info brief

August 2024 https://www.cifor-icraf.org

Promotion of 'Low Carbon Agriculture' (LCA) in India

AUTHORS:

Nandini Kelkar, Tesfaye Woldeyohanes, Leigh Winowiecki, Tor Vagen, Karl Hughes, Shiv Dhyani, Chandrashekhar Biradar, Rupesh Bhomia, Noor Jamal (Finance Advisor), Ravi Prabhu (Special Advisor)

1. Executive Summary

This policy brief emphasizes the importance of implementing Low Carbon Agricultural (LCA) practices on large scale and establishes a framework for their monitoring. Drawing from significant positive outcomes observed during the initial pilot implementation, this document provides key highlights on the adoption of LCA practices and analysis of its benefits, including improved soil health and socioeconomic outcomes. This document serves as an essential guide for policy makers, researchers, and implementing agencies offering strategic insights and practical guidance for scaling LCA practices.

2. Introduction

2.1 Background

India's agricultural sector has been a significant contributor to greenhouse gas (GHG) emissions. Implementing Low Carbon Agriculture (LCA) practices is essential to curb these emissions while ensuring sustainable agricultural growth. LCA practices encompass a range of sustainable farming techniques designed to reduce carbon footprints, to enhance soil health and to boost crop yields. These practices not only contribute to environmental health but also ensure long-term agricultural productivity.

To promote LCA activities, the Low Carbon Agriculture (LCA) programme, supported by the Children's Investment Fund Foundation (CIFF), partnered with the Aga Khan Foundation India (AKFI) and Aga Khan Rural Support Program India (AKRSPI) to engage 18,000 farmers in Gujarat, Madhya Pradesh, and Uttar Pradesh. The three years initiative (2021-2023) aimed to reduce carbon emissions and to enhance carbon sequestration by promoting the use of sustainable practices like optimized water use, reduced chemical inputs, and organic farming. Collaborating with organizations like the Foundation for Ecological Security (FES) and the National Coalition of Natural Farming (NF Coalition), the LCA programme sought to build a resilient agricultural sector, improve farmers livelihoods and contribute to climate change mitigation.

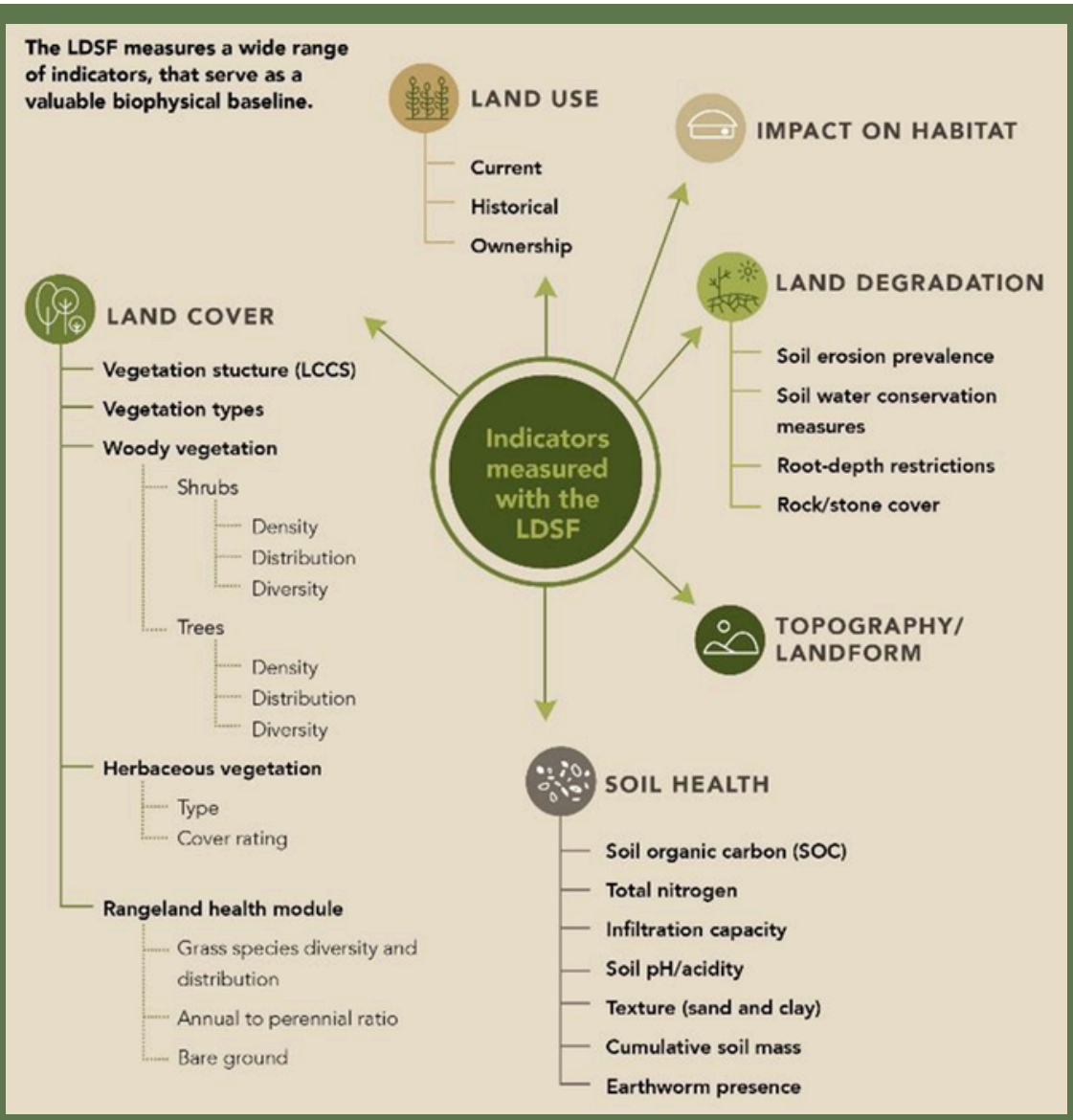
3. Methodology

3.1 Land Degradation Surveillance Framework (LDSF)

- **Description:** The LDSF is a scientific tool for assessing land health by focusing on indicators such as soil organic carbon, soil *pH*, nitrogen content of soil, soil texture, soil erosion prevalence, vegetation covers etc.

- **Application:** Used to monitor the changes in these indicators due to implementation of LCA practices relying on field measurement and geospatial data.

- **Outputs:** High-resolution maps of soil health indicators and identification of critical areas requiring intervention.



3.2 Farm Family Survey

- **Description:** A field-based activities and household socioeconomic surveys that capture data on farming practices, asset ownership, food security status, coping strategies behaviours from a representative farming family.

- **Application:** Conducted at baseline (2022), midline or follow-up (2023) and endline (2024) to track changes in the adoption of LCA practices and understand the socioeconomic benefits and identify barriers to scaling these practices.

- **Outputs:** Adoption rates of LCA practices, insights into the socioeconomic benefits of implementing LCA practices across varying agroecological landscapes in three states.

4. Findings

4.1 Key Findings from LDSF

pH: Overall, not much variation in soil *pH* was observed at Sayla. At Jhirnya, slight depth-wise variation and plot-wise variation was noted but the change was not significant. Significant increase in *pH* of Topsoil and Subsoil of LCA plot over non-LCA at Bahraich shows positive impact as the increase in pH of both Topsoil and Subsoil of LCA plots are towards neutral class. The shift of soil *pH* was a good sign possibly leading to higher nutrient availability.

Soil Organic Carbon: Notable improvements in soil carbon levels in regions practicing low carbon agriculture were observed. This probably indicates extended adoption of LCA practices on long term basis to achieve sustainable positive change.

Nitrogen Content: Higher content in Topsoil of LCA plots was noticed than non-LCA plots at Sayla while nitrogen content was found to be higher in Topsoil and Subsoil of LCA plot than non-LCA plot at Jhirnya. Bahraich site showed improvement in LCA plots over non-LCA plots.

Our results further show proper selection and long term implementation of ecosystem specific LCA practices can add to the organic carbon and nitrogen content substantially.

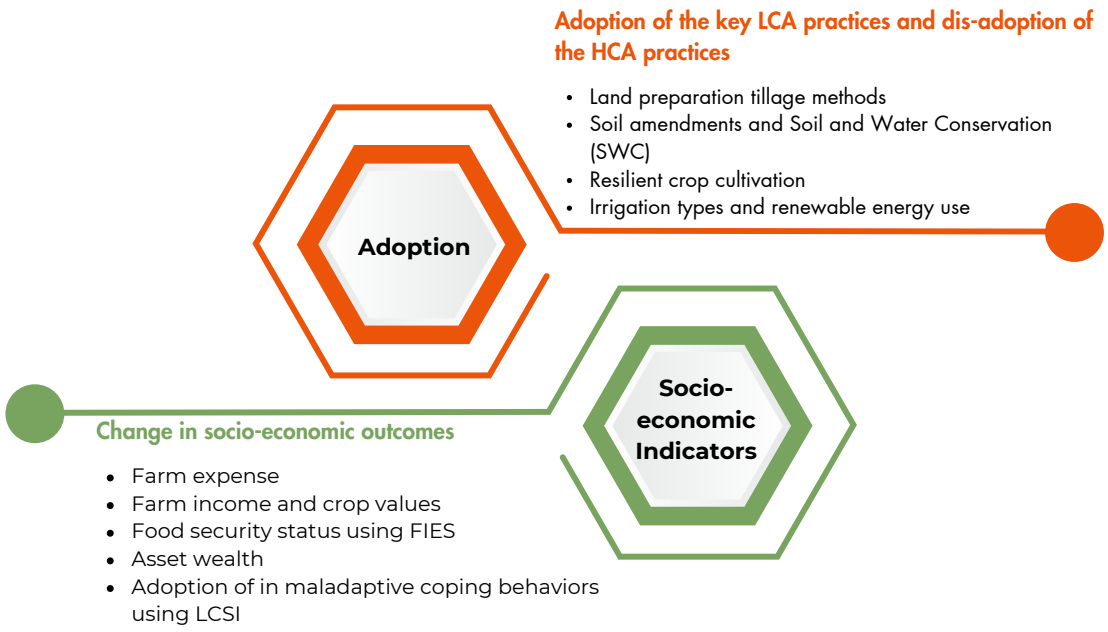
Texture (sand, silt and clay contents in %): The Sayla site showed dominance of sand content and textural class as 'Sandy loam'. Further, improvement in clay and silt percentage in Topsoil of LCA plots over non-LCA plots was seen along with decline in sand content at Sayla. These changes were statistically significant. Slight replacement of high values of sand content by clay in case of Sayla (Gujarat) may add to improvement in soil water holding capacity. At Jhirnya site, overall textural class was observed as 'Sandy clay loam' along with non-significant depth-wise and plot-wise variation. Looking to texture at Bahraich, it was classified as 'Sandy loam' along with no significant variation.

Soil Infiltration: The single-ring infiltration test, which is a robust method, was used for calculating infiltration rates. From the results, we observed no significant variation plot-wise and also location-wise.

Land Cover/Use Classification: In all three project locations, agroforestry systems were less common, with annual crops prevailing over trees. This highlights the need to increase tree cover as well as pasture, which could ultimately lead to improvements in soil and ecosystem health.

4.2 Key Findings from Farm Family Survey

The two important indicator dimensions from the farm family survey highlighted are:



- **Increased Adoption of LCA Practices:** The adoption of Low Carbon Agriculture (LCA) practices among surveyed households showed significant changes between 2021 and 2024. At the baseline in 2021, 13% of households did not adopt any LCA practices, with most households adopting between one to three practices. By the endline (Kharif 2023), this percentage of non-adopters of LCA practices reduced to 2.9%, while a notable increase was observed in households adopting two to four practices, highlighting increased intensification of LCA and dis-adoption of HCA practices. Specifically, the percentage of households adopting two practices increased from 27% to 34%, three practices from 18% to 24%, and four practices from 11% to 13%. There is a big variation across the three states. Gujarat showed the most comprehensive adoption of multiple LCA practices, with the highest percentage of households adopting three or more practices, while Uttar Pradesh saw significant growth in households adopting two or more practices. In contrast, Madhya Pradesh had more households adopting one or two practices, but fewer adopting more than three, indicating varying levels of engagement and intensity in LCA adoption across the states, suggesting a need for tailored strategies to enhance further adoption.

- **LCA Intensification Index:** We identified 16 LCA practices promoted across the three states and constructed a weighted LCA index to understand the level of intensification.The overall index showed a slight improvement across the surveyed households. This indicates a gradual but positive shift towards more sustainable low-carbon agricultural practices, although the index remained relatively low due to the limited number of practices adopted.

Like the number of practices adopted, we observe some variations in the gains of the LCA index across the three states. In Gujarat and Uttar Pradesh, the LCA Index demonstrated significant progress whereas in Madhya Pradesh the adoption decreased statistically significant.

Adoption by types of Practices:

- **Soil Treatment Practices:** There are some shifts towards biofertilizers and organic soil amendments, specifically in Gujarat, the overall reliance on chemical fertilizers and the lack of adoption of natural farming practices persist across the three states
- **Crop Protection Practices:** The use of chemical pesticides has considerably dropped in both Gujarat and Uttar Pradesh. However, the use of natural pesticides has significantly increased only in Uttar Pradesh. The project encouraged the use of bio-inputs, promoted IPM practices, and established bio-input centers, particularly in Uttar Pradesh and Gujarat.
- **Tillage Practices:** There has been no significant change in these practices compared to the baseline.
- **Soil Cover Practices:** A significant increase in the proportion of farmers reporting the use of pre-crop soil cover in Gujarat in Kharif 2023 (endline) compared to Kharif 2021 (baseline). Boundary trees, which are widely practiced across the three states, saw a slight increase only in Madhya Pradesh and Uttar Pradesh, compared to the baseline.
- **Soil and Water Conservation Practices:** A decrease in the adoption of SWC practices compared to the baseline. Farm bunding remains widely used across the three states, although its use also showed a slight decline in the latter seasons, as indicated in the endline survey.
- **Cultivation of Resilient, High Nutrition and Nitrogen Fixing Crops:** No significant changes in production patterns were observed across the two Kharif seasons, although a few more farmers in Gujarat and Madhya Pradesh began cultivating crops like soybeans.
- **Irrigation Types:** Less water-efficient and unsustainable methods like flood irrigation are widely practiced across the three states, especially in Uttar Pradesh and Gujarat. Encouraging efficient irrigation techniques and providing necessary incentives and resources are crucial for promoting sustainable agriculture and ensuring water conservation in these regions.
- **Energy Sources for Irrigation:** In Uttar Pradesh, diesel is a common energy source for irrigation, while electricity is more prevalent in Madhya Pradesh and Gujarat. Though use of energy-efficient and low-carbon sources, such as solar pumps, showed a slight increase in UP. This indicates that farmers are beginning to diversify their energy sources for irrigation from diesel to electric and solar. However, the project's support to increase the use of energy-efficient irrigation systems did not lead to significant uptake.
- **Livestock Feed:** The overall composition of feed sources remained largely unchanged but there was a notable increase in the proportion of households in Gujarat reporting the use of plant/tree leaves and stems as livestock feed, rising from less than 1% to over 12%

Impact of LCA Practices Adoption

The project examined whether households that

a) Intensified their overall LCA practices (as measured by the LCA index) and
b) Upscaled LCA practices and accumulated more assets, developed adaptive capacity, experienced less food insecurity and improved farm income at the endline compared to the baseline situation.

- **Household Asset Wealth:** Results observed a significant gain in the overall asset index for the sampled households compared to the baseline. The largest asset gains were experienced by households in Gujarat, followed by Uttar Pradesh, while the change was smaller in Madhya Pradesh.
- **Livelihood Coping Strategies Index (LCSI):** The results show a decrease in households' use of maladaptive coping strategies compared to the baseline across all states. At the endline, 67 % reported less need to engage in maladaptive coping behaviours compared to the baseline, as measured by the change in LCSI.
- **Food Insecurity Experience Scale (FIES) – 8 points:** Overall FIES score showed a notable improvement, with the median score dropping from 2 to 0 on a scale of 8 points. This indicates a significant reduction in food insecurity. 51% of the families reported improvement in their food security as indicated by the change in FIES.
- **Net Farm Income:** The results show that 33% reported at least a 10% increase in crop income after adjusting for inflation. In Gujarat, 35% saw income gains, likely due to adopting biofertilizers and reducing chemical inputs. Uttar Pradesh had the highest improvement, with 50% reporting increased income, likely due to a shift towards natural pesticides and biofertilizers that enhanced soil health and yields. However, only 50 farmers in Madhya Pradesh (14%) experienced income gains, possibly due to lower adoption or effectiveness of these practices, influenced by limited local support and training.

5. Recommended Actions

By taking into account, considerably positive impact of LCA interventions during short period of project duration, following policy level actions may be suggested.

5.1 Policy Recommendations

- **Incentives for LCA Adoption:** Provide financial incentives such as subsidies and carbon credits to encourage farmers to adopt LCA practices.
- **Strengthen Extension Services:** Strengthen agricultural extension services to provide technical support to farmers.
- **Public-Private Partnerships:** Promote collaborations to drive innovation and scale LCA practices.

5.2 Capacity Building

- **Farmer Training Programs:** Large-scale training initiatives to educate farmers on LCA practices.
- **Awareness Campaigns:** Nationwide campaigns to raise awareness of the benefits of LCA.

5.3 Research and Development

- **Investment in R&D:** Support research

a) To develop set of ecosystem specific LCA practices and technologies.
b) To establish framework for their monitoring and evaluation.

- **Pilot Projects:** Implement pilot projects to test and refine LCA practices before scaling.

6. Implementation Strategy

6.1 National and State-Level Programs

- **National LCA Program:** A flagship national program to coordinate LCA efforts across India.
- **State Initiatives:** State-level programs tailored to local conditions with central government support.

6.2 Resource Mobilization

- **Funding:** Secure funding through national budgets, international climate finance, and private investments.
- **Technology Transfer:** Facilitate the transfer of LCA technologies to farmers.

6.3 Stakeholder Engagement

- **Government Coordination:** Foster coordination among ministries and departments.
- **Farmer Involvement:** Engage farmers in the policy-making and implementation processes.
- **Research Collaboration:** Partnership with research institutions for scientific backing.

7. Conclusion

Low Carbon Agriculture presents an opportunity for India to achieve sustainable agricultural development while addressing climate change. By adopting a comprehensive and scientifically grounded policy framework, India can lead the way in transforming its agricultural sector into a model of sustainability and resilience.

Acknowledgements

We are profoundly grateful to the Children's Investment Fund Foundation (CIFF) for the financial support. We deeply acknowledge all those who directly or indirectly in presence or in absence have helped make this project success.

Annexure

Materials related to the Land Degradation Surveillance Framework (LDSF):

- **LDSF Webpage:** *https://ldsf.thegrit.earth/*
- **LDSF Field Manual:** *https://www.cifor-icraf.org/knowledge/publication/25533/*

References

- FAO, 2020. "Low Carbon Agriculture for Sustainable Development."
- World Bank, 2021. "Land Degradation Surveillance Framework (LDSF)."
- UNEP, 2022. "Sustainable Farming Practices in Developing Countries."
- Government of India, 2023. "National Action Plan on Climate Change (NAPCC)."