Assessing the impact of sunflower frontline demonstrations on farmer practices and outcomes in Patiala district, Punjab

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ABSTRACT

The present study assessed the impact of frontline demonstrations (FLDs) on farmers' adoption behaviour in sunflower cultivation and identified the constraints encountered by them in Patiala district, Punjab, during 2023-24. Data were collected from 25 FLD and 25 non-FLD sunflower growers through a simple random sampling procedure and analyzed using frequencies and percentages. Findings indicated that while basic practices such as timely preparatory cultivation, seed rate and inter-cultural hoeings were universally adopted, FLD farmers showed significantly higher adoption of nuanced technologies like proper spacing (54% vs 40%), dibbling method of sowing (68% vs 56%), recommended fertilizer application (80% vs 72%) and need-based plant protection (62% vs 36%). Economically, FLD farmers achieved 41.3 per cent higher yield, 41.3 per cent higher gross return and 61.5 per cent higher net return compared to non-FLD farmers, with a favourable incremental benefit-cost ratio of 2.78. Major constraints faced by farmers included necrosis disease (96-100% prevalence), lack of locally available fertilizers and pesticides (92-96%) and low rainfall (88-92%). Non-FLD farmers perceived seed quality, high seed cost and credit access as more critical constraints. All the farmers suggested remunerative price for their produce and all the non-FLD and 96.00 per cent FLD farmers suggested timely seed supply at the local level. The study concluded that FLDs effectively promoted advanced sunflower cultivation practices leading to improved economic returns, though persistant constraints required targeted interventions.

Keywords: Sunflower; frontline demonstration; adoption; economic impact; constraints; suggestions

INTRODUCTION

Crop diversification involves shifting from traditional, less remunerative crops to more profitable alternatives (Khanam et al 2018). Sunflower can play an important role in this strategy due to its short duration, photo-insensitive nature and wide adaptability to diverse agro-climatic regions and soil types (Chandhana et al 2022, Babu et al 2014), leading it to occupy an important place across various agro-climatic zones. Globally, sunflower stands as a crucial oilseed crop, valued for its premium oil and dietary fiber, which significantly contribute to human health (Khan et al 2015). In India, sunflower has been traditionally cultivated in states such as Karnataka, Maharashtra, and Andhra Pradesh. However, in recent years, its cultivation has expanded into non-traditional states, including Haryana, Punjab, Uttar Pradesh, Gujarat, Tamil Nadu, Orissa, Madhya Pradesh and Rajasthan (Shrine 2024).

Due to sunflower's comparatively higher productivity during the spring (zaid) season (Ahmad et al 2013), it is predominantly cultivated in this period in areas like Patiala district.

Frontline demonstrations (FLDs) are an appropriate tool for showcasing recommended technologies directly to farmers under their actual field conditions (Kumar et al 2019). Enhancing sunflower production and marketing is crucial for reducing India's dependence on imported edible oils (Khatun et al 2016). Sunflower is well-suited to diverse climatic conditions, offering significant potential for area expansion and horizontal intensification to boost India's oilseed production (Ahmad et al 2013).

Despite the availability of improved techniques, a notable gap exists between the potential and actual adoption of these practices in sunflower cultivation. This presents a tremendous opportunity to increase sunflower productivity by embracing modern technologies. Therefore, laying out frontline demonstrations directly on farmers' fields is essential to showcase the scientific cultivation of sunflower (Verma et al 2014).

To demonstrate the potential of proven sunflower technologies within the state, Krishi Vigyan Kendra, Patiala, Punjab, organized frontline demonstrations (FLDs) on sunflower production technology under the Cluster Frontline Demonstrations (CFLDs) Oilseeds Project. The present study was specifically undertaken to assess the impact of these FLDs on farmers' adoption behaviour and to identify the constraints they encountered.

METHODOLOGY

The present study was carried out during 2023-24 in seven villages of Patiala district viz Kherki, Lalina, Binaheri, Maawi, Rajlah, Kurhali and Dhanouri where FLDs were conducted during 2020-24. The impact assessment was done on comparative basis between FLD farmers and non-FLD farmers. In total 25 FLD and 25 non-FLD sunflower growers were selected as respondents based on simple random sampling procedure. Data were collected to assess the impact of demonstrations on farmers' adoption of recommended sunflower production technologies. The study also examined sunflower's productive potential, its economics and the challenges farmers faced in sunflower cultivation and their proposed solutions through a well-structured interview schedule. The data were analysed using frequencies and percentages.

RESULTS and DISCUSSION

Impact of frontline demonstrations on adoption of recommended sunflower production technologies: Table 1 details comparative analysis of technology adoption rates among the farmers.

Practices such as timely preparatory cultivation and adhering to the recommended seed rate of 5 kg per ha were universally embraced, with 100 per cent of both FLD and non-FLD farmers implementing them. Similarly, 2-3 intercultural hoeings and timely harvesting were adopted by all farmers in both groups indicating these were well-established and widely accepted practices regardless of direct demonstration involvement. However, the application of FYM at 5 tonnes per ha remained consistently low, with only 28 per cent FLD farmers and an equivalent percentage of non-FLD farmers adopting this specific recommendation.

Kaveri Champ emerged as the most popular choice, adopted by 48 per cent FLD farmers and a notably higher 74 per cent non-FLD farmers. Other hybrids like PSFH2080 were adopted by 20 per cent FLD and 12 per cent non-FLD farmers while Pioneer was chosen by 8 per cent FLD and 12 per cent non-FLD farmers. Tejas saw identical adoption, with 16 per cent farmers from both groups.

Adoption of 60 cm × 30 cm spacing was higher among FLD farmers, with 54 per cent individuals adopting it, compared to 40 per cent non-FLD farmers. In sowing methods, while flat bed was more prevalent among non-FLD farmers (60% vs 36%), dibbling was considerably more adopted by FLD (68%) than non-FLD (56%) farmers, indicating that demonstrations encouraged this precise method. Drilling saw similar adoption rates of 48 per cent FLD and 44 per cent non-FLD farmers.

Concerning fertilizer application, the recommended rate of 75 kg N:57.5 kg P_2O_5 was adopted by a substantial majority of FLD (80%) and a high proportion of non-FLD (72%) farmers. Other, lower fertilizer rates saw very limited adoption, with typically only (4 to 12%) from either group using them. The practice of thinning was also adopted more by FLD (56%) than by non-FLD (40%) farmers. Most strikingly, need-based plant protection measures saw significantly higher adoption among FLD (62%) compared to non-FLD (36%) farmers, strongly suggesting the effectiveness of demonstrations in promoting timely pest and disease management.

Overall, the findings indicated that FLDs played a crucial role in promoting the adoption of more nuanced and specialized recommended technologies, leading to better adherence to comprehensive sunflower cultivation practices. While farmers made their own hybrid choices, the demonstrations clearly influenced their overall management practices, particularly for advanced techniques.

Table 1. Impact of sunflower demonstrations on the adoption of recommended production technologies by the farmers

Technology demonstrated	Technology adopted	FLD farmers		Non-FLD farmers	
		Frequency	%	Frequency	%
Preparatory cultivation	Timely preparation	25	100	25	100
FYM 5 tonnes/ha	3.5 cartloads/ha	7	28	7	28
Hybrid demonstrated	PSFH2080	5	20	3	12
	Kaveri Champ	12	48	15	74
	Pioneer (hybrid)	2	8	3	12
	Tejas	4	16	4	16
Seed rate (5 kg/ha)	5 kg/ha	25	100	25	100
Spacing (60 cm × 30 cm)/(45 × 30 cm)	60 cm × 30 cm	16	54	10	40
Method of sowing	Flat bed	9	36	15	60
	Drilling	12	48	11	44
	Dibbling	17	68	14	56
Fertilizer application	75 kg N:57.5 kg P_2O_5	20	80	18	72
	51 kg N:57.5 kg P_2O_5	1	4	1	4
	66.25N:37.5 kg P_2O_5	1	4	1	4
	57.5 kg N:40 kg P_2O_5	3	12	3	12
	86.5 kg N:28.75 kg P_2O_5	1	4	2	8
	72.5 kg N:22.5 kg P_2O_5	1	4	2	8
Thinning	Adopted	14	56	10	40
Intercultural hoeings (2-3)	2-3 hoeings	25	100	25	100
Need-based plant protection	Insecticides/pesticides used	18	62	9	36
Protective irrigation at critical stages of crop growth (2-4)	Applied at budding, flowering and seed filling (2-4)	21	84	18	72
Timely harvest	Harvested at right time	25	100	25	100

Vaster et al (2011) investigated the adoption behaviour of sunflower growers in Bagalkot, Karnataka, finding that recommended practices like land preparation (66.66%), sowing time (62.50%), method of sowing (58.33%) and FYM application (52.50%) showed relatively higher adoption rates. These were closely followed by time of inter-cultivation (51.66%) and time of weed control (50.00%). Conversely, practices such as weedicide application (0.00%), pollination work (10.83%) seed treatment (12.5%), recommended plant population (15.00%) and soil testing measures (16.66%) exhibited the least adoption.

More recently, Kingu et al (2024) assessed the adoption of recommended sunflower production practices among farmers in Mkalama district, Tanzania. Their study revealed that most farmers readily practiced land preparation before planting and typically used broadcasted seeds during sowing. However, only a small proportion of farmers adhered to recommended fertilizer application practices. They also observed a variation in preferred seed types, with the majority of farmers favouring farmer-saved seeds over hybrid varieties. Most of the farmers harvested their sunflower crops within a 90- to 130-day window after planting of the crop.

Productive potential and economic returns of sunflower cultivation: Table 2 provides a economic analysis of sunflower cultivation, highlighting productive potential and various cost-benefit components.

Regarding productivity, FLD farmers achieved a significantly higher yield, which was approximately 41.3 per cent greater than the yield recorded by non-FLD farmers (18.64 vs 13.19 q/ha). This increased productivity was accomplished with only a marginally higher operational cost of cultivation; FLD farmers incurred an operational cost that was about 4.1 per cent greater than that of their non-FLD counterparts (Rs 28,976 vs Rs 27,843/ha).

The higher yields translated directly into substantial economic advantages for FLD farmers. Their gross return was approximately 41.3 per cent higher than that of non-FLD farmers (Rs 111,840 vs Rs 79,140/ha). More critically, the net return for FLD farmers showed an even more pronounced improvement, being about 61.5 per cent higher than the net return experienced by non-FLD farmers (Rs 82,864 vs Rs 51,297/ha).

The data also quantify the incremental benefits attributable to the FLD interventions. FLD farmers experienced an incremental cost of Rs 1,133 per hectare. This relatively small additional investment yielded a substantial incremental return of Rs 31,567 per hectare. Consequently, the incremental benefit-cost ratio stood at 2.78, indicating that for every rupee invested incrementally, FLD farmers gained Rs 2.78 in additional benefit. These figures strongly suggested the economic viability and profitability of adopting the demonstrated sunflower production technologies.

Sonawane et al (2019) reported that the average annual gross income for sunflower sample families was Rs 506,984 at the overall level, with 63 per cent of this income derived from crop production. Their study indicated that yield increased from 5.8 to 11.88 q per ha with varying levels of adoption. Specifically, an added yield of 2.12 q per ha was observed over low adoption and 3.96 q per ha over medium adoption. Consequently, producing this extra yield involved increased costs, ranging from Rs 5,347.20 to Rs 7,140.84 per hectare, which in turn led to increased added returns, from Rs 9,584.11 to Rs 14,361.92.

In a study in the Prakasam district of Andhra Pradesh, Ramesh et al (2023) revealed that improved cultivation practices under CFLDs, including recommended hybrids, seed rate, timely sowing and plant protection technology, significantly increased sunflower yield over check plots. The improved technologies produced higher yields, recording 1,452 and 1,380 kg per ha of sunflower yield during 2019-20 and 2020-21 respectively. These yields were 38.28 and 45.26 per cent higher compared to the prevailing farmers' practice. The average seed yield under improved practice (1,416 kg/ha) was 41.60 per cent higher over farmers' practice. Furthermore, the benefit-cost ratio (B:C) was found to be between 2.23 and 2.84 under demonstration, while it ranged from 1.62 to 1.51 under control plots. The average B-C ratio under improved practice (2.53) was 40.5 per cent higher than that under farmers' practice.

Constraints faced by farmers in sunflower cultivation: Table 3 illustrates the distribution of farmers based on the various constraints they encountered in sunflower cultivation.

Necrosis disease emerged as the most significant constraint for both farmer groups, affecting 96 per cent of FLD farmers and an even higher 100 per cent of non-FLD farmers, consistently ranking as the primary challenge (Rank I) for both. Closely following, the lack of availability of fertilizers and pesticides locally was also a major concern, ranking as the second most pressing issue (Rank II) for both FLD (92%) and non-FLD (96%) farmers. Similarly, low rainfall was a substantial climatic constraint, reported by 92 per cent of FLD (Rank II) and 88 per cent of non-FLD (Rank IV) farmers.

Concerns related to seeds were highly prevalent: lack of quality seed and high seed cost were equally significant, each reported by 80 per cent of FLD (Rank IV) and a higher 92 per cent of non-FLD (Rank III) farmers, suggesting these issues were more acutely felt by farmers not under demonstration programmes. Market fluctuation was also a widespread concern, affecting 84 per cent of FLD (Rank III) and 88 per cent of non-FLD (Rank IV) farmers, indicating its broad impact on economic viability.

Less seed filling (center) was a notable physiological constraint for 72 per cent of FLD (Rank V) and 64 per cent of non-FLD (Rank VI) farmers, indicating a shared challenge in achieving optimal seed development. The lack of market information impacted 64 per cent of FLD (Rank VI) and a higher 76 per cent of non-FLD (Rank V) farmers, suggesting a greater informational gap for the latter. Similarly, the lack of institutional credit facility affected 60 per cent of FLD (Rank VII) but a more substantial 76 per cent of non-FLD (Rank V) farmers, indicating credit access was a more pronounced issue for the non-FLD group.

Finally, downy mildew disease was a less frequently reported constraint compared to necrosis, affecting 24 per cent of FLD (Rank VIII) and 36 per cent of non-FLD (Rank VII) farmers.

Table 2. Productive potential and economics of sunflower

Component	FLD farmers	Non-FLD farmers
Yield (q/ha)	18.64	13.19
Operational cost of cultivation (Rs/ha)	28,976	27,843
Gross return (Rs/ha)	111,840	79,140
Net return (Rs/ha)	82,864	51,297
Incremental cost (Rs/ha)	-	1,133
Incremental return (Rs/ha)	31,567	-
Incremental benefit-cost ratio	2.78	-

Table 3. Distribution of farmers based on the constraints confronted in sunflower cultivation

Constraint	FLD farmers			Non-FLD farmers		
	Frequency	%	Rank	Frequency	%	Rank
Necrosis disease	24	96	I	25	100	I
Market fluctuation	21	84	III	22	88	IV
Lack of quality seed	20	80	IV	23	92	III
High seed cost	20	80	IV	23	92	III
Less seed filling (center)	18	72	V	16	64	VI
Lack of institutional credit facility	15	60	VII	19	76	V
Downy mildew disease	6	24	VIII	9	36	VII
Low rainfall	23	92	II	22	88	IV
Lack of market information	16	64	VI	19	76	V
Lack of availability of fertilizers and pesticides locally	23	92	II	24	96	II

Multiple responses

Overall, the data indicated that while critical constraints like necrosis, input availability and rainfall were pervasive across both groups, issues related to seed quality, cost, market information and credit access appeared to be more critical for non-FLD farmers, often ranking higher for them.

Vaster et al (2011) reported that major problems in adoption of the recommended sunflower production technologies by the farmers were pest and disease incidence, non-availability of improved varieties, high cost of HYV, lack of extension work at village level, high inputs cost and insufficient training programmes.

Sumit et al (2025) reported that in eastern Haryana, the major production problems for sunflower growers were low crop productivity (revealed by 92.00% of growers) followed by high incidence of insect pests/birds (90.00%), poor seed quality (76.00%), shortage of human labour (74.00%) and high post-harvest losses (62.00%). Other production challenges included lower profitability of oilseeds compared with other crops (reported by 52.00% growers) and seed shattering due to untimely rainfall (46.00%).

Bindu et al (2025), in a study in Chitradurga district of Karnataka, indicated that uneven distribution of rainfall, bird damage, pest and disease incidence, high cost of production and low price for the produce were major constraints faced by sunflower growers.

Sahana et al (2024) reported that major constraints faced by the contract farmers of Haveri district, Karnataka, in marigold and sunflower farming were delay in payment, low contract price and disease outbreak. For non-contract farmers, lack of credit infrastructure and high transportation cost were the limitations.

Farmers' suggestions for enhancing sunflower cultivation: Table 4 presents the distribution of farmers based on their suggestions for improving sunflower cultivation.

A consensus emerged regarding the need for a remunerative price, with 100 per cent of both FLD and non-FLD farmers advocating for it, indicating this as a universal and paramount concern. The demand for efficient market systems was also high, suggested by 88 per cent of FLD and 80 per cent of non-FLD farmers. Similarly, incentives for farmers were suggested by 72 per cent of FLD and 64 per cent of non-FLD farmers, highlighting a desire for supportive policies.

Suggestions for short duration hybrids were made by 72 per cent of FLD farmers, a higher proportion compared to 56 per cent of non-FLD farmers, reflecting a perceived need for crop varieties that mature faster. The importance of timely seed supply locally was underscored by 96 per cent of FLD and 100 per cent of non-FLD farmers. Additionally, the supply of seed at a low rate was advocated by 92 per cent of FLD farmers, significantly more than the 76 per cent of non-FLD farmers.

Other suggestions given by the respondents included the importance of sunflower crop insurance, which was proposed by 84 per cent of FLD and 72 per cent of non-FLD farmers. The need for exposure visits for farmers was expressed by 64 per cent of FLD and 60 per cent of non-FLD farmers. Lastly, the supply of bio-control agents locally was suggested by 48 per cent of FLD and 56 per cent of non-FLD farmers.

Overall, the data indicated strong shared priorities among both farmer groups, particularly concerning market and seed-related issues, with FLD farmers often showing a slightly higher proportion for suggestions related to technological inputs and supportive programmes.

Bindu et al (2025), in a study conducted in Chitradurga district of Karnataka, reported that sunflower growers requested the provision of minimum support price, disease and drought tolerant hybrids, crop insurance and timely availability of inputs at lower prices.

Sahana et al (2024) found that contract farmers of Haveri district, Karnataka, involved in marigold and sunflower farming asserted the need for good quality seed supply, timely payment and timely technical guidance. Conversely, non-contract farmers suggested creating profitable marketing channels and increasing employment opportunities.

CONCLUSION

The study highlighted the vital role of sunflower in crop diversification and oilseed production in India. Frontline demonstrations (FLDs) proved to be an effective intervention tool, significantly influencing the adoption behaviour of farmers and enhancing the productivity and economic viability of sunflower cultivation. The findings demonstrated the positive impact of FLDs. While basic cultivation practices were universally embraced, FLD farmers exhibited markedly higher adoption rates for more advanced and nuanced

Table 4. Distribution of farmers as per their suggestions

Suggestions	FLD farmers		Non-FLD farmers	
	Frequency	%	Frequency	%
Remunerative price	25	100	25	100
Efficient market systems	22	88	20	80
Incentives to farmers	18	72	16	64
Short duration hybrids	18	72	14	56
Timely seed supply locally	24	96	25	100
Supply of seed at low rate	23	92	19	76
Exposure visit to farmers	16	64	15	60
Sunflower crop insurance	21	84	18	72
Supply of bio-control agents locally	12	48	14	56

Multiple responses

technologies such as optimal spacing, dibbling method of sowing, recommended fertilizer application and crucial need-based plant protection measures. This enhanced adoption directly translated into substantial economic benefits for FLD farmers, who realized significantly higher yields, gross returns and net returns compared to non-FLD farmers. The incremental benefit-cost ratio further highlighted the profitability of investing in these demonstrated technologies. The study also brought to light several persistent challenges hindering sunflower growers. Necrosis disease, lack of readily available fertilizers and pesticides and low rainfall were identified as pervasive constraints across both farmer groups. Issues pertaining to seed quality, high seed cost and limited access to institutional credit were particularly pronounced for non-FLD farmers. In response to these challenges, farmers strongly advocated for remunerative prices, efficient market systems, timely local seed supply, crop insurance and the provision of disease and drought tolerant hybrids.

Thus while FLDs were highly successful in bridging knowledge and adoption gaps for improved practices, a holistic approach is necessary. Future interventions should continue to leverage the effectiveness of demonstrations while simultaneously addressing the identified constraints, particularly those related to market infrastructure, quality input access and financial support, to ensure sustainable growth and profitability in sunflower cultivation.

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