REGENERATIVE PRODUCTION LANDSCAPE COLLABORATIVE: PEOPLE, NATURE, ECONOMY

Summary of insights from the baseline & proposal of Compact targets for Chhindwara

Assessment done by: CGIAR IRRI

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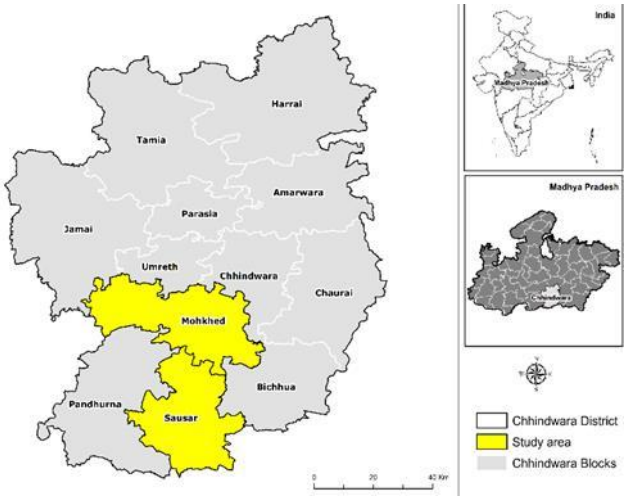
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About the Chhindwara Production Landscape

The Chhindwara Landscapes diagnostics analysis using comprehensive and complementary approaches i.e. household surveys, GIS & remote sensing and high-tech laboratory soil assessment, conducted by CGIAR- IRRI, provides us with the basis for developing the Compacts that work for people, nature and the economy. This assessment was conducted in the landscape consisting of the representative and targeted Sausar and Mohkhed blocks of Chhindwara district, Madhya Pradesh. This is an ecologically sensitive area situated in Central India and hometown to two of the country's oldest nature reserves. The total area covered by the study area is 1833 Sq. Kms.



Agriculture is the mainstay of the majority of population (>90%) in the landscape and is dominated by crops like cotton, wheat, maize, vegetables, and soybean. Most of the farmers integrate crop production with livestock however, the existing unsustainable agriculture commodities production and ecosystem management system requires a systemic transformation if we are to improve the small-scale producer yields and incomes, poverty, gender disparities and social inclusion, biodiversity conservation and ecosystem protection, and local governance, among others.

Our results for this study are based on a survey of 680 farmers, most of whom are in 35 villages in the two blocks of Chhindwara district. These villages were selected and categorised based on the area under irrigation and are also prone to climatic change-induced effects such as floods, drought, and pest attacks. An overwhelming majority of the respondents hail from socio-economically disadvantaged backgrounds, with over half of the households being belongs to some other backward caste (OBC), and remaining to *Dalit* (Scheduled Caste), *Adivasi* (Scheduled Tribe), with around 5 per cent belonging to General category.

As described previously, these villages are in a flood-prone area *and* drought-prone area of the Chhindwara district – this is distinctly because of the undulating topography of the geography. Close to 38 per cent of the respondents' report having suffered some sort of stress event in the last five years. Out of which, 36 per cent listed the occurrence of floods as the main climate-induced stress, followed by drought and pest attacks.

With all the insights we gathered using extensive research, analysis, and stakeholder consultation, we identify the various challenges that require urgent attention and collective action for landscape restoration, climate change adaptation and mitigation while raising the income and improving the livelihood of the population in the landscape.

Outcome based on RPLC Theory of Change

1. *Improved production* through adoption of regenerative principles: using sustainable land management and climate positive practices, thereby avoiding further degradation.
2. *Natural ecosystems flourish* with reduced interference from production activities: natural ecosystems and resources including forests, water, soils are protected & restored, biodiversity enhanced & GHG emissions are reduced/ stored.
3. *Improved incomes* and livelihoods and *greater resilience*: land management is inclusive & leads to improved livelihoods, higher income & improved climate resilience of farmers & communities.
4. Improved *enabling environment* for sustainable production & protection of natural resources: Convergence and support to government and public sector towards inclusive governance models through participation of producers (associations), private sector, community.
5. Market level shifts and *demand for sustainable production*: with institutional & private market actors adopting responsible and jurisdictional sourcing in Madhya Pradesh towards a regenerative and just economy.
6. Accelerate *investment in sustainable production and ecosystem preservation*/ restoration by incentivising the market and financial sector, catalysing the development of jurisdictional approaches for climate positive practices, equity and inclusion

1. The PPI Approach: PRODUCTION

'Production' focus under PPI

- Increasing productivity of farmers in a sustainable Way
- Diversification farmers' sources of income

through

- Improved land use planning, resulting in cropping systems that maximize economic value for farmers while de-risking them from climate shock
- Improved utilization of fallow/cultivable land, crop diversification through multi-cropping, agroforestry and other mixed cropping systems

Production Pillar Indicator 1: Cropping intensity

In cropping intensity (Cropping Intensity = Gross Cropped Area/Net Sown Area x 100) in the landscape as mapped using GIS and remote sensing land cover analytics showed that around 50% of the area in northern region had a cropping intensity of 100 % while it was only 50% in the southern region of the landscape. There is a large percent of area (17%) that is kept fallow in the southern region of the landscape.

Definition	Baseline	Proposed Targets – 2026	Benchmark
Percent increase in cropping intensity in the landscapes This indicator measures the gross sown area (area under the crop cultivation in various seasons) by a farmer in a year	Existing cropping intensity of the landscapes is 139 percent, Source: HH survey 2022.	Increase Sustainable cropping Intensity >160%	191 percent (Wu, W., Yu, Q., You, L., Chen, K., Tang, H., & Liu, J. (2018). Global cropping intensity gaps: Increasing food production without cropland expansion. Land use policy) The study highlights this is possible for India, referring to states like Telangana, even MP where it has been achieved,

Key Strategies	Risks & Assumptions
– Site suitability mapping for land use – ***Residue management & mulching** – ****Increase irrigation facilities**	R: Non-availability of inputs for improving cropping intensity R: Degraded soils R: Unavailability of irrigation water R: Socio-political constraints A: Market available for improved production and yields

**Facilitate production of mulch through weeds, as landscape lacks mulch for mulching practices*

*** Farm ponds construction need to given more emphasis as it is proven model in the landscape.*

Some known enablers:

- MP Government's focus on Irrigation water availability
- Availability of funds under the MNREGS for soil and water conservation, land development
- CSO partners' proven skills and expertise on soil water conservation and convergence with Govt.
- Farmers' willingness to invest in developing waterbodies and micro-irrigation technology for assured irrigation
- Agricultural Infrastructural development in terms of adequate electricity supply, access to irrigation

Production Pillar Indicator 2: Crop Productivity

Yield data of various crops grown in the landscape shows high yield gaps in the major cultivated crops. Except groundnut, all the crops had yield lower than the state average and much lower (up to 11 quintals/acre) than the attainable yields of these crops.

Crop yield for the major crops in the regions are cotton is 4.1 q/acre, Maize 8.6 q/acre, soyabean 4.2 q/acre, Wheat 8.3 q/acre, Gram 1.5 q/acre, Tur 2.5 q/acre. There is a huge opportunity to increase the yield of crops in the Chhindwara landscape and thus improving the overall household income, since >90% households are dependent on agriculture as a main source of income.

Definition	Baseline	Proposed Targets – 2026	Benchmark
Percent increase in focus crop/s yield grown in the landscape This indicator measures the increase in productivity of major crops grown by the farmer	Significant yield gaps across crops have been reported in the landscapes ranging from 50 to 100 percent. Source: HH survey 2022.	Enhance crop yield by >25 %	15 q/acre, 20 q/acre, 20 q/acre, 14.4 q/acre for Cotton, Maize, Wheat and Soyabean, respectively. (Mueller, N., Gerber, J., Johnston, M. et al. Closing yield gaps through nutrient and water management. Nature) These are the highest yields attained in India under smallholder farm conditions (as opposed to potential yields achieved under highly controlled, university/research farms)

Key Strategies	Risks & Assumptions
– ***Improved high yielding and/or drought resistant varieties.** – ****Optimised balanced nutrients use** – Optimum irrigation – Efficient pest and weed management. – *****Optimisation of crop calendar based on resource-use efficiency** – Crop diversification through identifying & introducing best paired crops, including coarse crops, cover crops, legume crops.	A: Better extension services and widely dissemination of knowledge on improved practices. A: Access to high yielding varieties R: Information gap & Market volatility R: Non-availability of inputs on time R: Financial constraint R: Lack of credit and resources

**Build partnership with Government and international research institution for technology transfer.*

***Development and standardised the PoPs based on farmer field evaluation*

**** Optimising the crop calendar might not be a good strategy considering the rainfed condition of the farmers. Instead, more powerful integrated pest solutions need to be identified and demonstrated to the farmers.*

Some known enablers:

- Active presence of farmer producer companies towards access to input and credit
- Promotion of farmers' groups such as seed production societies/farmer producer company by government

– Network of ICAR institutes in the Chhindwara (KVK, Agriculture college, Zonal agriculture research station)

Production Pillar Indicator 3: Crop Diversification

98% landowners cultivated their field in kharif (monsoon) season but only 53% cultivated their fields in rabi (winter) season while the rest left the land fallow. Most of the landowners in the landscape cultivate only 1-2 crops in a year. Wheat, cotton, maize and arhar (pulses) were major crops grown by the majority of landowners in the landscape. The crop diversity in the landscape is low with multiple crops being cultivated by <10 percent landowners.

Definition	Baseline	Proposed Targets – 2026	Benchmark
Percent decrease in the fallow areas in the landscapes This indicator measures the conversion of fallow land into productive land.	GIS and remote sensing analysis demonstrates the significant increase (4 percent) in crop fallow land in last ten years. Currently 17 percent and 2.6 percent area under fallow in southern and northern part. Source: HH survey 2022.	~5 % reduction in fallow area. (Annual progress report, 2019-20)	Annual Progress Report. Increasing Productivity of Rice-based Systems and Farmers' Income in Odisha (2019). India Office, International Rice Research Institute. The study describes the successfully conversion if fallow land, in a similar agro ecological area.

Key Strategies	Risks & Assumptions
– Identifying the causes of fallow – Crop/tree species suitability mapping – *__Encourage agroforestry, silvo-pastoral systems.__	R: Poor degraded soil R: Non-availability of quality sapling R: Lack of markets for produce from agroforestry and silvo-pastoral systems A: Fallow land should be agricultural land recognised by government.

**Participatory approach with farmers to identify the best-suited model to reclaim fallow land.*

Some known enablers:

– Government priority towards promoting crop diversification
– MNREGS fund availability towards horticulture development
– Value addition through market linkages or processing of orange production under one district one product (ODOP) scheme
– Government willingness to invest agricultural infrastructure, especially towards primary and secondary processing
– SRIJAN's (CSO partner) established proof of concept of agro-horticulture model with more than 1,000 farmers mobilized under NABARD's Fund
– Agro -Horticulture model is a part of agri-systems in the landscape

2. The PPI Approach: PROTECTION

'Protection' focus under PPI

- Introducing measures to conserve and restore natural resources, including soil, water, forests and biodiversity

through

- Adoption of sustainable production practices that restore soil health, water resources, reduce emissions and secure the natural environment
- Improvement in conservation and protection of forests around agri-commodity production areas
- Promotion of sustainable harvesting practices of non-timber forest products (NTFPs)

Protection Pillar Indicator 1: Soil Health

– Soil analysis revealed most of the soils in the landscape were low in available nitrogen. Thus, there is a need to diversify with nitrogen fixing crops *and* optimise the use of fertilizers and improve the nutrient use efficiency without increasing environmental footprints with overuse of nitrogenous fertilizers.

– Farmers in the sample use four common types of fertilizer: Urea, DAP, Potash(K), and SSP. Data shows the usage per acre for each of the different types of fertilizers in the Kharif (monsoon) and Rabi (winter) seasons. By numbers, organic/composting is the least popular type of fertilizer owing to its requirement of labour and the time to develop quality compost. Focusing on the inorganic fertilizers, there seems to be an excessive use of nitrogen fertilizer, as urea is 46 percent nitrogen. Therefore, farmers are using around 62 kilograms of urea per acre in Cotton and 100 kilograms in maize crop, which generally exceeds agronomists' recommendations. The figure for DAP is 60 kilograms and 47 kilograms per acre for cotton and maize. The extent to which these are actually being use is contributing significantly to GHG emissions. The trend is similar for the rabi crop.

– Similarly, around at the rate of 700 ml per acre insecticide (Monocrotophos 36%, Imidacloprid and Beta- Cyfluthrin) is being used by cotton farmers along with 800 ml per care of herbicide (2-4 D, melsulfuran methyl), which hampers biodiversity and local fauna and flora to a great extent.

Definition	Baseline	Proposed Targets – 2026	Benchmark
Percent increase in the availability of key nutrients in the soil The indicator measures the retention and uptake of key plants nutrients (kgs per hectare) in the soil	Soil health analysis has shown poor nutrient (N, P, K) availability in the soil, ranging from (N 155 to 160kg/ha, P2O5 29 to 66 kg/ha, K2O 150 to 180 kg/ha.	Enhance Nutrient use efficiency by 10-15 %.	240 kg/ha Nitrogen (Chivenge P, Sharma S, Bunquin MA and Hellin J (2021a) Improving Nitrogen Use Efficiency—A Key for Sustainable Rice Production Systems. Front. Sustain. Food System)

Key Strategies	Risks & Assumptions
– ***Increase soil carbon through residue management, integrated nutrient management** – Improve soil micro-biome – Develop models for production of organic and bio inputs at scale	R: Non-availability of fertilizers and organic manures on time A: Willingness to adopt integrated nutrient management

**Identification of focal demonstration points to induce adoption of regen practices and standardised PoP's.*

Some known enablers:

- Practices followed under ongoing organic cotton program in the landscape

Protection Pillar Indicator 2: Soil organic carbon

There was huge variation in the soil health parameters across the landscape. The soils in the southern part of the landscape have lower soil carbon stock (SOC) and higher bulk densities than the northern soils. The SOC in the agriculture field is significantly lower than the forest soils in the landscape, clearly indicating a degradation in soil due to intensive tillage for cultivation (>90% of the landowners indicated intensive tillage in their fields). The carbon stock map explains the spatial variability of carbon in soil. The forest soils have higher carbon content whereas the soils under intensive agriculture have low SOC. Farmers' crop yield was significantly correlated with SOC stock. The farmers' crop yield increases by 18.61 kg/acre with every point increase in SOC stock.

Definition	Baseline	Proposed Targets – 2026	Benchmark
Percent increase in the soil organic carbon (SOC) This indicator measures the percent increase in the organic carbon content of on-site, productive area, including cropland, agro-forestry	Low soil organic carbon (averaging 0.7%) in the landscapes due to intensive cultivation and non-use of organics, while its around 2% in forest land	Increased Soil Organic Carbon by 0.3-0.5 %	2 %. Manna, M. C., Swarup, A., Wanjari, R. H., Ravankar, H. N., Mishra, B., Saha, M. N., & Sarap, P. A. (2005). Long-term effect of fertilizer and manure application on soil organic carbon storage, soil quality and yield sustainability under sub-humid and semi-arid tropical India. Field crops research

Key Strategies	Risks & Assumptions
– Agroforestry system – Reduced tillage. – Greater use of organic inputs – Residue management	R: Non-availability of improved saplings R: Non- availability of organic inputs A: Incentive or transition packages are available for farmers to adopt regenerative practices

Some known enablers:

- Partnership with technical institutes like CGIAR, IISS
- Residue Management policy of Government of MP
- CSO deep rooted relationship with Farming community

Protection Pillar Indicator 3: Water use efficiency (WUE)

- Water utilization by the crop is generally described in terms of water use efficiency or productivity. WUE can be increased in two ways, either by increasing yield or by saving water. Irrigated agriculture is far more productive than rainfed agriculture, but in India, more than 65 % of the area is under rainfed agriculture and there is an equal need of increasing productivity of water.
- In this baseline, the WUE of key crops in the landscape was comparatively low as per the previous reported studies (Reddy and Reddy 2004). There is a scope for increasing the WUE in crops like

vegetables, wheat, gram and oranges through use of micro irrigation systems and implementation of in-situ soil moisture options like mulching and increasing SOC.

Definition	Baseline	Proposed Targets – 2026	Benchmark
Percent increase in the Water Use Efficiency (WUE) in the major crops Water use Efficiency: Water (irrigation) use efficiency to describe how effectively water is delivered to crops and to indicate the amount of water wasted at plot, farm, command, or system level. Water productivity is measured in units of kg m-3.	Analysis has shown poor water use efficiency. Cotton – 1.19kg/ha-mm Maize – 2.50 kg/ha-mm Wheat – 2.60 kg/ha-mm Soyabean - 1.2kg/ha-mm (The difference in WUE (reported and attainable) was found to be around 54% in cotton; 34% in Maize; 89% in Groundnut; 70% in wheat, 42% in soyabean and 30% in pigeonpea) in the landscape vis-a vis achievable WUE with higher yields and optimum water use.	Increased WUE by 15-20%	1.4 kg/ha-mm, 3.6 kg/ha-mm, 2.8 kg/ha-mm & 2.4 kg/ha-mm for Cotton, Maize, Wheat and Soyabean, respectively. Hatfield, J. L., Sauer, T. J., & Prueger, J. H. (2001). Managing soils to achieve greater water use efficiency: a review.

Key Strategies	Risks & Assumptions
– Increase soil moisture retention capacity – Residue management – Micro-irrigation systems – Irrigation scheduling	R: Degraded soils R: Poor knowledge on water management R: Non-availability of micro irrigation systems R: Poor knowledge on maintenance

Some known enablers:

- CSO's ongoing work on soil and water conservation and water management
- Government schemes /subsidies available for micro -irrigation systems
- Government schemes to develop skill set of rural youth related to agriculture machinery and development of village based custom hiring centres

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Protection Pillar Indicator 4: Greenhouse gas (GHG) emissions

- Cotton, maize, wheat, soyabean, the major crops grown in the region also have highest GHG emissions. Conventional tillage coupled with excessive fertilizer input led to higher GHG emissions. The production of synthetic nitrogen (N) fertiliser incurred significant GHG emissions, mainly as CO2 from the use of fossil fuels in the production of ammonia and N2O emissions during the production of nitric acid. Several factors impact on the GHG emissions from fertiliser production, namely the type of fertiliser, the technology and feedstock used and the presence or absence of N2O abatement technologies (*Brentrup et al., 2004).*
- Reducing tillage intensity, optimizing nitrogen fertilizer application, improving soil health through increased SOC, change in cropping systems, and diversification can help in reducing the GHG emission from the Chhindwara landscape.

Definition	Baseline	Proposed Targets – 2026	Benchmark

Percent Greenhouse gas emissions reduced Greenhouse gases warm the earth by absorbing energy and decreasing the rate at which the energy escapes the atmosphere. These gases differ in their ability to absorb energy, that is, they have various radiative efficiencies. They also differ in their atmospheric residence times. Each gas has a specific global warming potential (GWP), which allows comparisons of the amount of energy the emissions of 1 ton of a gas will absorb over a given time period, usually a 100-year averaging time, compared with the emissions of 1 ton of CO_2	Analysis shown high Global Warming Potential (ranges from 3.6 MT CO_2 eq/ha in cotton; 3.9 MT CO_2 eq/ha in Maize; 3.2 MT CO_2 eq/ha in Groundnut; 3.8 MT CO_2 eq/ha in wheat, 1.2 MT CO_2 eq/ha in soyabean and 0.7 MT CO_2 eq/ha in pigeonpea) owing to intensive tillage and non-optimum fertilizer and water management.	Reduction in crop-wise GHG emission by 10% (in MT CO_2 eq/ha)	Sapkota, T. B., Vetter, S. H., Jat, M. L., Sirohi, S., Shirsath, P. B., Singh, R., & Stirling, C. M. (2019). Cost-effective opportunities for climate change mitigation in Indian agriculture. Science of the Total Environment. The study suggests a possible reduction of 50% is possible by focusing on the suggested interventions

Key Strategies	Risks & Assumptions
– ***Optimise Fertilizer use** – Introduce integrated nutrient management – Increase access to quality bio-inputs – Integrated Weed Management – Ecological intensification for – Integrated pest management – Encourage Renewable sources of energy – Identify practices with high energy requirements and introduce alternate sustainable practice	R: Poor knowledge on nutrient and water management R: Non-availability of quality bio-inputs R: No schemes for adoption of renewable energy sources

** Focus on continuous evaluation and demonstration of bio-inputs performance and enhancement.*

Some known enablers:

- Solar subsidies available for individual farmers
- Upcoming Government policy to promote crop diversification (reducing the area of Maize and wheat)
- Organic practices (Use of FYM, bio pesticide, integrated pest Management) promoted by CSO in cotton cultivation as proof of concept

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Protection Pillar Indicator 5: Agro-forestry

Agroforestry is a land-use management system in which trees are grown around or among crops or pastureland. Only a small portion (10 percent) of farmers planted mango, orange, lemon, papaya, pomegranate trees on their farmland, and they are very willing to plant more trees and learn more about agroforestry because that will help reduce the pollution and the farmers can diversify and improve their incomes, once the trees mature by selling the fruits or vegetables.

Protection Pillar Indicator #5:	Baseline	Proposed Targets – 2026
Adoption rate of agro-forestry land-use management practices This indicator reflects the adoption rate of the practices agro-forestry models for improving natural resources	Close to 10 percent of farmers have reported to have involved in agroforestry. Source: HH survey 2022.	Enhance adoption of agro-forestry models for improving natural resources and habitat by >30 % of farmers

		Data received from WRI using the Restoration Atlas shows immense potential for mosaic restoration in the areas studied. (Restoration Atlas)

Key Strategies	Risks & Assumptions
– Best Pairing of trees and crops through participatory approach and evidence hubs. – Development of tree nursery saplings through micro-entrepreneurship or self-help groups	R: Non availability of tree species suitable for the landscape R: Lack of credit and resources to purchase saplings or small landholdings A: Economic case for diversification through agroforestry is proven

Some known enablers:

- Availability of saplings though forest and horticulture nursery at subsidized rates
- Schemes under the National Bamboo Mission
- Fund availability under MNREGS for Horticulture species
- SRIJAN's skill to promote Agro-Horticulture models and convergence with Govt and NABARD

Protection Pillar Indicator 6: Adoption of regenerative and restorative agriculture practices

Overall, the adoption rate of various improved and sustainable agricultural practices is poor. Only 25 per cent of farmers report having followed the reduced tillage practices in their field. Close to 11 per cent of farmers have reported having minimised or eliminated synthetic fertiliser use. Five per cent of respondents said to have used cover crops. None of the farmers reported constructing on-farm ponds for irrigation purposes: mulching, crop residue was reported by 5 per cent of farmers.

Definition	Baseline	Proposed Targets – 2026	Benchmark
Adoption rate of Regenerative and sustainable production farm practices This indicator measures the percent of farmers adopted Regenerative farm practices (i.e., no/reduced tillage, crops crops, reducing or eliminating use of synthetic fertilizer and pesticides, adopt one of these practices)	Around 25 percent farmers have reported to have partially adopted at least one regenerative practice in the landscape, Source: HH survey 2022.	Enhance the adoption of regenerative farm practices among 60 % of farmers	n/a

Key Strategies	Risks & Assumptions
– ***Formation of Evidence hubs cum demonstration with the involvement of scientists, community leads, market sector players and farmers groups for the evaluation and scaling of RA.**	A: Timely access to agri-technologies R: Limited access to credit for purchase of new technologies

**Establishment of advanced zero tillage machinery service providers in the landscapes*

Some known enablers:

- Reference farms of individual farmers in the landscape
- Good agricultural practices and models demonstrated by local stakeholders (KVKs, Srijan)
- Alignment of government officials towards benefits of regenerative/ natural farming

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Protection Pillar Indicator 7: Incidences of straw/crop burning

Fire incidents after the Rabi harvest were relatively higher and also increasing over time. Around 14 and 8 percent farmers in the landscape reported burning the fields to clear the residues. The higher number of fires after rabi could be attributed to farmer's ability to take up a third cropping cycle (summer crop) for short term crops after rabi, when soil moisture is still optimum and therefore, a need to clear fields quickly despite the shortage or costliness of available labour.

Definition	Baseline	Proposed Targets – 2026	Benchmark
Percent reduction in the straw burning incidences by farmers Percent reduction in the Straw burning incidences by farmers in the landscape	Close to 12 percent farmers during kharif (monsoons) and 7 percent in rabi (winters)have reported to have burnt straw in the field, the findings also substantiated through GIS.	Reduce crop residue burning to more than 50 percent	Bhuvaneshwari, S., Hettiarachchi, H., & Meegoda, J. N. (2019). Crop residue burning in India: policy challenges and potential solutions. . International journal of environmental research and public health. The study suggests a possible reduction of 50% is possible by focusing on the suggested interventions

Key Strategies	Risks & Assumptions
– ***In Situ, ex-situ straw management.** – Optimisation of crop calendar.	R: No awareness R: Lack of resources for straw management R: Lack of facilities and knowledge for residue management

**Effective Biochar production unit establishment and training*

Some known enablers:

- Government policy on stubble burning

– Provision of developing custom hiring centres by GoMP's Agriculture Engineering department

Further areas of query:

Biodiversity: the study covers some aspects of biodiversity status in the landscape through household surveys, including agroforestry land use management system, propagation of earthworms in the soil, propagation of bees, fisheries, and integration of livestock. The data reveals that 29 per cent of farmers are involved in some biodiversity activity, out of which 10 per cent engage in agroforestry and livestock integration, and little per cent of farmers report being engaged in earthworm and bees' propagation. Nonetheless, some more rigorous exercises to capture the biodiversity are required to identify the existing scenario and post that target will be drafted.

Wild boar and Indian Antelope are frequently causing losses in the farmers' fields and landscapes. The intrusion of animals has increased over the years. As a result, farmers are forced to hurt these animals to protect their crops from them. Farmers also stated that intrusion has increased due to the loss of trees surrounding the village. Significant interventions are required to protect the wild animals and the farmer's field by developing the natural fencing of bamboo trees or community plantations surrounding the villages.

Water level and water quality: as per Central Ground Water Board, Ministry of Jal Shakti, Government of India, report the water table fluctuation in the landscape over the period, especially during the Rabi season (between 5 to 10 mbgl), also the Fluoride and Nitrate concentration are more than the permissible limit, i.e., >1.5mg/l and >45mg/l in out landscape, this requires more probing and monitoring over a cropping season to develop an improvement plan with targets.

3. The PPI Approach: INCLUSION

'Inclusion' focus under PPI

- Improving livelihoods of farmers, through income diversification and creating local ownership and gender inclusive interventions through participatory approaches

through

- Improved net incomes for farming households
- Equitable access to and optimal use of water resources
- Increased participation of women farmers in decision making across value-chains and in stewardship of the commons.
- Inclusive and representative decision making for land use planning

Inclusion Pillar Indicator 1: Household Income

The data suggests low Household income across the landscape and primary occupation is agriculture. Average income of an HH's including all sources is INR 1,28,000 per annum.*

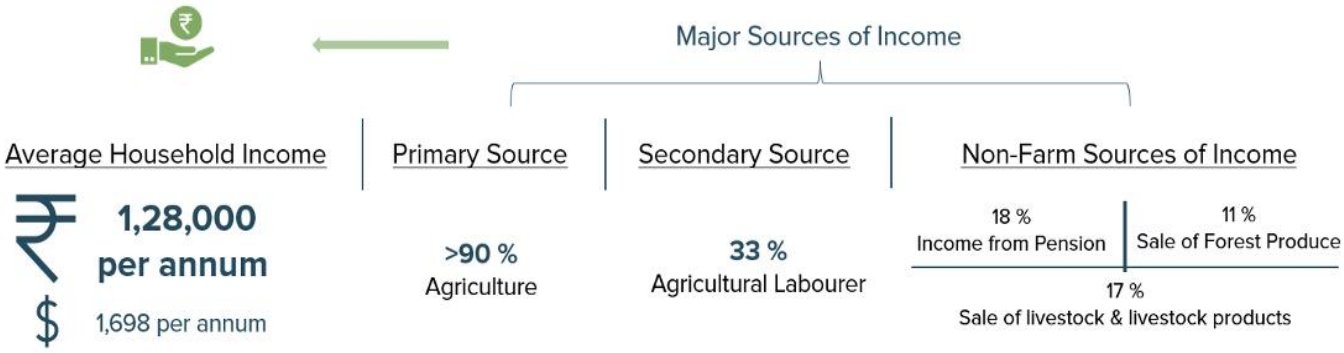


*Figure 1: *Source - Household Survey*

Definition	Baseline	Proposed Targets – 2026	Benchmark
Percent increase in net income of farming households in the landscape Measurement of the increased income due to RPLC intervention of farming households, adjusted, when possible, as per the consumer price index during the intervention	The data suggests low HH income across landscapes and primary occupation is agriculture. Average income of an HH's including all sources is 128000 INR per annum.	Increase HH income increased by 30%, mainly through farming and income diversification	Pellegrini, L., & Tasciotti, L. (2014). Crop diversification, dietary diversity, and agricultural income: empirical evidence from eight developing countries. Canadian Journal of Development Studies. The study focused on productivity & diversification in India as strategies for income enhancement.

Key Strategies	Risks & Assumptions
– Increase System productivity	– R: Climate change
– Increase sources of Income	– R: Lack of other opportunities
– Decrease costs	– R: Lack of awareness

- Access to markets with better prices
- Introduce Diversified sources of income viable in the target geographies e.g., Sheep rearing, Food processing, Poultry, agroforestry etc.

- R: Lack of input and output markets
- R: Lack of knowledge on diversification

Some known enablers:

- Government schemes to support income diversification and improve household income through agricultural and allied livelihood activities (bee keeping, nurseries, poultry, animal husbandry)
- Vegetable cultivation models (Machaan – multi-layer model) established by Srijan
- SHG enterprise towards service delivery towards farmers such as access to input

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Inclusion Pillar Indicator 2: Gender

At the household level, decision-making reveals various interesting observations. Firstly, house maintenance is the decision that women participate in the most, largely because both men and women make that decision. Second, women also participate a lot in the decision about post-harvest activities (cleaning, drying, etc), and this is the decision that women are most likely to be involved significantly. Importantly, women show only modest levels of participation in selection of crops and selection of varieties, use of fertilizer, use of pesticide, among other agricultural related and income activities.

Definition	Baseline	Proposed Targets – 2026	Benchmark
Percent of women-led bio-inputs commercial production and supply facilities in the landscape This indicator reflects the women gained access to services, including materials for agricultural production and finance, because of activities co-financed by RPLC	The data suggests low decision-taking of women in agricultural activities across the landscapes, close to 4 percent female only decision making in agricultural activities	Establish localised commercial bio inputs production, marketing led by women, by 25% **Revised target** **Establish localised commercial bio inputs production, nature-based solution manufacturing units and quality seedlings entrepreneurs' model, marketing-led by women, by 25%.**	Kumar, P., Singh, N. P., & Mathur, V. C. (2006). Sustainable agriculture and rural livelihoods: A synthesis. Agricultural Economics Research Review; Hodson, E., Niggli, U., Kitajima, K., Lal, R., & Sadoff, C. (2021). Boost Nature Positive Production. The study suggests that gender balance in decision making can be enhanced by looking at adding value in agricultural activities + capacity building

Key Strategies	Risks & Assumptions
– Develop inclusive systems – Target women for specific trainings – Encourage women entrepreneurship – Improve access to knowledge	A: Alignment of women's aspirations with the RPLC interventions R: Social bias R: Support and handholding for entrepreneurship development

Some known enablers:

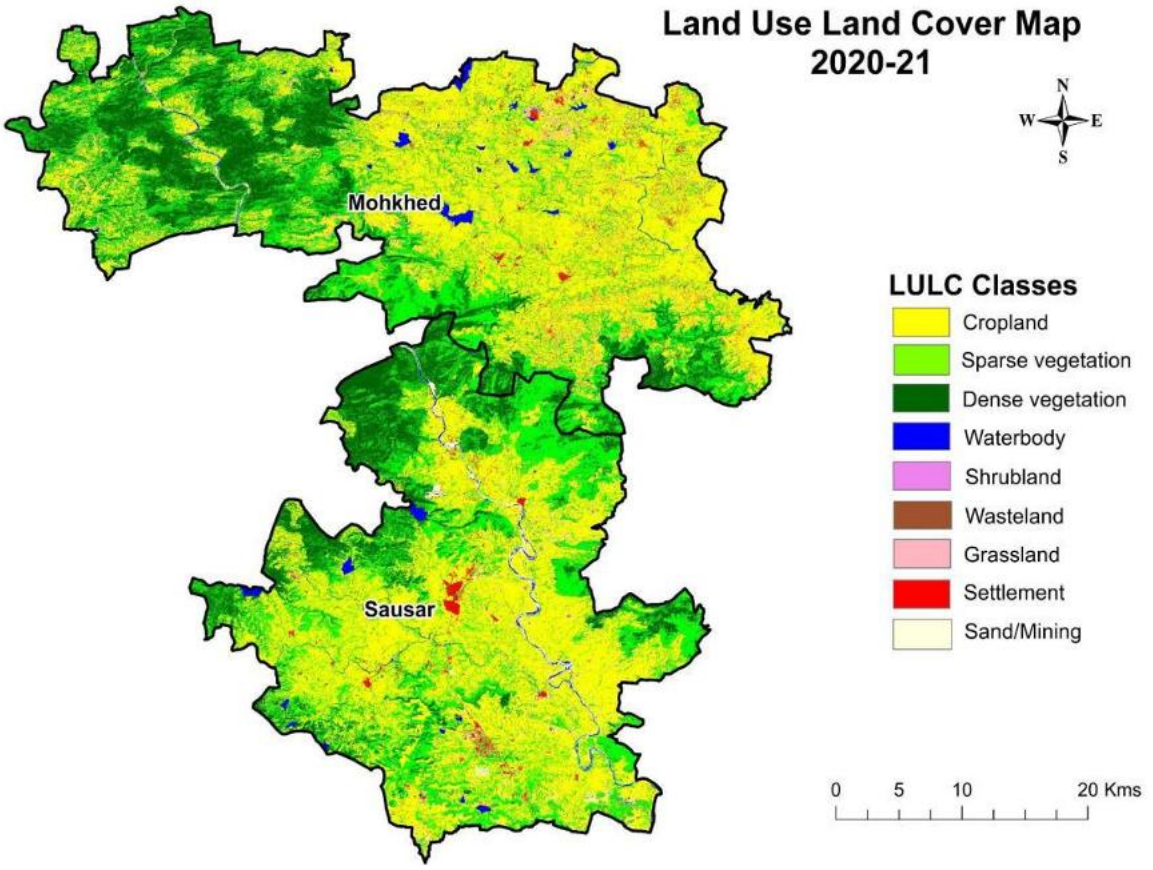
- Strong women led microfinance movement in the landscape
- Strong leadership and presence of women in the COFE
- IDH Gender tool to work with partners towards gender intentional and gender transformational interventions

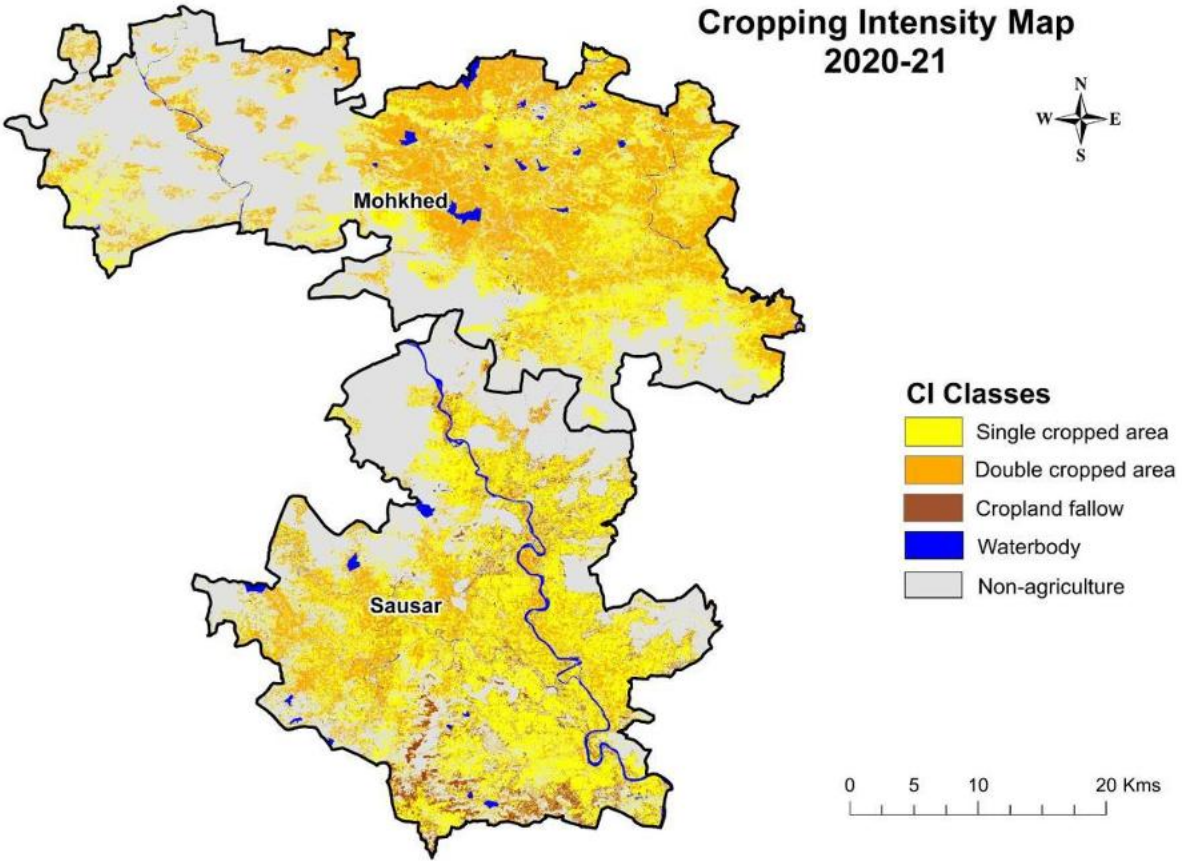
Annexure 1

Demographic and farmer profiling

S. No.	Particulars	%
Caste		
1	Other Backward Classes	54
2	Scheduled Castes/Tribes	41
3	Open or General	5
4	Age of the respondent (Years)	45
Education		
1	Illiterate of No Schooling	12.97
2	Some Primary School	10
3	Some Middle School	36
4	Completed Secondary or Higher Secondary	28
5	Some College	11
Other characteristics		
1	Number of years of farming	21
2	Number of household members	4.1
3	Primary Occupation is Agriculture	92
4	Cultivable Land ownership (Acres)	4.5
5	Number of plots cultivated	1.5
6	Have access to a mobile phone	95
7	Have access to internet	45
8	Touch screen phone	50
9	Regular/Qwerty keypad	50

Annexure 2 – Production





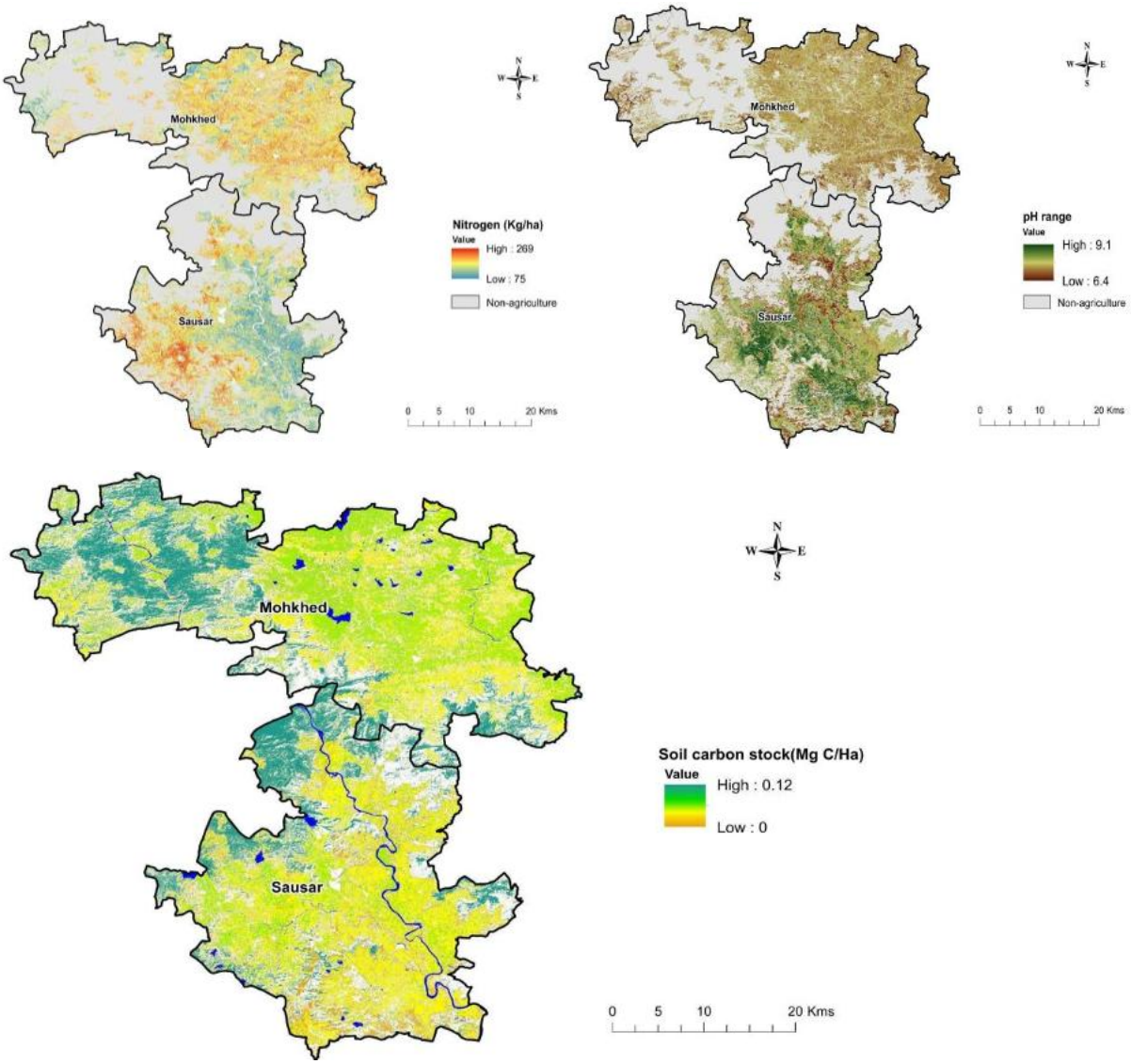
Adoption of various Agricultural Technologies

Different Agricultural Technologies	%
High yielding improved varieties- Drought Tolerant	10.35
High yielding improved varieties- Submergence Tolerant	4.66
High yielding improved varieties- Salt Tolerant	0.29
High yielding improved varieties- High grain quality	9.48
Crop management - Leaf Colour Chart (LCC)	1.02
Crop management - Alternate Wetting and Drying (AWD)	6.56
Crop management - Direct seeding	21.57
Crop management - green manure	3.35
Crop management - Farmyard manure	15.01
Crop management - Straw compost	7.14
Crop management - Integrated Pest Management (IPM)	1.31
Crop management - Construction of on-farm pond	0.00
Crop management - Crop/Nutrient Manager Software	0.15
Crop management - Weather advisories	2.33
Machineries - Mechanical transplanter	0.00
Machineries - Drum seeder	0.15
Machineries - Combined harvester-thresher	0.00
Machineries - Mechanical thresher	0.29
Post-harvest technology - Plastic/Poly bag for seeds	0.73
Post-harvest technology - Metal/Plastic drum for seeds	0.00
Other technologies	0.44

Crop productivity

S.No.	Crop	Yield as per baseline (qtls/acre)	Attainable Yield (quintals/acre)
1	Cotton	4.1	10
2	Wheat	8.3	28
3	Gram	1.5	10
4	Maize	8.6	32
5	Soyabean	4.2	12
6	Arhar	2.5	8

Annexure 3 – Protection



Biodiversity - activities undertaken

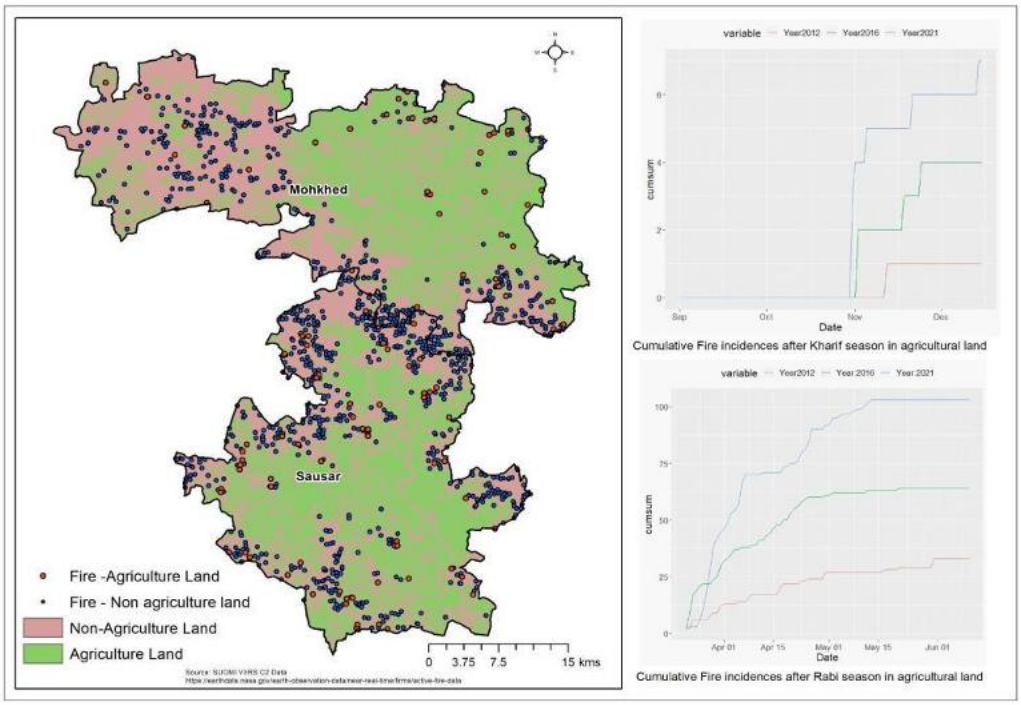
S. No.	Overall (all farmers both blocks)	%
1	Type of biodiversity activity - Agroforestry	10.06
2	Type of biodiversity activity - Livestock	8.31
3	Type of biodiversity activity - Fisheries	0.15
4	Type of biodiversity activity - Earthworm	2.04
5	Type of biodiversity activity - Bees	0

Good Agricultural Practices – current status (partial adoption)

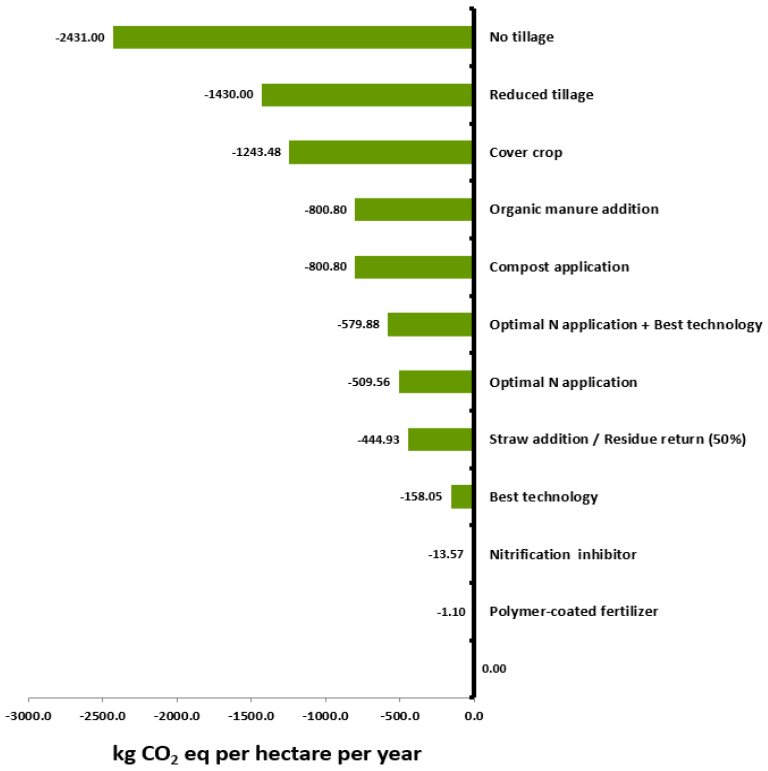
S. No.	Good Agricultural Practices	%
1	Eliminating use of synthetic fertilizer	11%
2	Eliminating use of synthetic pesticide	7%
3	Cover crops	6%

4	No or minimum tillage to protect soil	26%
5	Mulching, Crop residue	5%

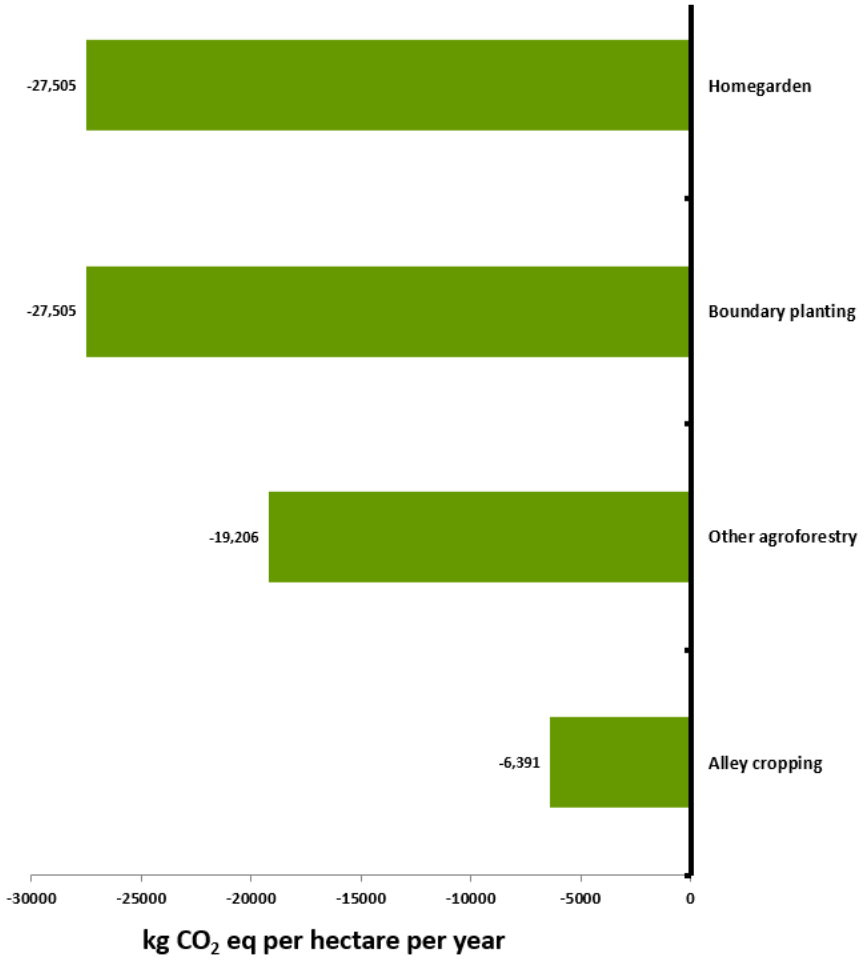
The distribution of fire incidents in study site



GHG Mitigation options under various RA interventions



Agroforestry options (aboveground and belowground carbon sequestration)



Annexure 4 – Inclusion

Household income sources – non farming

S. No	Other Sources	% Of respondents
1	Sale of Forest Produce	17
2	Rental income (house, land, machinery, etc)	2
3	Sale of assets (land, machinery, etc)	0.4
4	Pension	18
5	Remittances	9.4
6	Interest from savings	0
7	Gifts or donations received	1.2
8	Household business (small shop)	2
9	Buying and selling of vegetables	12
10	Buy and sell business	1.6
11	Sale of livestock and livestock products	28
12	Others	3

Decision making by Gender

S. No.	Over all (sausar & Mohkhed)	Who decides (%)			Who implements (%)		
	Decision points	**Male**	**Female**	**Both**	**Male**	**Female**	**Both**
1	Choice Of the Crop Variety	56.7	4	39.2	50	6.85	43
2	Use Of Own or Purchased Seeds	57.7	4.23	37.9	49.42	8.89	41.69
3	Use Of Fertilizer	57.58	4.52	37.9	47.81	9.33	42.86
4	Use Of Pesticide	58.89	4.08	37.03	50.29	7.73	41.98
5	Use Of Hired Labor & Which Activity to Use Hired Labor	56.41	3.64	39.94	47.67	8.31	44.02
6	Rent-Out Owned Machines	56.27	3.79	39.94	47.23	8.31	44.46
7	Rent-In Machines	56.41	3.64	39.94	47.81	7.29	44.9
8	Farm Implements to Purchase	55.25	3.35	41.4	45.77	8.16	46.06
9	Obtain Loan to Pay for Material and Labor Inputs	54.52	3.5	41.98	43.15	9.48	47.38

10	Sowing Date of Crop	50.73	4.23	45.04	39.21	8.75	52.04
11	Method Of Establishing the Crop	51.31	4.08	44.61	41.11	9.18	49.71
12	Handweeding	41.4	9.62	48.98	29.3	16.91	53.79
13	When To Apply Pesticides	53.06	3.35	43.59	42.42	8.75	48.83
14	When To Apply Inorganic Fertilizers	53.94	3.21	42.86	41.69	9.18	49.13
15	Use Of Mechanical Plant Protection Measures	54.37	3.06	42.57	43.73	9.33	46.94
16	Start Of Irrigation	52.92	3.5	43.59	39.8	10.06	50.15
17	Harvesting And Threshing	45.92	4.66	49.42	33.82	10.79	55.39
18	Post-Harvest Activities (Cleaning, Drying, Etc)	35.71	17.49	46.79	31.34	18.95	49.71
19	Selection Of Seeds to Store for Next Season	45.34	6.12	48.54	34.26	10.35	55.39
20	Adoption Of New Technology in Crop Production	48.1	5.39	46.5	37.46	9.77	52.77
21	Disposal Of Crops Cultivated	43.59	4.66	51.75	32.36	8.89	58.75
22	Disposal Of Animals Raised	45.19	4.52	50.29	34.99	9.04	55.98
23	Disposal Of Livestock Products	43.59	4.96	51.46	34.4	8.45	57.14
24	Marketing Of Farm Produce	46.21	3.35	50.44	36.73	8.02	55.25
25	Decision On Who Keeps the Net Income	40.38	5.25	54.37	32.07	8.31	59.62
26	Allocation Of Farm Income	39.8	4.96	55.25	31.34	7.87	60.79
27	Allocation Of Total Household Income	35.28	9.77	54.96	28.57	10.93	60.5
28	Allocation Of Time Between Work and Leisure	30.47	9.62	59.91	25.95	8.02	66.03
29	House Maintenance	25.51	24.64	49.85	21.43	25.07	53.5
30	Education Of Children	34.4	6.12	59.48	26.09	6.71	67.2
31	Local Or International Migration	38.19	6.71	55.1	32.94	6.71	60.35
32	Coping With Disasters	36.3	4.08	59.62	29.15	5.83	65.01
33	Mortgage Of Property for Frame Investment	40.23	3.64	56.12	33.97	5.1	60.93
34	Loan Repayment	38.34	4.52	57.14	31.92	6.27	61.81

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