Project Report

Expansion of Sunflower Areas in Paddy Fallows

15 August 2025

Submitted to
National Food Security Mission-Oilseeds
Ministry of Agriculture & Farmers Welfare (MoAFW)
Government of India

ICRISAT
INTERNATIONAL CROPS RESEARCH INSTITUTE FOR THE SEMI-ARID TROPICS

कृषि एवं किसान कल्याण मंत्रालय
MINISTRY OF AGRICULTURE AND FARMERS WELFARE
सत्यमेव जयते

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Title: Expansion of Sunflower Areas in Paddy Fallows: Insights from the NFSM-Oilseeds Initiative Across Six Indian States (2024-25)

Authors: Manzoor Dar, Amrita Pal, Vinay K Sonkar, Randhir Singh, Anil Gaddameedi, Kumara Charyulu Deevi, Sean Mayes, R.K.Mathur and G.D. Satish Kumar.

Contributors: Chakradhara Panda, Pradipta K Sen, Pradeep K Sethi, Saba Afreen, Samiul Islam, Adnan Khan, Syed Maaz Ahmed, Hitesh K Sahu, Ashis K Mohapatra, Birendra K Dharua, Harish Chandra Pramanik, Mihir K Jena, Sunil K Ram, Rakesh K Sen.

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Executive Summary

India, despite being the fourth-largest producer of oilseeds globally with an output of 39.67 million tons in 2024, remains heavily dependent on imports to meet nearly 60% of its edible oil demand. This dependence burdens the country's foreign exchange reserves and points out the underutilization of vast post-monsoon rice fallows. To address this strategic gap, a multi-state initiative was launched under the National Food Security Mission (NFSM)-Oilseeds to promote **sunflower cultivation in 8,000 hectares of rice fallows** across six states-**Bihar, Chhattisgarh, Jharkhand, Karnataka, Odisha, and West Bengal**-during the 2024–25 *rabi* (post-monsoon) season.

Sunflower, due to its low water requirement, adaptability to residual soil moisture, and high oil content, is one of the climate-resilient and economically viable crop for rice-fallow intensification. The initiative led by ICRISAT with support from MoAFW to boost sunflower cultivation in rice fallows was rooted in scientific planning and participatory outreach, backed by geospatial targeting, soil testing, and alignment with agro-climatic suitability. **Eighteen districts** were selected based on land availability and institutional readiness, with **Odisha accounting for the highest area coverage (4,600 ha)**, followed by Karnataka, Bihar, and West Bengal (1,000 ha each), and pilot-scale operations in Jharkhand and Chhattisgarh (200 ha each).

A total of **16,871 farmers** participated in the initiative, **44.8% of whom were women**, emphasizing strong gender inclusivity. Women's participation was particularly high in Jharkhand (98.7%), Odisha (60.8%), and Chhattisgarh (60.1%), achieved through targeted mobilization via SHGs and training programs. The intervention covered **420 farmer training sessions** and **19 officer-level trainings**, equipping over **8,400 stakeholders** with technical knowledge on agronomy, post-harvest handling, and value addition.

Adoption intensity was high, with farmers allocating an average of **33.8% of their total landholdings** to sunflower, peaking at 58% in Karnataka. Rice remained the dominant *kharif* crop (97.1% of participants), validating the suitability of fallow intensification through sunflower in these rice-dominated systems. Crop performance monitoring, field observations, and feedback from farmers confirmed improved seed filling, uniformity, and oil content in bee-supported plots.

The initiative also successfully linked production with early-stage **market and value chain development**. **Farmer Producer Organizations (FPOs)** played a key role in aggregation, procurement, and establishing market linkages. In Odisha, over **51.3% of farmers sold sunflower to processors**, while Karnataka showed the highest proportion (**62.8%**) of processor-linked sales. Conversely, farm gate sales dominated in states like West Bengal, Jharkhand, and Chhattisgarh, indicating a need for improved aggregation and marketing infrastructure.

Soil testing of **640 samples** revealed critical deficiencies in organic carbon, phosphorus, sulphur, calcium, boron, and zinc, highlighting the need for **site-specific nutrient management**. The use of short-duration (82-85 days) hybrid sunflower variety KBHS-78, combined with conservation tillage and nutrient supplementation, enabled cultivation in low-input, moisture-limited conditions.

The integration of **150 beekeeping demonstration units** (110 in Karnataka and 40 in Odisha) served both ecological and economic functions—enhancing sunflower yields through improved pollination and offering an additional income stream from honey production. These units catalyzed local interest in beekeeping, especially among women's groups in tribal districts.

The initiative's social equity lens is reflected in its outreach to marginalized groups-**Scheduled Tribes (STs) comprised 36.6%** and **Other Backward Castes (OBCs) 41.2%** of all participants. Jharkhand and Chhattisgarh had the highest ST representation at **76.1% and 83.7%**, respectively. Tailored engagement strategies ensured the inclusion of communities traditionally excluded from high-value crop cultivation and market systems.

By aligning with national priorities of reducing edible oil imports, enhancing farmers' incomes, and promoting gender-responsive climate-smart agriculture, the project directly contributes to several **Sustainable Development Goals** (SDG 1 - No Poverty, SDG 2 - Zero Hunger, SDG 5 - Gender Equality, SDG 12 - Responsible Consumption and Production, SDG 13 - Climate Action and SDG 17 - Partnerships for the Goals).

In conclusion, the sunflower intensification initiative presents a **replicable and scalable model** of sustainable agricultural development that leverages underutilized land, empowers women and marginalized farmers, strengthens ecological services, and establishes value chains in dryland systems. Going forward, institutional convergence, capacity building for processing enterprises, and policy support on Minimum Support Price (MSP) and procurement will be essential to consolidate gains and sustain momentum.

1. Project Background

India continues to grapple with a substantial deficit in edible oil production, a challenge with both economic and nutritional implications. Despite being the fourth-largest producer of oilseeds globally in 2024-with a production volume of 39.67 million (396.7 lakh) tons— domestic supply remains insufficient to meet growing market demand. As a result, the country imports nearly 60% of its edible oil requirements. This dependence exposes the economy to global market fluctuations and imposes a considerable burden on foreign exchange reserves. It also reflects the underutilization of the country's agroecological potential, particularly in regions where vast tracts of cultivable land remain fallow during the post-monsoon (*rabi*) season.

One of the most promising opportunities to address this gap lies in the productive utilization of rice fallows that remain uncultivated after the *kharif* rice harvest. These fallows, widespread across eastern, central, and southern India, are often left unused due to constraints such as inadequate irrigation, limited access to quality inputs, and the absence of suitable crop varieties. However, the increasing availability of short-duration, climate-resilient oilseed varieties opens new avenues for agricultural intensification. Among these crops, sunflower emerges as a highly suitable crop due to its easy agronomic and economic advantages.

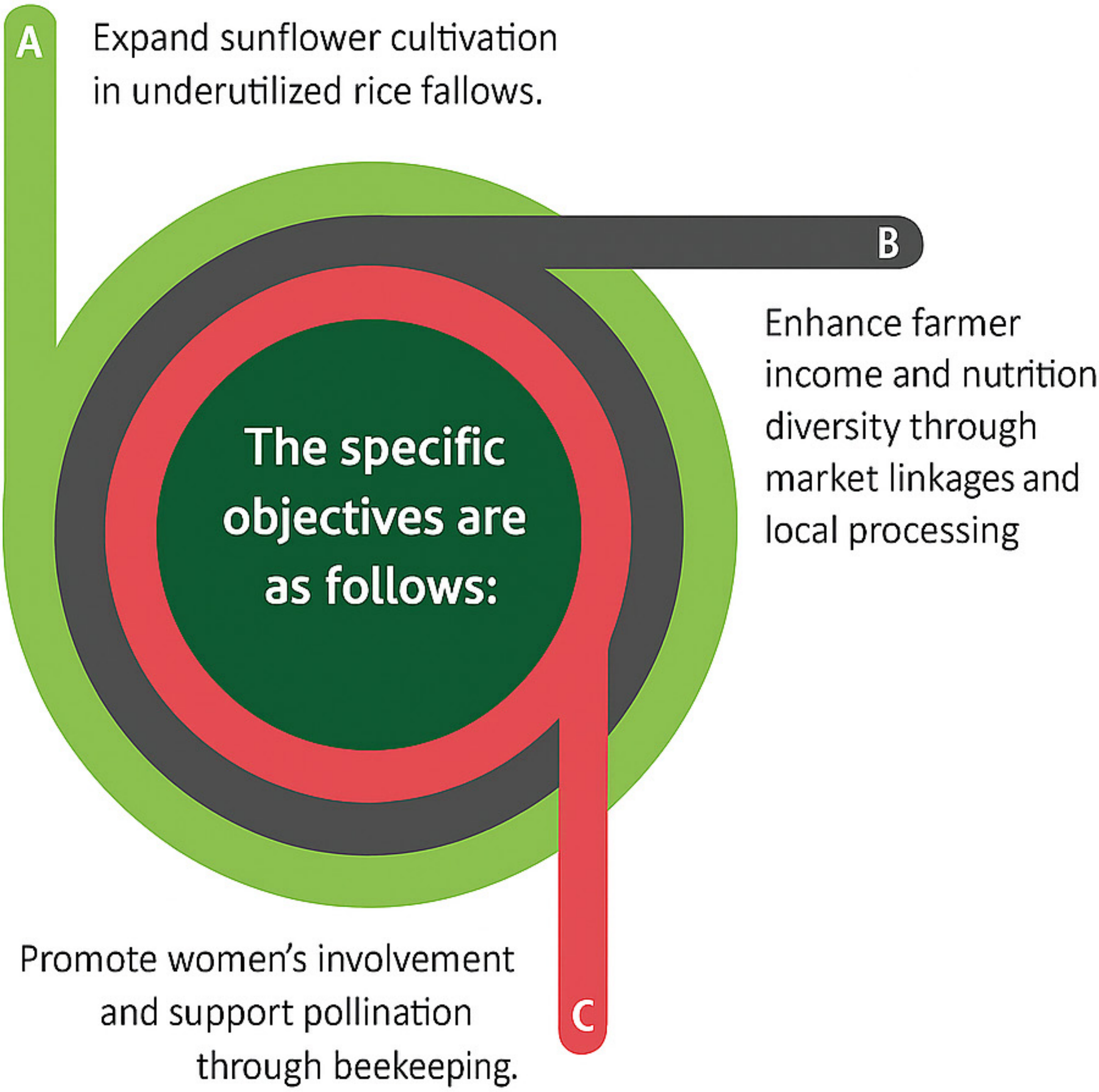
Sunflower is one of the oilseed crops that requires relatively low water and is well adapted to diverse agro-climatic conditions. Its cultivation fits well within the residual moisture window of rice fallows, allowing farmers to intensify land use without significant additional investment in irrigation. The crop is responsive to improved agronomic practices and offers favorable market prospects due to its high oil content and its utility in both edible oil and value-added products. Moreover, sunflower enhances ecological sustainability by supporting pollination, especially when integrated with honeybee demonstrations, as implemented in this project. All these attributes position sunflower as a strategic crop for promoting climate-smart intensification in rice-fallow systems as a viable option for the farmers.

Recognizing these current challenges, the initiative was conceptualized as a scalable, field-tested solution that leverages the untapped potential of rice fallows to strengthen India's self-reliance in oilseed production. It builds on evidence from earlier interventions and agroecological assessments that demonstrated the suitability of sunflower for cultivation under residual moisture conditions, as well as the willingness of smallholder farmers, particularly women, to adopt a short-duration high-value crop. The intervention goes beyond input support to encompass the capacity building of small and marginal farmers, promotion of pollination support through honeybee demonstrations, and market-oriented value chain integration. By embedding this approach within public-private extension systems and aligning it with NFSM priorities, this initiative offers a replicable model for climate-resilient and inclusive agricultural intensification in the country.

The current initiative, implemented under the aegis of the NFSM-Oilseeds, is closely aligned with the Government of India's broader agricultural development agenda. The program supports the national objective of reducing import dependency in edible oils by expanding domestic production through efficient land use and improved farming practices. It also advances the vision of doubling farmers' income by introducing market-oriented, high-value crops into underutilized areas. Notably, the intervention emphasizes gender inclusivity by actively promoting the participation of women farmers and SHGs in production, training, and value addition activities.

In addition to addressing national policy goals, the project directly contributes to several Sustainable Development Goals (SDGs), including SDG 1 (No Poverty), SDG 2 (Zero Hunger), SDG 5 (Gender Equality), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action), and SDG 17 (Partnerships for the Goals). By fostering sustainable intensification, enhancing resource-use efficiency, and creating equitable livelihood opportunities, the sunflower area expansion initiative exemplifies a systems-oriented approach to agricultural development.

2. Project Objectives

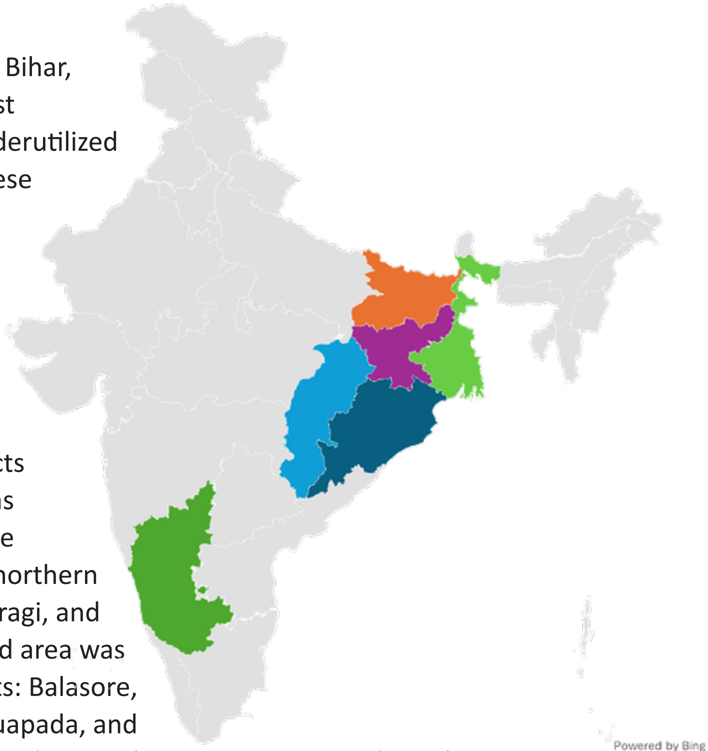


3. Project Implementation

The implementation of the sunflower area expansion initiative was grounded in a multi-layered strategy that combines scientific planning, geographic targeting, and participatory outreach. This approach ensured that interventions were context-specific, resource-efficient, and aligned with both national priorities and local needs. This section outlines the geographic coverage of the initiative and the agroecological characteristics of the intervention areas.

3.1. Geographical Coverage

The sunflower expansion initiative under the NFSM-Oilseeds was implemented across six states namely - Bihar, Chhattisgarh, Jharkhand, Karnataka, Odisha, and West Bengal, covering a total area of 8,000 hectares of underutilized rice fallows during the 2024-25 *rabi (dry)* season. These states were selected based on the prevalence of post-monsoon fallows, agroecological suitability for sunflower cultivation, and the readiness of implementing partners at the state and district levels.



A total of 18 districts across 6 states were identified and included for the intervention. In Bihar, the districts of Araria and Supaul were targeted, while Sarguja was selected in Chhattisgarh. In the case of Jharkhand, the interventions were focused on Jamtara. Karnataka's northern dry zones were represented by Bidar, Bijapur, Kalaburagi, and Yadgir districts. In Odisha, where most of the targeted area was concentrated, the intervention spanned eight districts: Balasore, Gajapati, Ganjam, Kalahandi, Koraput, Malkangiri, Nuapada, and Rayagada. In West Bengal, the project was implemented in Purulia and South 24 Parganas.

This multi-state coverage ensured both regional representation and agroclimatic diversity. The geographical spread allowed the project to demonstrate the adaptability of sunflower cultivation across distinct agroecologies from humid coastal regions and plateau zones to dryland belts and tribal-dominated districts. Table 1 presents a detailed depiction of state and district-wise coverage accompanied by area targets and achievements.

Table 1: State and districts under sunflower front-line demonstration (2024-25)

State	Area (ha)	Districts
Bihar	1000	Araria and Supaul
Chhattisgarh	200	Sarguja
Jharkhand	200	Jamtara
Karnataka	1000	Bidar, Bijapur, Kalaburagi, and Yadgir
Odisha	4600	Balasore, Gajapati, Ganjam, Kalahandi, Koraput, Malkangiri, Nuapada and Rayagada
West Bengal	1000	Purulia and South 24 Parganas

3.2. Target Area Characterization and Assessing its Suitability

The intervention areas were characterized in detail prior to implementation to ensure site-specific planning and resource optimization. The assessment was conducted using remote sensing, Geographic Information System (GIS)-based mapping, and secondary data on agroecological parameters. High-resolution satellite imagery was used to identify actual fallow tracts within the selected districts, allowing precise targeting of intervention zones.

The project spans a range of agro-climatic zones, including Eastern Plateau and Hills, Eastern Coastal Plains, Southern Dry Zones, and the Chhota Nagpur Plateau. Soil types in these regions vary from red and lateritic soils in Odisha and West Bengal to alluvial soils in Bihar and black soils in Karnataka. These variations influenced input packages and agronomic recommendations tailored to local conditions.

Rainfall patterns across the project sites range from 900 to 1,400 mm annually, predominantly received during the southwest monsoon (June to September). Given the seasonal nature of precipitation, the targeted fallow lands are typically devoid of irrigation infrastructure and rely heavily on residual soil moisture for post-monsoon cropping systems.

Sunflower variety KBHS-78 was identified as a viable option owing to its moderate moisture requirement, short growing season (90–100 days), and compatibility with zero or minimum tillage practices. This made it suitable for cultivation in low-input, water-constrained environments such as those found in rice fallows. The agronomic strategy emphasized minimum soil disturbance, line sowing, integrated nutrient management, and use of region-specific improved varieties and hybrids.

The comprehensive target area characterization thus served as the scientific foundation for input distribution, demonstration plot placement, soil sampling strategy, and training curricula, etc., all of which were tailored to ensure ecological fit and optimize yield performance across locations.

3.3. Inception Meeting and Stakeholder Mobilization

On 16 August 2024, ICRISAT HQ organized a comprehensive inception meeting and planning workshop for the 2024-25 implementation cycle. The workshop brought together key stakeholders from across partner institutions, including representatives from state agriculture departments, Krishi Vigyan Kendras (KVKs), All India Coordinated Research Project (AICRP) on Sunflower, seed companies, and NGOs involved in last-mile delivery. The meeting aimed to lay a strong foundation for the coordinated implementation of the sunflower expansion initiative across the target states.

Key objectives of the meeting included finalizing the selection of districts and demonstration sites based on GIS and remote sensing data; identifying suitable sunflower cultivars adapted to rice fallow conditions; planning seed sourcing and timely distribution mechanisms; and aligning all partners on the package of practices to be promoted. Experts from the Indian Council of Agricultural Research – Indian Institute of Oilseeds Research (ICAR-IIOR), Odisha University of Agriculture and Technology (OUAT), and ICRISAT presented scientific insights on variety suitability, agronomic management, and area characterization, while ICRISAT also facilitated discussion on value chain development and decentralized processing opportunities through agri-incubation support. The digital monitoring framework was also introduced for real-time tracking of implementation progress.

Deliberations also emphasized the need for decentralized oil extraction facilities, strengthening FPOs and SHGs partnership for cluster-based interventions, and building capacity for large-scale farmer training and market linkage development. The workshop concluded with a joint planning session that established clear timelines and activity plans for each partner, ensuring shared accountability and readiness ahead of field deployment. This collaborative planning effort ensured technical rigor, operational clarity, and institutional alignment for the successful rollout of the sunflower intensification program.

4. Methodology

The implementation of the sunflower expansion initiative was guided by a data-driven, participatory, and inclusive methodology designed to ensure both geographic relevance and social equity. The selection of target areas and beneficiaries was based on objective agroecological criteria and institutional readiness, while technical interventions were tailored to optimize sunflower productivity in rice fallows. This section details the methodological framework that underpinned the initiative.

4.1. Selection of States/Districts

The selection of states was pre-determined by the Government of India, but the districts were selected by three principal criteria: (i) the extent of underutilized rice fallows, (ii) agro-climatic suitability for sunflower cultivation, and (iii) institutional capacity and implementation readiness of partners. Secondary data, GIS and remote sensing, and field reconnaissance were used to identify regions with significant fallow land potential following the *kharif* rice harvest.

Based on these criteria, we identified the districts in the following states—Bihar, Chhattisgarh, Jharkhand, Karnataka, Odisha, and West Bengal—and the selection was undertaken in consultation with State Agricultural Departments, Krishi Vigyan Kendras (KVKs), and NGO partners. A total of 18 districts were finalized, ensuring a wide representation of agroecological conditions ranging from high rainfall coastal areas to moisture-deficit drylands and uplands.

4.2. Selection of Farmers

The selection of beneficiary farmers was carried out in a participatory manner, with active involvement of local institutions such as SHGs, FPOs, and Panchayati Raj Institutions (PRIs). Priority was given to smallholders and marginal farmers, particularly those who had not previously cultivated *rabi* crops on their land. Special emphasis was placed on the inclusion of women, Scheduled Castes (SC), Scheduled Tribes (ST), and landless farmers through collective cultivation models.

A total of 16,871 farmers were selected, of which 44.85% were women. The mobilization process included awareness meetings, field visits, village-level meetings, and agreement on the adoption of recommended practices. Beneficiaries received comprehensive support, including critical input kits, training, and technical guidance throughout the cropping season.

Table 2: State and District-wise Area and Beneficiaries Covered						
State	District	Allocated Area (ha)	Area Covered (ha)	Total No of Beneficiaries		
				Men (No.)	Women (No.)	Total (No.)
Bihar	Araria	100	100	119	13	132
	Supaul	900	900	1040	269	1309
Chhattisgarh	Sarguja	200	200	159	239	398
Jharkhand	Jamtara	200	200	0	1094	1094
Karnataka	Bidar	100	100	87	12	99
	Bijapur	600	600	76	22	98
	Kalaburagi	200	200	384	76	460
	Yadgir	100	100	104	18	122
Odisha	Balasore	800	800	1116	303	1419
	Gajapati	700	700	0	1506	1506
	Ganjam	600	600	413	1031	1444
	Kalahandi	950	950	564	946	1510
	Koraput	100	100	0	265	265
	Malkangiri	150	150	0	335	335
	Nuapada	1250	1250	1780	286	2066
	Rayagada	50	50	24	135	159
West Bengal	Purulia	950	950	3230	945	4175
	South 24 Parganas	50	50	209	71	280
Total		**8000**	**8000**	**9305**	**7566**	**16871**

4.3. Soil Sample Collection

Systematic soil sampling was conducted across the intervention areas to guide region-specific agronomic recommendations. A total of 661 composite soil samples were collected from farmers' fields in all 18 project districts. The sampling strategy was designed to represent varying soil types and cropping histories across the six participating states.

Samples were analyzed at the Charles Renard Analytical Laboratory (CRAL) at ICRISAT, using standard protocols to assess parameters such as soil pH, organic carbon, macronutrient and micronutrient content, moisture retention capacity, etc. The results revealed considerable spatial heterogeneity in soil fertility, necessitating site-specific nutrient management plans. These findings helped inform decisions in the input distribution and agronomic advisories delivered to farmers.

4.4. Interventions

The project implemented a comprehensive package of interventions, designed to support the entire sunflower cultivation cycle to enhance productivity in low-input environments. Key components included:

- **Input Kits**: Each participating farmer received an input kit comprising hybrid sunflower seed varieties (KBHS-78), micronutrients like borax (to address boron deficiency), need-based pesticides and other applications, and guidance material in local languages.

- **Agronomic Support**: Our team provided on-site technical assistance on line sowing, seed rate, nutrient application, and weed/pest management. We promoted zero-tillage or minimum-tillage to conserve soil moisture.
- **Beekeeping Units**: Demonstrations were established at selected locations (150 Front Line Demonstrations in Odisha and Karnataka) to enhance pollination efficiency and provide a supplementary income stream through honey production.
- **Value Addition and Processing Support**: In response to local demand, preliminary efforts were initiated to support community-level oil extraction and processing. This included awareness on market linkages, identification of potential FPOs, and encouragement of women-led enterprises.

These integrated interventions ensured that farmers not only adopted sunflower as a viable crop in rice fallows but were also linked to appropriate markets and value chains for broadening their livelihood-enhancing opportunities.

5. Findings

The implementation of the sunflower expansion initiative yielded significant insights across agroecological, socio-economic, and institutional dimensions. This section presents the core findings from field-level monitoring and evaluation activities, covering soil health diagnostics, crop performance, beneficiary engagement, and outcomes in training, pollination support, gender inclusion, and value chain integration.

5.1. State-wise Progress

All six participating states achieved full coverage of their allocated sunflower cultivation targets, indicating effective field mobilization and coordination. The largest share of the implementation area was in Odisha (4,600 ha), reflecting its extensive rice-fallow potential and early readiness for this intervention. Other participating states included Karnataka, Bihar, and West Bengal (1,000 ha each), along with Jharkhand and Chhattisgarh, where pilot-scale activities were carried out over 200 ha each. Challenges such as delayed rice harvests and dry sowing windows were addressed through adaptive measures including flexible sowing calendars, advance seed distribution, and intensive field support. Figure 1 presents the state-wise performance in area coverage.

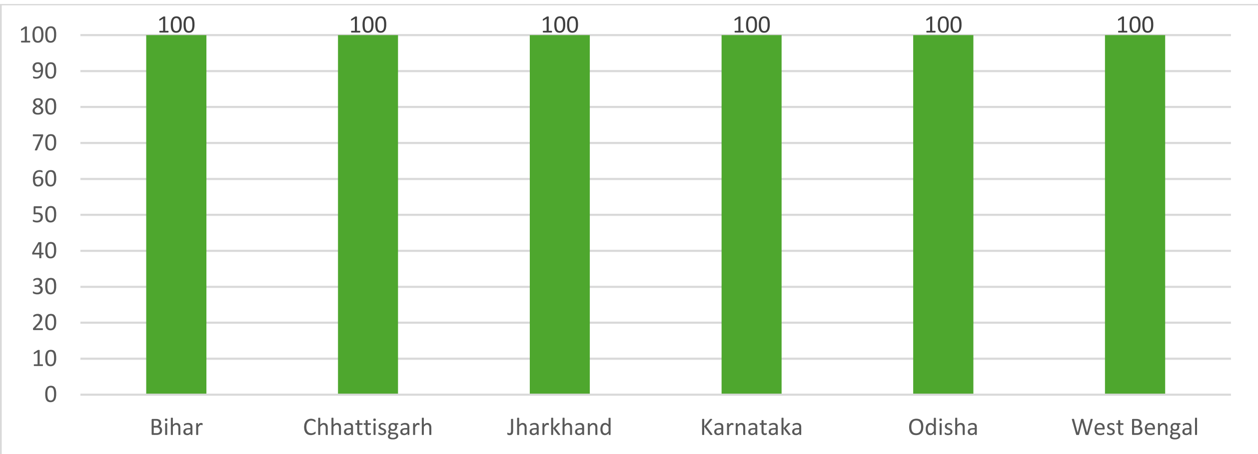


Figure 1: Area Achieved by State (in %) as on March 25, 2025.

5.2. District-wise Progress

All 18 project districts achieved their respective sunflower cultivation targets for the 2024-25 season. Higher area was recorded in districts such as Supaul (900 ha), Nuapada (1,250 ha), and Purulia (950 ha), reflecting a combination of land availability, timely input supply, and effective field-level coordination. The alignment of technical guidance, input provisioning, and farmer training contributed to the smooth and consistent implementation of project interventions. A detailed district-wise summary of the area covered and achieved is provided in Figure 2.

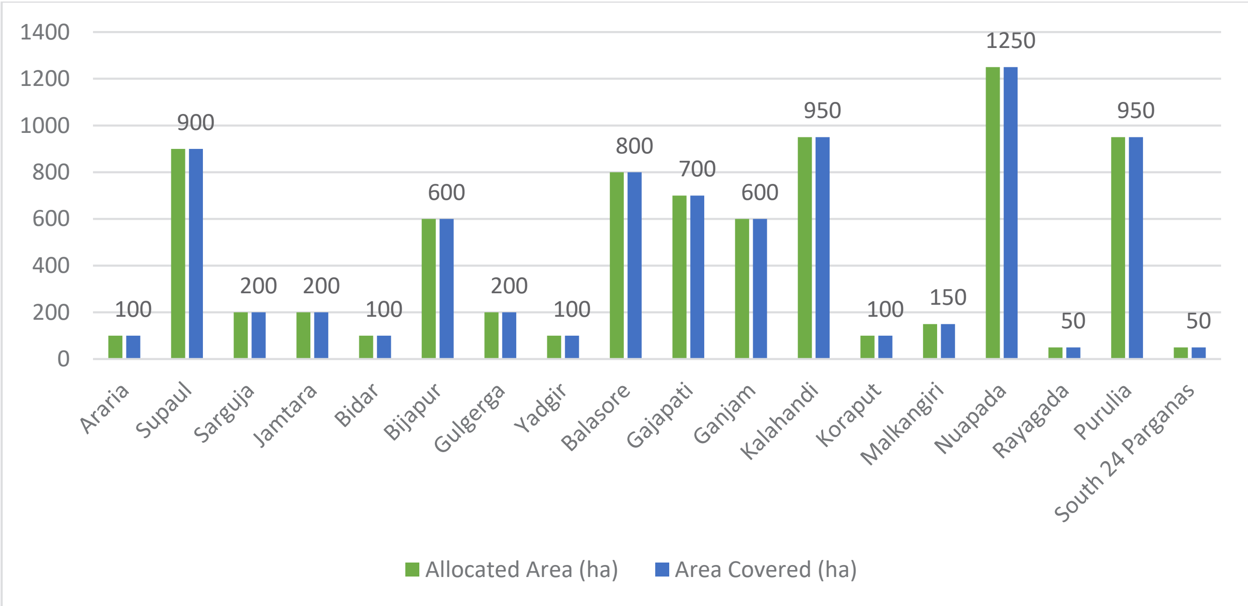


Figure 2: Targeted vs. Achieved Area by District (in Ha) as on March 25, 2025.

5.3. Beekeeping Demonstrations

The integration of honeybee demonstrations into the sunflower cultivation initiative served both ecological and economic functions. Pollination is a critical ecosystem service that directly influences the productivity of cross-pollinated crops like sunflower. Although sunflower is capable of self-pollination to some extent, studies have consistently shown that open pollination by honeybees can significantly enhance seed set, oil content, and yield (Free, 1993; Chandel et al., 2004). Recognizing this potential, the project embedded honeybee promotion as a core intervention in selected demonstration sites.

Table 3: Honeybee Demonstrations – Outreach by State

State	No. of Villages Covered	No. of Demonstrations Conducted	No. of Women Participants	No. of Trained Beneficiaries
Odisha	12	40	48	60
Karnataka	42	110	57	138
Total	54	150	105	198

A total of 150 Front Line Demonstrations (FLDs) on honeybee integration were conducted during the *rabi* 2024-25 season, with 110 sites in Karnataka and 40 in Odisha. The selection of locations was based on cluster-level concentration of sunflower fields to maximize pollination impact. Farmers received technical training on bee-box installation, colony management, seasonal care, and the synergistic relationship between sunflower and bee activity.

5.3.1. Ecological Rationale and Agronomic Benefits

Sunflower exhibits enhanced outcrossing when pollination agents such as *Apis mellifera* and *Apis cerana indica* are present in significant numbers during flowering. The movement of bees between plants increases genetic diversity, leading to:

- Improved seed filling and higher seed weight
- Better uniformity in seed maturity
- Higher oil yield per unit area
- Reduction in seed sterility and deformities

Field observations from the project sites, particularly in Ganjam, Gajapati, and Bidar, confirmed these benefits. Farmers reported visibly more vigorous flower heads, better seed formation, and higher satisfaction with crop quality compared to non-demo plots.

5.3.2. Livelihood and Value Addition Potential

In addition to boosting crop performance, beekeeping introduces a secondary income stream, especially for women and marginal farmers. Participating households in Karnataka and Odisha began small-scale honey harvesting by the end of the cropping season. Although still in the nascent stage, these activities demonstrated the feasibility of localized honey production, with some FPO/SHG groups expressing interest in branding and marketing community-produced honey.

The integration of beekeeping into sunflower cultivation is particularly valuable in tribal and dryland districts, where livelihood diversification options are limited. Women's groups in Odisha (e.g., Nuapada and Rayagada) showed strong enthusiasm. They were supported by NGOs in training and enterprise planning.

5.3.3. Knowledge Transfer and Demonstration Value

Each FLD acted as a practical, field-level knowledge hub. Farmers from surrounding villages visited these plots to observe the beekeeping and sunflower technology demonstrations, attend on-site training, and discuss input requirements. The demonstrations were complemented with Information, Education, and Communication (IEC) materials explaining the mutual benefits of pollination and crop yield.

Table 4: Beekeeping Demonstration Activities by State

State	No. of FLD Plots Established	No. of Training Sessions Conducted	No. of Field Days/ Exposure Visits	No. of Farmers Trained	Women Participants
Odisha	40	8	8	86	23
Karnataka	110	22	22	238	62
Total	**150**	**30**	**30**	**224**	**85**

By linking ecological intensification with economic incentives, the beekeeping demonstrations exemplified the project's broader goal of promoting sustainable intensification as an approach that improves crop productivity while conserving natural resources and enhancing community resilience.

Table 5: State and District-wise Farmers Training Programs						
State	District	Farmers Training Programs				
		Training (No.)	Men (No.) (a)	Women (No.) (b)	Youth (No.)	Total (a + b)
Bihar	Araria	4	150	0	10	150
Bihar	Supaul	30	563	245	252	808
Chhattisgarh	Sarguja	16	185	248	86	433
Jharkhand	Jamtara	54	228	665	0	893
Karnataka	Bidar	2	64	10	6	74
Karnataka	Bijapur	1	28	4	7	32
Karnataka	Kalaburagi	2	84	12	9	96
Karnataka	Yadgir	1	29	6	8	35
Odisha	Gajapati	67	0	1381	0	1381
Odisha	Kalahandi	78	882	476	2	1358
Odisha	Koraput	10	0	165	0	165
Odisha	Malkangiri	10	0	240	0	240
Odisha	Nuapada	63	627	255	0	882
Odisha	Rayagada	8	20	113	0	133
West Bengal	Purulia	45	325	195	0	520
West Bengal	South 24 Parganas	28	178	97	38	275
Total		**419**	**3363**	**4112**	**418**	**7475**

5.4. Farmer Profile: Farm Household Characteristics

Table 6 and Figure 3 illustrate the caste-wise (social group) distribution of farmers who participated in the sunflower FLD initiative across six states and the overall sample. The classification follows the Government of India's social categories: General, Other Backward Classes (OBC), Scheduled Castes (SC), and Scheduled Tribes (ST).

Table 6: Social Group (Caste) Distribution of Beneficiary Farmers (%)							
	Bihar	Chhattisgarh	Jharkhand	Karnataka	Odisha	West Bengal	Total
General	20.4	1.8	0.0	91.3	3.5	19.3	13.0
OBC	71.3	14.3	21.2	4.9	51.3	27.3	41.2
SC	3.4	0.3	2.7	3.8	12.1	9.4	9.2
ST	4.9	83.7	76.1	0.0	33.2	44.0	36.6
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

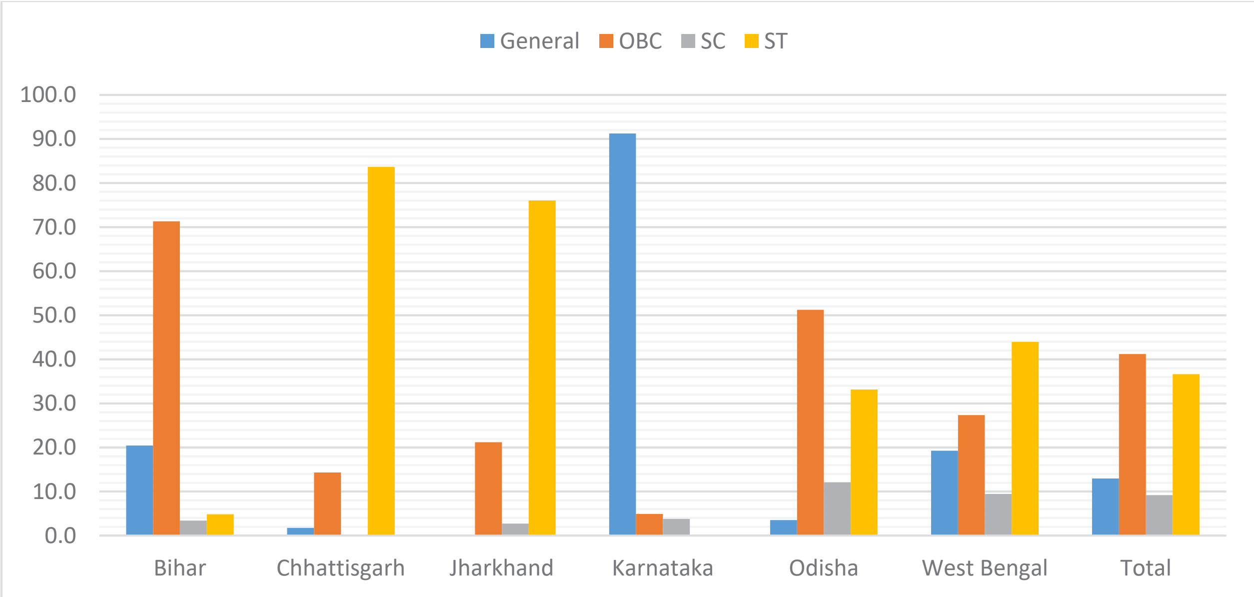


Figure 3: Social Group (Caste) Distribution of Beneficiary Farmers (%).

The data reveals significant regional variation in social group representation across states. In Jharkhand, the program primarily reached Scheduled Tribe (ST) households, accounting for 76.1% of the beneficiaries, reflecting the state's strong tribal demographic profile. This was followed by Other Backward Classes (OBCs) at 21.2%, with negligible representation from the General and Scheduled Caste (SC) categories.

In Odisha, the distribution was relatively more balanced, with OBCs constituting the largest group at 51.3%, followed by STs at 33.2%, and SCs at 12.1%, indicating inclusive outreach among marginalized communities. West Bengal exhibited significant representation from STs at 44.0%, followed by OBCs at 27.3%, and General caste households at 19.3%, highlighting the program's alignment with tribal regions, even in a state known for a notable General caste presence.

Karnataka presented a contrasting scenario, where most beneficiaries were from the General category (91.3%), with limited representation from SCs (3.8%) and OBCs (4.9%), and no participation from ST households, underscoring distinct demographic dynamics. Bihar showed dominance of OBC beneficiaries (71.3%), followed by General caste households (20.4%), with very low representation from SC (3.4%) and ST (4.9%). Chhattisgarh stood out for its extremely high ST representation at 83.7%, highlighting strong engagement with tribal communities.

At the aggregate level, the sample comprised 36.6% Scheduled Tribes, 41.2% OBCs, 9.2% SCs, and 13.0% General caste households. These figures underline the initiative's success in targeting and engaging socially disadvantaged communities, particularly Scheduled Tribes and OBCs, who often face systemic barriers in accessing agricultural support and market-linked interventions.

Overall, this social group distribution affirms the program's focus on social equity, aligning well with government priorities under NFSM and broader development goals. It emphasizes the necessity for context-specific strategies and community-sensitive implementation models, particularly in tribal regions where traditional land-use practices, language barriers, and collective farming systems often require tailored approaches distinct from mainstream agricultural interventions.

Figure 4 presents the gender-wise distribution of farmers participating in the sunflower FLD initiative across states, along with the aggregated figures for the entire program area. It reflects the degree of women's involvement in the initiative and serves as a key indicator of gender inclusivity in project implementation.

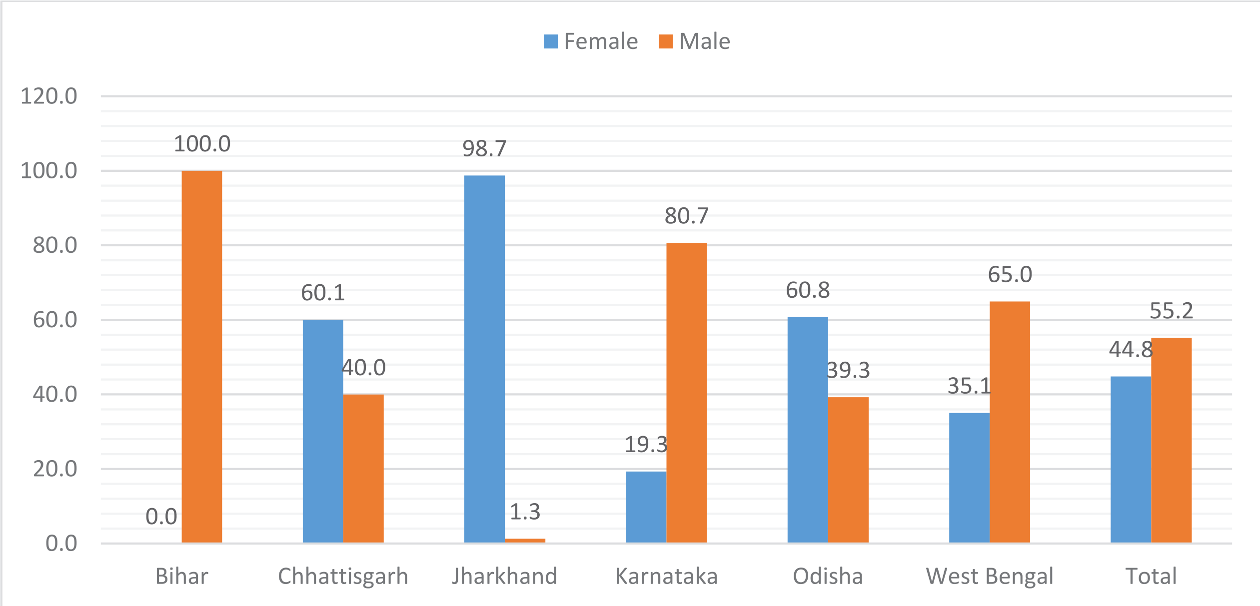


Figure 4: Gender-wise Participation of Farmers (%).

The data reveals notably high participation of women, especially in Jharkhand, where 98.7% of the beneficiaries were female. This significant level of engagement is primarily due to the program's deliberate collaboration with SHGs and women's collectives in tribal regions, where women often play a crucial role in agricultural decision-making and land management. Similarly, in Odisha, women constituted 60.8% of the participants, highlighting effective female farmer engagement, particularly through SHG-driven implementation models in targeted districts. Chhattisgarh also demonstrated substantial female participation at 60.1%, reflecting the initiative's success in reaching women farmers in the region.

Conversely, male participation was notably higher in Bihar (100.0%), Karnataka (80.7%), and West Bengal (65.0%), potentially indicating region-specific norms related to land access, ownership, and agricultural decision-making. At the aggregate level, women comprised 44.8% of all participating farmers, indicating a balanced gender outreach effort across the entire initiative. This level of inclusion is particularly significant given the general trend of underrepresentation of women in formal agricultural programs.

The strong representation of women farmers underscores the program's alignment with national goals and Sustainable Development Goal 5 (Gender Equality). It also validates the project's strategy of leveraging SHGs and women-led groups, not just for production but also for training, monitoring, and potential value addition activities such as beekeeping and oil processing. This gender-inclusive approach enhances both the equity and effectiveness of agricultural interventions by building local capacity, ensuring community ownership, and strengthening the role of women as agents of change in dryland farming systems.

5.5. Land Use and Agronomic Practices

Table 7 presents a comparative overview of average landholding size, total land cultivated under FLDs, and the percentage of landholding allocated to sunflower cultivation under the project across Bihar, Chhattisgarh, Jharkhand, Karnataka, Odisha, and West Bengal.

Table 7: Total landholding, area under FLD, and % FLD area of the total landholding					
	Average Area (in hectare)		Total Area (in hectare)		% FLD area
	Total landholding	Area under FLD	Total landholding	Area under FLD	
Bihar	3.7	0.6	5365.3	920.1	17.1
Chhattisgarh	1.2	0.5	469.3	201.6	43.0
Jharkhand	0.7	0.2	612.4	202.4	33.1
Karnataka	1.6	1.6	1012.1	1012.1	100.0
Odisha	1.3	0.5	9282.2	3765.0	40.6
West Bengal	1.0	0.2	4322.2	1011.3	23.4
Total	**1.4**	**0.5**	**21063.5**	**7112.6**	**33.8**

The average total landholding per farmer varied significantly, from 0.7 hectare in Jharkhand to 3.7 hectare in Bihar, with an overall average of 31.4 hectare across all states. This range indicates the diverse farmer profiles the initiative engaged with, spanning from small and marginal farmers to relatively larger landholders.

The last in the table 7, column representing the percentage of FLD area relative to total landholding provides valuable insights into adoption intensity. On average, 33.8% of total landholdings across all states were allocated to sunflower cultivation within FLD plots. Karnataka demonstrated the highest commitment, with farmers allocating 58% of their total landholdings to FLD cultivation, reflecting strong institutional support and farmer confidence in sunflower cultivation. Chhattisgarh (43.0%) and Odisha (40.6%) also exhibited high levels of adoption, signifying robust institutional engagement and farmer interest. Jharkhand (33.1%) and West Bengal (23.4%) showed moderate adoption levels, while Bihar had the lowest percentage (17.1%), likely influenced by competing agricultural priorities and regional cultivation patterns and preferences.

Overall, the data underscores the project's success in promoting sunflower cultivation as a viable option for enhancing agricultural productivity and farmer incomes across diverse agroecological and socioeconomic contexts. The proportionate high share of FLD coverage suggests that with adequate inputs, training, and technical guidance, farmers are willing and able to diversify cropping systems and allocate significant portions of their landholdings to sunflower cultivation.

5.6. Cropping pattern (*kharif* crops) under FLD areas

Table 8: State-wise, crops cultivated under FLD areas							
	Bihar	Chhattisgarh	Jharkhand	Karnataka	Odisha	West Bengal	Total
Pigeonpea	0.0	0.0	5.7	0.0	0.0	0.0	0.4
Maize	0.0	4.0	9.9	0.0	2.9	0.0	2.2
Paddy	100.0	96.0	82.3	100.0	96.9	100.0	97.1
Vegetable	0.0	0.0	2.2	0.0	0.0	0.0	0.2
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 8 illustrates the cropping patterns (*kharif* crops) across Bihar, Chhattisgarh, Jharkhand, Karnataka, Odisha, and West Bengal, highlighting their cropped area distribution under *kharif* crops by study farmers participating in the initiative. Rice emerged as the dominant *kharif* crop across all states, cultivated by 97.1% of the participating farmers, indicating its crucial role in the regional agricultural economy. It was universally grown in Bihar, Karnataka, and West Bengal (100%), closely followed by Chhattisgarh and Odisha (96% and 96.9%, respectively). Jharkhand also showed high rice cultivation at 82.3%, although it had a relatively higher diversity in cropping patterns.

Jharkhand presented the most varied cropping pattern, including maize (9.9%), pigeonpea/*arhar* (5.7%), and vegetables (2.2%), alongside rice. Chhattisgarh also demonstrated some diversity, with maize cultivated by 4.0% of farmers. Odisha recorded limited maize cultivation at 2.9%. In contrast, Bihar, Karnataka, and West Bengal showed no diversification, exclusively cultivating rice.

Overall, the data clearly indicates rice's predominance, reflecting its importance as a staple crop in these regions during the monsoon season. However, the presence of crops such as maize, pigeonpea, and vegetables, particularly in Jharkhand, underscores the potential and willingness among farmers to diversify into alternative crops, which can help enhance agricultural resilience and improve nutritional outcomes. The proposed diversification strategy could be explored further through targeted interventions to support sustainable cropping systems and agricultural development in the study states.

5.7. Sunflower Sowing Methods

Table 9: State-wise sowing methods

	Bihar	Chhattisgarh	Jharkhand	Karnataka	Odisha	West Bengal	Total
Broadcasting	0.0	21.4	8.5	0.0	41.2	26.7	28.7
Line Sowing	100.0	78.6	91.5	100.0	58.8	73.3	71.3
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 9 shows the distribution of sowing methods used by study farmers for sunflower cultivation across different states. Line sowing emerged as the dominant practice, with 71.3% of farmers adopting this method at the aggregate level. It was exclusively practiced in Bihar and Karnataka (100%) and widely adopted in Jharkhand (91.5%) and Chhattisgarh (78.6%). West Bengal also had substantial use of line sowing (73.3%), though slightly lower compared to other states. Line sowing ensures optimum plant population, enhances resource-use efficiency, and effectively controls the weed population.

Conversely, broadcasting was notably used in Odisha (41.2%) and West Bengal (26.7%), indicating considerable reliance on traditional methods in these states. Lack of access to mechanization was one of the reasons for following the traditional practices. Chhattisgarh (21.4%) and Jharkhand (8.5%) had lower but still significant use of broadcasting. No broadcasting was reported in Bihar and Karnataka. The overall preference for line sowing suggests effective dissemination of recommended agricultural practices, aiming for higher yield and resource efficiency. However, the continued presence of broadcasting highlights the need for targeted training and extension efforts to promote optimal cultivation techniques uniformly across regions. Line sowing improves crop stand, enhances resource-use efficiency, and increases yields by 15–25% compared to broadcasting, resulting in an estimated net income gain of ₹4,000–₹6,000 per hectare.

5.8. Sale points

The data presented in Table 5.10 provides insights into the marketing channels utilized by sunflower farmers across Chhattisgarh, Jharkhand, Karnataka, Odisha, and West Bengal. Farm gate sales emerged as the most common marketing method, accounting for 57.8% of total transactions. This channel was used exclusively in Chhattisgarh, Jharkhand, and West Bengal (100%), indicating a strong preference among farmers in these states for direct, on-farm sales. In Karnataka, farm gate sales accounted for 37.2% of transactions, showing moderate usage.

Odisha displayed the most diversified marketing pattern. While 23.1% of farmers sold at the farm gate, a significant 51.3% sold directly to processors, and 20.8% utilized *mandi* systems. Karnataka also exhibited a significant shift toward processing channels, with 62.8% of sunflower sold directly to processors—highlighting the role of agribusiness linkages in this state.

Overall, processor sales accounted for 28.1% of the total, driven by strong participation in Karnataka and Odisha. Mandi sales formed the smallest segment at 11.4%, limited to Odisha. These variations point to differing state-level market ecosystems and levels of institutional support. The predominance of farm gate sales in several states indicates the need for better aggregation systems, organized procurement models, and infrastructure to strengthen market access. Under the project, efforts are ongoing to encourage processor engagement and build structured procurement pathways that can improve price realization and reduce transaction costs for farmers.

5.9. Soil Fertility and Nutrient Profile

A total of 661 composite soil samples were collected and analyzed across 18 districts in six states to assess the suitability of rice fallows for sunflower cultivation. The results processed at ICRISAT's Charles Renard Analytical Laboratory (CRAL) revealed substantial heterogeneity in key soil parameters, including pH, organic carbon, and macro and micronutrient status. The soil health analysis of sunflower fields across samples in six project states revealed stark agroecological contrasts and critical nutrient constraints affecting the sunflower productivity. Acidity is highly prevalent in Jharkhand, Chhattisgarh, and West Bengal (≥98% acidic soils), demanding urgent lime application and pH correction to enhance nutrient availability. Conversely, Karnataka's soils are predominantly alkaline (92%), indicating potential micronutrient lock-up and necessitating sulphur- and zinc-based amendments. Electrical Conductivity (EC) remained within normal thresholds in 98% of samples, suggesting negligible salinity stress across all states.

Organic carbon deficiency is widespread, particularly acute in Karnataka (68%) and Odisha (40%), pointing to declining soil organic matter and the need for sustained organic enrichment through composting and green manures. Among macronutrients, phosphorus and potassium deficiency is severe in Jharkhand and West Bengal (39–56%), while calcium deficiency is alarmingly high in Jharkhand (94%) and Bihar (58%), impacting plant cell development and root health. Sulphur deficits are prevalent in Chhattisgarh (44%), Odisha (60%), and West Bengal (64%), warranting sulfurous fertilizer supplementation to boost oilseed quality.

Micronutrient deficiencies pose a significant yield barrier, particularly boron, which is critically low across the board (≥80% deficiency in four states), directly affecting flowering and seed formation in sunflower. Zinc deficiency is highest in Bihar (61%), and Karnataka reports the most substantial iron deficiency (46%). However, copper and manganese levels are largely adequate across all sites.

The broad ranges observed across indicators (e.g., pH 4.32–8.6, organic carbon 0.08–1.85%) underscore the high spatial heterogeneity of soil conditions, reinforcing the need for site-specific nutrient management plans. These findings emphasize that scaling sunflower in rice fallows must be accompanied by localized soil health interventions and training on balanced fertilization to ensure sustained productivity and environmental resilience.

Table 10: State-wise percentage deficiency data

State	pH - Acidic	pH - Neutral	pH - Alkaline	EC - Normal	EC - Injurious	OC	Av P	Av K	Av Ca	Av Mg	Av S	Av Zn	Av B	Av Fe	Av Cu	Av Mn	No of samples
Bihar	30	32	39	95	5	18	4	14	58	0	14	61	81	0	0	0	57
Chhattisgarh	100	0	0	100	0	13	13	6	25	0	44	38	63	0	0	0	16
Jharkhand	100	0	0	100	0	28	39	56	94	0	67	6	89	0	0	0	18
Karnataka	0	8	92	97	3	68	46	0	0	0	26	88	17	46	0	0	76
Odisha	44	46	11	98	0	40	13	3	1	19	60	38	89	1	2	2	300
West Bengal	98	1	1	100	0	33	39	34	45	3	64	24	94	0	0	0	80
Grand Total	**48**	**30**	**23**	**98**	**1**	**39**	**21**	**10**	**17**	**11**	**51**	**44**	**78**	**7**	**1**	**1**	**547**

Table 11: State-wise mean data

State	pH	EC	OC	Av P	Av K	Av Ca	Av Mg	Av S	Av Zn	Av B	Av Fe	Av Cu	Av Mn	No of samples
Bihar	7.0	1.0	0.7	40.3	200.3	1215.9	221.9	67.8	1.2	0.4	95.0	2.4	11.4	57
Chhattisgarh	5.6	0.2	0.6	11.3	138.8	1738.6	349.1	11.7	0.9	0.5	102.4	3.0	64.6	16
Jharkhand	5.3	0.1	0.6	6.7	61.6	637.1	189.5	7.9	1.6	0.3	159.4	4.0	29.1	18
Karnataka	8.1	0.5	0.4	8.5	354.8	5756.4	1312.3	32.5	0.4	0.9	4.5	2.0	6.2	76
Odisha	6.5	0.3	0.6	40.8	414.4	1594.4	280.4	11.8	1.5	0.3	66.3	2.1	26.4	300
West Bengal	5.4	0.1	0.6	10.0	75.3	1117.1	228.1	10.5	1.2	0.3	168.4	2.9	29.6	80
Grand Total	**6.6**	**0.3**	**0.6**	**29.8**	**314.6**	**2036.1**	**409.1**	**20.0**	**1.2**	**0.4**	**79.8**	**2.3**	**23.7**	**547**

Table 12: State-wise range data

State	pH	EC	OC	Av P	Av K	Av Ca	Av Mg	Av S	Av Zn	Av B	Av Fe	Av Cu	Av Mn	No of samples
Bihar	4.84-8.38	0.08-17.48	0.18-1.4	4.52-124.82	39.9-2309.25	175.5-6340.75	41.95-1799.25	4.16-972.2	0.04-6.62	0.12-2.55	12.16-368.12	0.6-4.64	2.82-54.66	57
Chhattisgarh	5.16-6.5	0.06-0.35	0.34-0.87	4-24.49	47.75-348.6	500.75-4023.55	87.55-746.8	2.82-26.87	0.34-1.98	0.3-0.65	29.82-178.84	0.82-5.48	28.8-124.1	16
Jharkhand	4.68-6.28	0.05-0.2	0.32-0.98	1.41-28.64	21.4-204.55	215.3-1207	51.85-368.75	2.02-17.92	0.62-4.88	0.13-0.62	28.54-315.9	0.42-31.06	9.86-58.84	18
Karnataka	7.15-8.6	0.12-7.11	0.15-0.81	1.44-45.05	81.35-1272.35	2637.1-7546.75	556.1-2271.8	2.13-535.05	0.06-1.16	0.18-5.38	1.54-9.58	0.72-4.32	2.28-40.32	76
Odisha	4.32-8	0.03-1.3	0.08-1.85	0.14-285.06	69.33-1629.26	127.25-4484.55	38.1-1171.15	1.14-128.8	0.02-14.14	0.01-10.26	3.86-360.64	0.32-6.18	2.82-105.7	300
West Bengal	4.77-7.92	0.05-0.43	0.2-1.05	1.41-44.86	19.55-298.95	175-2482.6	33.5-628.15	2.43-89.68	0.22-6.26	0.08-0.62	33.6-387.8	1.14-6.62	7.04-86.76	80
Grand Total	**4.32-8.6**	**0.03-17.48**	**0.08-1.85**	**0.14-285.06**	**19.55-2309.25**	**127.25-7546.75**	**33.5-2271.8**	**1.14-972.2**	**0.02-14.14**	**0.01-10.26**	**1.54-387.8**	**0.32-31.06**	**2.28-124.1**	**547**

5.10. Sunflower Mean Productivity Levels

Table 13: Sunflower Yield in FLD Plots vs. District Average Yield				
State	**State Average Yield (Kg/ha)**	**District**	**District Average Yield (Kg/ha)**	**FLD Yield (Kg/ha)**
Bihar	1419	Araria	1550	1630
		Supaul	1400	1480
Chhattisgarh	528	Sarguja	290	671
Jharkhand	595	Jamtara	550	648
Karnataka	955	Bidar	1220	1380
		Bijapur	790	1153
		Kalaburagi	1200	1269
		Yadgir	1170	1251
Odisha	1256	Gajapati	1150	1338
		Kalahandi	1100	1317
		Koraput	1080	1286
		Malkangiri	1120	1327
		Nuapada	1100	1312
		Rayagada	1140	1358
West Bengal	1218	Purulia	1180	1492
		South 24 Parganas	1220	1472

Note: With honeybee intervention, sunflower yields increased by about 150 kg/ha - from ~1,250 to 1,400 kg/ha in Karnataka (≈12%), and from ~1,300 to 1,450 kg/ha in Odisha (≈12%).

Table 10 summarizes the mean sunflower productivity levels across targeted states and districts. The productivity levels are highly heterogeneous because the crop was introduced into diverse ecologies.

5.11. Women Empowerment

Women's empowerment formed a central pillar of the sunflower expansion initiative, both as a strategy for inclusive development and as a practical pathway to increase adoption, productivity, and sustainability of interventions. Recognizing that rural women in India play a critical role in agriculture, household nutrition, and livelihood diversification, the project actively sought to mainstream gender across all stages from planning and beneficiary selection to training, production, and enterprise development.

5.12. Gender Participation in Awareness Programs

Of the 16,871 farmers mobilized across six states, 44.8 % were women. This high level of female participation was the result of deliberate targeting of SHGs, women's collectives, and joint landholders, with implementation facilitated through NGOs and community-based organizations. In tribal and underserved districts such as Gajapati, Ganjam, Nuapada, Jamtara, and Purulia, women either cultivated sunflower individually or through collective plots on fallow land.

In many cases, these women were cultivating a second-season crop for the first time. Project teams provided handholding support in seed selection, sowing, and field monitoring. The progressive farmers trained under the project and facilitated by the staff conducted door-to-door advisory visits and organized farmer field schools that enabled women to learn in peer groups and gain confidence in adopting improved agronomic practices.

5.13. Capacity Building and Technical Leadership

The project delivered 419 farmer training programs, of which over 55% of participants were women. Topics covered ranged from soil health and nutrient management to pest control, intercropping, and post-harvest handling. Additionally, 19 officer training programs were conducted to sensitize government functionaries and NGO staff on gender-responsive extension methods.

Table 14: State and District wise Officer Training Programs

State	District	Officer Training Programs				% of Female
		Training (No.)	Male (No.)	Female (No.)	Total (No.)	
Bihar	Supaul	3	89	0	89	0.0
Chhattisgarh	Sarguja	2	95	70	165	42.4
Jharkhand	Jamtara	1	23	2	25	8.0
Odisha	Balasore	2	67	43	110	39.1
Odisha	Gajapati	2	76	34	110	30.9
Odisha	Ganjam	2	74	27	101	26.7
Odisha	Kalahandi	2	54	32	86	37.2
Odisha	Nuapada	3	87	22	109	20.2
West Bengal	Purulia	2	105	34	139	24.5
Total		**19**	**670**	**264**	**934**	**28.3**

In Odisha and West Bengal, women farmers also played a lead role in data collection, crop monitoring, and hosting field days. Their participation in knowledge-sharing sessions with scientists and extension agents highlighted the value of experiential learning.

5.14. Market Linkages, Processing and Value Addition

The sustainability of sunflower cultivation in rice fallows hinges not only on improved production practices but also on robust post-harvest systems that ensure market access and value addition. Recognizing this, the project actively facilitated the integration of market linkages and processing support alongside agronomic interventions. Across the six states, 12 FPOs were engaged to support aggregation, streamline input delivery, and create direct connections with buyers. These FPOs served as crucial intermediaries in organizing farmers, disseminating market information, and initiating early-stage procurement dialogues. In states like Karnataka, Odisha, and West Bengal, FPOs collaborated with local traders to ensure farmers received competitive prices for their high-quality sunflower seed.

Beyond aggregation, a critical dimension of the project involved promoting decentralized processing at the community level. In Odisha and West Bengal, several SHGs, particularly women-led collectives, expressed keen interest in establishing small-scale sunflower oil extraction units. These units hold significant promise for enhancing local value retention, enabling access to pure, unblended cooking oil, and generating by-products such as oilcake for livestock feed. In Gajapati district, during a farmer exhibition organized by Gram Vikas, SHG members showcased cold-pressed oil and sunflower-based products, reinforcing the crop's livelihood potential beyond primary production. Beekeeping activities linked to sunflower plots further enhanced the economic profile of the crop, offering supplementary income through honey sales and strengthening pollination benefits.

However, challenges such as the absence of knowledge about the Minimum Support Price (MSP) for sunflower in several states and limited access to working capital for FPOs constrain scale-up. To address this, the project emphasized capacity building in quality management, drying, and storage, and promoted buyer-seller interfaces at the local level. To facilitate convergence, the project plans to integrate SHGs and FPOs with PMFME for subsidies, training, and financial support to establish decentralized oil extraction units. Collaboration with Mission Shakti will enable women-led SHGs to access revolving funds and strengthen market participation. Buyer-seller platforms and joint capacity-building programs will further institutionalize local processing and value addition. The preliminary outcomes underline the need for convergence with national schemes like Pradhan Mantri Formalisation of Micro Food Processing Enterprises (PMFME) and Mission Shakti to institutionalize support for rural processing enterprises. Overall, the integration of market linkages and value addition into the sunflower initiative reflects a holistic approach to rural development linking production with enterprise and empowering smallholders, especially women, to participate actively across the agri-value chain. Still, a lot of efforts are needed to make it a reality.

5.14.1: Pooja Foods – A Case Study of Women-led Farmer Producer Organization

Organization Overview

- **FPO Name:** Pooja Foods
- **Date of Registration:** 31 January 2025
- **Location:** Appareddyguda, Telangana
- **Procurement Start Date:** 1 May 2025
- **Number of Members:** 7
- **Average Landholding per Member:** 1 acre
- **Total Landholding:** 7 acres

Members are predominantly small and marginal farmers who have significantly improved their livelihoods through collective aggregation and value-added processing of sunflower seeds.

Introduction

Pooja Foods, a Farmer Producer Organization (FPO), was established on 31 January 2025 in Appareddyguda, Telangana. This initiative aims to empower rural women and increase their income through value-added oilseed processing. Beginning procurement and processing operations on 1 May 2025, the FPO rapidly demonstrated significant progress, becoming a successful model of collective enterprise and women-led agribusiness, contributing substantially to rural economic development.

Participation in National Food Security Mission (NFSM)

Pooja Foods primarily focuses on sunflower cultivation in Telangana but also engages in cultivating safflower, groundnut, sesame, and coconut. The FPO actively participated in the NFSM sunflower initiative, which included training programs led by Krishi Vigyan Kendra (KVK) with technical support from ICRISAT. Partnerships with local NGOs provided members with access to quality seeds and demonstration kits, fostering the adoption of advanced farming practices.

Produce Aggregation and Procurement Practices

In its initial two months, Pooja Foods aggregated approximately 50–60 quintals of sunflower seeds from its members, processing them into around 2,000 liters of sunflower oil. Members benefited from procurement prices of ₹5,600 per quintal, surpassing local *mandi* rates by ₹150–₹200, thereby earning additional income of ₹800–₹1,000 per quintal, showcasing the advantages of collective marketing and negotiation.

Oil Processing Unit Operations

Pooja Foods operates its own oil processing unit, with an installed capacity of 1 ton per day. Currently, the unit processes approximately 200–250 liters weekly, totaling 800–1,000 liters monthly. The operations are managed entirely by trained women members, highlighting effective skill development and entrepreneurship. Despite current operations being below full capacity, considerable scope exists for future expansion.

Branding and Marketing Strategy

The sunflower oil produced by Pooja Foods is branded as "Sai Anna" and is available in 1-liter, 5-liter, and 15-liter packaging, priced at ₹350 per liter. The initial marketing strategy utilized grassroots approaches, including word-of-mouth, community outreach, and live demonstrations, effectively building trust and visibility within local communities.

Financial Performance and Profit Margins

Pooja Foods achieves profits ranging from ₹3,000–₹4,000 per ton of sunflower seeds processed. These profits result from direct sales, eliminating intermediaries, and maintaining efficient local distribution. The current business scale, while modest, is sustainable, covering fixed costs and minimizing variable expenses, positioning the organization for future sustainable growth.

Challenges and Solutions

Initially, the FPO encountered minimal challenges primarily related to machinery setup and training. These issues were effectively addressed through practical on-site demonstrations, peer-to-peer learning, and support from NGO partners.

Future Expansion Plans

To increase its impact and operational capacity, Pooja Foods plans to:

- Fully utilize existing infrastructure by enhancing oil production capacity.
- Create additional employment opportunities for rural women.
- Promote healthy, chemical-free sunflower oil consumption in local and surrounding communities.

Required Support for Future Growth

To realize its future goals, Pooja Foods requires:

- Financial assistance to enhance processing infrastructure.
- Digital marketing and e-commerce training for broader market reach.
- Support in establishing market linkages in urban markets such as Appa Reddy Guda, Telangana, and beyond.

Community Response and Impact

The local community has enthusiastically supported Pooja Foods, appreciating the women-led local production of quality sunflower oil. This positive reception has resulted in robust demand, strong customer loyalty, and growing interest from neighboring communities wishing to replicate the successful model. Thus, Pooja Foods has become a symbol of rural innovation, economic empowerment, and women's leadership in agriculture.

Conclusion

Pooja Foods represents the transformative potential of women-led FPOs to drive meaningful socio-economic impacts through collective action and value-added agribusiness. With continued support and strategic growth, its sustainability and positive influence on rural communities are poised to increase significantly.

6. Awareness, Training & Capacity Building

Capacity building and community sensitization formed a core component of the sunflower expansion initiative, enabling farmers to adopt improved agronomic practices, understand the economic potential of sunflower, and actively participate in associated value chains. The project placed a strong emphasis on inclusive knowledge dissemination, targeting not just farmers but also extension personnel and institutional stakeholders to create a supportive ecosystem for adoption and scaling.

A total of **419 farmer training programs** were conducted across the six states, reaching **7,475 participants**, including **4,112 women and 3,363 men**. These programs were designed to be practical and participatory, with a focus on field-based demonstrations, interactive sessions, and visual learning aids in local languages. Topics covered included soil preparation using minimal tillage, optimal sowing windows, nutrient and pest management, and post-harvest handling. In many districts, particularly in Odisha and West Bengal, training events also incorporated modules on collective marketing and entrepreneurship tailored specifically for women-led SHGs.

In addition to farmer outreach, **19 training programs were organized for officers**, including agricultural extension agents, NGO field staff, and local officials. A total of **934 officers** (670 men and 264 women) participated in these sessions, which focused on building technical competence, field monitoring skills, and gender-sensitive extension approaches. These trainings helped create a multiplier effect, ensuring consistent field-level guidance and enhancing the institutional capacity to support farmers.

To strengthen community awareness, the project utilized a range of Information, Education, and Communication (IEC) tools. These included printed leaflets and farmer-friendly videos. Field days and exposure visits served as powerful platforms for experiential learning and peer exchange. In all six states, field days attracted high participation, especially from women, and facilitated farmer interaction with scientists and agri-entrepreneurs. Demonstration plots, especially those with beekeeping units, became local knowledge hubs encouraging non-participating farmers to consider sunflower cultivation in subsequent seasons.

The strategic layering of awareness and capacity-building activities ensured that interventions were not limited to input delivery but embedded in a learning ecosystem. This approach fostered local ownership, improved adoption rates, and equipped communities with the knowledge and confidence to sustain sunflower cultivation and explore value-addition opportunities. As the initiative progresses, continued investment in training, particularly in post-harvest, enterprise management, and digital extension, will be vital for long-term impact and scalability.

Case Study 1

The story of Sunflower Cultivator, Ms Sujata Naik, Gidhamal village, Narla block, Odisha

Introduction:

Tribal communities in India often face systemic challenges that limit their access to resources and economic opportunities, leading to persistent poverty and food insecurity. Agriculture remains their primary source of livelihood, but traditional practices and limited crop diversification often restrict income potential. This case study focuses on Ms Sujata Naik, a tribal woman farmer from Gidhamal village in Narla block, Kalahandi district, Odisha, located 60 km from Bhawanipatna. Owning 5 acres of partially irrigated land, Ms Sujata relied solely on rice cultivation, leaving her land fallow after the *kharif* season. In 2024, she participated in a farmer training program organized by Action for Social Advancement (ASA) and ICRISAT, where she learned about sunflower cultivation in rice fallows as a climate-resilient, income-enhancing strategy. This intervention marked the beginning of her journey towards sustainable agriculture and economic resilience.

Objectives:

The intervention aimed to address multiple challenges faced by tribal farmers by:

- Promoting sunflower cultivation in rice fallows to utilize otherwise idle land and increase cropping intensity.
- Conserving soil moisture and improving soil health by enhancing soil biomass and organic carbon content.
- Increasing agricultural productivity and diversifying income sources for smallholder farmers.
- Improving household nutrition and economic security through additional income from sunflower cultivation.
- Empowering women farmers to become leaders in climate-resilient agriculture in their communities.

Before Intervention Scenario:

Before the intervention, Ms Sujata cultivated only rice on her 5 acres during the *kharif* season, leaving the land unused post-harvest due to a lack of awareness and resources for *rabi* cultivation. This led to low annual income, limiting her ability to meet her family's needs and invest in improving her farm's productivity. Additionally, mono-cropping contributed to soil degradation and underutilization of available resources, preventing economic growth and nutritional security within her household.

Intervention and Capacity Building:

Under the project, Ms Sujata received quality sunflower seeds (KBSH-72) and borax to cultivate her land after the rice harvest. She participated in a Master Trainer Program at Regional Research and Technology Transfer Station (RRTTS) Bhawanipatna, where she learned about scientific cultivation practices, including seed treatment, optimal sowing techniques, pest and nutrient management, and post-harvest handling.

She further attended cluster-level training sessions that refined her skills and allowed her to share her learnings with other women farmers in her village. This training empowered Ms Sujata to become a local resource person, encouraging the adoption of sunflower cultivation among other farmers in Gidhamal and promoting collective action for sustainable farming.

Economic Analysis

The intervention significantly improved Ms Sujata's economic situation. With a total investment of ₹21,000, she cultivated sunflower across 5 acres, achieving a yield of approximately 35 quintals, which she sold at ₹7,280 per quintal in the local market. This resulted in a gross income of ₹2,54,800 and a net profit of ₹2,33,800. This additional income allowed her to invest in better nutrition and education for her children and reinvest in her farm for future crops. The experience demonstrates the profitability of sunflower cultivation and its potential as a livelihood-enhancing strategy for smallholder tribal farmers.

Investment Details:

Input (A)	**Cost (In ₹)**
Seed cost	0
Fertilizers	1,500
Pesticides	6,000
Irrigation cost	4,500
Labour cost	9,000
Total Input cost:	21,000
Output (B)	
Average yield(Approx.)	7 quintals per acre
Total Harvest in 5 acres(Approx.)	35 quintals
Market selling price	7,280 per quintal
Gross income(Approx.)	2,54,800
Net income (A-B)	**2,33,800**

Impact of the Initiative:

Ecological Impact: The intervention increased cropping intensity on rice fallow lands, improved soil health, and promoted moisture conservation, contributing to sustainable land management.

Social Impact: Through peer-to-peer learning and Farmers Field School approaches, Ms Sujata's participation encouraged other women farmers in her village to adopt sunflower cultivation, fostering collective community resilience.

Economic Impact: The initiative reduced cultivation costs while increasing productivity and profitability, significantly improving the household's financial stability and enabling investments in health and education.

Policy Impact: Ms Sujata's success story serves as a model for promoting climate-resilient agriculture and women-led farming initiatives under government and development partner programs. It demonstrates the potential of targeted interventions to sustainably uplift tribal communities.

This case study demonstrates how structured interventions, capacity building, and the promotion of climate-resilient crops can transform livelihoods while empowering women farmers to become leaders in their communities.

Case Study 2

Sunflower Cultivation Helps Farmer Tularam Majhi Provide a Better Life for His Family

Introduction

Smallholder farmers in Odisha often face difficulties in utilizing upland fields effectively due to poor soil quality, lack of irrigation, and limited access to improved farming practices. This case study features Mr Tularam Majhi, a 56-year-old smallholder farmer from Chhata village, B Sikuan Gram Panchayat, Khariar block, Nuapada district. Tularam owns 2.2 hectares of land—comprising 0.8 hectares each of medium and low land, and 0.6 hectares of upland. While he and his wife are educated only up to early primary levels, they have diligently pursued agriculture as their sole livelihood to support their large family of six, including two sons and two daughters. Despite owning basic agricultural tools, bullocks, a sprayer, and wells, his upland remained underutilized for years due to its sandy to silty loam soil, sloping terrain, and lack of irrigation.

Objectives of the Intervention

- Promote the adoption of improved sunflower varieties for rainfed upland farming.
- Introduce scientific practices for enhancing productivity and profitability.
- Improve livelihoods through better income from underutilized land.
- Encourage sustainable agricultural practices and crop diversification among smallholder farmers.

Situation Before the Intervention

Before the intervention, Tularam's upland remained mostly fallow or yielded marginal returns, due to the absence of irrigation and low soil fertility. The land's potential was untapped, contributing little to the household's income. Farming efforts focused on lower and medium lands during the *kharif* season, limiting income generation to a single cropping cycle.

Intervention and Capacity Building

In 2025, Tularam attended a farmer awareness program conducted by Youth for Action and Research (YAR) with technical support from ICRISAT. The session introduced farmers to the benefits of sunflower cultivation, particularly the KBSH-78 variety, suited for upland conditions. Motivated by the training, Tularam enrolled in the program and received high-quality seeds and boron fertilizer.

He prepared his 0.4-hectare upland plot through four rounds of ploughing. Using ropes for proper spacing (60 cm x 30 cm), he adopted line sowing and applied fertilizer in the seed rows. Sowing took place on January 5th and 6th. With active support from his family, he managed crop care, including weeding, hoeing, a second dose of DAP fertilizer, and earthing up. The crop showed excellent vegetative growth and began flowering by late February. Harvesting was done in the last week of March.

Economic Analysis

Tularam harvested 330 kg (3.3 quintals) of sunflower from his 0.4-hectare plot. Of this, he sold 200 kg in the local market at ₹3,500 per quintal, earning ₹7,000. He retained 130 kg for household use, which yielded approximately 40 liters of sunflower oil, contributing to household food security. The return from this small patch of upland exceeded his previous years' earnings (nearly ₹10,000 – ₹11,000) from the same land. This additional income supported family expenses, including purchasing clothes and making contributions for marriage gifts to relatives.

Impact of the Initiative

Ecological Impact: The intervention enabled effective use of previously underutilized upland, demonstrating the potential of climate-resilient crops like sunflower for rainfed farming.

Social Impact: Tularam's success inspired other farmers in the village, showing how simple practices and quality inputs can improve livelihoods.

Economic Impact: The income from sunflower cultivation surpassed previous returns from the same land, contributing to household well-being and food security through retained produce.

Policy Impact: Tularam's story showcases the potential of small-scale interventions to drive sustainable rural development. With the right support, farmers can successfully transition to diversified, climate-adapted farming systems.

Encouraged by his success, Tularam now plans to expand sunflower cultivation to more of his upland in the upcoming *rabi* season. With continued support from YAR and ICRISAT, he is confident about scaling up and improving his family's future. He expresses heartfelt gratitude to the organizations for opening new doors to prosperity and stability.

Case Study 3

Mr Sankar Majhi

Introduction

Farmers in rainfed regions often struggle with fluctuating yields and uncertain returns, especially in areas with limited irrigation and variable land quality. This case study shares the experience of Mr Sankar Majhi, a 58-year-old progressive farmer from Kamlamal village, Rokal Gram Panchayat, Boden block, Nuapada district, Odisha. Sankar owns 7 acres of mixed-type agricultural land (low, medium, and upland) and supports a large household of nine members. While his land is mostly rainfed, he has access to a borewell and an open dug well, which he uses during water-scarce periods. Traditionally, Sankar cultivated vegetables, millets, and occasionally pigeonpea on 0.8 hectares. However, in 2025, he was introduced to sunflower cultivation through a program led by Youth for Action and Research (YAR) and supported by ICRISAT. This intervention opened new possibilities for improved income and crop diversification.

Objectives

- Promote climate-resilient crops like sunflower for rainfed farming systems.
- Introduce scientific cultivation techniques to improve yield and profitability.
- Support household income enhancement and livelihood diversification.
- Build farmer capacity through technical training and practical demonstration.

Situation Before the Intervention

Before adopting sunflower, Sankar mainly cultivated vegetables and millet in a small portion of his land, with limited returns due to low market prices and climatic risks. His upland fields remained underutilized or produced inconsistent yields. Household financial stability was often impacted by seasonal income gaps, making it difficult to meet large expenses such as family weddings

Intervention and Capacity Building

In early January 2025, after attending a village awareness meeting organized by YAR with support from ICRISAT, Sankar was motivated to try sunflower cultivation. He received training on scientific practices, quality seeds (KBSH-78 variety), and boron fertilizer. He cultivated sunflower on 0.4 hectares of his land using recommended practices—four rounds of ploughing and line sowing at 60 cm x 30 cm spacing, sowing one seed per hill, and applying basal fertilizer at the time of sowing. His family actively participated in crop management, encouraged by excellent germination and healthy plant growth. The crop was harvested by the YAR team on 2 April 2025.

Economic Analysis

Sankar harvested 352 kg (3.52 quintals) of sunflower from the 0.4-hectare plot. He sold 250 kg in the local market for ₹8,000 and retained 102 kg, from which he extracted around 50 liters of sunflower oil for household consumption. The financial return was significantly higher (around ₹7,000–₹8,000) than the previous years' earnings from the same land. Notably, the income helped cover essential household needs and contributed toward the marriage expenses of his younger daughter, demonstrating the real-life impact of adopting new agricultural practices.

Impact of the Initiative

Ecological Impact: Effective utilization of rainfed land for a climate-resilient crop enhanced cropping intensity and resource use efficiency.

Social Impact: Sankar's success and practical example encouraged other farmers in the village to consider sunflower cultivation as a viable alternative.

Economic Impact: The intervention increased household income and reduced dependency on traditional crops with low margins. It also supported vital family expenditures.

Policy Impact: The case highlights the potential of localized training and resource support to drive inclusive agricultural transformation in tribal and rainfed farming areas.

Encouraged by his success, Sankar plans to scale up sunflower cultivation in the future *rabi* seasons. With sustained support from YAR and ICRISAT, he is confident about achieving greater economic returns. He expresses sincere gratitude to the project team for guiding him toward a path of improved livelihood and hope for a better future.





7. Partnership and Collaborations

The successful implementation of the sunflower expansion initiative was made possible through a strong and diverse network of partnerships involving government institutions, research organizations, civil society actors, and community-based organizations. These partnerships were critical in leveraging local knowledge, mobilizing farmers, disseminating technical information, and ensuring last-mile delivery of inputs and services. The collaborative approach also enabled efficient scaling across geographically and socio-economically diverse regions.

At the national and state levels, the project was anchored under the NFSM-Oilseeds and implemented in coordination with the Department of Agriculture and Farmers Welfare (DA&FW). Research institutions such as the Indian Council of Agricultural Research—Indian Institute of Oilseeds Research (ICAR-IIOR) provided technical oversight and guidance.

At the state and district levels, implementation was supported by a range of public extension agencies including Krishi Vigyan Kendras (KVKs) and State Agricultural Universities (SAUs), such as Odisha University of Agriculture and Technology (OUAT) and Dr Rajendra Prasad Central Agricultural University (RPCAU), Pusa. These institutions played a pivotal role in conducting frontline demonstrations, supervising field trials, and providing ongoing tailormade agronomic advisories.

A particularly significant contribution came from Non-Governmental Organizations (NGOs) operating at the grassroots level. A total of 11 NGOs were engaged across the six states - seven in Odisha, two in West Bengal, and one each in Bihar, Jharkhand, Karnataka, and Chhattisgarh. These partners were instrumental in community mobilization, beneficiary identification, training delivery, and follow-up support. Local NGOs brought deep contextual knowledge and trust-based relationships with local communities, which were essential for the uptake of new technologies, especially among women and marginalized groups.

The project also collaborated with FPOs and SHGs for aggregation, input distribution, and exploring market linkages. These institutions provided a platform for organizing smallholder farmers, enhancing their bargaining power, and facilitating post-harvest value addition and enterprise development. This collaborative model underscores the importance of convergence and coordination in agricultural transformation. By bringing together actors across research, extension, civil society, and community institutions, the initiative was able to foster multi-stakeholder ownership and build a foundation for sustainability and future scale-up. Going forward, strengthening these partnerships - particularly around value chain development, financial linkages, and digital extension - will be key to institutionalizing gains and embedding sunflower cultivation in the broader development agenda of the participating states.

8. Project Monitoring & Evaluation

A robust and technology-enabled monitoring and evaluation (M&E) framework was established to ensure timely tracking, adaptive management, and evidence-based decision-making throughout the implementation of the sunflower expansion initiative. The project adopted a digital approach, leveraging tools such as ODK (Open Data Kit) and Krishi Mapper, which enabled real-time data collection and seamless integration with a centralized Management Information System (MIS). To justify the digital approach, more funds are desired for staff mobility. Enumerators and field coordinators used GPS-enabled mobile applications to record geo-tagged information on area coverage, beneficiary profiles, training participation, and demonstration plot performance.

Key Performance Indicators (KPIs) were defined at the outset, including metrics on land coverage, seed distribution, gender participation, soil health parameters, training outcomes, and market access efforts. These indicators were reviewed periodically to assess progress and identify emerging challenges. District- and state-level dashboards were developed to visualize performance, track variances, and guide decision-makers in real time.

In addition to quantitative tracking, the project incorporated qualitative feedback mechanisms through field visits, farmer interactions, and stakeholder consultations. Mid-season reviews and cluster-level debriefs enabled corrective actions, particularly in areas facing delayed sowing, pest outbreaks, or input delivery bottlenecks. Monitoring responsibilities were shared across implementing NGOs, research partners, and government officers to ensure triangulated verification and accountability.

This integrated M&E framework not only strengthened transparency but also enhanced the responsiveness of implementation teams. It provided continuous learning loops, enabled timely reallocation of resources, and fostered a culture of data-driven program management. The system will also serve as a foundation for scaling, allowing for improved replication and targeted interventions in future phases.

9. Conclusion & Way Forward

The sunflower expansion initiative in rice fallows, implemented under NFSM – the National Food Security Mission (Oilseeds), has demonstrated that strategic, science-based, and community-driven interventions can unlock the vast potential of underutilized land resources in India's post-monsoon season. Across the country, nearly 11–12 million hectares of rice fallows remain uncultivated after the kharif season, contributing significantly to India's heavy dependence on edible oil imports — currently close to 60% of domestic consumption. By achieving 100% of the targeted area across 18 districts in six states, the project validated sunflower as a viable, climate-resilient, and economically attractive crop for smallholders, particularly in rainfed and tribal regions.

Equally important are the social and institutional gains achieved through this initiative. The participation of over 7,566 women, the establishment of 150 bee-keeping demonstrations, and the early momentum in value addition and processing reflect a shift towards inclusive, resilient, and enterprise-oriented rural development. The involvement of grassroots institutions — FPOs, SHGs, NGOs, and local governments — ensured contextual relevance, local ownership, and sustainability of interventions.

Looking ahead, several strategic priorities emerge. First, there is a need to institutionalize market linkages, including formal procurement mechanisms, private sector engagement, and aggregation models that can stabilize farmer returns. Second, investment in decentralized processing infrastructure, such as oil extraction units and micro-enterprises led by women's groups, will be critical to embedding value addition at the community level. Third, a focus on participatory varietal evaluation, seed system development, and digital advisory services can further enhance productivity and resilience.

Finally, the approach adopted in this initiative offers a replicable blueprint for sustainable intensification of fallow lands across diverse agro-ecological zones. With convergence from government schemes such as PMFME, Mission Shakti, and Mahila Kisan Sashaktikaran Pariyojana (MKSP), this model can be scaled to significantly reduce edible oil imports, improve smallholder incomes, and drive gender-equitable rural transformation.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About

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is a pioneering non-profit organization focused on scientific research for development, committed to transforming dryland farming and agri-food systems. Working with global partners, ICRISAT develops innovative solutions to address hunger, poverty, and environmental degradation, benefiting 2.1 billion people across the drylands of Asia, Africa, and beyond.

ICRISAT was established under a Memorandum of Agreement between the Government of India and CGIAR, dated 28 March 1972. In accordance with the Headquarters Agreement, the Government of India has extended the status of a specified “International Organization” to ICRISAT under section 3 of the United Nations (Privileges and Immunities) Act, 1947 of the Republic of India through Extraordinary Gazette Notification No. UI/222(66)/71, dated 28 October 1972, issued by the Ministry of External Affairs, Government of India.

Asia

ICRISAT - India (Headquarters)
Patancheru 502 324, Hyderabad
Telangana, India
Phone: +91 8455683071
Fax: +91 8455683074
Email: icrisat-ind@icrisat.org

ICRISAT - India (Liaison Office)
CG Centers Block
NASC ComplexDev Prakash Shastri Marg, New Delhi 110012, India
Phone: +91-11-25840294
Fax: +91 1125841294
Email: icrisat-ind@icrisat.org

West and Central Africa

ICRISAT - Mali
(Regional hub WCA)
BP 320 Bamako, Mali
Phone: +223 20 709200
Fax: 223 20 709201
Email: icrisat-mli@icrisat.org

ICRISAT - Niger
BP 12404
Niamey, Niger (via Paris)
Phone: +(227) 20722725, 20722626
Fax: +227 20734329
Email: icrisat-ner@icrisat.org

ICRISAT - Nigeria
PMB 3491
Sabo Bakin Zuwo Road
Tarauni, Kano, Nigeria
Phone: +234 7034889836
Email: icrisat-nga@icrisat.org

ICRISAT - Senegal
c/o Africa Rice
Mamelles Aviation, Villa 18
BP 24365 Dakar, Senegal
Phone: +221 338600706
Email: icrisat-sen@icrisat.org

Eastern and Southern Africa

ICRISAT - Kenya
(Regional hub ESA)
PO Box: 39063, Nairobi, Kenya
Phone: +254 20 7224550
Fax: +254 20 7224001
Email: icrisat-ken@icrisat.org

ICRISAT - Ethiopia
C/o ILRI Campus
PO Box 5689, Addis Ababa, Ethiopia
Phone: +251-11 617 2541
Fax: +251-11 646 1252, +251 11 646 4645
Email: icrisat-eth@icrisat.org

ICRISAT - Malawi
Chitedze Agricultural Research Station
PO Box 1096, Lilongwe, Malawi
Phone: +265 1 707 297/071/067/057
Fax: +265 1 707 298
Email: icrisat-mwi@icrisat.org

ICRISAT - Zimbabwe
Matopos Research Station
PO Box 776, Bulawayo, Zimbabwe
Phone: +263 292 809314/315
Fax: +263 383 307
Email: icrisat-zwe@icrisat.org

ICRISAT - Mozambique
(c/o IIAM) nr 2698 1st Floor, AV. FPLM
Maputo, Mozambique
Phone: +258 1 461657
Fax: +258 1 461581
Email: icrisat-moz@icrisat.org

ICRISAT - Tanzania
Plot 25, Mikocheni Light Industrial Area
Mwenge Coca-Cola Road, Mikocheni B,
PO Box 34441, Dar es Salaam, Tanzania
Email: icrisat-tza@icrisat.org