Impact of CFLD Programs on the Adoption of Improved Sesame Production Technologies Among Farmers

Suggested title: Evaluating the Impact of Cluster frontline Demonstrations (CFLDs) on Adoption of Improved Sesame Cultivation Practices in Banda, Uttar Pradesh

ABSTRACT

Adoption of the recommended package of practices can increase sesame production by 20–30%. To promote the adoption of ~~scientifically~~ cultivation methods, Cluster Frontline Demonstrations (CFLDs) on sesame were organized by Krishi Vigyan Kendras (KVKs). These demonstrations aimed to showcase the effectiveness of the recommended package of practices under real farm conditions, thereby encouraging wider adoption among local farming communities. To assess the Impact of these CFLDs a study was carried out in the Banda district in 2021 to investigate the extent to which farmers have adopted new technology for improving sesame production, as well as the constraints faced by them in adoption of recommended package of practices. From KVK, Banda, a list of the 178 recipients of the sesame CFLD was received. 50 respondents were chosen from among these 178 beneficiaries, and 50 non-beneficiaries were chosen from each designated area. As a result, 100 respondents in total were chosen, and data were gathered using the personal interview approach. According to the survey, beneficiaries show a significant higher adoption of recommended sesame production practices than non-beneficiaries. Practices which show major difference in adoption were ~~Organic~~ organic manure and fertilizer management, weed management, and ~~Plant~~ plant protection measures, ~~shows.~~ a significant difference of 0.01 level of significance. The highest-ranking constraints in adoption of recommended package of practices were ~~Non-Availability of Quality Inputs, High Input Costs and Lack of Awareness and Knowledge.~~

Keywords: Adoption, CFLD, Impact, Sesame, Banda, Constraints, Package of Practices.

INTRODUCTION

~~India ranks third in sesamum production world~~ with 7.893 Lakh tones production and covering an area of 16.27 lakh ha during 2022-23, accounting for a significant share of global

production (Shaikh, S.S.N 2018). According to the Ministry of Agriculture and Farmers Welfare, India produced around 0.87 million metric tons of sesame seeds in the year 2020-2021. The major sesame-producing states in India include Rajasthan, Gujarat, Uttar Pradesh, Madhya Pradesh, and Maharashtra. The average yield of sesame (484.8 kg/ha) in India during 2022-23, ~~Which low as compared to international average~~ of 535 kg/ha (FAOSTAT). Tripathi *et al.* (2023) stated that Low yields are primarily due to the limited availability of high-yielding variety (HYV) seeds, insufficient seed replacement, and farmers' hesitation to adopt advanced agronomic practices that rely on modern technology and precise identification of problem areas for maximizing productivity. However, improved sesame varieties and production technologies have been developed to suit various agro-ecological regions across the country. When managed effectively, sesame crops can yield between 1200–1500 kg/ha under irrigated conditions and 800–1000 kg/ha under rainfed conditions. (Kumar B.R. 2020).

To minimize the gap between recommended sesame production technologies and actual practices adopted by farmers, the Krishi Vigyan Kendra (KVK), ~~Banda perform Cluster Frontline Demonstrations~~ (CFLDs) on sesame. These demonstrations aimed to raise awareness among farmers by showcasing the benefits of improved practices under real field conditions. By involving local and progressive farmers directly in the demonstration process, the program seems to enhance technology dissemination and encourage large-scale adoption of improved sesame cultivation practices across the district. The adoption of such practices is important for improving productivity, profitability, and long-term sustainability. Key technologies demonstrated in the ~~CFLD~~ were seed variety, balanced fertilization dose, timely weed and pest management, and recommended planting density. Additionally, farmers were informed about better post-harvest techniques such as proper drying and storage, which help maintain seed quality over long term storage and secure premium market prices. These interventions not only increase farm income but also contribute to improved nutritional outcomes for consumers because many farmers cultivate sesame not only for selling but also ~~for own use~~.

To increase the adoption rate of technology and increased awareness among farmers, several measures for human resource development are essential. ~~Today emphasize and use of~~

~~Information and Communication Technology (ICT)~~ for stakeholder education, reduced dependence on human resources for extension work. Despite the financial attractiveness of improved technology packages, adoption levels remain low for several components, highlighting the need for better dissemination (Kiresur et al., 2001). ~~minimizing~~ the technological gap between recommended agricultural practices and farmers' adoption is crucial. Krishi Vigyan Kendras (KVKs) play a important role through Cluster Frontline Demonstrations (CFLD) in promoting improved sesame cultivation practices. CFLD provides hands-on training, demonstrations, and exposure to advanced techniques such as improved seed varieties, precision farming, and efficient pest and disease management. Kumar *et al.* (2022) stated that ~~Cluster Frontline Demonstration (CFLD) is~~ an innovative approach that establishes a direct interaction between KVK scientists and farmers, facilitating the transfer of technologies developed by scientists and enabling the collection of direct feedback from the farming community. This approach increases productivity, profitability, and sustainability in sesame farming, ensuring that scientific advancements reach farmers effectively. Keeping these factors in view, the ~~present investigation was be conducted.~~

METHODOLOGY

A list of the 178 CFLD beneficiaries was asked from KVK Banda. Under the direction of KVK scientists, the CFLDs on ~~Sesamum~~ production technologies were carried out at the ~~farms field~~ of all the beneficiaries. ~~50 responders were chosen~~ at random from among these 178 beneficiaries using L.H.C. Tippet's random number table. Following that, the villages of the 50 beneficiaries were identified, and from each of those villages, an equal number of non-beneficiary respondents were chosen to serve as the control group. As a result, there were 100 responses in all, 50 in the treatment group and 50 in the control group.

For the present investigation, ~~quasi-experimental design and a descriptive research design were adopted~~. Data were collected using the personal interview method with the help of a structured interview schedule. The schedule included eight major sesame production practices, comprising a total of 26 itemized questions. Each question was measured on a three-point scale, with a possible score ranging from a minimum of 26 to a maximum of 78, allowing for a quantitative assessment of the adoption level among farmers

Table 1: Selection of respondents

Sl. No.	Name of the villages	Total Beneficiaries	Treatment Group Beneficiary farmers (N_1=50)	Control Group Non- beneficiary farmers (N_2=50)
1	Luktara		17	17
2	Karhaiya		6	6
3	Pathari	178	7	7
4	Mawai buzurg		15	15
5	Paprenda		5	5
	Total		**50**	**50**

Statistical analysis

Mean Percent Score: The average score of beneficiaries and non-beneficiaries were calculated for each ~~package pf practices~~. It's calculated by finding the average of the individual percentage scores obtained by each member of the group.

$$MPS(\%) = \left(\frac{\sum Individual\ Scores}{Total\ Respondents\ \times Maximum\ Possible\ Score} \right)$$

Where:

- $\sum$ Individual Scores = Sum of scores obtained by all respondents for a particular practice.
- Total Respondents = Number of farmers surveyed.
- Maximum Possible Score = Highest possible score for that practice.

Adoption Index: An adoption index is measured to find the extent to which package of practices of sesame were adopted by beneficiaries and non-beneficiaries Farmers of CFLD Program.

$$Adoption\ index(\%) = \left(\frac{\sum Obtained\ Score}{\sum Maximum\ Possible\ Score} \right) \times 100$$

Independent Samples t-test

To compare the mean scores between two independent groups of farmers — beneficiaries (n=50) and non-beneficiaries (n=50) — the Independent Samples t-test was used. The t-test was computed using the formula:

$$ t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}} $$

where:

- $\bar{X}_1$, $\bar{X}_2$ are the group means,
- S_1^2, S_2^2 are the group variances,
- n_1, n_2 are the sample sizes for each group.

Garret ranking

Garret ranking procedure was followed for the analysis of constraints (Garret and Woodworth, 1969 and Kathiravan et al. 1999). Respondents were asked to rank the given constraints from 1st to 8th rank. The orders of rank, assigned by the farmers were converted into position using the following formula:

Percent Position of Each Rank = 100 (R$_{ij}$ -0.5) / Nj

- R = Rank given for i constraint by j respondent
- N = Number of constraints ranked by j respondent

Each rank given by respondents was first changed into a score using a table from Garret and Woodworth (1969). Then, for each constraint, the scores from all respondents were summed up and divided by total respondents to get an average score. These average scores were listed from highest to lowest, and ranks were given accordingly. This helped to identify the most limiting factors.

RESULTS AND DISCUSSION

Table 2: Adoption of improved sesamum production technology among beneficiary and non-beneficiary farmers.

S.N.	PARTICULAR	Beneficiaries	Non-beneficiaries	t value	P value

1	**Soil and field preparation**	92.67	87.33	1.958*	0.05
2	**High yielding varieties**	68.67	51.50	2.523*	0.012
3	**Sowing of seed and spacing**	98.00	97.00	0.598	0.549
	Seed treatment	37.00	35.67	0.972	0.331
4	**Organic manure and fertilizer management**	56.17	51.33	3.203**	0.001
5	**Weed management**	87.80	82.20	2.729**	0.006
6	**Plant protection measures**	91.90	85.20	2.406*	0.016
7	**Harvesting**	88.67	82.33	2.222*	0.026
8	**Storage**	80.67	71.83	2.012*	0.026
	Adoption index	79.11	71.6		

Table 2 represents a comparative analysis for the adoption of improved sesame production technology among beneficiary and non-beneficiary CFLD farmers. The table includes different practices of sesame cultivation, with statistical comparisons based on Mean Percentage Score (MPS), and Z and P values to determine the significant difference in adoption among beneficiaries and non-beneficiary farmers.

Soil and Field Preparation

Soil and field preparation is a crucial step in sesame cultivation ~~which influencing crop productivity~~. Beneficiary farmers showed a higher adoption rate (MPS = 92.67) of recommended soil and field preparation practices than non-beneficiaries (MPS = 87.33), with a significant t value (1.958, P = 0.05). This indicates that CFLD programme helped beneficiaries implement better land preparation techniques, such as deep ploughing, levelling, and moisture conservation practices, leading to improved crop establishment and weed control. Similar results were observed by Mahale *et al.* (2016).

High-Yielding Varieties

Table 2 indicate that the adoption of improved sesame varieties significantly differed between beneficiaries (MPS = 68.67) and non-beneficiaries (MPS = 51.50), with a t value (2.523, P = 0.012). Beneficiary farmers had better access to quality seeds through CFLD programs, resulting in increased yield and resistance to pests and diseases while ~~non-beneficiaries have low adoption behind due to~~ limited awareness and availability of

Improved/certified seeds and similar results were observed by Sarkar, S. *et. al.* 2025 in his research.

Sowing of Seeds and Spacing

Both beneficiaries (MPS = 98.00) and non-beneficiaries (MPS = 97.00) exhibited high adoption levels regarding Sowing of Seeds and Spacing. The t value (0.598, P = 0.549) was non-significant, indicating that farmers, irrespective of training or assistance, followed recommended sowing and spacing practices. Proper row spacing and optimal seed rate are widely practiced as they reduce disease incidence and improve overall yield.

Seed Treatment

Adoption of seed treatment was relatively low among both groups, with beneficiaries having an MPS of 37.00 and non-beneficiaries 35.67. The t value (0.972, P = 0.331) was non-significant, highlighting a need for increased awareness about the benefits of seed treatment. Seed treatment with fungicides and biofertilizers enhances germination, protects against seed-borne diseases, and ensures uniform crop establishment. The low adoption suggests that more targeted interventions are required.

Organic Manure and Fertilizer Management

Nutrient management is essential for optimal growth of sesame and Beneficiaries (MPS = 56.17) showed significantly higher adoption than non-beneficiaries (MPS = 51.33), with a significant t value of 3.203 (P = 0.001). This indicates that CFLD helped beneficiaries to understand and implement balanced nutrient management practices, including the use of farmyard manure, compost, and chemical fertilizers. Non-beneficiaries had lower adoption due to a lack of technical knowledge and financial constraints. Singh *et. al.* (2023) also reported similar results in his research.

Weed Management

Effective weed control significantly impacts sesame yield. Beneficiaries (MPS = 87.80) had better adoption rate than non-beneficiaries (MPS = 82.20), with a t value of 2.729 (P = 0.006). This suggests that CFLD programs helped beneficiaries to adopt timely and effective weed management techniques such as pre-emergence herbicide application, hand weeding, and mulching. While non-beneficiaries relied on traditional methods, which may

cause a decline in the yield, Chatterjje *et. al.* (2018) also observed similar results in his research.

Plant Protection Measures

Beneficiaries exhibited a higher adoption level of plant protection measures (MPS = 91.90) than non-beneficiaries (MPS = 85.20), with a significant t value of (2.406 (P = 0.016). This indicates that CFLD programme effectively improved farmers' knowledge about pest and disease management through the use of integrated pest management (IPM) techniques and were adopting plant protection measures. Non-beneficiaries had lower adoption rate, which can be due to limited access to plant protection chemicals and advisory services, Similar results were observed by Singha *et al.* (2020).

Harvesting

Proper harvesting techniques ensure maximum yield and quality of sesame seeds. Beneficiaries had a higher adoption (MPS = 88.67) of proper harvesting tools, time and techniques compared to non-beneficiaries (MPS = 82.33), with a t value of 2.222 (P = 0.026). Farmers who received training were more likely to harvest at the right maturity stage, preventing shattering losses and maintaining seed quality. In contrast, non-beneficiaries may have faced challenges in determining the right harvesting time, Similar results were observed by Singha *et al.* (2020).

Storage

Post-harvest storage practices are critical for maintaining sesame seed quality and preventing losses. Beneficiaries (MPS = 80.67) had significantly better adoption compared to non-beneficiaries (MPS = 71.83), with a t value (2.012, P = 0.026). Proper drying, use of airtight containers, and treatment with neem leaves or other organic preservatives helped beneficiaries reduce post-harvest losses while the non-beneficiaries have a lower adoption due to inadequate storage facilities and lack of awareness.

Adoption Index

The overall adoption index was higher for beneficiaries (MPS = 79.11) compared to non-beneficiaries (MPS = 71.60). This demonstrates the positive impact of CFLD programs. Beneficiaries had significantly better adoption in high-yielding varieties, fertilizer

management, weed control, and plant protection measures, while non-beneficiaries lagged in these practices which cause less yield as compared to beneficiaries, similar findings were reported by Singh B. *et. al.* 2023 and Singha *et. al.* (2020).

Table 3: Overall distribution of respondents according to their extent of Adoption

Sr. No.	Adoption category	Beneficiary	Non-Beneficiary
1.	Low Adoption (below 22)	5(10%)	11(22%)
2.	Medium Adoption (22-44)	29(58%)	33(66%)
3.	High Adoption (above 44)	16(32%)	6(12%)

The table 3 shows the distribution of respondents based on overall adoption of sesame production technology and comparing beneficiaries and non-beneficiary farmers. Adoption levels are categorized into low (below 22), medium (22-44), and high (above 44) categories, The majority population of both groups are represented in the medium adoption category, with 58% of beneficiaries and 66% of non-beneficiaries, shows that even without direct benefits, many farmers have adopted some improved sesame production techniques. However, a significant difference can be seen in the high adoption category, where 32% of beneficiaries have fully adopted the technology as compared to 12% of non-beneficiaries. This indicates that CFLD programs have played a crucial role in promoting higher adoption levels. Overall, beneficiaries show a higher adoption rate of improved sesame production technologies, emphasizing the effectiveness of CFLD programs in bridging the adoption gap and increasing productivity and also indicating that non-beneficiaries face more challenges in adopting improved practices.

Table 4: Constraints in adoption of Recommended package of practices

Rank	Constraints	Total Garret Score	Garret Mean Score
1.	Non-Availability of Quality Inputs	6590	65.9
2.	High Input Costs	6467	64.67
3.	Lack of Awareness and Knowledge	5338	53.38
4.	Low Market Returns	5133	51.33
5.	Erratic Rainfall and Water Scarcity	4887	48.87
6.	Weak Policy Support	4289	42.89

| 7. | Inadequate Extension Services | 3761 | 37.61 |
| 8. | Distant Supply Agencies | 3535 | 35.35 |

In table 4 constraints were arranged according to rank which was obtained through Garrat ranking technique. Garrett Ranking analysis reveals that non-availability of quality inputs is most significant constraint in adopting RPP (Recommended package of practices) for sesame cultivation in Banda district, with the highest Garrett mean score of 65.90. This shows that farmers face substantial challenges in accessing quality seeds, fertilizers, and other inputs critical for implementing recommended practices, Similar results were observed by Verma *et al.* (2025). High input costs ranked second (mean score: 64.67), indicating that purchasing inputs is a major barrier due to its high cost, particularly for marginal and small-scale farmers in the Bundelkhand region.

Lack of awareness and knowledge (mean score: 53.38) and low market returns (mean score: 51.33) were ranked third and fourth respectively, highlighting gaps in farmer's awareness about RPP and economic return due to fluctuating sesame prices or inadequate market linkages. Erratic rainfall and water scarcity (mean score: 48.87), is a critical agro-climatic constraint in the Banda district, and was ranked fifth, underscoring the dependence on timely irrigation for optimal sesame yields.

Lower-ranked constraints include weak policy support (mean score: 42.89), inadequate extension services (mean score: 37.61), and distant supply agencies (mean score: 35.35), which, while still significant, were perceived as less pressing. These findings suggest that while institutional and logistical issues exist, farmers prioritize immediate input-related and economic barriers over policy or extension-related constraints.

Discussion

The findings indicate a significant difference in the adoption of improved sesame production technology between beneficiary and non-beneficiary farmers. Beneficiary farmers exhibited higher adoption rates across major agricultural practices, reflecting the positive impact of cluster frontline demonstrations (CFLD).

Soil and field preparation, high-yielding variety adoption, fertilizer management, weed control, plant protection measures, harvesting, and storage showed statistically

significant differences between the two groups. This suggests that CFLD programe, access to quality inputs, and extension services played a crucial role in improving the adoption levels of beneficiary farmers.

Despite these advancements, certain practices like seed treatment and sowing techniques did not show significant differences, indicating that sowing practices were already well adopted across both groups and as for seed treatment ~~don't shows~~ any significant difference ~~because of seed which are provided to the~~ beneficiaries were pretreated and the seeds used by non-beneficiaries were also pretreated, Additionally, the lower adoption scores in organic manure and fertilizer management among non-beneficiaries ~~shows a gap~~ in awareness and accessibility to sustainable farming practices.

The overall adoption index was higher for beneficiaries (MPS = 79.11) compared to non-beneficiaries (MPS = 71.60), reinforcing the role of structured training and support systems in bridging the technology adoption gap. However, the results also highlight the need for continuous capacity-building programs, financial support, and improved dissemination strategies to enhance adoption levels among non-beneficiary farmers.

The overall adoption of sesame production technology varies between beneficiaries and non-beneficiaries. Most farmers fall into the medium adoption category, indicating that some improved practices are widely integrated. However, a significant difference is seen in the high adoption category, where 32% of beneficiaries fully adopted the technology compared to only 12% of non-beneficiaries. This highlights the effectiveness of CFLD programs in enhancing adoption and productivity while indicating that non-beneficiaries face more challenges in adopting improved practices.

The most critical constraint in adopting Recommended Package of Practices (RPP) for sesame in Banda district was the ~~non-availability of quality inputs like seeds because of Limited availability~~ of certified seeds locally, followed by ~~high input costs due to rising prices~~ of seeds, fertilizers, and pesticides and low purchasing power of marginal and small farmers. Lack of awareness, low market returns, and erratic rainfall ranked third, fourth and fifth, respectively. Lower-ranked issues included weak policy support, inadequate extension

services, and distant supply agencies, indicating farmers give higher importance to input-related and economic challenges over.

Conclusion

The study highlights a significant difference in the adoption of improved sesame production technology between beneficiary and non-beneficiary CFLD farmers. Beneficiaries demonstrated higher adoption levels across key practices, including soil preparation, high-yielding varieties, nutrient management, weed control, plant protection, harvesting, and storage. This underscores the effectiveness of CFLD programs in enhancing awareness, access to inputs, and technical guidance. However, low adoption of seed treatment among both groups suggests the need for targeted interventions to improve awareness and accessibility. Overall, the findings emphasize the role of CFLD programs in bridging the adoption gap, improving productivity, and ensuring sustainable sesame cultivation. Low yields are primarily due to the limited availability of high-yielding variety (HYV) seeds, insufficient seed replacement, and farmers' hesitation to adopt advanced agronomic practices that rely on modern technology and precise identification of problem areas for maximizing productivity.

HIGHLIGHT

- Overall ~~twenty percent~~ more beneficiaries show high adoption rate
- Organic manure and fertilizer management, weed management and Plant protection measures shows major difference in adoption rate among beneficiary and non-beneficiary respondents
- Non-Availability of Quality Inputs(seed) and High Input Costs were the main cause of not adopting recommended package of practices

Reference

Chatterjee, D., Jha, S. K., & Maiti, S. (2018). *Effect of multimedia on preparation of traditional dairy products at the household level* (Doctoral dissertation, NDRI).

FAO. (2024). FAOSTAT Statistical Database, Crops and livestock products. [Accessed on 14 March 2025]. https://www.fao.org/faostat/en/#data/QCL

Kiresur, V. R., Rao, S. V., and Hegde, D. M. (2001). Improved technologies in oilseeds production-An assessment of their economic potentials in India. *Agricultural Economics Research Review*, *14*(2), 95-108.

Kumar, A., Kumar, A., Jha, S. K., & Singh, S. K. (2022). Appraisal of cluster front line demonstration on rapeseed and mustard in Bihar and Jharkhand. *Indian Journal of Extension Education*, 58(1), 31-35.

Kumar, B. R., Rao, S. G., & Kondababu, P. (2020). Yield and economics of sesame based cropping system in north coastal zone of Andhra Pradesh. *Current Agriculture Research Journal*, *8*(2), 146-151.

Mahale, M., Patil, S., & Chavan, A. (2016). Impact of FLD intervention on yield, adoption and horizontal spread of oilseed crops in Konkan. *Indian Journal of Extension Education*, *52* (3 and 4), 79-83.

Sarkar, S., Padaria, R. N., Burman, R. R., Gurung, N., & Barma, P. (2025). Evaluating the Performance of Cluster Frontline Demonstration (CFLD) on Mustard in North Bengal. *Indian Journal of Extension Education*, *61*(1), 42-47.

Singh, B., Prasad, S. M., Kumar, M., Kumari, C., & Ranjan, R. (2023). Impact of cluster frontline demonstration (CFLD) on yield improvement of mustard crop in Koderma district of Chhota Nagpur plateau of Jharkhand. *Journal of Community Mobilization and Sustainable Development,* 18(4), 1153-1157.

Singha, A. K., B. C. Deka, D. Parisa, C. Nongrum, and A. Singha (Year missing). Yield gap and economic analysis of cluster frontline demonstrations (CFLDs) on pulses in Eastern

Himalayan Region of India." *Journal of Pharmacognosy and Phytochemistry* 9(3), 606-610.