



Gap Analysis and Economic Viability of Indian Mustard

Rakesh Choudhary*, Bheru Lal Kumhar, Mamta Nehra and Rahul Bhardwaj

Dr. B. R. Choudhary Agricultural Research Station, Mandor, Agriculture University, Jodhpur-342
304, Rajasthan

ABSTRACT

The study was undertaken to analyze the effects of improved practices through frontline demonstrations (FLDs) on productivity and profitability of Indian mustard (*Brassica juncea* L.). Farmers' inadequate adoption of better technologies is the main factor contributing to mustard's low production. A significant enhancement in productivity was noted due to the adoption of interventions such as improved varieties, balanced nutrient management, seed treatment, improved sowing methods, timely operations and plant protection measures. The impact of improved practices revealed that cultivation of improved mustard varieties recorded yield increase up to 16.55% at Hatundi (Jodhpur) during *rabi* 2023–24, 12.36% at Khardamewas (Jodhpur) and 14.29% at Sinla (Pali) during *rabi* 2024–25 over the farmers' practices. The technology gap showed the difference between the potential yield under optimum conditions and the yield actually achieved in practice was 706 kg/ha at Hatundi (Jodhpur) during *rabi* 2023–24, 918 kg/ha at Khardamewas (Jodhpur) and 823 kg/ha at Sinla (Pali) during *rabi* 2024–25. The technology index varied between 29.42% and 35.31%, with a mean value of 32.21%. The mean gaps observed for technology and extension were 816 kg/ha and 164 kg/ha, respectively, while the average technology index was 32.21%. Demonstration of improved technologies also increased average gross return (₹ 1,00,405 /ha), net return (₹ 70,905 /ha), net gain (₹ 9348 /ha) and additional return (₹ 10915 /ha) compared to farmers' practice. Conductance of front line demonstration helped in raising the awareness and encouraged farmers to adopt improved mustard production technologies in the state.

Keywords: Farmer practices, Extension gap, Improved practices and Technology gap.

INTRODUCTION

Mustard (*Brassica juncea* L.) is a major oilseed crop contributing significantly to the dietary needs, economic sustainability and crop diversification in farming systems. It contributes in the production of edible oils, vegetables, condiments, animal feed and making them economically significant (Jat *et al*, 2019). India accounts for approximately 19.8 per cent of the total area on a global scale, while its contribution to the overall agricultural output stands at 9.8 per cent (Anonymous, 2024). Although rapeseed-mustard is cultivated across most states in India, the majority of its production during 2023-24 was contributed by Rajasthan (45.40%), Uttar Pradesh (14.24%), Madhya Pradesh (13.28%), Haryana (10.78%) and West Bengal (6.0%). Approximately 74% of the total area under rapeseed-mustard cultivation is irrigated. Rajasthan is the major producer of mustard and ranks first in both area (4.0 million ha.) and production (6.29 million tonnes) with an average productivity of 1573 kg/ha

(Anonymous, 2024a). However, Kumar *et al* (2017) highlighted that the major constraints leading to lower yields include the use of inappropriate production practices by farmers, such as broadcasting method of sowing, imbalanced and untimely fertilizer application, limited awareness of plant protection practices, inadequate weed management and inadequate extension services. However, the adoption of several technological components remained low, highlighting the need for more effective dissemination strategies. (Kiresur *et al*, 2001).

Mustard productivity can be significantly enhanced by adopting improved agronomic practices, including the use of high-yielding varieties, integrated nutrient management, seed treatment, appropriate sowing methods and effective plant protection measures. The population of Jodhpur and Pali districts dependent primarily on agriculture and allied activities. Front line demonstrations were designed to showcase the production potential of recommended

Table 1. Details of demonstration sites and number of farmers covered during the frontline demonstrations on mustard during 2023-24 and 2024-25.

Sr. No.	Year	Village/site of demonstration	No. of farmer (n= 85)
1	2023-24	Hatundi, Jodhpur	25
2	2024-25	Khardamewas, Jodhpur	25
3	2024-25	Sinla, Pali	35

Table 2. Existing farmer's practices and improved practices demonstrated through FLDs at farmer's field in Jodhpur and Pali districts of Rajasthan.

Sr. No.	Technological intervention	Farmer's practice	Improved practice
1	Variety	Local variety <i>i.e.</i> Bio-902, Kranti	RH 749 and RH 761
2	Seed rate	3-4 kg/ ha	2-3 kg/ ha
3	Seed treatment	Not done	Seed treatment with Mancozeb 75 WP @ 2.5 g/kg of seed, along with Azotobacter and PSB each @ 500 g/ha.
4	Nutrient management	Imbalance use of fertilizers	Balance use of fertilizers: 60:40:40 Kg NPS as per package of practices or Microgranular fertilizer (pre mixed sulphur 67% + 14% zinc) 10 kg/ha instead of sulphur
5	Sowing method	Broad casting	Line sowing
6	Time of sowing	25 September to 25 October	15 September to 15 October
7	Weed management	Not done	Spray pendimethalin 38.7% CS @ 340 g/ha and hand weeding at 25-30 DAS
8	Irrigation management	As per traditional methods	Irrigation was provided at critical growth stages, namely branching, flowering, and pod filling
9	Insect and pest management	Injudicious use of pesticides	Use of pesticides as per recommendations of package of practices.
10	Disease management	Not done	As per recommendations of PoP
11	Harvesting and post harvesting	Traditional method	As per recommendations.

technologies under actual field conditions, bridging the gap between research and farmer-level adoption. This study evaluated the impact of FLDs on the productivity and profitability of mustard cultivation in Western Rajasthan. By comparing demonstrated plots with farmers' traditional practices helped in quantifying yield gains, economic returns, and improvements in technological adoption. The front-line demonstrations were conducted in three villages across the Jodhpur and Pali districts of Rajasthan with the objective to evaluate the yield gap, economic performance of the improved technologies and to study the profile and impact of frontline demonstrations among mustard grower in Western Rajasthan.

MATERIALS AND METHODS

The study was conducted in the Jodhpur and Pali districts of Rajasthan. Frontline demonstrations on the oilseed crop mustard were carried out over two consecutive years during the *rabi seasons* of 2023–24 and 2024–25. A total of 35 ha area was sown under FLDs on mustard in three villages in two district at 85 farmers' fields (Table 1). Each demonstration covered an area of 0.4 ha, with an adjacent 0.1 ha plot maintained under farmers' traditional practices for comparison. A list of frontline demonstration (FLD) beneficiary and non-beneficiary mustard growers were prepared from the selected villages. The package

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Figure 1: Distributed critical inputs of improved technologies for FLDs



Figure 2: Organized field day on mustard at farmers' field, at Sinla (Pali)

Table 2. Effect of improved practices on yield attributing traits of mustard.

Site and Year	Number of Siliquae/plant		IP % increase over FP	Number of Seed/silique		IP % increase over FP
	IP*	FP*		IP	FP	
Hatundi, 2023-24	320	270	18.5	15.3	13.2	15.9
Khorda Mewas, 2024-25	311	282	10.3	13.2	12.1	9.0
Sinla, 2024-25	336	302	11.3	16.1	13.9	15.6
Average	322	285	13.4	14.9	13.1	13.5

*IP= Improved practices; FP= Farmer's practices

of improved practices like improved variety, nutrient management, seed treatment, sowing method and plant protection measures were applied in the demonstrations. The varieties of mustard such as RH 749 and RH 761 were included in demonstrations. In frontline demonstrations, complete package of practices as recommended by Agriculture University, Jodhpur whereas in the farmers' practice, existing practices being used by the farmers of the area were followed (Table 2).

The extension activities including training programmes, group meetings and field days were also organized at demonstration sites to create awareness among farming community of neighbouring areas about the advantages of demonstrated technologies. The collected data were analysed using suitable statistical methods. Descriptive statistics such as mean and percentage were computed. Further, a paired t-test was applied to assess the significance of differences between improved practices (IP) and farmer practices (FP). Statistical analysis was carried out using Microsoft Excel (MS Excel 2019) along with the paired t-test. To estimate the technology & extension gap and the technology index the formulae used (Samui *et al.*, 2000)

The study followed a positivism research philosophy, emphasizing objective measurement and quantitative evaluation of improved agricultural practices under field conditions. A deductive research approach was used to evaluate the effectiveness of the recommended technologies. The study employed a quantitative methodological choice using measurable data on yield and yield attributes. For the economic analysis, the cost of cultivation comprised expenses incurred on inputs such as seed, fertilizers and pesticides, which were procured by farmers themselves under the farmers' practice treatment. In contrast, inputs for the demonstration plots were provided by Dr. B. R. Choudhary Agricultural Research Station, Mandor, Jodhpur. Costs related to labour, sowing and post-harvest operations were borne individually by the farmers in both cases. The total cost of cultivation was estimated by summing expenditures on land preparation, seed, sowing, fertilizers, plant protection chemicals (insecticides, fungicides, herbicides), irrigation, labour and harvesting for each plot. Gross and net returns were computed based on the total cost of cultivation and the value of produce, using grain yield and prevailing market prices during the study period.

Table 3: Seed yield of mustard as influenced by improved practices compared to farmers' practices under field conditions.

Site and Year	Yield (kg/ha)		Additional yield (kg/ha) over farmer practices	Increase in yield over farmer practices (%)
	IP*	FP*		
Hatundi , 2023-24	1694	1456	238	16.55
Kharda Mewas, 2024-25	1682	1498	184	12.36
Sinla , 2024-25	1777	1553	224	14.29
Average	1717	1553	215	14.40

*IP= Improved practices; FP= Farmer's practices

Table 4. Paired t-test analysis of yield attributes and yield under improved practices (IP) and farmer 's practices (FP) in FLDs.

Parameter	Mean Difference (IP–FP)	t-value	Significance
Siliquae/plant	37.67	6.22	Significant
Seeds/siliquea	1.80	5.00	Significant
Yield (kg/ha)	215.33	13.20	Highly Significant

RESULTS AND DISCUSSION

Technology interventions v/s farmers' practice

Prior to the initiation of front-line demonstrations at farmers' fields, a participatory rural appraisal (PRA) was conducted to assess existing practices. Based on this assessment, the differences between prevailing farmers' practices and recommended technologies for Indian mustard cultivation in Jodhpur and Pali districts of Rajasthan are summarized in Table 1. Among the various technological components, complete gaps were identified in the adoption of improved varieties, thinning, seed treatment, seed rate and plant protection measures. In contrast, partial gaps were observed in aspects such as sowing time, method of sowing, fertilizer application, weeding and irrigation practices. No significant gap was observed with respect to farming conditions and field preparation. The observed gaps at the farmers' level may be attributed to the limited effectiveness of extension services, inadequate outreach of public extension systems, and restricted access to improved agro-technologies, particularly among small and marginal farmers and other vulnerable groups (Geat *et al*, 2024). Furthermore, farmers often relied on traditional or older low-yielding varieties instead of recently released high-yielding cultivars, along with improper adoption of recommended production practices. The situation was further compounded by the untimely availability of quality seed and insufficient awareness regarding improved technologies, which collectively

contributed to lower productivity at the farm level.

Effect on yield-contributing characteristics

The number of siliquae per plant with improved practices were 320, 311 and 336 as compare farmer practices 270, 282 and 302 (Hatundi, Khardamewas and Sinla) during the year 2023-24 & 2024-25, respectively (Table 2). There were 18.5, 10.3 and 11.3% higher siliquae per plant during both years (2023-24 & 2024-25, respectively) with demonstration of improved practices over farmer's practices. The average number of siliquae per plant was 322 with improved practices and 285 under farmer practices, thus there were 13.4% more capsules per plant under improved practices. The average number of seeds per siliquea in improved practice was 14.9 as compared to 13.1 in farmer practices. The number of seeds per siliquea under improved practices and farmers practice were 15.3, 13.2 & 16.1 and 13.2, 12.1 & 13.9 during the year 2023-24 & 2024-25, respectively at different sites (Hatundi, Khardamewas and Sinla). The percentages increased in seeds per siliquea during the three years were 15.9, 9.0 and 15.6, respectively with an average of 13.5% seeds per siliquea. Higher weed infestation under farmers' practices as evident from the higher weed cover and reduced supply of nutrients and water under farmers' practice led to lower yield due to less capsule as compared improved practices. Adoption of improved practices increased mustard yield attributing traits as compared to farmer practices. The yield contributing traits have also been reported in mustard crop by

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Table 4. Cost of cultivation, net return and benefit cost ratio of mustard as affected by improved and farmers practices

Site and Year	Cost of cultivation (₹/ha)		Net returns (₹/ha)		BC ratio	
	IP*	FP*	IP*	FP*	IP*	FP*
Hatundi , 2023-24	27500	27000	68213	55237	2.48	2.05
Kharda Mewas , 2024-25	30500	28400	69558	60750	2.28	2.14
Sinla, 2024-25	30500	28400	74943	63981	2.46	2.25
Average	29500	27933	70905	59989	2.41	2.15

Sale price of mustard: ₹ 56.5 /kg (2023-24) and ₹ 59.5 /kg (2024-25)

Table 5. Additional cost of cultivation and additional net return, effective gain and incremental BC ratio of mustard as affected by improved and farmer's practices.

Site and Year	Additional cost of cultivation (₹/ha)	Additional net return (₹/ha)	Effective gain (₹/ha)	Incremental B:C ratio
Hatundi , 2023-24	500	12976	12476	25.95
Kharda Mewas, 2024-25	2100	8808	6708	4.19
Sinla , 2024-25	2100	10962	8862	5.22
Average	1567	10915	9348	6.97

Meena *et al* (2018), Kumar *et al* (2014) and reported in mustard crop by Choudhary and Nehra (2021).

Seed yield

The seed yield of mustard was 1694 and 1682 & 1777 kg/ha with improved practices as compared to farmer's practices as 1456 and 1498 & 1553 kg/ha during 2023-24 and 2024-25, respectively (Table 3) and the average seed yield was 1717 kg/ha with improved practices over 1553 kg/ha. The additional yield obtained under improved technologies over farmers' practices ranged between 184 to 238 kg/ha, with an average increase of 215 kg/ha. The higher seed yield under improved practices was primarily due to line sowing, use of improved varieties, balanced nutrient management, effective weed control, and timely plant protection measures. Singh *et al* (2018) also reported higher productivity in improved practices as compared to farmer practices. Similar results have been reported by Raikwar and Srivastva (2013) Poonia *et al* (2017), Singh *et al* (2014) and Choudhary and Nehra (2021).

Paired t-test analysis

The paired t-test analysis indicated that improved practices (IP) significantly enhanced yield attributes and yield over farmer's practices (FP) across all demonstration sites. The number of siliquae per

plant under IP (mean 322) was higher than FP (285), with a mean difference of 37.67, which was statistically significant ($t = 6.22$). Similarly, the number of seeds per siliqua increased from 13.1 under FP to 14.9 under IP, with a mean difference of 1.80, also showing significant improvement ($t = 5.00$). The yield under IP (1717 kg/ha) was markedly higher than FP (1553 kg/ha), with an average increase of 215.33 kg/ha, corresponding to a 14.40 per cent increase, and this difference was found to be highly significant ($t = 13.20$). In conclusion, the results clearly show that the adoption of improved practices under Front Line Demonstrations significantly enhanced both yield components and overall crop productivity.

Effect of improved practices on economics

The economic viability of improved practices over farmer practices was calculated depending on prevailing prices of inputs and output costs (Table 4). It was found that, the average cost of cultivation of mustard under improved practices was ₹ 29500 /ha as compared with farmer practices ₹ 27933 /ha during both years at three sites. The improved practices registered an additional cost of cultivation between ₹ 500 to 1900 /ha over farmer practices. The higher cost in improved practices was primarily attributed to increased expenditure on adequate fertilizer application, improved seed, weeding and integrated

Table 5. Gap analysis of cluster frontline demonstrations on mustard.

Year	Extension gap (kg/ha)	Technology gap (kg/ha)	Technology index (%)
Hatundi, 2023-24	238	706	29.42
Khorda Mewas, 2024-25	184	918	35.31
Sinla, 2024-25	224	823	32.21
Average	164	816	32.21

pest and disease management. Mustard under improved practices gave higher net returns which ranged from ₹ 68213 to 74943 /ha with additional net returns average ₹ 10916 /ha (2 years) as compared to farmer practices which were ranged between ₹ 55237 to 63981 /ha. The highest BC ratio (average of two years) was obtained 2.41 with improved practices over farmer's practices (2.15). This finding was in corroboration with the findings of Raikwar and Srivastva (2013), Singh *et al* (2018), Choudhary and Nehra (2021).

Analysis of yield and technology gaps in cluster frontline demonstrations on mustard

The findings showed that the extension gap varied from 184 to 238 kg/ha across different locations, indicating the need to enhance farmers' awareness and adoption of improved mustard production technologies. A considerable difference was observed between yields obtained under farmers' practices and those achieved through recommended improved practices demonstrated in cluster frontline demonstrations. The results clearly indicated that the adoption of improved practices outperform traditional farmer methods, as also reported by Kumar *et al* (2014). The average technology gap over two years across three locations was 816 kg/ha, which may be attributed to variations in soil fertility and local field conditions. The technology index ranged from 29.42 to 35.31 percent, with an overall average of 32.21 percent. These findings indicate considerable potential for enhancing productivity through wider dissemination and adoption of recommended technologies. Similar results have been reported by Rohit and Singh (2019), Zimik *et al* (2020) and Choudhary and Nehra (2021).

CONCLUSION

Front-line demonstrations on mustard conducted at farmers' fields clearly indicated that the adoption of improved production practices significantly enhanced yield, yield attributes, and farmers' income. The improved agro-technologies

proved to be more productive, economically viable, and sustainable compared to existing farmers' practices. On average, higher gross returns (₹1,00,405 /ha), net returns (₹70,905 /ha), effective gain (₹9,348 /ha), incremental cost–benefit ratio (6.97), and benefit–cost ratio (2.41) were achieved under demonstration plots compared to farmers' practices. Thus, adoption of improved technologies demonstrated has a long-term impact on crop productivity, profitability and sustainability in Indian mustard over farmers' practice. Hence, greater emphasis is required on the dissemination of improved technologies through effective extension strategies such as training programmes and field demonstrations. Farmers need to be encouraged and supported to adopt the recommended package of practices to ensure higher productivity and better economic returns.

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