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Evaluation of cluster frontline demonstrations on soybean productivity and profitability under Vidarbha condition of Maharashtra

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Abstract

The study evaluated the effect of Cluster Frontline Demonstrations (CFLDs) on Soybean (*Glycine max* L.) productivity and profitability in Buldhana district of Maharashtra (MS.) during 2020-21 to 2024-25. A total of 400 (160 ha area) demonstrations were conducted on farmers' fields using improved varieties KDS-726 (2020-21 and 2021-22), AMS-1001 (2022-23) and AMS-100-39 (2023-24 and 2024-25) under recommended improved package practices. The results revealed that a consistently increase in soybean yield under CFLDs oilseed with a mean yield of 19.78 q/ha compared to 15.96 q/ha in local checks, registering an average yield advantage of 19.12%. The mean of technology gap was 5.69 q/ha, while the extension gap averaged 3.19 q/ha. The technology index ranged from 15.48% to 29.08% over the local check across the study period that indicating the feasibility and adoption potential of the demonstrated technology, with a decreasing trend suggesting growing farmer motivation to adopt improved practices. Economic analysis of demonstration plots significantly higher is mean of gross returns (₹82,397/ha) and net returns (₹62,967/ha) with benefit-cost ratio of 2.83 compared to than local check is mean of gross returns (₹65,909/ha) and net returns (₹ 47,292/ha) with benefit-cost ratio of 2.46, This integrated package of practices were attributed to the adoption of improved varieties of soybean, timely and consistently monitored cultivation practices. The field study resulted that CFLDs enhance the yield and profitability, recommending their integrate implementation under scientist supervision for r dissemination of improved cultivation practices of soybean and potential for good quality seed production on farm.

Keywords: Cluster frontline demonstration, soybean, technology index and yield

Introduction

The Ministry of Agriculture and Farmers Welfare, Government of India started Cluster frontline demonstrations in 2015-16 as part of the National Food Security Mission (NFSM). The main objective of CFLDs is to demonstrate newly released crop production and protection technologies and its management practices in the farmers field under the micro farming situation. A Cluster Frontline Demonstration (CFLD) on oilseeds is a unique approach by the Indian Council of Agricultural Research (ICAR). In CFLDs, scientists guide to farmers during demonstrations on the implementation of improved technologies like seed treatment, line sowing, integrated nutrient management and integrated pest management. During CFLDs, KVK scientists guide to farmers on how to implement improved technologies. Edible oils occupy a unique place in Indian society, culture, dietary patterns and economy of the country.

Soybean (*Glycine max* L.) belonging to family *Leguminosae* is one of the important oil seed crops of the world and has recognized as beneficial source of protein, edible oil and functional food. It is unique in the sense that large numbers of diverse end-products such as fortified soya flour, soya milk, tofu, biscuit, bread, products are made from it.

Soybean is predominantly grown as a rainfed crop covering the states of Madhya Pradesh, Maharashtra and Rajasthan on vertisols and high to medium range of soils. Severe variations across time of sowing and plant geometry serve as a major constraint to achieve higher productivity of soybean crops, along with the influence of technology adoption levels and other factors. Soybean stands out as a unique crop, being both an oilseed and a legume. It is contributing almost 25% of global oil production and offering high-quality protein (40%) and oil

(20%). It also provides essential nutrients like amino acids and lysine, often lacking in cereals (Verma *et al.*, 2021) ^[9]. Soybean one of the oilseed crop that cover 11.33 million hectares with an estimated production of 13.79 million tonnes and a productivity of 1217 kg per. India faces a substantial demand-supply imbalance in vegetable oil, necessitating significant imports. In 2021, India imported around 13.35 million tonnes of edible oils worth ₹ 1,17,000/- crore, fulfilling 60% of its overall demand hectare. There are so many improved technologies generated at pulses and oilseeds researcher but the productivity of pulses and oilseeds is still very low due to poor transfer of technology from the points of its development to the points of its utilization and only a little new knowledge percolates to the farmers field hence, a vast gap has been observed between knowledge production and knowledge utilization. To achieve targeted production of pulses and oilseeds Cluster frontline demonstration (CFLD) of pulses and Oilseed on Farmer's field may be helpful. Cluster Frontline demonstrations in pulses and oilseeds under CFLD have been initiated involving Krishi Vigyan Kendra, Buldhana-II across the state.

Materials and Methods

The present study was conducted in 16 villages of Buldhana district during five consecutive Kharif seasons (2020-21 to 2024-25) under the Cluster Frontline Demonstration (CFLD) programme on soybean. A total of 400 demonstrations were implemented on farmers' fields to evaluate the performance of improved varieties under real farming situations. The variety KDS-726 was demonstrated during *Kharif* season of 2020 and 2021, AMS-1001 during *Kharif* 2022 while AMS-100-39 was introduced during *Kharif* 2023 and 2024. Cluster Frontline Demonstration (CFLD) were laid out on rainfed fields with soils ranging from medium to heavy texture and medium fertility status. The data were collected through personal contacts with the help of well structured interview schedule. The gathered data were processed, tabulated, classified and analysed in terms of mean per cent score and ranks in the light of objectives of the study. More than 10 per cent difference between beneficiary and non beneficiary farmers' was considered as significant difference. The extension gap, technology gap and technology index were calculated using the formula as suggested by Samui *et al.*, (2000) ^[7].

Extension gap (qha⁻¹) = Demonstration yield (DY) - local Check Yield (LY)

Technology gap (qha⁻¹) = Potential yield (PY) - Demonstration yield (DY)

Technology index (%) = [Technology gap (qha⁻¹) / Potential yield (PY)] x 100

Wherein, DY - Demonstration Yield,
LY - local Check Yield,
PY - Potential Yield of variety

Benefit-Cost ratio (B:C) = Gross return ÷ Cost of cultivation
Economic analysis was carried out by computing gross returns, net returns, and B:C ratio to determine the profitability of demonstrated technologies compared to farmers' practices. Similar methodology adopted by Taru *et al.* 2025 ^[8].

Results and Discussion

Demonstration plot significantly outperformed farmers' traditional practices across all five years of study (Table 1). The average yield of CFLD plots was 19.78 q ha⁻¹, compared with 15.96 q ha⁻¹ in local checks, resulting in an mean yield advantage of 3.19 q ha⁻¹ (19.12%). Superior growth parameter like more primary branches and pods per plant was the reason for higher yield which was due to combined effect of seed treatments, application of fertiliser, timely intercultural operations and integrated pest diseases management practices in CFLD plots. Similar findings were also reported by Rai *et al.*, and Kalita *et al.*, (2019) ^[4]. Among the tested varieties, KDS-716 (2020 and 2021) recorded higher mean yield gains (25.93%), AMS-1001 (2022) is 19.44% while AMS-100-39 (2023 and 2024) is 21.71% over local check. It is indicating that varietal improvement coupled with recommended practices substantially contributed to yield enhancement. These results similar with earlier reports, where Basediya *et al.* (2023) ^[1] and Garud *et al.* (2023) ^[3] Similarly, Lakshmi *et al.* (2020) ^[5] reported that adoption of improved varieties and integrated crop management practices enhanced soybean yields. Such findings revealed that FLDs are effective tools for reducing yield gaps and motivating farmers toward adoption of improved technologies

Table 1: Yield performance of Soybean under CFLDs compared with farmers' practice during 2020-21 to 2024-25.

Year	No. of Demo	Area covered (ha)	Variety	Yield (Kg/ha)		Additional yield over local check (kg/ha)	% increase yield over Local Check FLD
				Demonstration	Local check		
2020	50	20	KDS-726	20.12	17.73	2.39	13.48%
2021	25	10	KDS-726	21.13	15.27	5.86	38.38%
2022	50	20	AMS-1001	18.06	15.12	2.94	19.44%
2023	75	30	AMS-100-39	21.05	16.36	4.69	22.28%
2024	200	80	AMS-100-39	18.56	15.32	3.24	21.15%
Total	400	160	-	98.92	79.80	19.12	-
Mean	-	-	-	19.78	15.96	3.19	19.12%

The average technology gap across years was 5.69 q ha⁻¹, reflecting the difference between potential yield and demonstration yield (Table 2). Although Cluster Frontline demonstrations on soybean varieties improved productivity, the persisting gap highlights the need for timely input use, better disease and pest management, and climate-resilient practices. The extension gap, i.e., the difference between demonstration

yield and farmers' yield, averaged 3.19 q ha⁻¹, showing the practical advantage of improved technologies. The technology index averaged 22.78%, which is comparable to values reported by Garud *et al.* (2023) ^[3] in Maharashtra but slightly higher than those observed by Verma *et al.* (2021) ^[9], suggesting regional variation in technology adoption and agro-ecological response.

Table 2: Yield gaps and technology index of Soybean under CFLDs compared with farmers' practice during 2020-21 to 2024-25.

Year	No. of FLDs	Technology gap (q/ha)	Extension Gap (q/ha)	Technology Index (%)
2020	50	7.27	2.39	29.08%
2021	25	3.87	5.86	15.48%
2022	50	6.94	2.94	27.76%
2023	75	3.95	4.69	15.80%
2024	200	6.44	3.24	25.76%
Total	400	28.47	19.12	-
Mean	-	5.69	3.19	22.78%

Economic analysis revealed that Cluster frontline demonstrations were more profitable than local checks (Table 3). The mean gross return from demonstration plots was ₹ 82397 ha⁻¹, compared with ₹ 65909 ha⁻¹ in local checks. While mean net return from demonstration plots was ₹ 62967 ha⁻¹, compared with ₹ 47293 ha⁻¹ in local checks. The average B:C ratio was

2.83 for FLDs, higher than 2.46 in local practices. These findings corroborate the reports of Garud *et al.* (2023) [3] who observed higher profitability with improved Soybean technologies in Maharashtra. Similarly, Lakshmi *et al.* (2020) [5] highlighted that adoption of high-yielding varieties coupled with IPM practices significantly enhances farmers' income.

Table 3: Economic performance of Soybean under CFLDs compared with farmers' practice during 2020-21 to 2024-25.

Year	Cost of Cultivation (Rs/ha)		Gross return (Rs/ha)		Net return (Rs/ha)		B:C ratio	
	Demonstration	Local check	Demonstration	Local check	Demonstration	Local check	Demonstration	Local check
2020	29143	27535	84969	74876	55826	47341	2.92	2.72
2021	30829	27049	64744	42019	95573	69068	3.10	2.55
2022	28398	26545	86688	72576	59542	47114	3.10	2.77
2023	31400	29055	93921	72664	62521	43609	3.00	2.51
2024	40290	38080	81664	67408	41374	29328	2.03	1.77
Mean	32012	29653	82397	65909	62967	47292	2.83	2.46

Conclusion

It is concluded that CFLDs included high-yielding varieties of soybean (KDS-726, AMS-1001 and AMS-100-39) with balanced fertilizer use, seed treatment of Biofertilizers, and IPM-based pest management. In contrast, farmers' practices relied on local varieties, higher seed rates, imbalanced fertilizer use, and indiscriminate use of pesticide. Full adoption gaps were observed in seed management, irrigation, weed control, and bio fertilizer use, while partial gaps existed in seed rate, fertilizer application, and pest management. This clearly indicates that bridging these gaps through capacity building, timely availability of inputs, and extension efforts can significantly enhance productivity and sustainability of Soybean cultivation. Potential yield of soybean crop and varieties nearly achieved by imparting scientific knowledge to the farmers, providing need based quality inputs in due time and proper and timely application of inputs. The horizontal spread of improved technology might be achieved by successful implementation of CFLDs and by various extension activities like training, organizing field day, field visit, kisan gosthi, group meeting and exposure visit of nearby farmers to CFLD plots. Training to extension functionaries under District Agricultural Offices is essential for rapid dissemination of the technology to the entire district. It can be concluded that newly introduced variety of soybean along with improved package of practices performed well in the Tirap district of Arunachal Pradesh and adoption is also appreciable among the farmers.

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