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Promoting oilseed productivity in western Rajasthan: Assessing the impact of front-line demonstrations on mustard cultivation

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Abstract

The study aimed to assess the impact of front-line demonstrations (FLDs) conducted from the year 2018-19 to 2022-23 using crop management technologies with integrated approaches on mustard. Total 365 beneficiaries were selected across the Jodhpur, Nagaur, and Pali blocks of the arid region of Rajasthan for conducting the FLDs. The obtained results from both the demonstrated and local farmer practices plots were compared, and the average yield of the improved mustard variety NRCHB 101 and RH 0749 from the demonstrated plots was significantly higher than that from the local plots during all the five years. The average extension and technology gaps were recorded as 2.67 q/ha and 7.19 q/ha, respectively. The average technology index was 28.20%, indicating the increased adaptability and efficiency of recommended technologies in field conditions. Economic analysis reveals higher gross and net returns in FLDs despite increased cultivation costs, highlighting the economic viability of recommended technologies. The study underscores the importance of tailored recommendations to minimize technology gaps and enhance yield levels, thus promoting sustainable agricultural practices in the region.

Keywords: *Extension gap, FLDs, impact, mustard, technological index, technology gap*

Introduction

Oilseed production plays a vital role in sustaining agricultural economies worldwide, contributing significantly to food security, income generation, and rural development. In the Indian economy, oilseed crops hold a substantial position, following closely behind food grains (Sangwan *et al.,* 2021). Mustard is the leading cultivated oilseeds in India followed by soybean and groundnut (Choudhary *et al.,* 2023). Mustard is primarily used for extraction of mustard oil. In India, Rajasthan, Uttar Pradesh, Madhya Pradesh and Haryana are the major mustard producing states in the country. Rajasthan alone accounts for 45.52 lakh hectares under mustard cultivation, yielding 66.84 lakh tonnes with a productivity of 1468 kg/ha (Anonymous, 2023). In the arid regions of western Rajasthan, where agricultural activities face formidable challenges due to water scarcity and harsh climatic conditions, enhancing oilseed cultivation represents a crucial avenue for bolstering agricultural resilience and improving livelihoods.

Mustard cultivation predominantly thrives in the north-eastern districts, particularly Bharatpur, which contributes to 28% of the state's total production. Additionally, mustard holds importance in Barmer, Jalore, Nagaur, and Jodhpur districts, where its cultivation is favored due to its low water requirement. However, in these areas, yields remain low compared to the state average, attributed to various factors such as weather variations, monsoon failures, low adoption of improved varieties, inadequate plant protection and weed management practices, nutrient management issues, and limited farmer knowledge. Efforts by both central and state governments have been made to enhance mustard production through various incentives, including the adoption of recommended technologies (Anonymous, 2013). Despite these efforts, there persists a wide gap between the technologies available at research centres and their utilization by farmers. Therefore, understanding farmers' knowledge, adoption rates, attitudes, and the challenges associated with mustard production is crucial. Efforts should focus on minimizing these challenges and facilitating the adoption of new mustard cultivation technologies. In line with this objective, front-line demonstrations (FLDs) were organized by the Agricultural Research Station, Mandor in western Rajasthan, aimed at transferring technology among mustard growers. This study evaluates the impact of FLDs on potential yield, demonstration yield, extension gaps, technological gap, and technological index.

Materials and Methods

The front-line demonstrations (FLDs) on mustard were conducted at farmers' fields across Jodhpur, Nagaur, and Pali blocks of the arid region of Rajasthan over five consecutive *Rabi* seasons from 2018-19 to 2022-23. The soils in the study area ranged from sandy loam to loam, characterized by poor fertility and water holding capacity. The aim of the FLDs was to assess gaps between the potential yield and demonstration yield, extension gap and technology index. A total of 365 FLDs covering 146 hectares were implemented across different blocks, with each farmer allocated 0.4 hectares for demonstration (Table 1). Critical inputs such as quality seeds, balanced fertilizers, and agro-chemicals were provided in demonstration plots, along with non-monetary inputs like timely sowing and weeding. Traditional practices were followed in local check plots. Scientists provided guidance in field operations like sowing, spraying, weeding, and harvesting during their visits. The technologies demonstrated and local practices are detailed in Table 2. Rigorous monitoring and supervision of FLD plots were carried out from sowing to harvesting through frequent visits, with appropriate suggestions provided when necessary. Field days were organized to promote improved agro-techniques among mustard growers. All technological interventions were implemented according to prescribed packages and practices for improved mustard varieties. The seed yield was recorded and yield gap analysis, cost of cultivation, net returns and additional return parameters were calculated (Table 3 and 4). All the necessary information was documented at the farmer's field and analyzed for comparative evaluation between front line demonstration and farmer's practice. To estimate the extension gap, technology gap and the technology index, the following formulae were used (Samui *et al.,* 2000).

Extension gap = Demonstration yield - Farmers yield

Technology gap = Potential yield - Demonstration yield

Technology index = [(Potential yield - Demonstration yield)/ (Potential yield)] × 100

Additional returns = Demonstration net returns - farmer's practice net returns

Table 1: Year wise details of front-line demonstrations (FLDs) conducted

Year	District	Villages under district	No. of FLDs	Total no. of FLDs	Total area covered (ha)
2018-19	Jodhpur	Padasala and Raimalwara	25	50	20
	Nagaur	Khundala and Nagadi	25		
2019-20	Jodhpur	Nevra road, Kiramsariya khurd, Dhanari kalan and Ramnagar	32	45	18
	Nagaur	Kurchhi and Nahar Singhpura	13		
2020-21	Jodhpur	Anwana and Bawari	25	70	28
	Nagaur	Tankla	25		
	Pali	Angore, Ramnagar, Galthani, Sonpura, Boya, Kothar and KerlaPadar	20		
2021-22	Jodhpur	Kiramsariya	25	50	20
	Pali	Galthani, Sonpura, Koliwada, Jawai Bandh, Pomava, Sadalva and Bisalpur	25		
2022-23	Jodhpur	Basni Budha, Dev Nagar, Kharia Khangar, Ratkudia and Khudiyala	75	150	60
	Nagaur	Pundlu	35		
	Pali	Ramnagar, Sonpura, Koliwada, Angore, Galthani, Jhakhora and Sumerpur	40		
Total				365	146

Results and Discussion

Yield performance and gap analysis

The results indicate that under FLDs, crop yield consistently exceeded that of traditional farmer practices. The average yield achieved with improved technologies under FLDs stood at 22.15, 21.22, 18.24, 15.79, and 16.67 q/ha, contrasted with 18.74, 17.74, 15.76, 13.19, and 15.22 q/ha under farmer practices during the years 2018-19 to 2022-23, respectively. The results also showed that due to adoption of scientific practices, the yield of mustard increased by 18.31% over the yield obtained under farmers practices during 2018-19 to 2022-23 (Table 3). The results further indicated that the B:C ratio of mustard cultivation enhanced up to 2.56, 2.78, 3.02, 2.33 and 3.41 in comparison to 2.21, 2.45, 2.74, 2.06 and 3.21 in farmers practices during the year 2018-19, 2019-20, 2020-21, 2021-22 and 2022-23, respectively (Table 4). Jha *et al.* (2021) corroborated these findings by reporting similar yield enhancements

Table 2: Details of mustard cultivation practices under FLDs and existing practices

Technological intervention	Existing farmers practices	Improved practices demonstrated
Variety	Use of local variety seed and other variety like Kranti, Laxmi, Bio-902, Pusa Mustard 27	NRCHB -101 RH -0749
Seed rate (kg /ha)	6	4
Sowing method	Broadcasting, non -uniform plant population	Line sowing at 45 × 15 cm by tractor operated seed drill followed by thinning at 30 DAS
Seed treatment	Not applied	Carbendazim 50 WP @ 2 g/kg seed
Time of sowing	1 October to 30 November	15 October to 15 November
Nutrient management	Not applied	Application of sulphur, microgranules and $ZnSo_4$. Foliar application of N :P:K (18:18:18)
Weed management	Only manual weeding or no weeding	Pendimethalin CS 38.7%
Plant protection measures	Not applied any pesticide	Metalaxyl 8% + mancozeb 64% for seed treatment against seed and soil borne diseases Thiamethoxam 25WG and monocrotophos for insect pest control

of mustard crops under FLDs. Moreover, the study highlights a significant disparity between the potential yield and the yield obtained from local check plots for mustard crops in the region. This yield gap is attributed to a lack of awareness regarding suitable mustard varieties and inadequate knowledge of improved agronomic practices and fertilizer scheduling among farmers.

Furthermore, farmers enthusiastically collaborated in conducting FLDs, resulting in positive outcomes. The results unveiled an extension gap of 3.41 q/ha in 2018-19, 3.48 q/ha in 2019-20, 2.48 q/ha in 2020-21, 2.61 q/ha in 2021-22 and 1.45 q/ha in 2022-23, with an average of 2.67 q/ha. The highest extension gap, 3.48 was observed in 2019-20 (Table 3). Increasing adoption of cutting-edge production technologies alongside high-yielding varieties is anticipated to counteract this concerning trend of high extension gaps. This study underscores the imperative to educate farmers through various channels to facilitate the adoption of improved agricultural production technologies, thereby reversing the widening extension gap.

Moreover, a technology gap of 2.85 q/ha in 2018-19, 3.78 q/ha in 2019-20, 6.76 q/ha in 2020-21, 10.71 q/ha in 2021-22 and 8.33 q/ha in 2022-23 and average 7.19 q/ha was observed (Table 3). This gap can be attributed to disparities in soil fertility status, agricultural practices, local climate conditions, rainfed agriculture, and the timely availability of inputs. Hence, tailoring recommendations to specific locations is imperative to minimize the technology gap and enhance yield levels across diverse farming situations. These findings align with the conclusions drawn by Patel *et al.* (2009), Kalita *et al.* (2019), Chaudhary *et al*. (2018), Kumar *et al.* (2022), Mehriya *et al*. (2020) and Sharma *et al*. (2022) in their studies on mustard cultivation.

The results of technology index revealed that the technology index value was 11.4% in 2018-19, 15.12% in 2019-20, 27.04% in 2020-21, 39.68% in 2021-22 and 33.32% in 2022-23. The average technology index value was calculated at 28.20% (Table 3). These findings are consistent with previous research by Mitra and Samajdar (2010) and Dhaka *et al.* (2010). Effective adoption of demonstrated technical interventions can mitigate the technology index, thereby enhancing the yield performance of mustard crops.

Economic and income augmentation through FLDs

The economic analysis of mustard production indicates that demonstrated plots, where additional inputs like herbicides, seed treatments, micronutrients, and insecticides were used, incurred higher cultivation costs compared to local check plots across all five cropping seasons. However, despite the increased expenses, the average gross and net returns were significantly higher in demonstrated plots due to their higher grain yield. This underscores the importance and economic feasibility of the recommended production technologies. The analysis of yield performance revealed that mustard crop grown in frontline demonstrations (FLDs) with recommended practices recorded higher mean gross monetary returns

Table 3. Yield performance, technology gap, extension gap and technology index of mustard under front-line demonstrations and farmers practices

FLD Year	Variety used in improved practices	No. of demonstrations	FLD area (ha)	Yield (q/ha)			% increase yield over farmers field	Technology gap (q/ha)	Extension gap (q/ha)	Technology Index (%)
				Potential yield	Demonstration yield	Farmer yield				
2018-19	NRCHB 101	50	20	25.0	22.15	18.74	18.20	2.85	3.41	11.4
2019-20	NRCHB 101	45	18	25.0	21.22	17.74	19.61	3.78	3.48	15.12
2020-21	NRCHB 101	70	28	25.0	18.24	15.76	15.73	6.76	2.48	27.04
2021-22	NRCHB 101	25	10	25.0	18.21	15.34	18.71	6.79	2.87	27.16
	RH 0749	25	10	28.0	13.38	11.04	21.19	14.62	2.34	52.21
2022-23	NRCHB 101	150	60	25.0	16.67	15.22	9.53	8.33	1.45	33.32
Average				25.5	18.31	15.64	17.16	7.19	2.67	28.20

Table 4. Economics of mustard production under frontline demonstrations and farmers practices

Year	Cost of cultivation (Rs/ha)		Gross returns (Rs/ha)		Net returns (Rs/ha)		Additional net returns (Rs/ha)	B:C ratio	
	Demonstration field	Farmers field	Demonstration field	Farmers field	Demonstration field	Farmers field		Demonstration field	Farmers field
2018-19	26100	24450	93034	78695	66934	54245	12689	2.56	2.21
2019-20	25119	23589	93884	79925	68765	56336	12318	2.78	2.45
2020-21	24914	23157	100331	86692	75417	63535	11942	3.02	2.74
2021-22	28400	25950	94776	79152	66376	53202	13174	2.33	2.06
2022-23	26643	25837	90857	82939	64214	57102	7112	3.41	3.21
Average	26235	24597	94576	81481	68341	56884	11457	2.82	2.53

(Rs.94576/ha) and additional net monetary returns (Rs.11457/ha) with a higher benefit-cost ratio (2.82) compared to crops under farmer practices (2.53). Additionally, there were notable additional returns recorded from the demonstrated plots in each cropping season, further supporting the economic viability of the recommended interventions.

An additional return of Rs.12689/ha in 2018-19, Rs.12318/ha in 2019-20, Rs.11942/ha in 2020-21, Rs.13174/ha in 2021-22 and Rs.7112/ha in 2022-23 were recorded from the demonstrated plots. The pattern of benefit-cost ratios of mustard production under FLDs was recorded as 2.56, 2.78, 3.02, 2.33 and 3.41 for the consecutive cropping seasons, which were higher in comparison to the local check plots under farmers' practice, i.e., 2.21, 2.45, 2.74, 2.06 and 3.21 respectively (Table 4). The higher benefit-cost ratio observed in the demonstrated plots confirmed the economic feasibility of the recommended technological interventions, yielding additional returns on each rupee invested in production. Farmers were notably convinced of the effectiveness of the recommended package of practices for mustard production. The findings were confirmatory with the study of Meena *et al.* (2020) and Sahu *et al.* (2022) as higher additional returns and effective gain was obtained from the demonstrated plots as compared to the plots under farmer practice with local mustard variety. Sharma *et al.* (2022) and Basediya *et al.* (2023) also obtained similar results for mustard crop. The rise in mustard yield resulting from FLDs significantly benefited the farming community in Western Rajasthan, motivating them to embrace the new agricultural technologies employed in the FLD plots. Yield fluctuations were attributed to variations in social, economic, and micro-agroclimatic conditions specific to each location.

Conclusion

The assessment of conducted front-line demonstrations (FLDs) unequivocally demonstrates that both crop yield and economic returns were markedly superior in the demonstrated plots compared to the local check plots. The productivity gains observed under FLDs, surpassing those of farmer's practices, have heightened awareness and motivated fellow farmers to adopt advanced crop management techniques and high-yielding mustard varieties throughout Jodhpur, Pali, and Nagaur districts. Therefore, well-timed and carefully executed FLDs, closely overseen by scientists, stand as crucial extension tools to showcase newly released crop production and protection technologies, along with their management practices, in various agro-climatic regions and farming scenarios. FLDs play a pivotal role in motivating the farmers for adoption of improved agricultural technologies, thereby engendering augmented seed yields and profits.

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