. No.	Project Areas	SLEM Practices scaled up in CPR, private lands and Government lands	Area Coverage (ha)
1.	Bhaura Forest Range, North Betul Forest Division, MP	Pond deepening, construction of ponds, crop diversification and WADI system	347.77
2.	Itarsi Forest Range, Hoshangabad Forest Division, MP	Pond deepening, construction of ponds, crop diversification and WADI system	314.25
3.	Sukhtwa Forest Range, Hoshangabad Forest Division, MP	Pond deepening, construction of ponds, crop diversification and WADI system	153.44
4.	Banapura Forest Range, Hoshangabad Forest Division, MP	Pond deepening, construction of ponds, crop diversification and WADI system	225.00
5.	Budhni Forest Range, Sehore Forest Division, MP	Pond deepening, construction of ponds, crop diversification and WADI system	14.57
		Total	**1055.03**
6.	Marwahi Forest Range, Marwahi Forest Division, CG	Pond deepening, construction of ponds, crop diversification, WADI system, land levelling and pasture land management	487.16
7.	Kanker Forest Range, Kanker Forest Division, CG	Pond deepening, construction of ponds, crop diversification, WADI system and land levelling	320.00
8.	West Pandriya Forest Range, Kawardha Forest Division, CG	Pond deepening, construction of ponds, crop diversification, WADI system, land levelling and pasture land management	274.32
9.	Ragunathnagar Forest Range, Ambikapur Forest Division, CG	Pond deepening, construction of ponds, crop diversification, WADI system and land levelling	250.91
10.	Pali Forest Range, Katghora Forest Division, CG	Pond deepening, construction of ponds, crop diversification, WADI system and land levelling	30.00
		Total	**1362.39**
		Grand Total	**2417.42**

5.2.2. Building National Capacity for Land Degradation and Desertification Monitoring

5.2.2.1. Roadmap for Institutional and Policy Mainstreaming of SLEM in India

A Baseline Report on SLEM highlighted that mainstreaming and scaling up of SLEM requires a Road Map and Action Plan aimed at minimizing the policy and institutional gaps and guides the harmonization of efforts by various policies, programs and institutions at the national and sub-national level (ICFRE, 2014 a). Accordingly, a roadmap for institutional and policy mainstreaming of SLEM in India was developed and published (ICFRE, 2022 a and 2022 b) under ESIP which was released by the Secretary to the Government of India, Ministry of Environment, Forest and Climate Change on 19 December





2022. The roadmap provided specific guidelines to different Ministries/ Departments/ Research Organizations/ Civil Society Originations involved in restoration of degraded lands and combating land degradation and desertification. The roadmap also provided the guidelines and action plans for achieving Land Degradation Neutrality, Sustainable Development Goals and Nationally Determined Contribution targets of India. The roadmap identifies the key nodal or initiating agencies for each of the action points, their role, agencies that they would require support from, areas of support and timeline wise breakdown of milestones.

Key recommendations of the roadmap for institutional and policy mainstreaming of SLEM are highlighted as under:

- The issues of land degradation and ecosystems conservation are enshrined in a number of policies (National Forest Policy 1988, National Agriculture Policy 2000, National Environment Policy 2006, National Farmers Policy 2007, National Water Policy 2012, National Agroforestry Policy 2014 and National Mineral Policy 2019) but they remain focused on their core sector agenda. In a combined manner, the issue of SLEM does not rise to the level of importance that it ought to. Thus, there is a need for a dedicated policy on land degradation in the country.
- Forest policy needs to respond to future expectations particularly in the areas of climate change, sustainability of ecosystem services, and livelihood sustenance, thus strengthening of forest policy is required.
- The budgetary allocation of the central and state governments has been inadequately low required to restore the degraded land and to address critical aspects of forestry, i.e. enhancing technical capacities for planning and monitoring, improving quality of planting material used for afforestation, fighting forest fires and eradicating invasive species. Additional funding will also be required for meeting the Nationally Determined Contributions (NDC) commitment of creation of additional carbon sink of 2.5 to 3 billion tonnes of CO_2 equivalent through additional forest and tree cover. Thus, increased funding for forestry programmes are required.
- Consciously reducing dependencies of people living in Forest Fringe Villages (FFVs) is absolutely necessary to reverse forest degradation. There is a need for special effort towards the holistic development of communities living around forests and therefore, a specific scheme for the development of FFVs is recommended.
- Due to the non-uniform status of digitization of forest, the benefits of use of GIS in planning or monitoring as well as portals, such as those developed by Ministry of Environment, Forest and Climate Change at the national level, cannot be fully realized.
- The identification of areas that were forests of higher density and have now lost forest cover can be critical for the prioritization of target areas for afforestation and assisted natural regeneration. Targeted afforestation would be more successful.
- Low quality planting material enhances the threat of depletion of forest resources over time. There is a need to put special focus on the development of quality planting material sporadically in mainstream afforestation programmes.
- Due to global warming, there exist an increased risk of damage to forests because of forest fire, pests, invasive species, and drought. This calls for special and enhanced attention to address these issues of forest health.

- Contributions of forest carbon assessment towards climate change mitigation is an important action for NDC. Monitoring of forest carbon at the local level is increasingly becoming important because it will not only enhance the quality of data for forest carbon accounting, but also help in monitoring forest health and its role in climate change mitigation.
- SLEM best practices being undertaken by specialized institutions need to be mainstreamed and scaled up. It can be achieved by collaboration with research institutions by involving them more closely in programmes through design, training and advisory support. Besides, the feedback on technology, know-how and appropriate costing from research findings may be incorporated in the national and state-level programmes.
- Wildlife corridor development in Project Tiger as well as other protected areas (PAs) will enhance ecological integrity of PA network. Focus needs to be on a large gap in the management capabilities between protected areas other than Tiger Reserves vis a vis the Tiger Reserves, which affects the capabilities of the lesser-known PAs to manage corridors.
- The Biodiversity Management Committees or Gram Panchayats have not been able to measure up to the responsibility of conservation of commercially valuable bioresources in their area. Institutionally, State Biodiversity Boards (SBBs) are very weak with limited scientific staff and financial resources, therefore their strengthening is critical to enhancing biodiversity governance in the country. Benefits from bioresource should reach communities and SBBs are the main agency to make this happen.
- Regular updation of wetland inventory and water bodies at the local or regional level does not exist. Multiple uses and multiple agencies have made wetland conservation a challenge. The State Wetlands Authorities are at the initial stages of functioning and will require consistent support to be institutionally relevant.
- The criticality of trees outside forest in India's strategy for climate change mitigation requires a boost to agroforestry. A closer collaboration with wood-based industries is also required to open up the ecosystem and bring in private enterprises and innovation to harness the full potential of agroforestry.
- Good quality data regarding forest land diversion is available since 1980, the impact of diversion beyond the forest land may be studied and learnings should be used in the revised design of compensation structure as many of the unintended consequences, which may be difficult to avoid as it may not be priced in the compensatory value of forest land diverted. Pricing of forest land is required to be backed by science to avoid moral hazard.
- Multiple definitions of wasteland and degraded land and multiple agencies measuring the same have created an information system inappropriate for field work. As multiple agencies are involved, the process of target setting and monitoring requires to be made more systematic for better monitoring and impact assessment. Framework to monitor LDN involves identification of stakeholders and compilation of data related to restoration of degraded land by various departments.
- Develop a center of excellence for sustainable land management and capacity building. Achieving LDN will require interventions on multiple fronts. A large project on SLEM at the national level will serve as a model for showcasing such an approach,

deploying scientific knowledge, replicating best practices, highlighting successful use of technology, and building the capacity of institutions and implementers.

- Contributing to LDN and NDC through the greening of Highways. The country is witnessing massive road building exercises with 4000 to 10000 Km of national highways constructed in the last six years and about 10 million trees planted along the national highways. Improving the administration of greening activities under highways development can be a huge contributor in India's attempt towards reaching LDN and NDC targets.
- The Environmental Management Plan (EMP) is mandatory as part of the environmental clearance. The objectives are to mitigate adverse impacts on identified environmental components, protect environmental resources and enhance the value of environmental components. It also includes a monitoring plan to evaluate the success or failure of the environmental management measures and carry out reorientation of the plan if necessary. Monitoring of EMP has remained a weak area for the mining industry. Focused attention on rehabilitation of mined-out areas and abandoned mines is required.
- India, as of today, does not have a national level market for carbon emission trading. Pricing of carbon and ecosystem services could be a way to attract private funding since funding has been a challenge for climate change mitigation in the Agriculture, Forestry and other Land Uses sector.
- There is no effective regulatory mechanism for preventing the mining of sand from riverbeds and along riverbanks and therefore, enforcement of Sand Mining Guidelines is required.
- Involving students in fighting land degradation. Leveraging the large population of students would have a multiplier effect in raising awareness about fight against land degradation.
- Establishing a mechanism for measuring SDG indicators related to SLEM can be an effective tool to coordinate interventions in addition to business as usual methods. Comprehensive monitoring and reporting framework for collating achievements under identified indicators will be necessary for uniformity across the country.
- Policy on development of grasslands and grazing lands are important. Grasslands are not only important from ecological perspective but also form one of the key pillars to support livelihoods. However, they are not covered under any structured policy instrument. There is also the absence of detailed assessment of the biodiversity values and ecosystem services that the grasslands provide in the Indian context.
- Unrestrained and overgrazing is one of the chief drivers of grassland degradation. There is no department which is explicitly targeting the development of grazing land in the country. Common lands in villages are under tremendous pressure of land diversion and encroachment. It is recommended that a special scheme for the development of grazing and grassland may be taken up.
- The problems due to overuse of water are well known. National and state-level water policies need to identify measures to optimize the existing irrigation facilities, including building small reservoirs locally and reducing water transportation and distribution losses through long-distance canals. Therefore, there exist an urgent need to disincentivize the overuse of water in agriculture, which is not only threatening water availability but also is a cause of land degradation.

- Promoting agroforestry requires the development of the entire ecosystem related to the supply and demand of wood. Though information on trees, viz. its characteristics, suitability as per site conditions, details of how and when to get seeds, nursery techniques, silviculture practices, diseases and cure, economics, plantation models, research-based techniques that can be taken to the field and training manuals are available widely but unverified. A one-stop portal can solve many of these challenges related to the information gap. The portal can be expanded in reach and content with time via networking with larger number of organizations and users, so that in due course, it will become a useful repository of data, that can be used in planning and agroforestry extension activities.
- Wider extension of techniques and tools are also missing, which causes a hindrance in propagating sound agricultural practices to reduce or cease land degradation of agricultural lands. To increase the participation of farmers and landowners in taking up land protection measures, facilitation in the form of a specific programme is required.
- Subsidies have distorted the agriculture landscape and are required to be studied to aid far more informed discourse, as removing them outrightly may not be immediately feasible. A study and the modelling of the impact of subsidies on land degradation have not been undertaken so far and is therefore being proposed.
- Availability of water depends totally on how land on which it falls is managed. Integration of the policies on land, water and forests will enable coordinated action by various agencies. Focus on land and forests under the National Water Policy in the context of management of water resources will give a boost to the sustainable management of land and forests by formally connecting it with the supply of a tangible resource, such as water, and will also in due course lay the foundation for payment of ecosystem services.
- The statutory framework applicable to rivers consisting of the Water Act, the Environment Protection Act and the National Water Policy 2012 do not make a minimum amount of flows needed by a river to survive and flow; only protection of rivers and streams from pollution is provided for. Preventing death of rivers due to no or negligible flow would require legislative intervention. A legislation on mandatory flows in all rivers where water is impounded or water is extracted is being recommended.
- Changing the pattern of use of ground water would require significant behaviour changes in addition to re-organising economic activities. Participation and decentralization of ground water management appear to be a possible solution, which needs to be upscaled in the water stress areas of the country.
- Funds under MGNREGA are being tapped by various departments, but an institution for common planning of land related works would enhance outcomes.
- Tribal areas require more livelihood support to relieve natural resources from sustenance related exploitation. It is recommended to allow up to 200 person-days of employment per household instead of 100 days in tribal and forest fringe areas. Therefore, special provision in MGNREGA for tribal and forest fringe village areas are recommended.
- A nodal agency to address and manage land use related issues is missing today, therefore revival of Land Use Boards is suggested.

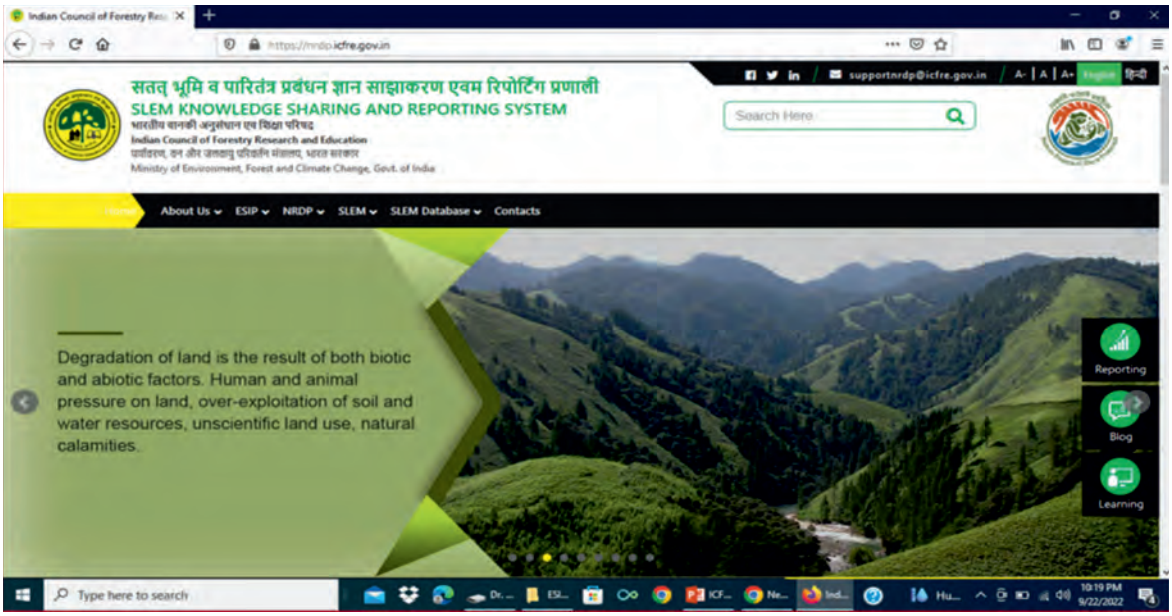
- The integration of SLEM with the planning process at the grassroots level, i.e. in Gram Panchayat Development Plan, Block and District Plans, will bring the focus of communities on sustainability and access to land and water resources.
- Large variations are found in the institutions within panchayat in the country to deal with sustainable land management and environment protection. A Standing Committee on environment/ forests/ land conservation has not been the norm at the Gram Panchayat level across the country and is therefore, required as mandate to coordinate with Joint Forest Management Committees, Eco-development Committees and Watershed Management Committees at the village level.
- People are an important component of SLEM and there should be an equal amount of investment in addition to scientific inputs. Hence, strengthening the community participation aspect in SLEM programmes through systematic interventions is proposed.
- Gender neutrality at times also is gender discriminatory. Women have a large role in managing land and forests, which needs recognition in policies and programmes.
- Women farmers are often clubbed with men folk assuming their disabilities are the same as men. Therefore, addressing needs of women farmers in implementation of SLEM is required.
- Weak institutional oversight on Common Property Resources (CPRs) is leading to their total misuse. Special attention to the management of CPRs, along with support to institutions, is required.
- Since Panchayat (Extension to Scheduled Areas) Act, 1996 (PESA) seeks to empower the *Gram Sabha* and *Gram Panchayat*, its implementation also requires people to be aware of the laws as well as information about the programmes so that the *Gram Sabha* and *Gram Panchayat* can make informed choices.

5.2.2.2. SLEM Knowledge Sharing and Reporting System

A portal on SLEM Knowledge Sharing and Reporting System (https://nrdp.icfre.gov.in) was developed under ESIP for sharing the knowledge, learnings, practices and success stories related to scaling up of SLEM best practices for achieving land degradation neutrality by 2030 and also help in strengthening the national capacity for reporting to UNCCD Secretariat regarding progress made in implementation of the convention. This portal was launched by the Director General, ICFRE on 28 March 2022.

Key features of the portal are highlighted as under:

- Useful for number of stakeholders including various Central Ministries, departments, organizations, State Governments, NGOs and local community members.
- A repository of information on desertification, land degradation and drought as well as the best practices on sustainable land and ecosystem management.
- Help in increasing national capacity for monitoring the status of land degradation and desertification and SLEM outcomes, as well as the results of UNCCD action programs at the country level.
- Have national database on SLEM practitioners for the development of institutional and individual networks. The knowledge network also helps in developing a community of practice by connecting stakeholders with common interests in adopting and expanding SLEM approaches and knowledge dissemination.
- Provide necessary assistance for preparation of national report for submission to the UNCCD Secretariat
- Help in organizing and implementing learning events at the interface of the different stakeholders.
- Platform will have an integrated learning management system for the different courses and Trainings on SLEM for capacity building of the stakeholders.
- Help in developing network of the SLEM practitioners/ stakeholders through using integrated SLEM - Networking and Blogs.



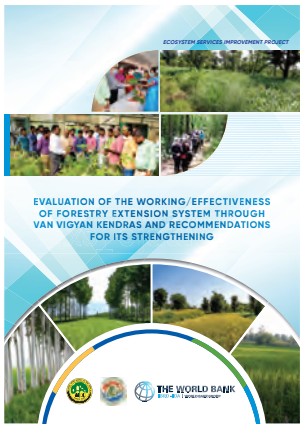
The portal was visited by more than 34000 visitors since its launching (28 March 2022) up to project completion (30 July 2023).

5.2.3. Development and Implementation of a National Knowledge Network

5.2.3.1. Strengthening of Van Vigyan Kendras

ICFRE have rich portfolio of innovations, ready-to-use technologies and best practices and protocols in different aspects of forestry. Various programmes/ projects are being implemented by ICFRE for effective dissemination of the

outcomes of its research to various end users and stakeholders by employing different extension strategies, tools and platforms. Two important programmes for strengthening the front-line extension in the forestry namely Van Vigyan Kendra and Demo Village were launched by ICFRE during the year 2007-08 for show-casing and demonstrating technologies in the field and capacity building of State Forest Departments, farmers, rural communities and other stakeholders. Van Vigyan Kendras (VVKs) were conceptualized as a collaborative effort between ICFRE and State Forest Departments for extension in the field of forestry. VVKs were established in partnership with the State Forest Departments. Most of the VVKs were established between 2008 and 2010.

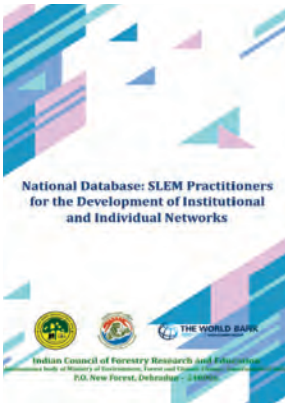


Strengthening of the VVKs are required for effective frontline extension in the field of forestry. Accordingly, a study was conducted under ESIP to evaluate working/ effectiveness of VVKs established in different parts of the country for fulfilling the objectives of forestry extension services to enable technologies from lab to land and make practicable suggestions to improve the working and effectiveness of VVKs in future. Report of the study highlighted status and functioning of VVKs, analysis of VVKs and KVKs, recommendations for improved VVK functioning and management, and strategies and guidelines for modified VVK system. Report of the study was submitted to the Director General, ICFRE for further necessary action. Some of the key recommendations given in the report (ICFRE, 2022 c) are highlighted as under:

- Mandate of the VVKs should be expanded to include various types of frontline extension (FLE) activities and capacity building. VVKs should be made the primary platform for FLE in rural areas targeting farmers, rural communities especially youth, women and extension workers.
- ICFRE should aim to create and support 100 to 200 robust VVKs covering all the agro-ecological regions of the States in next 10 years.
- The strategy for establishment of new VVK should begin with the identification of the high potential districts for VVKs by research institutions and each VVK must serve a cluster of 2 to 4 districts. Wherever feasible, the focus should be on developing the existing VVKs as 'models' for frontline extension and capacity building of farmers and forest-dependent communities in forestry and allied sectors.
- Various options need to be explored for tapping adequate and ensured funds for VVKs.
- The VVKs should be allowed to produce technological products – seedlings, seeds, bio-fertilizers, bio-pesticides etc. – for sale to generate sufficient funds to sustain some of its core activities on its own.
- A database of technologies, techniques and practices developed by the research institutions, SFDs, and other institutions in the field of forestry should be identified and prioritized for extension through VVKs.
- The information communication and technology should be opted with focus on practical training and experience-based learning for forestry extension.
- Linkages of VVKs with KVKs need to be developed.

5.2.3.2. National Database of SLEM Practitioners

National database on SLEM practitioners for development of institutional and individual networks was prepared (ICFRE, 2021 b). Database consist of 362 SLEM practitioners



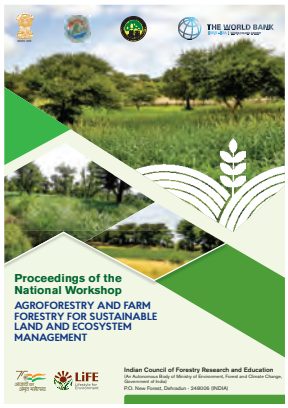
comprising of 117 organisations/ institutions, 159 individuals and community groups of SLEM practitioners, 21 awards winning practitioners and 65 other organizations. The database having detailed information on the SLEM best practices developed/ adopted in the country by institutions/ organizations and individuals. Database also provide information on community-specific traditional/ indigenous practices for water conservation, land management, natural resource management including agriculture in the region. Database of SLEM practitioners will be useful for networking of land practitioners/ stakeholders to adopt SLEM practices, locate the organization working in the respective areas of sustainable land management and scale up the tested and proven best practices.

5.2.3.3. National Workshop on Agroforestry and Farm Forestry for Sustainable Land and Ecosystem Management

National Workshop on 'Agroforestry and Farm Forestry for Sustainable Land and Ecosystem Management' was organised under the Ecosystem Services Improvement Project on 5-6 January 2023 at Dehradun with the objective to develop the suitable strategies/ frameworks and to provide policy inputs to the Government for addressing issues and challenges for development of agroforestry and farm forestry and achieving India's national targets and international commitments related to climate change mitigation and adaptation, biodiversity conservation, combating desertification and land degradation and sustainable development goals, and shifting India towards an innovative, resource efficient and carbon neutral economy.

Following themes were covered under the national workshop:

- Agroforestry and farm forestry practices for sustainable land and ecosystem management
- Quality planting materials for scaling up of agroforestry and farm forestry practices
- Rationalization of policies and regulatory regimes for development of agroforestry and farm forestry
- Certification framework and market mechanism for agroforestry and farm forestry
- Knowledge sharing and learning session for scaling up of agroforestry and farm forestry practices for sustainable land and ecosystem management



A total number of 152 experts and participants from key Ministries, Departments, Science and Technology Institutions, International Organisations, Universities, NGOs, Industries Farmers and Tree Growers actively participated in the deliberation during the technical sessions and panel discussion of the workshop, and shared their vast experience and knowledge in the field of agroforestry and farm forestry for sustainable land and ecosystem management. Proceedings of the workshop was published and submitted to the Ministry of Environment, Forest and Climate Change, Ministry of Agriculture and Farmers Welfare, NITTI Aayog, State Governments and R&D organisations for further actions in implementation of the recommendations of the workshop. Proceedings of the workshop was also shared with participants of the workshop and international organisations. Following recommendations were made during the workshop for development of agroforestry and

farm forestry for sustainable land and ecosystem management in the country (ICFRE, 2023 d):

- Develop a Digital Agroforestry Management Information System (DAMIS) with geo-referenced database of agroforestry tree species and other species for trees outside forests (including trees growing in farm forestry, roadside, railway trackside, canal side, sacred groves and others) for different agroclimatic zones.
- ICFRE and ICAR should collaborate closely to extend the ecologically sustainable and economically viable integrated agroforestry models with the defined trees, diversified crops and livestock components developed for different niches and agroclimatic zones to the farmers so as to bridge the demand and domestic supply gap and increase income to farmers.
- Liberalize the regulatory system for promoting cultivation of high-value long-rotation tree species like teak, mahogany, red sanders, sandalwood, shisham and others species in agroforestry. States to be assisted in developing protection systems for the forest population of these species.
- Diagnosing and documenting the best agroforestry practices and their scaling-up strategy with a focus on sustainable land and ecosystem management.
- Defining and documenting parameters of quality planting material for most suitable agroforestry tree species, their sources of availability, and pricing for the end-uses at nominal cost.
- Developing a framework for accreditation and star-rating of the nurseries for mass production of quality plating material and certification of quality planting materials.
- Large-scale production of clonal materials of genetically superior and /or certified germplasm of commercially important agroforestry species in collaborative mode by industries, research organisations and growers for enhancement of farmer income and uptake of quality produce by industry.
- Create awareness among Farmers/ tree growers and related stakeholders regarding new and released clones and varieties for use in agroforestry through appropriate means.
- Reduce dependency on imported timber by promoting indigenous and underutilized tree species and perennials with a broad gene pool base for agroforestry. Continuously develop new genetically improved material and package of practices for higher yields and productivity in agroforestry.
- Develop a policy for certification standards and their rolling out for agroforestry and farm forestry products. ICFRE and IIFM may take a lead to develop the Indian Forest Certification Framework for certification of agroforestry produced timber and NTFPs.
- Develop necessary standards for certification of seeds, plants, quality planting materials and agroforestry and farm forestry produces by engaging all the stakeholders which may include ICFRE and its institutes, ICAR and its institutes, and state agriculture universities, state forest departments, private branded nursery growers and other national and international agroforestry agencies (e.g, CIFOR, ICRAF) operating in the country.
- Developing and enforcing uniform felling and transit system for agroforestry produce across the country by operationalisation of the online National Transit Permit System being piloted by Ministry of Environment, Forest and Climate Change.
- Create a domestic market mechanism for agroforestry produce to facilitate the adoption of agroforestry and farm forestry. Such a market system must ensure remunerative prices for agroforestry produce which needs to be higher than the traditional agricultural produce.
- Develop a standardized cost low-cost methodology for capturing and quantifying the carbon sequestered in agroforestry and

develop domestic carbon financing and trade for the same.

- Promotion of poplars, eucalyptus, Casuarina and Melia species along with multi-purpose tree species in agroforestry under marginal/ degraded/ dry lands of farmers for income generation.
- Develop strategy and policy framework for fixing minimum purchase price for the tree crops produced by the farmers from agroforestry and farm forestry produce.
- Develop a technology-based solution for the movement of agroforestry products (timber/ wood) and develop on-farm primary processing technology to reduce transportation costs on agroforestry produce.
- Develop a mechanism for PPP-driven tools for effective harvesting starting with bamboo. ICFRE may take a lead to collaborate with suitable technological institutions for this purpose.
- Develop agroforestry entrepreneurship for economic revolution including development of bamboo value chain as a business enterprise.
- Develop an extension mechanism for sharing of knowledge and its dissemination for the extension of agroforestry-related research findings, best practices, and success stories from lab to land for sustainable land and ecosystem management.
- Developing and strengthening Van Vigyan Kendras (VVKs) on the pattern of Krishi Vigyan Kendra (KVKs) with trained manpower and demonstration plots for agroforestry extension.
- Creating a nodal agency and an institutional mechanism for agroforestry at both the central and state levels by roping in the human resources from forest and agriculture ministries and departments.
- Develop a suitable framework/ mechanism along with suitable safeguards for raising the plantation in the wastelands of the states for increasing tree cover and carbon sequestration, and meeting the industrial requirement of woods in a public-private partnership.
- Keeping in view the small land holdings of Indian farmers, Farmer Producer Organisations (FPO) and Cooperatives for agroforestry need to be formed under the scheme of Ministry of Agriculture and Farmers Welfare for Formation of FPOs.

5.2.3.4. International Workshop on Enhancing Ecosystem Services by Improving Forest Quality and Productivity, and SLEM Knowledge Dissemination

International Workshop on 'Enhancing Ecosystem Services by Improving Forest Quality and Productivity, and SLEM Knowledge Dissemination' was organised at Dehradun on 22-24 March 2023. The purpose for organization of an international workshop was to develop a mechanism for networking of national and international institutions/ organisations working in the field of restoration of degraded forest lands, forest carbon measurement and monitoring besides sharing of knowledges, experiences and techniques related to nursery management, plantation techniques, restoration techniques for degraded forest lands and dissemination of best practices on sustainable land and ecosystem management. Deliberation, discussion and experience sharing were made on the following themes during the workshop:

- Nursery Management, Plantation and Restoration Techniques,
- Enhancing Carbon Sequestration Potential of Forests and Assessment of Forest Carbon Stocks and
- SLEM Knowledge Sharing and Dissemination: Sharing of ESIP Learnings, Success Stories, Best Practices and Case Studies

Each session comprised of talks by distinguished and eminent experts/ specialists. A total of 248 delegates (174 delegates in physical mode and 74 delegates in virtual mode) from National and International Research organizations from Bangladesh, Bhutan, Malaysia, Nepal, Myanmar, Thailand and Japan, representatives of the international organizations viz. the World Bank, FAO, GCF, GIZ, ICIMOD, IUCN, UNDP, and representatives of Ministry of Environment, Forest and Climate Change, academic institutions, State Forest Departments, Science and Technology institutions and NGO participated in the workshop. Proceedings of the workshop was published and submitted to the Ministry of Environment, Forest and Climate Change, Ministry of Agriculture and Farmers Welfare, Ministry of Rural Development, NITI Aayog, State Governments and R&D organisations for further actions in implementation of the recommendations of the workshop. Proceedings of the workshop was also shared with participants of the workshop and international organisations. Following recommendations were made during the workshop (ICFRE, 2023 e):

Nursery Management and Plantation Techniques for Productivity Enhancement:

- Availability of Quality Planting Material to the stakeholders and quality standards of planting stock for degraded sites needs to be ensured.
- To exploit the true potential of the tree genetic resources, awareness of the tree growers to retain trees for a minimum production cycle need to be developed.
- Domestic forest certification mechanism needs to be developed.
- Promoting use of short rotation crops to encourage farmers in tree planting activities with definite financial incentives.
- Promoting mosaic clone cultivation to maintain the genetic base and ensuring profitability for the grower's community and other stakeholders.

- At least one Hi-tech nursery at a Forest Range level needs to be established.

Forest Landscape Restoration Techniques for Improving Forest Quality and Productivity:

- Use of pioneer tree species in restoring degraded lands, stabilizing disturbed ecosystems and ensuring better survival of climax species.
- Adoption of Integrated Farming System (IFS) including agroforestry practices in Forest Landscape Restoration approaches.
- Adopting innovative techniques like Restoration Opportunity Assessment Methodology (ROAM) to achieve Forest Landscape Restoration with a flexible and affordable framework to rapidly analyze degraded areas.
- Regional collaboration amongst collaborating government and other partners, for restoring mountain landscapes.
- Promotion of local species with proper soil and moisture conservation practices, and method of planting for restoring degraded lands.
- "Community Water Stewardship" on water use planning need to be inbuilt in land restoration projects.

Enhancing Carbon Sequestration Potential and Assessment of Forest Carbon Stocks:

- Expanding use of geospatial techniques in mapping and monitoring biophysical parameters for forest and plantation management and accurate carbon stock assessment.
- Promote REDD+ activities and financial incentives in community-based forest management for the enhancement of carbon sequestration.
- Promoting climate change mitigation and adaptation practices in the AFOLU sector.
- Strengthening of the national forest monitoring system, implementation of REDD+ strategy, participation in the voluntary carbon market.
- Accessing finance from Green Climate Fund for forest sector climate change mitigation and adaptation projects and leveraging domestic financing through green bonds.
- Forest and tree plantation programmes to be more remunerative with definite market for ecological services including mitigation/ adaptation to climate change and the market aligned with Article 6 of the Paris Agreement.
- Plantation owners should have long-term management plan certified by accredited agencies.
- Indo Flux network needs to be developed by bringing together all the institutions involved in eddy covariance-based carbon flux studies of forests in the country. Scientists/ researchers can use flux data to better understand forest ecosystem functioning, and to detect trends in climate and carbon sequestration.
- Government of India need to promote its own forest carbon market to incentivize small and marginal farmers. Carbon credits generated through these projects should be named differently for the credits generated from public and private lands.
- Government of India should include bamboos and palms in the forest definition for the purpose of market mechanism under Article 6.4 of Paris Agreement and same need to be communicated to UNFCCC. ICFRE can send an *aide-memoire* to the MoEFCC on this issue.
- Transboundary ecosystems in the South East Asia region need to be protected.

Sustainable Land and Ecosystem Management (SLEM) Knowledge Sharing and Dissemination:

- Broad agri-food system-oriented approaches by integration, optimization, diversification and innovations to be included in action plans for sustainable land management.
- Integrating various technical, social and institutional approaches for landscapes restoration including traditional water harvesting structures and small land irrigation systems like "*Naulas*", for enhancing contribution in building climate resilient watershed.
- Innovative approaches in PME (Participatory Monitoring and Evaluation) with financial autonomy in *Gram Panchayat* and Women *Aam Sabha* to ensure regular flow of funds by way of income generation.
- Capacity building of the stakeholders and sharing of knowledge on SLEM best practices of local communities in sustained use of natural resources and better management of forest and land resources.
- Scaling up and adopting SLEM best practices (vermicomposting, application of biofertilizers and biopesticides for integrated farm development for sustainable land productivity, Wadi system- A tree-based farming system, lac cultivation for livelihood generation and biodiversity conservation, rain water harvesting and augmentation of water resources, system of rice intensification, and Azolla cultivation) need to be promoted for sustainable land productivity.
- Entrepreneurship interventions in agribusiness growth centres should be channelized for livelihood growth.
- Implementation of recommendations of Roadmap developed for institutional and policy mainstreaming of sustainable land and ecosystem management in India to combat land degradation and desertification.
- Documentation and dissemination of standard methodologies for the assessment of various ecosystem services among the various stockholders.
- Promotion of practices like use of nets for collection of Mahua flowers in Madhya Pradesh need to be scaled up in other parts of the country for prevention of forest fire.

5.2.3.5. Brainstorming workshop on 'Strengthening of Forestry Extension System in India'

The brainstorming workshop on 'Strengthening of Forestry Extension System in India' was organised on 14 July 2023 at ICFRE, Dehradun under ESIP with a motive to share forestry extension experiences of ICFRE, Indian Council of Agricultural Research (ICAR), State Forest Departments and to get the views and ideas of experts for identification of suitable strategies and actions for strengthening of forestry extension system in India. A total number of 94 participants from Ministry of Environment, Forest and Climate Change (MoEFCC), the World Bank, ICFRE, ICAR, State Forest Departments, Science and Technology Organisations, Academic and Training Institutions, Krishi Vigyan Kendras, NGOs, Forest-based Enterprises/ Cooperatives, Wood-based Industries, Mining Companies, Tree Growers and Farmers participated in the workshop. Proceedings of the workshop was published and submitted to the Ministry of Environment, Forest and Climate Change, Ministry of Agriculture and Farmers Welfare, Ministry of Rural Development, NITI Aayog, State Governments and Research and Development organisations for further actions in implementation of the recommendations of the workshop. Proceedings of the workshop was also shared with participants of the workshop.

Following recommendations were made during the workshop (ICFRE, 2023 f):

Issues and Challenges for Strengthening of Forestry Extension	Strategies for Strengthening of Forestry Extension	Actions for Strengthening of Forestry Extension
1). Strengthening of infrastructure, manpower and lack of capacity building of the staff for forestry extension of SFDs and ICFRE Institutes		
• Lack of focused vision and strategy for forestry extension	• Development of focused vision and strategy for forestry extension	• Preparation of Forestry Extension Action plan(s) for stakeholders for implementation of Forestry Extension Strategy

• Policy for transfer of technologies/ practices in the field of forestry • Insufficient infrastructure for forestry extension activities • Non-availability of land for research and for technology demonstrations (forestry extension) with research institutions • Lack of extension specialists and social scientists in ICFRE • Man-power constraints in ICFRE and SFDs • Lack of trained and motivated extension personnel in ICFRE and SFDs • Lack of regular capacity building programmes for the frontline staff of SFDs	• Policy Guidelines to be in place for transfer of technologies/ package of practices • Development of infrastructure (modern nurseries, demonstration plots, testing laboratories etc.) • Strengthening of Van Vigyan Kendras • Provision for providing lands for forestry extension to the research institutions by SFDs • Engagement of extension experts/ professionals and social science expert and staff • Strengthening of Extension Division/ Wings of SFDs and research institutions • Organisation of capacity building programme for the extension staff of ICFRE and frontline staff of SFDs • Building of institutional support for forestry extension programmes	• Implementation of Forestry Extension Action Plan(s) • Actions for transfer of technologies/ practices in the field of forestry as per the Policy Guidelines • Application of proper communication platforms for transfer of technologies/ package of practices • Setting up of Technology Incubation Centres with appropriate funding at research institutions • Establishment/ strengthening of modern nurseries and demo plots at ICFRE institutes and State Forest Departments (SFDs) • Implementation of recommendations of the study on Strengthening of Van Vigyan Kendras • Allotment of lands to the research institutions for the purpose of forestry extension activities • Recruitment of experts/ professionals and social science scientists in ICFRE • Regular recruitment of vacant positions in the SFDs and ICFRE • Conducting training need assessment exercises • Develop training modules for strengthening the capacity of extension staff in research institutions and SFDs • Develop online training modules in you-tube channel for forestry extension • Organisation of trainings/ capacity building programmes for staff of the Extension Wings of SFDs and ICFRE • Execution of formal courses/ specialization of forestry extension in forestry universities
2). Awareness generation, communication & knowledge sharing and networking for forestry extension		
• Poor community participation in the forestry programmes • Limited awareness in SFDs and local communities about new and innovative technologies and practices in forestry	• Motivating stakeholders for taking up new technologies, package of practices and best practices in forestry • Awareness generation and developing effective mechanism for knowledge sharing	• Documentation of success stories, package of practices and best practices (in multilingual formats) in the field of forestry for sharing with stakeholders • Exposure visits of nurseries producing QPM including collection of seeds

• Lack of effective communication and coordination mechanism between SFDs, research institutions, academic institutions, training institutions and industries for sharing of knowledge	• Application of Information and Communications Technology (ICT) as modern extension tool • Documentation and dissemination of extension best practices and sharing • Two-way communication (Lab to land and vice versa) for strengthening forestry extension • Development of roadmap for networking of research, academic and training institutions for knowledge sharing and transfer of technologies • Mechanism for sharing of ICAR extension infrastructure facilities for forestry extension • Networking of Van Vigyan Kendras and Krishi Vigyan Kendras	• Knowledge sharing in public domain through social media platform (ICT extension platforms) • Publication and printing of extension material in simple vernacular languages • Publication of findings of forestry research project in open access journals • Participation of research institutions in business expos, trade fairs etc. • Organization of regular Silviculture Conference • Organisation of Annual Forestry Extension Conference • Organization of regular stakeholders meet to discuss the forestry research and extension needs and sharing of research findings • Effective implementation of MoU for utilization of ICAR extension facilities including networking of KVKs and VVKs for forestry extension by ICFRE and SFDs. • Periodical monitoring and reviews (indicator based) of the extension activities
3). Funding mechanism for forestry extension		
• Lack of sufficient fund for forestry extension and capacity building	• Provision of sufficient regular funding for forestry extension activities and capacity building programmes • Provision of compulsory extension component with sufficient funds in a research project for implementation of the extension activities	• Annual activities calendar to be framed for dissemination of technologies and capacity building programmes • Execution of the extension activities of the research project as per the work plan
4). Policy and regulatory issues for promotion of tree outside forests for forestry extension		
• Complex felling and transit regulations for tree species growing on non-forest areas and private lands • Lack of policy on certification of forest produces	• Stakeholders awareness generation about the latest rules and guidelines for felling and transit of forest produce to promote forestry activities outside the forest areas. • Development of certification mechanism/ policy for planting materials and forest products	• Submission to the Government for liberalizing felling and transit regime for tree species grown in non-forest and private lands • Protocols and standards for certification of forest products, forest seeds and planting stocks

5). Production of quality planting materials and certification of forest products for forestry extension		
• Non-availability of quality planting materials (QPMs) of forestry species • Lack of certification of forest nurseries, forest produces and wood products	• Development of QPMs of forestry species • Development of standards for accreditation of forest nurseries for production of QPMs of forestry species • Certification of planting materials, forest produces and wood products	• Standard operating procedures and standards for production of QPM of forestry species • Development of minimum seed standards for forestry species • Development of domestic certification system and facility
6). Marketing mechanism of forest products for forestry extension		
• Lack of proper markets and value chain for NTFPs • Lack of value addition and proper packaging of the forest products • No provision for Minimum Support Price (MSP) for NTFPs and other forest products	• Policy guidelines for marketing of NTFPs • Policy guidelines for introduction of MSP for NTFPs and other forest products	• Development of value addition for NTFPs, and forward and backward market linkages for NTFPs and other forest products in line with Pradhan Mantri Van Dhan Yojana • Online platform for marketing NTFPs and other forest products

5.2.3.6. Knowledge Dissemination

Knowledge products in the form of reports, books, brochures, proceedings and flyers were developed and disseminated to the stakeholders through ICFRE website and SLEM Knowledge Sharing and Reporting System:

1. Baseline report of forest carbon stocks of ESIP areas of Madhya Pradesh
2. Baseline report of forest carbon stocks of ESIP areas of Chhattisgarh
3. Baseline Report of Socio-economic status of ESIP areas of Chhattisgarh
4. Baseline Report of Socio-economic status of ESIP areas of Madhya Pradesh
5. Resource manual on Measurement of Forest Carbon Stocks for the capacity building of SFDs (in Hindi)
6. Resource manual on Measurement of Forest Carbon Stocks for the capacity building of SFDs (in English)
7. Ecosystem Services Improvement Project Sustainable Land and Ecosystem Management: Communication Strategy
8. National Database: SLEM Practitioners for the Development of Institutional and Individual Networks
9. Evaluation of the Working/ Effectiveness of Forestry Extension System through the Van Vigyan Kendras and Recommendations for its Strengthening
10. Roadmap for Institutional and Policy Mainstreaming of Sustainable Land and Ecosystem Management in India: Summary for Policy Makers
11. Roadmap for Institutional and Policy Mainstreaming of Sustainable Land and Ecosystem Management in India
12. Measurement of Carbon Fluxes in the Tropical Dry Deciduous Forests of

Chhattisgarh and Madhya Pradesh under Ecosystem Services Improvement Project

13. Ecosystem Services Improvement Project: Assessment of Forest Carbon Stocks of Project Areas of Madhya Pradesh and Chhattisgarh
14. Draft on Establishment of Domestic Forest Carbon Market in India
15. Proceedings of National Workshop on Agroforestry and Farm Forestry for Sustainable Land and Ecosystem Management
16. Brochure on International workshop on Enhancing Ecosystem Services by Improving Forest Quality and Productivity, and SLEM Knowledge Dissemination
17. Proceedings of International workshop on Enhancing Ecosystem Services by Improving Forest Quality and Productivity, and SLEM Knowledge Dissemination
18. Proceedings of Brainstorming Workshop on Strengthening of Forestry Extension System in India
19. Sustainable Land and Ecosystem Management in India
20. Brochure on Forest Carbon Stocks Measurement for Joint Forest Management Committees (in Hindi)
21. Ecosystem Services Improvement Project
22. Wadi system – A tree-based farming system: A SLEM Best Practice

    वाडी पद्धति वृक्ष आधारित खेती की व्यवस्थाः सतत् भूमि एवं पारितंत्र प्रबंधन की सर्वोत्तम प्रणाली
23. System of rice intensification: A SLEM Best Practice

    धान सघनीकरण की श्री पद्धति : सतत् भूमि एवं पारितंत्र प्रबंधन की सर्वोत्तम प्रणाली
24. Integrated farm development for sustainable land productivity: A SLEM Best Practice

    सतत् भूमि उतपादकता हेतु एकीकृत कृषि विकास : सतत् भूमि एवं पारितंत्र की सर्वोत्तम प्रणाली
25. Eco-restoration and institution strengthening: A SLEM Best Practice

    संस्थागत सुदृढ़ता पारि–पुनरूद्धार (ईको रिस्टोरेशन): सतत् भूमि एवं पारितंत्र प्रबंधन की सर्वोत्तम प्रणाली
26. Lac cultivation for livelihood generation and biodiversity conservation: A SLEM Best Practice

    जैवविविधता संरक्षण एवं जीविकोपार्जन हेतु लाख की खेती : सतत् भूमि एवं पारितंत्र प्रबंधन की सर्वोत्तम प्रणाली
27. Aonla based agro-forestry: A SLEM Best Practice

    एकीकृत उत्पादन प्रणाली के माध्यम से जीविका विविधीकरणः आंवला आधारित कृषि–वानिकीः सतत् भूमि एवं पारितंत्र प्रबंधन की सर्वोत्तम प्रणाली
28. Climate proofing fish farming: A SLEM Best Practice

    जलवायु रोधी मत्स्य पालनः सतत् भूमि एवं पारितंत्र प्रबंधन की सर्वोत्तम प्रणाली
29. Chauka system- A water conservation practice: A SLEM Best Practice 'चौकापद्धति' –सामुदायिक संसाधनों के प्रबंधन के लिए की जाने वाली जल संग्रहण आधारित पद्धतिः सतत् भूमि एवं पारितंत्र विकास की सर्वोत्तम प्रणाली
30. Rehabilitation of degraded bamboo forests: A SLEM Best Practice

    बांस के क्षरित वनों का पुनरद्वार एवं बांस से अगरबत्ती निर्माणः सतत् भूमि एवं पारितंत्र प्रबंधन की सर्वोत्तम प्रणाली
31. Rain water harvesting and augmentation of water resources: A SLEM Best Practice

    वर्षा जल संचयन से जल संसाधनों के संवर्धनः सतत् भूमि एवं पारितंत्र प्रबंधन की सर्वोत्तम प्रणाली
32. वनो की गुणवत्ता सुधार, उत्पादकता वृद्धि एवं वनाधरित समुदाओ की आजिविका सुधार हेतु पारितन्त्र सेवाएं सुधार परियोजना

33. केंचुआ खाद – पोषक तत्वों से भरपूर जैविक उर्वरक : सतत् भूमि प्रबंधन की सर्वोत्तम प्रणाली
34. अमृत पानी – खेती के लिए अमृत : सतत् भूमि प्रबंधन की सर्वोत्तम प्रणाली
35. बीजामृत – स्वस्थ बीज उत्तम फसल : सतत् भूमि प्रबंधन की सर्वोत्तम प्रणाली
36. ब्रह्मास्त्र – खेती की कीड़ों व रोगों से पूर्ण सुरक्षा : सतत् भूमि प्रबंधन की सर्वोत्तम प्रणाली
37. दसपर्णी अर्क – फसल का रक्षक : सतत् भूमि प्रबंधन की सर्वोत्तम प्रणाली
38. जीवामृत – पौधों की स्वास्थयवर्धक औषधि : सतत् भूमि प्रबंधन की सर्वोत्तम प्रणाली
39. नीमास्त्र – खेती का रक्षा कवच : सतत् भूमि प्रबंधन की सर्वोत्तम प्रणाली
40. वर्षा जल संचयन – भू–मरुस्थलीकरण रोकने का अचूक उपाय : सतत् भूमि प्रबंधन की सर्वोत्तम प्रणाली
41. लाख की खेती – लाखों की आमदनी का श्रोत : सतत् भूमि प्रबंधन की सर्वोत्तम प्रणाली
42. नाडेप खाद – व्यर्थ को देती अर्थ : सतत् भूमि प्रबंधन की सर्वोत्तम प्रणाली
43. Environmental and Social Safeguards for ESIP

In addition to the above-mentioned knowledge products, following documentaries were also prepared under the project and disseminated through YouTube channel of ICFRE:

1. Ecosystem Services Improvement Project
2. Scaling up of SLEM Best Practice on Lac Cultivation for Livelihood Generation and Biodiversity Conservation
3. Scaling up of Biopesticides and Biofertilizers Preparation for Sustainable Land Productivity
4. Measurement and Monitoring of Forest Carbon Stocks and Capacity Building
5. Scaling up of Improved Cook Stoves for Sustainable Land and Ecosystem Management
6. Scaling up of SLEM Practice on Rain Water Harvesting and Augmentation of Water Resources for Sustainable Land and Ecosystem Management
7. Scaling up of SLEM Practice on Vermicomposting for Sustainable Land Productivity

Knowledge products were also shared with the participants of trainings, workshops and seminars organised by ICFRE under ESIP and other projects. Project outcomes were also presented at national and international forums through participation in the national and international workshops and seminars.

5.3. Component 4: Project Management

A Project Implementing Unit (PIU) was established under Directorate of International Cooperation, ICFRE for coordination and implementation of project activities and a Field Unit was also established at ICFRE-TFRI, Jabalpur (MP) for implementation of field activities in the states of Madhya Pradesh and Chhattisgarh under the project.

ICFRE on behalf of the Directorate of Green India Mission (GIM), Ministry of Environment, Forest and Climate Change, Government of India hired M/s Insight Development Consulting Group, New Delhi to conduct an independent evaluation of the overall impacts of the project activities in accordance with the project objectives and indicators set out in its Results Framework. The evaluation was also focused on assessing the impacts of the project's physical interventions on the local ecology of a specific landscape, as well as the socio-economic benefits generated in terms of skill development/enhancement and livelihood enhancement for the beneficiary communities. Key findings of the independent

evaluation of the overall impacts of the project activities is summarised as under:

- In terms of project accomplishment, the ESIP project has been successful in achieving its development objectives by providing direct and indirect benefits to the targeted forest dependent and adjacent communities. The project interventions have led to significant increase in adaptation and resilience to climate change among the indigenous population of the project states. The key interventions and impacts of the project interventions have been presented below across five broad thematic areas of the project:

S. No.	Theme	Interventions	Impact
1	Sustainable Land and Ecosystem Management	• 25,000 ha of area managed under Sustainable Land Management (SLEM) Practices	• Farm yield and soil fertility enhanced in the project area. • Increase in agriculture income of Indigenous people after adopting SLEM best practices
2	Beneficiary Outreach, Engagement and Economic Benefits	• Strengthened the capacity of the local/ community Institutions. • Skill development of indigenous people by SFD. • Developed community-based models for sustainable utilization of NTFP.	• Significant shift in the perception of communities recognizing the importance of forest conservation and management. • Value addition led to an increase in the income of Indigenous NTFP collectors.
3	Improved Forest Quality and Carbon Stock	• 7,387 ha of the area restored through various activities such as plantation, soil moisture conservation works etc. contributing to the enhancement and restoration of carbon stock in forested areas.	• Improvement in forest productivity has enhanced ecosystem services.
4	Improved Landscapes and Biodiversity Monitoring and Management	• 50,538 ha landscape area restored by treatment of 10,000 ha with project support (ha)	• The States successfully expanded the implementation of a landscape approach to a larger area
5	Strengthened Government Capacity in forestry and land management programs	• Capacity building programmes organized for front-line staff and officers of SFDs by ICFRE • MP SFD developed GIS-based monitoring system. • Strengthened national capacity for land degradation and desertification monitoring. • Developed a National Knowledge Network (SLEM Knowledge Sharing and Reporting System, https://nrdp.icfre.gov.in/)	• Adoption of scientific approaches for enhancing forest quality

- In addition, through scaling-up sustainable land and ecosystem management in selected landscapes of the project helps to increase the national capacity for monitoring the status of land degradation and desertification and SLEM outcomes, thereby contributing to the commitments made under UNCCD and UNFCCC.
- Overall, the interventions undertaken under the ESIP project:
    a. was successful in achieving its objectives by adopting a participatory approach with the involvement of local communities and other stakeholders. The project has demonstrated that sustainable forest management can be achieved through a bottom-up approach and by empowering local communities to participate in forest management activities.
    b. use of nature-based approach such as integrated farming systems helped in building climate resilience in the target states by mitigating the human-induced factors of land degradation and desertification, and contribute to India's commitment of reaching net-zero emissions by 2070.
    c. supported development of community-based models for sustainable utilization of Non-Timber Forest Products that has provided a sustainable source of income and nutrition for the vulnerable communities in the target states. This indicates that the knowledge repository and sustainable harvesting protocols developed under the project have been effectively utilized by the State Forest Department and have contributed to sustainable forest management practices in the region.
    d. successfully achieved its objective of increasing the income of the forest dwelling and adjacent communities and improving the overall forest quality and ecosystems services. The project has also brought positive changes in the livelihood patterns and has provided various non-monetary benefits to the target communities.
    e. demonstrated the potential to bring comprehensive economic development, efficient management of natural resources, and financial security for rural and forest dwelling communities.
    f. project's interventions have shown significant results in reducing the consumption of fuelwood and reducing the incidence of forest fires thus ultimately contribute in reduction of Greenhouse gases emissions.
    g. helped to strengthen the capacity and skills of government institutions and local communities in forestry and land management programs. Provided technical assistance to enhance the institutional capacity of the State Forest Departments, Forest Development Agencies, and local communities, thereby contributing towards the achievement of the project's objectives. These interventions are expected to have a positive impact on sustainable forest management and the delivery of sustainable benefits to local communities that depend on these resources.
- Thus, learning from ESIP should be shared with other government departments, non-government institutions, and academia so that these best practices can be scaled up in other similar projects or interventions in the country. A majority of interventions implemented under ESIP are relevant for other parts of the country as well.

CHAPTER – 06

PERFORMANCE AND IMPACT OF THE ESIP: RESULTS FRAMEWORK INDICATORS

Performance and impact of the project components implemented by ICFRE under ESIP were measured through four key result indicators at project development objective level and complemented by an additional five intermediate outcome indicators as tabulated below:

PDO Level Results Indicators	Target	Achievements	Remarks
2. Land area under sustainable land management practices (Core Indicator)	25000 ha	25316 ha	25316 ha area coverage brought under SLEM through ESIP interventions and 2417.42 ha area brought under SLEM through interventions of other schemes of the Govt.
3. Average cumulative carbon sequestered per hectare in areas supported by the project	10% increment over the baseline	9.38%	11.25% in MP & 7.51% in CG
4. Targeted beneficiary groups engaged in participatory planning under the project	500	500	Members of the Gram Panchayats, JFMCs, SHGs, Women, Farmers and youths were engaged in participatory planning and preparation of village wise SLEM plans for the project areas of MP and CG
5. Direct project beneficiaries, of which female (50%)	25000	66402 (50% Female)	17472 beneficiaries in the project areas of MP and 48930 beneficiaries in the project areas of CG
Intermediate Results	**Target**	**Reported**	**Remarks**
Component 1: Strengthen capacity of government institutions in forestry and land management programs			
1.2: Participating states with carbon stock measurement and monitoring system supported by the project operational	02	02	SFDs of MP and CG
1.3: Government institutions provided with capacity building support to improve management of forest resources	08	21	ICFRE Hqs. and its institutes, SFDs of MP and CG, Forest Survey of India, Indira Gandhi Krishi Vishwavidyalaya, Raipur and Sant Gahira Guru Vishwavidyalaya, Sarguja, Ambikapur, NRSC, IIRS, GBPNIHE, IIT Madras, NIH Roorkee, Uttarakhand Watershed Management Directorate

Component 3: Scaling-up sustainable land and ecosystem management in selected landscapes			
3.1: Government agencies using the online land degradation and desertification indicator portal for reporting	05	05	Department of Science and Technology, Department of Economic Affairs, Tripura Forest Dept., Department of Forest and Wildlife Delhi, Directorate of Soil Conservation, Assam Agriculture Department
3.2: SLEM best practices disseminated on ICFRE knowledge platform	10	12	Integrated farm development for sustainable land productivity, System of rice intensification, Eco-restoration and institution strengthening, Lac cultivation for livelihood generation and biodiversity conservation, Wadi system, Aonla based agro-forestry, Climate proofing fish farming, Chauka system - a water conservation practice, Rehabilitation of degraded bamboo forests, Rain water harvesting and augmentation of water resources, Vermicomposting for productivity enhancement, Biopesticides and biofertilizers for productivity enhancement
3.3: Land users adopting sustainable land management practices as a result of the project	5000	22134	5824 land users in MP and 16310 land users in CG

CHAPTER – 07

SAFEGUARDS

Environmental and Social Management Framework document of the ESIP includes the measure to avoid, minimize or mitigate any adverse environmental and social impacts emanating from the implementation of project activities. Following mitigation actions were undertaken for addressing and respecting the environmental and social safeguards while implementing the activities for scaling up of SLEM practices in the project areas of Madhya Pradesh and Chhattisgarh:

S.No.	Potential risk/impact	Mitigation actions taken
Environmental		
1.	Use of exotic and non-native species for plantation/ restoration of forests and CPR – impacts on biodiversity of indigenous species	• Provided only improved varieties of indigenous and native horticultural plant species with multipurpose benefits for scaling up of SLEM best practice on WADI system. • Provided only improved varieties of vegetable seeds of Kharif and Rabi crops for crop diversification. • Provided naturalized species of earthworm commonly used in India for vermicomposting. • Provided indigenous species of brood lac insect for scaling up of lac cultivation.
2.	Use of agro-chemicals against pests and weeds – impacts on ground water, surface water and soil	• Promoted preparation and application of bio-pesticides for scaling up of integrated farm development
3.	Impact of rain water harvesting structures on local ecology and biodiversity and threat to the life and property	• Only old ponds were deepened and no new ponds were excavated. • Ponds were selected for deepening as per the consent of the local communities of the project areas • Excavated silt and soil were properly dumped and levelled in the sites marked by the local communities • Warning signage with proper messages were placed at the rain water harvesting sites • A safe disposal of excavated soil material during pond deepening works was ensured in ESIP villages of CG and MP. All the deepening works were done when ponds were dry to avoid any adverse impact on water resources and biodiversity. Due care was taken that there was no active channel or stream flowing through the dumping sites. In addition, a levelling and compaction of muck piles were done in a proper way. • Waste weirs also created to avoid soil erosion due to excess water

	Social	
4.	Low participation of vulnerable and backward classes (SC/ST/OBC) and women	• Village wise SLEM plans for scaling up of SLEM practices were prepared in consultation with local communities of the project areas • Focus group discussions were also organized in the project areas for ensuring participation of all the classes and women • Twenty six awareness programmes were also organised in the project areas for ensuring participation of all the classes of the society and women • One complete session on environmental and social safeguards of SLEM activities was organised in 65 trainings on scaling up of SLEM best practices for local communities of the project areas and 21 trainings on measurement of forest carbon stocks for JFMCs of the project areas • Distributed pamphlets on environmental and social safeguards to the local communities for generation awareness. • Overall participation of the female in the 223 trainings on scaling up of SLEM best practices was about 50%. • Overall representation of gender in scaling up of SLEM practices comprised of 73% female and 27% male (Figure 19). • Overall representation of vulnerable and backward classes (SC/ST/OBC) in scaling up of SLEM practices comprised of 98% (69% ST, 8% SC and 21% OBC) (Figure 20).

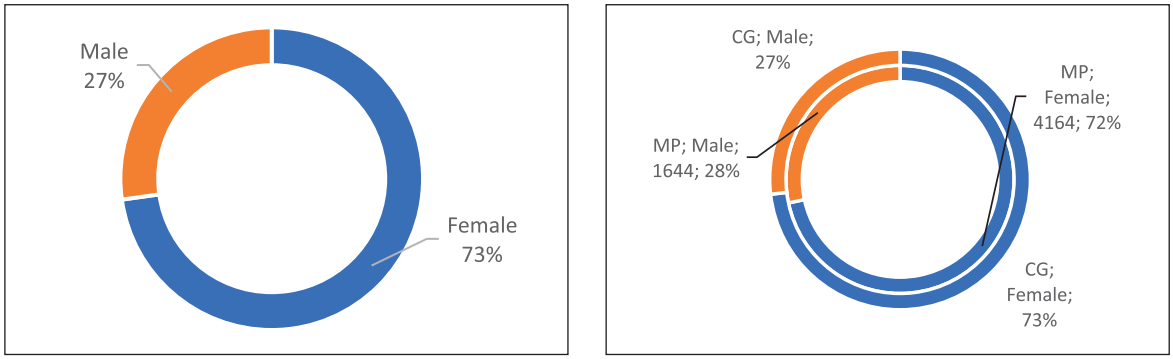


Figure 19: Gender wise representation in scaling up of SLEM best practices in the project areas of MP and CG

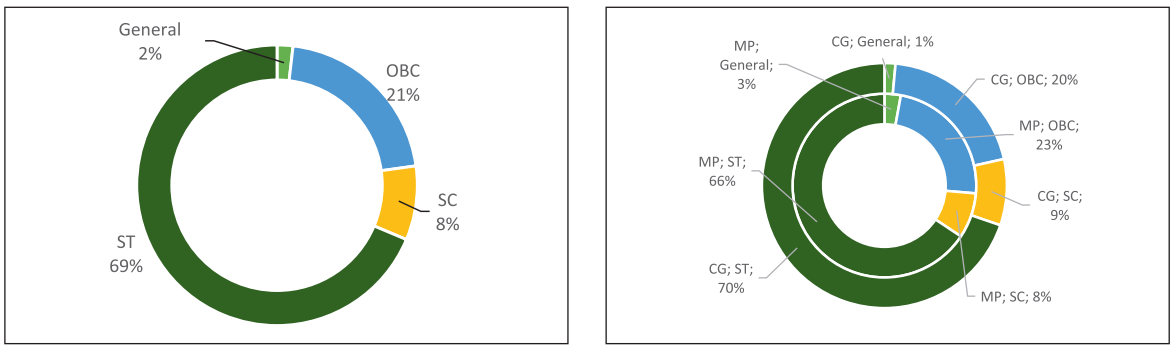


Figure 20: Category wise representation in scaling up of SLEM best practices in the project areas of MP and CG

CHAPTER – 08

UTILISATION OF FUNDS

S. No.	Project Components	Budget Allotted (in million USD)	Expenditure (in Rs.)
1	Strengthen Capacity of Government Institutions in Forestry and Land Management Programs	1.20	7,92,24,214.00
2	Scaling-up Sustainable Land and Ecosystem Management in Selected Landscapes	4.04	29,15,99,469.00
3	Project Management	*Year wise budget was approved for this component in Annual Plan of Operations by MoEFCC*	4,27,54,213.83
	Total	**5.24**	**41,35,77,896.83**

REFERENCES

Artigas, F., Shin, J. Y., Hobble, C., Marti-Donati, A., Schafer, K.V. and Pechmann, I. (2015). Long term carbon storage potential and CO_2 sink strength of a restored salt marsh in New Jersey. *Agric. For. Meteorol*., 200: 313–321.

Baldocchi, D. D., Hincks, B. B. and Meyers, T. P. (1988). Measuring biosphere-atmosphere exchanges of biologically related gases with micrometeorological methods. *Ecology*, 69(5):1331-1340.

Burba, G. (2013). Eddy covariance method for scientific, industrial, agricultural and regulatory applications: A field book on measuring ecosystem gas exchange and areal emission rates. LI-Cor Biosciences.

Falge, E., Baldocchi, D., Tenhunen, J., Aubinet, M., Bakwin, P., Berbigier, P., Bernhofer, C., Burba, G., Clement, R., Davis, K. J., Elbers, J.A., Goldstein, A.H., Grelle, A., Granier, A., Gu, J., Hollinger, D., Kowalski, A.S., Katul, G., Law, B.E., Malhi, Y., Meyers, T., Monson, R.K., Munger, J.W., Oechel, W., Tha, K., Paw, U., Pilegaard, K, Rannik, U., Rebmann, C., Suyker, A., Valentini, R., Wilson, K., Wofsy, S. (2002). Seasonality of ecosystem respiration and gross primary production as derived from FLUXNET measurements. *Agric For Meteorol,* 113:53–74.

Fei, X., Song, Q., Zhang, Y., Liu, Y., Sha, L., Yu. G., Zhang, L., Duan, C., Deng. Y., Wu, C., Lu, Z., Luo, K., Chen, A., Xu, K., Liu, W., Huang, H., Jin, Y., Zhou, R., Li, J., Lin, Y., Zhou, L., Fu, Y., Bai, X., Tang, X., Gao, J., Zhou, W. and Grace, J. (2018). Carbon exchanges and their responses to temperature and precipitation in forest ecosystems in Yunnan, Southwest China. *Sci Total Environ,* 616–617:824–840.

Foken, T. (2008). The energy balance closure problem: An overview. *Ecol. Appl.,* 18: 1351–1367.

FSI (1996). Volume Equations for Forests of India, Nepal and Bhutan. Forest Survey of India, Ministry of Environment and Forest, Dehradun.

FSI (2019). India State of Forest Report 2019. Forest Survey of India, Ministry of Environment, Forest and Climate Change, Dehradun.

FSI (2021). India State of Forest Report 2021. Forest Survey of India, Ministry of Environment, Forest and Climate Change, Dehradun.

FSI (nd). Carbon Stock in India's Forests. Forest Survey of India, Ministry of Environment and Forest Dehradun.

Holling, C. S. (2001). Understanding the complexity of economic, ecological, and social systems. *Ecosystems,* 4(5):390-405.

Hutyra, L. R., J. W. Munger, S. R. Saleska, E. Gottlieb, B. C. Daube, A. L. Dunn, D. F. Amaral, P. B. de Camargo, and S. C. Wofsy (2007). Seasonal controls on the exchange of carbon and water in an Amazonian rain forest. *J. Geophys. Res*., 112, G03008, doi:10.1029/2006JG000365.

ICFRE (2014 a). SLEM Baseline Report: Issues, Challenges and Prospects in Sustainable Land and Ecosystem Management. Indian Council of Forestry Research and Education, Dehradun.

ICFRE (2014 b). Sustainable Land and Ecosystem Management, Some Best Practices from India. Indian Council of Forestry Research and Education, Dehradun.

ICFRE (2020 a). Ecosystem Services Improvement Project: Baseline Report of Forest Carbon Stocks of Project Areas of Madhya Pradesh. Indian Council of Forestry Research and Education, Dehradun.

ICFRE (2020 b). Ecosystem Services Improvement Project: Baseline Report of Forest Carbon stock of Project Areas of Madhya Pradesh. Indian Council of Forestry Research and Education, Dehradun.

ICFRE (2020 c). Resource Manual: Measurement of Forest Carbon Stocks for Capacity Building of State Forest Departments. Indian Council of Forestry Research and Education, Dehradun.

ICFRE (2020 d). Ecosystem Services Improvement Project: Baseline Report of Socio-economic Status of Project Areas of Madhya Pradesh. Indian Council of Forestry Research and Education, Dehradun.

ICFRE (2020 e). Ecosystem Services Improvement Project: Baseline Report of Socio-economic Status of Project Areas of Madhya Pradesh. Indian Council of Forestry Research and Education, Dehradun.

ICFRE (2020 f). Ecosystem Services Improvement Project Sustainable Land and Ecosystem Management: Communication Strategy. Indian Council of Forestry Research and Education, Dehradun.

ICFRE (2021). National Database: SLEM Practitioners for the Development of Institutional and Individual Networks. Indian Council of Forestry Research and Education, Dehradun.

ICFRE (2022 a). Roadmap for Institutional and Policy Mainstreaming of Sustainable Land and Ecosystem Management in India: Summary for Policy Makers. Indian Council of Forestry Research and Education, Dehradun.

ICFRE (2022 b). Roadmap for Institutional and Policy Mainstreaming of Sustainable Land and Ecosystem Management in India. Indian Council of Forestry Research and Education, Dehradun.

ICFRE (2022 c). Evaluation of the Working/ Effectiveness of Forestry Extension System through the Van Vigyan Kendras and Recommendations for its Strengthening. Indian Council of Forestry Research and Education, Dehradun.

ICFRE (2023 a). Ecosystem Services Improvement Project: Assessment of Forest Carbon Stocks of Project Areas of Madhya Pradesh and Chhattisgarh. Indian Council of Forestry Research and Education, Dehradun.

ICFRE (2023 b). Measurement of Carbon Fluxes in the Tropical Dry Deciduous Forests of Chhattisgarh and Madhya Pradesh under Ecosystem Services Improvement Project. Indian Council of Forestry Research and Education, Dehradun.

ICFRE (2023 c). Draft on Establishment of Domestic Forest Carbon Market in India. Indian Council of Forestry Research and Education, Dehradun.

ICFRE (2023 d). Proceedings of National Workshop on Agroforestry and Farm Forestry for Sustainable Land and Ecosystem Management. Indian Council of Forestry Research and Education, Dehradun.

ICFRE (2023 e). Proceedings of International workshop on Enhancing Ecosystem Services by Improving Forest Quality and Productivity, and SLEM Knowledge Dissemination. Indian Council of Forestry Research and Education, Dehradun.

ICFRE (2023 f). Proceedings of Brainstorming Workshop on Strengthening of Forestry Extension System in India. Indian Council of Forestry Research and Education, Dehradun.

IPCC (2003). Good Practice Guidance for Land Use, Land-Use Change and Forestry. Penman, J., Gytarsky, M., Hiraishi, T., Krug, T., Kruger, D., Pipatti, R., Buendia, L., Miwa, K., Ngara, T., Tanabe, K. and Wagner, F., Eds., Institute for Global Environmental Strategies (IGES), Kanagawa, Japan.

IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). Institute for Global Environmental Strategies (IGES), Kanagawa, Japan.

IPCC (2019). Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems [P.R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.-O. Pörtner, D. C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, 896 pp. https://doi.org/10.1017/9781009157988.

Kaimal, J. C., Izumi, Y., Wyngaard, J. C. and Cote, R. (1972). Spectral characteristics of surface-layer turbulence, *Q. J. R. Meteorol. Soc*., 98(417): 563 – 589.

Loescher, H. W., Law, B. E., Mahrt. L., Hollinger, D. Y., Campbell, J. and Wofsy, S. C. (2006). Uncertainties in, and interpretation of, carbon flux estimates using the Eddy Covariance technique. *Journal of Geophysical Research*, 111, D21.

M.J. Sanz, J. de Vente, J.-L. Chotte, M. Bernoux, G. Kust, I. Ruiz, M. Almagro, J.-A. Alloza, R. Vallejo, V. Castillo, A. Hebel, and M. Akhtar-Schuster. 2017. Sustainable Land Management contribution to successful land-based climate change adaptation and mitigation. A Report of the Science-Policy Interface. United Nations Convention to Combat Desertification (UNCCD), Bonn, Germany.

McGloin, R., Sigut, L., Havrankova, K., Dusek, J., Pavelka, M., Sedlak, P. (2018). Energy balance closure at a variety of ecosystems in Central Europe with contrasting topographies. *Agric. For. Meteorol.,* 248: 418–431.

McMillen, R. T. (1988). An eddy-correlation technique with extended applicability to non-simple terrain, *Boundary Layer Meteorol*., 43(3), 231 – 245.

Migliavacca, M., Reichstein, M., Richardson, A. D., Mahecha, M. D., Cremonese, E., Delpierre, N., Galvagno, M., Law, B., E., Wohlfahrt, G., Andrew Black, T. and Carvalhais, N. (2015). Influence of physiological phenology on the seasonal pattern of ecosystem respiration in deciduous forests. *Glob. Chang. Biol*., 21(1):363–376.

MoEF (2012). India: Second National Communication to the United Nations Framework Convention on Climate Change. Ministry of Environment and Forest, Government of India.

MoEFCC (2014). National Working Plan Code-2014 (for Sustainable Management of Forests). Published by Forest Research Institute, Dehradun, on behalf of Ministry of Environment, Forest and Climate Change, Government of India.

MoEFCC. (2021). India: Third Biennial Update Report to the United Nations Framework Convention on Climate Change. Ministry of Environment, Forest and Climate Change, Government of India.

Moncrieff, J. B., Massheder, J. M., De Bruin H, Elbers, J., Friborg, T., Heusinkveld, B., Kabat, P., Scott, S., Søgaard, H. and Verhoef, A. (1997). A system to measure surface fluxes of momentum, sensible heat, water vapour and carbon dioxide. *J. Hydrol.,* 188:589–611.

Moncrieff, J. B., Clement, R., Finnigan, J. and Meyers, T. (2004). Averaging, detrending, and filtering of eddy covariance time series. *In: Handbook of Micrometeorology*, Springer, Dordrecht, pp.: 7–31.

Orr, B.J., A.L. Cowie, V.M. Castillo Sanchez, P. Chasek, N.D. Crossman, A. Erlewein, G. Louwagie, M. Maron, G.I. Metternicht, S. Minelli, A.E. Tengberg, S. Walter, and S. Welton (2017). Scientific Conceptual Framework for Land Degradation Neutrality. A Report of the Science-Policy Interface. United Nations Convention to Combat Desertification (UNCCD), Bonn, Germany

Pearson, T.R., S.L. Brown and R.A. Birdsey. (2007). Measurement guidelines for the sequestration of forest carbon. General technical report, USDA forest service.

Rawat, R.S., Gautam, S., Verma, D. and Sharma, R. (2023). Sustainable Land and Ecosystem Management in India. Indian Council of Forestry Research and Education, Dehradun.

Rajput, S.S., Shukla, N.K., Gupta, V.K. and Jain, J.D. (1996). *Timber Mechanics: Strength, Classification and Grading of Timber*. Indian Council of Forestry Research and Education, Dehradun.

Ranganathan, J., Waite, R., Searchinger, T and Hanson, C. (2018). How to Sustainably Feed 10 Billion People by 2050, in 21 Charts. World Resources Institute (WRI), Washington, DC, USA.

Reichstein, M. and Beer, C. (2008). Soil respiration across scales: The importance of a model–data integration framework for data interpretation. *J. Plant. Nutr. Soil. Sci.,* 171(3):344–354.

SAC (2016). Desertification and Land Degradation Atlas of India (Based on IRS AWiFS data of 2011-13 and 2003-05), Space Applications Centre, ISRO, Ahmedabad, 219 pages.

SAC (2021). Desertification and Land Degradation Atlas of India (Assessment and analysis of changes over 15 years based on remote sensing). Space Applications Centre, ISRO. Ahmedabad, 282 pages.

Schwilch, G., Bachmann, F. And Liniger, H.P. (2009). Appraising and Selecting Conservation Measures to Mitigate Desertification and Land Degradation Based on Stakeholder Participation and Global Best Practices. Land Degradation & Development, 20: 308–326.

TERI (2019). Economics of Desertification, Land Degradation and Drought in India. The Energy Resource Institute, New Delhi.

Vickers, D. and Mahrt, L. (1997). Quality control and flux sampling problems for tower and aircraft data. *J. Atmos Ocean Technol.,*14:512–526.

Walkley, A. and Black, I.A. (1934) An examination of Degtjareff method for determining soil organic matter and a proposed modification of the chromic acid titration method. *Soil Science,* 37: 29-37.

Wang, H. M., Saigusa, N., Zu, Y. G., Wang, W. J., Yamamoto, S. and Kondo, H. (2008). Carbon fluxes and their response to environmental variables in a Dahurian larch forest ecosystem in northeast China. *J. For. Res.,* 19(1):1–10.

Webb, E. K., Pearman, G. I. and Leuning, R. (1980). Correction of flux measurements for density effects due to heat and water vapour transfer. *Q. J. R. Meteorol. Soc*., 106(447):85–100.

World Bank (2017). Ecosystem Services Improvement Project. Project Appraisal Document. The World Bank.

Zhang, L., Yu, G., Sun, X., Wen, X., Ren, C., Song, X., Liu, Y., Guan, D., Yan, J. and Zhang, Y. (2006). Seasonal variation of carbon exchange of typical forest ecosystems along the eastern forest transect in China. Sci China Ser D: *Earth Sci*., 49(2):47–62.

Annexure-1

Village wise details of beneficiaries (households) of SLEM best practices scaled up in the project areas of Madhya Pradesh

S. No.	Name of villages	House-hold Targeted	SLEM Best Practices												
			Rain water har-vesting	Lac culti-vation	Vermi composting for sustainable land productivity	Biopesticides and biofertilizers for sustainable land productivity	Crop diversification for sustainable land productivity		Micro Irrigation System for Enhancing Water Use Efficiency and Productivity		WADI-System	Azolla cultivation for integrated farm develop-ment	System of Rice Inten-sifica-tion	Improved Cook Stoves for addressing forest degradation
							Vegetable seeds (Rabi Crop)	Vegetable seeds (Kharif Crop)	Drip system	Sprin-kler system				
Bhaura Forest Range, North Betul Forest Division														
1	Handipani	145	0	-	65	145	132	125	23	22	125	55	-	138
2	Kachhar	343	10	-	201	343	330	171	47	37	171	170	-	333
3	Koyal Buddi	77	16	-	35	77	64	70	21	17	70	25	-	75
4	Kuppa	192	0	-	120	192	190	185	53	30	185	110	-	190
5	Tetar Mal & Ryt	113	12	-	52	113	98	108	32	20	108	55	-	98
6	Koyalari	124	0	-	73	124	106	89	38	18	89	50	-	109
7	Banabehda	248	19	-	150	248	234	201	60	38	201	110	-	228
8	Bhaura Dhana	41	-	-	-	-	-	-	-	08	-	40	-	-
Total		**1283**	**57**	**-**	**696**	**1242**	**1154**	**949**	**274**	**190**	**949**	**615**	**-**	**1171**
Banapura Forest Range, Hoshnagabad Forest Division														
1	Pipalgota	164	22	-	79	164	134	134	62	42	136	80	-	100
2	Nayagaon	105	12	-	60	105	88	88	45	30	88	50	-	67
3	Bhavanda	154	-	-	51	154	104	104	25	25	104	50	-	80
4	Ghoghara	84	-	-	39	84	70	70	35	26	70	50	-	60
5	Nanderwada	560	-	-	184	560	352	352	194	99	352	245	-	389
6	Sota Chikhali	223	-	-	73	223	137	137	41	29	137	100	-	132
7	Jondhal	124	-	-	60	124	98	98	35	30	98	65	-	72
8	Salai	105	-	-	22	105	81	81	21	14	60	45	-	65
9	Narri	184	-	-	95	184	126	126	36	41	109	85	-	110
10	Chandakhad	176	-	-	80	176	129	129	39	38	129	85	-	106
11	Gotabarri	125	-	-	50	125	114	114	26	29	68	50	-	70

S. No.	Name of villages	House-hold Targeted	SLEM Best Practices											
			Rain water har-vesting	Lac culti-vation	Vermi composting for sustainable land productivity	Biopesticides and biofertilizers for sustainable land productivity	Crop diversification for sustainable land productivity		Micro Irrigation System for Enhancing Water Use Efficiency and Productivity		WADI-System	Azolla cultivation for integrated farm develop-ment	System of Rice Inten-sifica-tion	Improved Cook Stoves for address-ing forest degrada-tion
							Vegetable seeds (Rabi Crop)	Vegetable seeds (Kharif Crop)	Drip system	Sprin-kler system				
12	Keolajhir	139	-	-	62	139	125	125	33	36	125	85	-	110
13	Banspani	61	20	-	12	61	44	44	21	11	44	10	-	35
15	Banapura	180	-	-	-	-	-	-	80	-	-	**167**	-	-
Total		**2384**	**54**	**-**	**867**	**2204**	**1602**	**1602**	**693**	**450**	**1520**	**1167**	**-**	**1396**
Itarsi Forest Range, Hoshnagabad Forest Division														
1	Khatama	125	0	-	68	125	99	122	70	60	122	50	-	121
2	Lalpani	83	11	-	48	83	63	68	45	35	68	30	-	64
3	Bhatna	53		-	30	53	40	43	35	17	43	10	-	46
4	Ranjjhi	78	0	-	40	78	44	68	35	17	68	10	-	50
Total		**339**	**11**	-	**186**	**339**	**246**	**301**	**185**	**129**	**301**	**100**	**-**	**281**
Sukhtawa Forest Range, Hoshnagabad Forest Division														
1	Khoda	209	-	-	99	209	147	206	45	50	206	70	-	173
2	Manataker-Khoda	20	-	-	-	-	-	-	-	-	-	20	-	-
3	Pipariya Khurd	255	17	-	150	255	204	213	100	97	213	110	-	233
4	Amrai- Pipariya Khurd	20	-	-	-	-	-	-	-	-	-	20	-	-
5	Baramahua-Pipariya Khurd	20	-	-	-	-	-	-	-	-	-	20	-	-
6	Saradeh	45	-	-	-	-	-	-	-	-	-	45	-	-
Total		**569**	**17**	-	**249**	**464**	**351**	**419**	**145**	**147**	**419**	**285**	**-**	406
Budhni Forest Range, Sehore Forest Division														
1	Hathlewa	93	-	-	56	93	76	76	36	29	76	26	-	71
2	Paraswada	124	-	-	57	124	111	111	16	39	104	5	-	100
3	Paharkhedi	116	-	-	95	116	108	108	43	45	108	36	-	128

S. No.	Name of villages	House-hold Targeted	SLEM Best Practices											
			Rain water har-vesting	Lac culti-vation	Vermi composting for sustainable land productivity	Biopesticides and biofertilizers for sustainable land productivity	Crop diversification for sustainable land productivity		Micro Irrigation System for Enhancing Water Use Efficiency and Productivity		WADI-System	Azolla cultivation for integrated farm develop-ment	System of Rice Inten-sifica-tion	Improved Cook Stoves for address-ing forest degrada-tion
							Vegetable seeds (Rabi Crop)	Vegetable seeds (Kharif Crop)	Drip system	Sprin-kler system				
4	Makodiya-Paharkhedi	22	-	-	-	-	22	-	-	-	-	0	-	22
5	Chachmau	45	1	-	28	45	40	40	25	13	40	30	-	38
6	Naganpur	26	-	-	20	26	25	25	17	9	25	22	-	30
7	Saidganj	131	-	-	46	131	108	108	73	3	108	43	-	106
8	Akola	357	-	-	190	357	357	357	37	121	340	90	-	233
9	Khatpura	319	-	-	72	319	264	286	128	23	286	48	-	263
Total		**1233**	**1**	**-**	564	1211	**1111**	**1111**	**375**	**282**	**1087**	**300**	**-**	**991**
Grand Total		**5808**	**140**	**-**	**2562**	**5460**	**4464**	**4382**	**1672**	**1198**	**4276**	**2467**	**-**	**4245**

Annexure-2

Village wise details of beneficiaries (households) of SLEM best practices scaled up in the project areas of Chhattisgarh

S. No.	Name of villages	House-hold Targeted	SLEM Best Practices										
			Rain water harvest-ing	Lac cul-tivation	Vermi composting for sustain-able land productivity	Biopesticides and biofertilizers for sustainable land produc-tivity	Crop diversification for sustainable land productivity		Micro Irriga-tion System for Enhancing Water Use Efficiency and Productivity (Drip system)	WADI-System	Azolla cultivation for integrated farm develop-ment	System of Rice In-tensifi-cation	Improved Cook Stoves for addressing forest degradation
							Vegetable seeds (Rabi Crop)	Vegetable seeds (Kharif Crop)					
Marwahi Forest Range, Marwahi Forest Division													
1	Bansital	360	14	64	54	360	224	224	39	224	105	1	145
2	Danikundi	443	0	53	23	443	209	209	40	209	115	0	181
3	Naka	460	0	46	87	460	353	363	29	363	205	0	348
4	Bahri Jhorki	55	0	12	8	55	39	39	10	39	25	0	34
5	Silphari	478	0	132	184	478	452	519	142	519	270	0	407
6	Kolbirra	248	0	58	32	248	222	222	46	222	95	0	215
7	Ameratikra	649	30	70	67	649	326	262	50	262	210	2	474
8	Moharitola	253	0	94	44	253	127	127	36	127	78	0	145
9	Pathrra	949	0	41	42	949	444	492	67	500	215	0	450
10	Baghrra	138	0	27	23	138	62	42	10	42	30	0	61
11	Madai	797	0	80	265	797	404	404	110	404	245	0	535
12	Matiyadand	721	12	87	57	721	398	338	40	338	140	1	386
13	Rumga	885	15	57	95	885	591	602	45	602	267	1	700
Total		**6436**	**71**	**821**	**981**	**6436**	**3851**	**3843**	**664**	**3851**	**2000**	**5**	**4081**
Pali Forest Range, Katghora Forest Division													
1	Kodar	242	-	177	40	242	242	242	90	242	60	-	234
	Dumdumi-Kodar	20	-	0	6	20	20	20	7	20	10	-	20
	Hardikachhar-Kodar	103	-	0	22	103	103	103	40	103	25	-	93

S. No.	Name of villages	House-hold Targeted	SLEM Best Practices										
			Rain water harvest-ing	Lac cul-tivation	Vermi composting for sustain-able land productivity	Biopesticides and biofertilizers for sustainable land produc-tivity	Crop diversification for sustainable land productivity		Micro Irriga-tion System for Enhancing Water Use Efficiency and Productivity (Drip system)	WADI-System	Azolla cultivation for integrated farm develop-ment	System of Rice In-tensifi-cation	Improved Cook Stoves for addressing forest degradation
							Vegetable seeds (Rabi Crop)	Vegetable seeds (Kharif Crop)					
2	Jamnipani	24	-	0	4	24	24	24	0	24	9	-	24
3	Parsapani	38	-	0	15	38	38	38	20	38	25	-	38
4	Karranawadhi	63	-	20	15	63	63	62	25	62	15	-	63
5	Chanwaripara	79	-	42	12	79	79	78	18	79	20	-	69
6	Karranawapara	131	-	75	20	131	126	126	78	126	33	-	126
7	Kanhaiyapara	70	-	24	10	70	70	70	21	70	20	-	64
	Total	**770**	**-**	**338**	**144**	**770**	**765**	**763**	**299**	**764**	**217**	**-**	**731**
Pandaria West Forest Range, Kawardha Forest Division													
1	Neur	409	-	-	100	409	373	373	78	373	159	-	125
2	Rahidand	73	-	-	36	73	66	66	29	66	30	-	45
3	Amania	249	-	-	35	249	224	224	43	224	35	-	80
4	Taitirni	171	-	-	40	171	128	128	53	128	50	-	59
5	Rukhmidadar	110	-	-	48	110	104	104	48	104	25	-	59
6	Rokhni	135	-	-	48	135	135	135	34	135	25	-	48
7	Amilitola	95	-	-	39	95	78	78	25	78	29	-	63
8	Bhangitola	139	-	-	55	139	116	116	45	116	50	-	80
	Total	**1381**	**-**	**-**	**401**	**1381**	**1224**	**1224**	**355**	**1224**	**403**	**-**	**559**
Raghunathnagar Forest Range, Ambikapur Forest Division													
1	Kesari	680	-	329	204	680	680	608	110	608	134	1	592
2	Shankarpur	470	9	350	120	470	470	364	90	364	55	1	345
3	Babhani	287	15	144	101	287	287	250	0	256	55	2	286
4	Nawgai	512	-	161	150	512	512	337	110	337	55	1	431
5	Rameshpur	345	6	157	56	345	345	283	0	283	56	1	315

S. No.	Name of villages	House-hold Targeted	SLEM Best Practices										
			Rain water harvest-ing	Lac cul-tivation	Vermi composting for sustain-able land productivity	Biopesticides and biofertilizers for sustainable land produc-tivity	Crop diversification for sustainable land productivity		Micro Irriga-tion System for Enhancing Water Use Efficiency and Productivity (Drip system)	WADI-System	Azolla cultivation for integrated farm develop-ment	System of Rice In-tensifi-cation	Improved Cook Stoves for addressing forest degradation
							Vegetable seeds (Rabi Crop)	Vegetable seeds (Kharif Crop)					
6	Girwani	1001	-	254	237	1001	1001	464	150	464	187	2	837
7	Raghunathnagar	721	-	58	66	721	721	582	0	582	195	1	633
Total		**4016**	**30**	**1453**	**934**	**4016**	**4016**	**2888**	**460**	**2894**	**737**	**9**	**3439**
Narharpur Forest Range, Kanker Forest Division													
1	Bhansuli	186	-	-	-	186	-	-	25	177	20	-	-
2	Devgaon	326	-	-	-	326	-	-	60	323	80	-	-
3	Surhi	465	-	-	-	465	-	-	70	407	170	-	-
4	Dabbipani	195	-	-	-	195	-	-	40	164	75	-	-
5	Mandradarha	237	-	-	-	237	-	-	30	210	125	-	-
6	Rajpur	106	-	-	-	106	-	-	35	95	55	-	-
7	Barethinbahara	104	-	-	-	104	-	-	25	94	10	-	-
8	Bhiroud	279	-	-	-	279	-	-	56	174	136	-	-
9	Dabena	235	-	-	-	235	-	-	55	232	165	-	-
10	Jhaliyamari	201	-	-	-	201	-	-	40	122	60	-	-
11	Mashulpani	251	-	-	-	251	-	-	50	98	60	-	-
12	Charbhatha	196	-	-	-	196	-	-	10	136	53	-	-
13	Badbani	161	-	-	-	161	-	-	35	104	65	-	-
14	Dudumbahara	116	-	-	-	116	-	-	20	88	60	-	-
15	Dhaurabhatha	165	-	-	-	165	-	-	25	154	12	-	-
16	Jaamgaon	484	-	-	-	484	-	-	40	484	30	-	-
Total		**3707**	**-**	-	-	**3707**	**-**	-	**616**	**3062**	**1176**	**-**	**-**
Grand Total		**16310**	**101**	**2612**	**2460**	**16310**	**9856**	**8718**	**2394**	**11795**	**4533**	**14**	**8810**

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