Plant Archives

SOCIO-ECONOMIC IMPACT AND ANALYSIS OF PRODUCTION AND CONSTRAINTS IN RAPESEED AND MUSTARD CULTIVATION: A STUDY FROM ASSAM, INDIA

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ABSTRACT

A study was conducted to evaluate the performance of rapeseed and mustard under Cluster Frontline Demonstrations (CFLDs) in terms of grain yield, extension gap, technological gap, economics and constraints across various districts of Assam over five consecutive rabi seasons from 2020–'21 to 2024–'25. A total of 12,076 CFLDs were organized by the Krishi Vigyan Kendra's (KVKs) of Assam, covering an area of 4,777 hectares. The average grain yield achieved through the adoption of improved production technologies under CFLDs was 947 kg/ha which was 44.76% higher than the yield obtained under farmers' traditional practices (654 kg/ha). The average extension gap, technological gap, and technological index were recorded at 293 kg/ha, 1,553 kg/ha, and 62.12%, respectively. In terms of economics, the net return from demonstration plots was Rs. 25,152/ha compared to Rs. 16,134/ha from farmers' practices. Constraints such as lack of knowledge about high yielding varieties (2.67), lack of technical know-how of soil treatment (2.63), lack of knowledge and skill for seed treatment (2.40), lack of soil moisture (2.29), lack of knowledge about weed management (2.18), lack of irrigation water (2.78), lack of technical know-how about plant protection measures (1.96), lack of warehousing facility (2.66), lack of marketing facilities in rural areas (2.82),and lack of processing facilities (2.62) were some of the important constraints that are faced by the rapseed and mustard growers in Assam.

Keywords : Cluster Frontline Demonstration, Economics, Extension gap, Rapeseed and Mustard, Technology gap, Technology index, Yield, constraints.

Introduction

Oilseed crops are best known for their most important role in the Indian agricultural economy, next to field crops like cereals and pulses. The "Yellow revolution" of 1980s better underscores the critical importance of oilseed crops in India's agricultural, economic and nutritional landscape. The nine primary crops under the oilseed cluster include groundnut, castor, sesame, rapeseed & mustard, linseed, soybean, sunflower, niger and safflower; whereas coconut, palm oil, cotton seed, rice bran are considered as secondary sources of edible oil. India, being the fourth leading oilseed producing country, next to USA, China, and Brazil, harvests around 29 million tonnes of oilseeds per annum from around 27 million hectares area with

an annual average yield of 1058 kg/ha (Reddy and Immanuelraj, 2017). During 2020-'21, total oilseed production in India was 35.95 million tonnes with an average yield of 1247 kg/ha, from an area of 28.83 million hectares. The major contributing states in total oilseed production include Rajasthan (22.21%), Maharashtra (18.59%), Madhya Pradesh (17.62%) and Gujarat (17.22%) with an area coverage of 5.19, 4.72, 8.20 and 3.36 million hectares, respectively (Ministry of Agriculture and Farmers Welfare, 2023). Over the period, the area under nine primary oilseed crops has increased from 10.73 million ha in 1950-'51 to 28.83 million ha in 2020-'21 with a substantial increase in total production and yield status i.e., 5.16 to 35.95 million tonnes and 481 to 1247 kg/ha, respectively (Ministry of Agriculture and Farmers Welfare, 2023).

At the global level, India is the third largest producer of rapeseed mustard, which accounts for 19.8% of total acreage and 9.8% of total global production, and 20% of total global oilseed production, although the productivity is only 1,089 kg/ha (Reddy and Immanuelraj, 2017; Meena *et al.*, 2018). Through the synergistic efforts of the Government, the area under oilseed cultivation has increased from 25.60 million hectares in 2014-'15 to 30.19 million hectares in 2023-'24 (18.05% increase). Likewise, production and productivity has increased from 27.51 million tonnes to 39.67 million tonnes (44.20% increase) and from 1,075 kg/ha to 1,314 kg/ha (22.23% increase) respectively during the recent years. Furthermore, edible oil production has also increased from 86.30 lakh tonnes in 2015-'16 to 121.75 lakh tonnes in 2023-'24 showing a growth of 40% and reducing the import share from 63.2% to 57.29% by 2022-'23, despite rising demand and consumption (Department of Agriculture & Farmers Welfare, 2025). India, being one of the largest and fastest-growing developing countries with third-largest economy in Asia, is listed out as one of the largest importers of edible oils. Higher income, low productivity in domestic oilseeds production and more liberal policies for edible oil imports have driven expanding trade, with an increase in rate of annual demand by 6% (Reddy and Immanuelraj, 2017; Jha *et al.*, 2012).

Materials and Methods

The present study was conducted involving 26 Krishi Vigyan Kendras (KVKs) of Assam during the rabi seasons from 2020–'21 to 2024–'25 at farmers' fields. A total of 12,076 Cluster Frontline Demonstrations (CFLDs) were carried out over an area of 4,777 hectares, focusing on rapeseed and mustard varieties TS 36 and TS 38. All technological interventions were implemented according to the prescribed package of practices. As part of the technological intervention, awareness programs were organized by KVK scientists to educate farmers on improved practices demonstrated in the plots. Farmers' traditional practices involving local varieties, were maintained as control plots (local check). The KVKs supplied critical inputs such as seeds, fertilizers, implements and bio-fertilizers to the demonstration plots along with technical support. Site and farmer selection, as well as layout of demonstrations, followed the guidelines outlined by Choudhary (1999). KVK scientists regularly monitored both demonstration and control fields to ensure close supervision and accurate data collection throughout the demonstrations period. A total of 300 farmers were selected for studying socio economic profile, estimation of technology gap, extension gap, technology index, economic analysis and constraints faced by farmers in Rapeseed and Mustard Cultivation and the data is collected with the help of structured interview schedule.

The response of farmers was asked that indicated whether each constraint was relevant by placing a tick (√) mark. For the constraints marked as relevant, the marked response was further evaluated using a three-point scale: Most Important, Important, and Less Important, assigned weights of 3, 2, and 1 respectively. After collecting responses from all rabi mustard growers, the total scores for each constraint were calculated. These totals were then divided by the number of respondents to determine the mean score for each constraint. Based on these mean scores, ranks were assigned under each specific category of constraints and followed the guidelines from Markana *et al.* (2015).

% Yield increase over farmers' practice

$$\frac{\text{Grain yield under FLD - Grain yield under check}}{\text{Grain yield under check}} \times 100$$

Estimation of technology gap, extension gap, technology index: The estimation of technology gap, extension gap and technology index were done using following formulae (Kadian *et al.,* 1997; Samui *et al.,* 2000):

i) **Technology gap** = Potential yield - Demonstration plot average yield

ii) **Extension gap** = Demonstration plot average yield - Farmer's plot average yield

iii) **Technology Index** = $\dfrac{\left(P_i - D_i\right)}{P_i} \times 100$

Where,

Pi=Potential yield of crop

Di=Demonstration plot yield of crop.

Economic analysis: Cost of cultivation includes cost of inputs like seeds, fertilizers, pesticides, charges of bullocks / tractor, labor etc. The net-return was calculated by taking into consideration the cost of cultivation and gross return. Similarly, the Benefit-Cost-Ratio (BCR) was worked out as a ratio of gross return corresponding to costs of cultivation as followed by Vedna (2007); Ojha *et al.* (2020); Singha *et al.* (2020) and Singh *et al.* (2020).

Two sample t-test

Two sample t test statistic was calculated as:

$$t = \frac{(\overline{x_1} - \overline{x_2})}{s_p\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

where s_p refers to pooled standard deviation

$$s_p^2 = \frac{((n_1 - 1)s_1^2) + ((n_2 - 1)s_2^2)}{n_1 + n_2 - 2}$$

Results and Discussion

Distribution of farmers according to age

As presented in Table 1, the majority of respondents (61.66%) belonged to the middle-aged category followed by those in the older and younger age groups. This distribution indicates a lower level of interest in farming among younger individuals, possibly attributable to perceptions of limited profitability in the agricultural sector.

Table 1: Distribution of farmers according to age

N=300

Sl. No.	Category	Frequency	Percentage
1.	Young (Up to 30 years)	50	16.66
2.	Middle (30-50 years)	185	61.66
3.	Old (Above 50 years)	65	21.66

Distribution of farmers according to family size

As shown in Table-2, the majority of farmers (61.66%) belonged to the small family size category, followed by those with medium (20.66%) and large (17.66%) family sizes.

Table 2: Distribution of farmers according to Family size

N=300

Sl. No.	Category	Frequency	Percentage
1.	Small	185	61.66
2.	Medium	62	20.66
3.	Large	53	17.66

Distribution of farmers according to occupation

As indicated in Table-3, agriculture was the primary occupation for all the farmers with dairy serving as a subsidiary source of income for 78.33% of them. Additionally, horticulture emerged as another prominent enterprise practiced by 70.66% of the farmers.

Table 3: Distribution of farmers according to occupation

N=300

Sl. No.	Category	Frequency	Percentage
1.	Agriculture	285	95.00
2.	Subsidiary (Dairy and other animal)	235	78.33
3.	Horticulture (Vegetable + Fruit Crop)	212	70.66

Distribution of farmers according to size of the land holding

As shown in Table-4, the majority of farmers (54.33%) were classified as medium farmers, followed by small farmers (28.33%) and large farmers (17.33%) according to the size of land holding.

Table 4: Distribution of farmers according to land holding

N=300

Sl. No.	Category	Frequency	Percentage
1.	Small (below 1 ha)	85	28.33
2.	Medium (1-2 ha)	163	54.33
3.	Large (above 2 ha)	52	17.33

Sources of farm information and their preference ranking

Table-5 indicates that the primary source of information for farmers was neighbouring farmers followed by village-level workers and input dealers. Among mass media channels, mobile phones and television emerged as the major sources of information

Table 5 : Sources of farm information and their preference ranking

Sl. No.	Major Sources Personal Contact	Rank	Sources Mass Media	Rank
1.	Neighbouring farmers	**I**	Radio	**IV**
2.	Input dealers	**III**	TV	**II**
3.	Radio/TV/News paper	**IV**	News paper	**III**
4.	KVK scientist	**V**	Mobile	**I**
5.	Village level worker	**II**	Other sources	**V**

Grain yield: The results of the study clearly indicated that demonstration plots consistently outperformed in comparison to farmers' traditional practices in terms of grain yield. As shown in Table 6, the implementation of improved technologies under Cluster Frontline Demonstrations (CFLDs) in rapeseed and mustard led to a yield increase ranging from 39.97% to 50.76% over farmers' practices. Over the five-year period, the average grain yield in CFLD plots was 947 kg/ha, with the highest yield recorded in 2024–'25 and the lowest

yield (902 kg/ha) observed in 2020–'21. On an average, the demonstration plots showed a 44.76% increase in yield over farmers' practice during the study period and it was statistically significant. Two sample t test results indicated that there was a significant difference between the mean potential yield and mean demonstration yield (p<0.01), and between the mean demonstration yield and mean check yield (p<0.01). This significant improvement in productivity can be attributed to the adoption of the recommended package of practices including the use of high-yielding varieties, integrated nutrient management and integrated pest management, which enhanced crop growth and minimized losses due to biotic and abiotic stresses. The findings align with those of Singh *et al.* (2014), Dwivedi *et al.* (2014) and Tomar (2010) who reported notable yield improvements through the use of improved agricultural technologies. Similar results have also been documented by Hiremath *et al.* (2007), Mishra *et al.* (2009), Kumar *et al.* (2010), Suryawanshi and Prakash (1993), Dhaka *et al.* (2010, 2015), Kumar *et al.* (2017), Singha *et al.* (2020), Suresh *et al.* (2020), and Ojha *et al.* (2020).

Table 6 : Grain yield and gap analysis of CFLDs on Rapeseed and Mustard at farmers' fields

Year	Area (ha)	No. of demo	Potential yield (kg/ha)	Check yield (kg/ha)	Demo yield (kg/ha)	Yield Increase (%)	Extn. Gap (kg/ha)	Tech. Gap (kg/ha)	Tech. index(%)
2020-21	377	943	2500	632	902	42.86	270	1598	63.92
2021-22	390	1045	2500	663	928	39.97	265	1572	62.88
2022-23	1000	2446	2500	657	945	43.84	288	1555	62.20
2023-24	1050	2731	2500	659	965	46.43	306	1535	61.41
2024-25	1960	4911	2500	660	995	50.76	335	1505	60.20
Total	4777	12076	-	-	-	-	-	-	-
Average	-	-	-	654	947	44.76	293	1553	62.12

Table 7: Results of two sample t test for potential yield, demonstration yield and check yield

Particulars	Two sample t test		Two sample t test	
	Potential yield (kg/ha)	Demonstration yield (kg/ha)	Demonstration yield (kg/ha)	Check yield (kg/ha)
Mean	2500	947	947	654.2
Variance	0	1254.5	1254.5	158.7
Observations	5	5	5	5
Pooled Variance	627.25		706.6	
Hypothesized Mean Difference	0		0	
df	8		8	
t Stat	98.04		17.42	
P(T<=t) one-tail	<0.01		<0.01	
t Critical one-tail	1.86		1.86	
P(T<=t) two-tail	<0.01		<0.01	
t Critical two-tail	2.31		2.31	

Extension Gap : Extension gap refers to the difference in grain yield between demonstration plots and farmers' traditional practices. A higher extension gap indicates a greater need for educational and motivational interventions to encourage the adoption of improved agricultural technologies among farmers (Kumar *et al.*, 2016). During the study period, the extension gap ranged from 265 to 335 kg/ha with an average gap of 293 kg/ha. The lowest extension gap (265 kg/ha) was recorded during Rabi 2021–'22, while the highest (335 kg/ha) occurred in Rabi 2024–'25 (Table-6). This variation in extension gap can be attributed to the implementation of improved technologies in the demonstration plots, which consistently produced higher yields compared to traditional farmer practices. The results clearly demonstrate the effectiveness of improved production technologies such as high-yielding varieties, which, when popularized and adopted, have the potential to significantly reduce the extension gap. The findings are in agreement with those reported by Singh *et al.* (2014), Dwivedi *et al.* (2014), and Tomar (2010), who observed significant reductions in extension gaps through the adoption of improved production technologies. Similar results were also documented by Hiremath *et al.* (2007), Mishra *et al.* (2009), Kumar *et*

al. (2010), Dhaka *et al.* (2010, 2015), Kumar *et al.* (2017), Singha *et al.* (2020), and Ojha *et al.* (2020).

Technology gap : Technology gap refers to the difference between the potential yield and the yield obtained under demonstration plot conditions. A wide variation in technology gap was observed across different years of the study. The lowest technology gap (1505 kg/ha) was recorded during Rabi 2024-'25, while the highest (1598 kg/ha) occurred in Rabi 2020–'21 with an average gap of 1553 kg/ha over the study period (Table-6). The observed technology gap can be attributed to the factors such as variability in soil fertility, rainfall distribution, pest and disease incidence, and changes in demonstration plot locations. These site-specific agro-climatic and edaphic factors influence the performance of the demonstrated technologies. Similar findings regarding technological yield gaps due to soil and weather variability have been reported by Raj *et al.* (2013). Supporting studies include those by Balail *et al.* (2013), Mukherjee (2003), Kumar *et al.* (2017), Saikia *et al.* (2018), Ojha *et al.* (2020), Singha *et al.* (2020), and Singh *et al.* (2020).

Technology index : The technology index, which measures the feasibility of a technology under real field conditions, followed a trend similar to that of the technology gap. The technology index ranged from 60.20% to 63.92% across the years (Table-6). The highest index (63.92%) was recorded in Rabi 2020–21,

while the lowest (60.20%) was observed in Rabi 2024–25. A lower technology index indicates higher feasibility of the demonstrated technology under farmers' field conditions. These findings are consistent with those reported by Singh *et al.* (2014), Dwivedi *et al.* (2014), and Tomar (2010) who also observed that improved production technologies exhibited considerable feasibility under farmers' field conditions. Similar trends have also been documented by Jeengar *et al.*, 2006; Hiremath *et al.* (2007), Mishra *et al.* (2009), Kumar *et al.* (2010), Dhaka *et al.* (2010, 2015), Kumar *et al.* (2017), Singha *et al.* (2020) and Ojha *et al.* (2020). Thus, the growing season of Rabi 2024-'25 demonstrated the most favorable conditions for the adoption and performance of improved technologies.

From table 7, it can be observed that the t-statistic of 98.04 was significantly greater than the critical t-value of 2.31 (two-tailed) and 1.86 (one-tailed), providing strong evidence to reject the null hypothesis. The p-values were both <0.01, indicating statistical significance which means potential yield was significantly higher than the demonstration yield. Further, the t-statistic for demonstration yield and check yield was 17.42, greater than the critical t-value of 2.31 (two-tailed) and 1.86 (one-tailed), strongly suggesting that the null hypothesis could be rejected. The p-values were both <0.01, confirming statistical significance and indicating that the demonstration yield was statistically higher than the check yield.

Table 8 : Economics of Rapeseed and Mustard cultivation under CFLD and Farmers practice

Year	Economics of Farmers' practice (Rs./ha)				Economics of Demonstration (Rs./ha)			
	Gross Cost	Gross return	Net return	BC ratio	Gross Cost	Gross return	Net Return	B:C ratio
2020-21	17609	31218	13609	1.78	20381	44509	24128	2.19
2021-22	22500	48937.5	26437.5	2.18	13991	35584.33	21593.33	2.54
2022-23	20991	36730	15875	1.64	24009	51408	27585	1.99
2023-24	20269	34239	14010	1.69	22461	46191	23730	2.08
2024-25	28500	39240	10740	1.38	28500	57225	28725	2.01
Average	**21974**	**38073**	**16134**	**1.73**	**21868**	**46983**	**25152**	**2.16**

Economic analysis : The economics of Rapeseed and Mustard crop production under Cluster Frontline Demonstrations (CFLDs) was analysed over a five-year period and the results are presented in Table-8. The analysis revealed that Rapeseed and Mustard cultivation under improved technologies recorded higher gross returns compared to traditional farmer practices. The cost of cultivation under demonstration varied across years, primarily due to fluctuations in input prices and localized farming conditions. The economic evaluation was based on prevailing input and output prices during the demonstration years and included calculation of gross return, cost of cultivation, net return and benefit-cost (B:C) ratio. The higher cost

of cultivation in demonstration plots, compared to farmers' practices, was mainly attributed to the use of certified seeds, seed treatment, recommended doses of chemical fertilizers, and integrated pest management. Despite this increased cost, the economic benefits under improved practices were significantly higher. The average cost of cultivation under demonstration was Rs. 21868.00/ha, compared to Rs. 21974.00/ha under farmers' practices. The average net return from demonstration plots was Rs. 25152/ha, whereas farmers' practices yielded only Rs. 16134/ha and it was statistically significant. Two sample t test results indicated that there was a significant difference between the mean net returns under farmers' practice

and mean net returns under demonstration (p<0.01). The average benefit-cost ratio under improved technologies was 2.16, substantially higher than 1.73 recorded under traditional practices. These findings clearly indicate the economic superiority of improved technological interventions in rapeseed and mustard cultivation. The consistent increase in B:C ratio across all years of demonstration confirms that higher yields

under improved practices were the key drivers of profitability. These results are further corroborated by earlier studies conducted by Mokidue *et al.* (2011); Singh *et al.* (2014), Dwivedi *et al.* (2014) Kumar *et al.* (2017); Ojha *et al.* (2020); Singha *et al.* (2020), Raghav *et al.* (2020); and Singh *et al.* (2020) who also documented enhanced economic returns through the adoption of improved production technologies.

Table 9: Results of two sample t test for net returns

Particulars	Net returns from farmers practice (Rs./ha)	Net returns from demonstration (Rs./ha)
Mean	16134	25152
Variance	29242286	6884122
Observations	6	6
Pooled Variance		18063204
Hypothesized Mean Difference		0
df	10	
t Stat	-3.68	
P(T<=t) one-tail	<0.01	
t Critical one-tail	1.81	
P(T<=t) two-tail	<0.01	
t Critical two-tail	2.23	

The results of t-test for net returns from farmers practice and from demonstration is presented in table 9. Results indicated that the computed t-statistic of -3.68 (in absolute terms) was higher than the two-tailed critical t-value of 2.23 and one-tailed critical value of 1.81. For both one-tail and two-tail, the p-value was

less than 0.01 (lower than the usual significance criterion of 0.05). As a result, we can reject the null hypothesis and conclude that the net returns obtained from demonstration was statistically greater than the net returns from farmers' practice.

Table 10: Constraints faced by farmers in Rapeseed and Mustard Cultivation

Sl No.	Constraints	Mean Score	Rank
I	**Improved variety**		
1.	Lack of Knowledge about High yielding varieties	2.67	II
2.	Unavailability of quality seeds	2.78	I
3.	High cost of HYVs	1.72	III
II.	**Soil preparation and treatment**		
1.	Lack of technical know-how of soil treatment	2.63	I
2.	High cost of soil treatment chemicals	2.33	III
3.	High cost of soil preparation implements	2.50	II
III	**Seed treatment**		
1.	Lack of Knowledge and skill for seed treatment	2.40	I
2.	Unavailability of suitable equipment for seed treatment	2.18	II
3.	Non-convinced for the utility of seed treatment	2.17	III
IV	**Recommended dose of Fertilizers**		
1.	Lack of knowledge about recommended dose of fertilizers	2.18	II
2.	Non-availability of FYM	2.06	III
3.	Lack of soil moisture	2.29	I
V	**Weed Management**		
1.	Lack of knowledge about weed management	2.18	I
2.	Unavailability of manual labor at the weeding time	1.83	II
3.	Use of weedicides put an adverse effect on the soils & plants	1.20	III
VI	**Irrigation Management:**		
1.	Lack of irrigation water	2.78	I
2.	Critical stage of mustard irrigation is not known	2.41	II

3.	Timely unavailability of electricity	1.48	III
VII	**Plant Protection Measures:**		
1.	Lack of technical know-how about plant protection measures	1.96	I
2.	Unavailability of plant protection chemical sprayer in the local area	1.76	II
3.	Unavailability of recommended plant protection chemicals	1.47	III
VIII	**Harvesting Threshing & Storage**		
1.	Unavailability of technical advices	2.42	III
2.	Lack of suitable equipment for threshing	2.47	II
3.	Lack of warehousing facility	2.66	I
IX	**Other Constraints**		
1.	High cost of inputs	2.30	V
2.	Unavailability of credit on marginal interest rate	1.63	VIII
3.	Absence of assured marketing at remunerative price	2.50	IV
4.	No encouragement of oil extraction mills in cooperative system.	2.44	III
5.	Lack of marketing facilities in rural areas	2.82	I
6.	High incidence of insect pest and diseases	1.75	VII
7.	Lack of processing facilities	2.62	II
8.	Lack of coordination between extension workers and farmers	2.25	VI

The constraints faced by the farmers in adoption of Mustard Production technologies are as follows from Table 10. It is observed from the table that Improved variety where lack of knowledge about high yielding varieties (2.67), unavailability of quality seeds (2.78) and high cost of HYVs (1.72) were the major constraints.

Under Soil preparation and treatment, it is observed that lack of technical know-how of soil treatment (2.63), high cost of soil treatment chemicals (2.33) and high cost of soil preparation implement (2.50) were the major constraints perceived by mustard and rapeseed growers in Assam.

Lack of knowledge and skill for seed treatment (2.40), unavailability of suitable equipment for seed treatment (2.18) and non-convinced for the utility of seed treatment (2.17) are some of the major constraints observed under recommended dose of fertilizers category.

Lack of knowledge about recommended dose of fertilizers (2.18), non-availability of FYM (2.06) and lack of moisture (2.29) are some of the constraints which caused difficulty for the mustard rowers in Assam

Lack of knowledge about weed management (2.18), Unavailability of manual labour at the weeding time (1.83) and use of weedicides put an adverse effect on the soils & plants (1.20) are major constraints under weed management.

Lack of irrigation water (2.78), critical stage of mustard irrigation is not known (2.41) and timely unavailability of electricity (1.48) were major constraints related to irrigation management that has been mentioned by the growers of mustard.

Lack of technical know-how about plant protection measures (1.96), Unavailability of plant protection chemical sprayer in the local area (1.76) and unavailability of recommended plant protection chemicals (1.47) are some of the challenges encountered by the growers under plant protection measures.

With regards to harvesting threshing & Storage constraints such as unavailability of technical advices (2.42), Lack of suitable equipment for threshing (2.47) and Lack of warehousing facility (2.66), are constraints expressed by the mustard and rapeseed growers in Assam.

High cost of inputs (2.30), Unavailability of credit on marginal interest rate (1.63), Absence of assured marketing at remunerative price (2.50), No encouragement of oil extraction mills in cooperative system (2.44), Lack of marketing facilities in rural areas (2.82), High incidence of insect pest and diseases (1.75), Lack of processing facilities (2.62), and Lack of coordination between extension workers and farmers (2.25) were some other notable constraints faced by the farmers in adoption of mustard production technologies.

Conclusion

It is concluded from the study that a considerable gap exists between the potential and demonstration yields of rapeseed and mustard which is likely due to variations in weather conditions, soil health, and management practices. The adoption of improved technologies including suitable varieties, balanced nutrient application and effective pest management combined with active farmer participation, positively influenced grain yield and economic returns. Cluster

Frontline Demonstrations proved effective in showcasing the productivity potential and profitability of advanced technologies under real farming conditions. It can be concluded that unavailability of quality seeds, lack of technical know-how of soil treatment, lack of knowledge and skill for seed treatment, lack of soil moisture, lack of knowledge about weed management lack of irrigation water, lack of technical know-how about plant protection measures, lack of warehousing facility and lack of marketing facilities in rural areas were some of the constraints that were faced by the farmers of in Rapeseed and Mustard Cultivation. Thus, bridging these technological and extension gaps requires widespread dissemination of recommended package of practices emphasizing on improved seed varieties, appropriate seed rates, and balanced fertilization. Therefore, the adoption of suitable varieties alongside improved agronomic practices is essential for enhancing productivity and achieving better economic returns in rapeseed and mustard cultivation.

Acknowledgement

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