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Short Communication

Impact of technological interventions of cluster frontline demonstrations (CFLDs) on productivity and profitability of black gram (*Vinga mungo* L.) in the northern agroclimatic zone of Telangana

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ABSTRACT

In the present investigation, the impact of 150 cluster front-line demonstrations covering 60 hectares was studied. The results showed that improved varieties LBG-797 and VBN-8 showed a 33.27% yield advantage over farmers' practices. Demonstration plots recorded an average yield of 12.93 q/ha compared to 9.67 q/ha in farmers' practices, with an extension gap of 3.26 q/ha, a technology gap of 2.40 q/ha and a technological index of 15.94%. The improved practices resulted in 48.25% higher net returns and Rs. 19,890/- additional income per hectare, with a benefit-cost ratio of 3.28 compared to 2.45 under farmers' practices. The adoption rate of the demonstrated technology by gap farmers was 100%.

***Key words*: Adoption rate, Black gram, Cluster Front Line Demonstration, Extension gap, Technology gap, Technological index**

In order to solve issues of environmental impact and national food and nutritional security, pulses are an important part of the group of food crops. Blackgram, rich in protein (26%), vitamins and minerals, is an important pulse crop that is cultivated widely in India. By fixing atmospheric nitrogen in the soil, the crop increases soil fertility and can tolerate harsh weather conditions. As a supplement to a diet focused on cereals and a source of vegetable protein, blackgram is an essential component of the Indian diet (Reddy 2010). Being indigenous to India, it is used extensively in Indian cooking and is known by the Hindi term "urad" dal. It is primarily eaten as "dal" (whole or split, husked and unhusked). It is also utilized as a green manure crop and as nutrient-rich animal feed.

India produces and consumes more black gram than any other country in the world, making up over 70% of the total global production. During 2020-21, India produced about 24.3 lakh tonnes of black gram from 38.82 lakh hectares of land, with an average productivity of 533 kg per hectare (Black gram outlook 2020).

In India, during *rabi* season approximately 8.16 lakh hectares were covered by Black gram with 27.6 lakh tonnes of production in 2021–22 (Black gram Outlook 2022), approximately 7.79 lakh hectares were covered by Black gram with 26.12 lakh tonnes of production in 2022–23 (Black gram Outlook 2023); approximately 6.96 lakh hectares were covered by Black gram with 20 lakh tonnes of production in 2023–24 (Bengal gram Outlook 2024).

The states that produce the most black gram in India in 2023–2024 are Madhya Pradesh (5.61 lakh tonnes), Uttar Pradesh (4.87 lakh tonnes), Andhra Pradesh (3.81 lakh tonnes), Tamil Nadu (2.13 lakh tonnes), Rajasthan (1.49 lakh tonnes) and Maharashtra (1.08 lakh tonnes). In Telangana the major Black gram growing districts are Nagarkurnool, followed by Wanaparthy, Gadwal, Kamareddy and Nizambad (Black gram outlook 2024). To promote new agricultural innovative technologies, varieties, crop management practices like Integrated Nutrient Management (INM), Integrated Pest Management (IPM), micronutrients, extension, training and a mass media campaign, the National Food Security Mission (NFSM) came up with the concept of Cluster first line demonstrations (CFLD). In order to attain self-sufficiency in pulse production, the Indian government launched a new program under the National Food Security Mission by offering new technology packages in pulse cultivation in partnership with the Indian Council of Agricultural Research and Krishi Vigyan Kendra. This initiative aims to deploy Cluster Front Line Demonstrations in all Indian states (Gautam *et al*. 2023). These CFLDs will help in introducing new technologies, varieties (Tankodara *et al*. 2018) for filling up the gaps between farmers and research stations,by spreading the technologies through trainings and extension programmes (Madhushekar *et al*. 2022). Sumitra *et al*. (2022) opened that Krishi Vigyan Kendra's playing a crucial role in increasing the area and production of pulses cultivation in India through Cluster Front Line Demonstrations (CFLDs) at farmers' fields. Over time, several improved pulse types and novel production methods have been developed, but, due to low adoption rates, neither the technology nor its full potential could be achieved. Consequently, it is impossible to overlook the problems limiting output. Research and extension efforts need to be refocused to produce value-adding pulses. The creation of better stress-tolerant cultivars, the adoption and spread of new agricultural technologies, improving current production potential and quality traits may all be given a lot of weight. Therefore aim of the present investigation is to study the impact of technological interventions of cluster frontline demonstrations (CFLDs) on productivity and profitability of black gram (*Vinga mungo* L.) in the northern agroclimatic zone of Telangana.

Krishi Vigyan Kendra, Ramagirikhilla, Peddapalli district, has conducted Cluster Front Line Demonstrations (CFLDs) on Black gram in 20 hectares each in different clusters of Peddapalli district, Telangana, from the Rabi seasons of 2021-2022 to Rabi 2023–2024. A total of 150 demonstrations were conducted covering an area of 60 hectares with the view to promote improved cultivation practices and increase the area and production of Blackgram in the district by training the farmers on Integrated Crop Management in Black gram cultivation, and also provided with necessary need-based critical inputs. Various technological parameters and procedures for demonstrations and farmers' practices were provided in Table 1. Regular monitoring was done by the scientists to ensure effective utilization of the technology provided and to collect systematic feedback from the farmers on the technology provided. To increase the adoption of the new technologies, demonstrated field days were organized, mass media broadcasting, mobilizing neighboring communities, and collaborating with state agricultural department officials.

Yields from the demonstration plots were meticulously recorded and compared with those obtained through farmer practices at harvest, highlighting significant performance disparities. The data analysis also included cultivation costs, net income and benefit-cost ratios, demonstrating the advantages of advanced red gram technologies. The yield gap, technology gap, extension gap and technological index were calculated using the following formulas:

Extension gap (q/ha) = Demonstration yield – Farmers practice yield

Technology gap (q/ha) = Potential yield – Demo yield

$$\text{Technological Index (\%)} = \frac{\text{Potential Yield} - \text{Demo yield}}{\text{Potential Yield}} \times 100$$

Additional Yield Increase (q/ha) = Demonstration yield – Farmers practice (or) State (or) National yield

Yield increase (%) =

$$\frac{\text{Demonstration yield} - \text{Farmers practice (or) State (or) National yield}}{\text{Demonstration yield} - \text{Farmers practice (or) State (or)National yield}} \times 100$$

Data from cluster front line demonstrations (Table 3) revealed that the improved varieties and technologies in black gram cultivation result in average grain yield of 10.91, 12.80 and 15.08 q/ha as compared to 9.40, 9.50 and 10.12 q/ha recorded in farmers' practice and average yield increase of 16.06, 34.74 and 49.01 per cent during 2021, 2022 and 2023, respectively. The cumulative average yield over the three years (2021, 2022 and 2023) of black gram cultivation recorded a mean yield of 12.93 quintals per hectare, which is 33.27 percent higher than farmers' practice (9.67 q/ha), 36.57 percent higher than state yield (9.46 q/ha) and 31.56 percent higher than national yield (9.85 q/ha). Farmers were very much inspired by the new technology demonstrated through CFLD programmes and showed 100% adoption rates in the demonstrated clusters. The increased grain yield with improved technologies was mainly because of quality seed, weed management, improved package and practices and timely management of pests and diseases. These results are in accordance with Amrit *et al*. (2020), who also found that CFLD demostrations resulted in 9.52 q/ha grain yield with an increase of 47.52% higher yield compared to farmers' practice (6.45 q/ha). Meena *et al*. (2022) also reported that CFLD demonstrations on greengram recorded the highest average yield of 10.90 q/ha with an increase of 30.85% yield over the check (8.33 q/ha). These findings are also inline with findings of Venkanna and Bhaskar (2020) in Bengal gram, Bairwa *et al*. (2013) in black gram, Laxmi *et al*. (2017) and Meena and Dudi (2018) in green gram.

In the Northern Telangana agroclimatic

region, the cumulative average yields of black gram demonstrations through CFLD revealed a technology gap of 2.40 q/ha, and the technology gap was calculated as 3.09, 3.20, and 0.92 q/ha during 2021, 2022 and 2023, respectively. The discrepancy in productivity between farmers' practice and demonstration may be explained by the extension gap. The average Black gram yield statistics showed an extension gap of 1.51, 3.30 and 4.96 q/ha and technology index 22.07%, 20.00% and 5.75% was recorded during 2021, 2022 and 2023, respectively, with an average of 3.26 q/ha extension gap and 15.94% technology index (Table 3). The adoption of the extension gap should be attributed to improved dissemination process in recommended practices, which outcome in higher grain yield than the farmer's practice. Amrit KJ *et al*. (2020) also found that CFLD Black demos resulted 3.47 q/ha technology gap, a 3.07 q/ha extension gap and a 26.33% technology index. Menu *et al.* (2021) studied the impact of cluster front-line demonstrations of green gram and reported the technology gap of 6.76 q/ha, 2.4 q/ha extension gap and 38.68% technology index with the improved varieties. These findings are also inline with findings of Venkanna and Bhaskar (2020) in Bengal gram, Meena and Dudi (2018) in green gram and Sahare *et al*. (2018) in black gram.

Economic returns varied annually due to variations in grain yield and Minimum Support Price (MSP) set by the Government of India. According to the results shown in Table 4, from the CFLD demonstrations, the maximum gross returns with net returns and the highest benefit cost ratio were observed in the demonstration plots than the farmers' practices. Demonstration fields recorded the mean of gross returns of Rs. 88,416.67/- with net returns of Rs. 61,550.00/- and with a gross cost of Rs. 26,866.67/-. Whereas, farmers practice recorded gross returns of Rs. 69,493.33/- with net returns of Rs. 39,660.00/- and with a gross cost of Rs. 27,833.33/. The increased net returns in demonstration fields were attributed to the adoption of advanced

Table 1. Difference between Demonstration and Farmers practice under CFLD on Black gram

Particulars	Recommended practices	Farmer practice
Variety	LBG-797, VBN-8	PU-31
Seed treatment	Rhizobium400g/acre	No seed treatment done
Seed rate	6 kg/ha	10 kg/ha
Method of Sowing	Line Sowing	Broadcasting
Fertilizer dose	Balanced fertilization: N:P:K @ 15:30:0kg/ha at sowing time. Spray of 2% NPK (18:18:18) at flowering time.	Imbalance use of fertilizers and 30 kg/ha at sowing.
Weed management	Pre emergence herbicides Pendimethalin @1.2 lit per acre and post emergence herbicide Imazethapyr @ 250 ml acre at 15-20 Days after sowing (DAS)	Manual weeding
Plant protection	Neem oil @ 5ml/lit and Imidacloprid @ 0.5 ml/lit for control of sucking pest. Quinalphos 25 EC @1500 ml/ha for pod borer	Indiscriminate use of chemicals, without following any recommendations

Table 2. Yield, Extension gap, Technology Gap (q/ha), Technological Index (%) and Percent increase (%) in yield over farmers practice, state yield and national yield of Black gram as influenced by CFLD in Peddapalli District

Year	Variety demonstrated	No. of Demos	Yield (q/ha)					Extension gap (q/ha)			Technology Gap (q/ha)	Technological Index (%)	Percent Increase (%) over		
			Potential	Demo	FP	State	National	FP	State	National			FP	State	National
2021-22	LBG-797	50	14	10.91	9.40	9.50	10.08	1.51	1.41	0.83	3.09	22.07	16.06	14.84	8.23
2022-23	VBN-8	50	16	12.80	9.50	8.95	8.98	3.30	3.85	3.82	3.20	20.00	34.74	43.02	42.54
2023-24	VBN-8	50	16	15.08	10.12	9.93	10.48	4.96	5.15	4.60	0.92	5.75	49.01	51.86	43.89
	Average		**20**	**12.93**	**9.67**	**9.46**	**9.85**	**3.26**	**3.47**	**3.08**	**2.40**	**15.94**	**33.27**	**36.57**	**31.56**

Table 3. Cost of cultivation, Gross return, Net return and Benefit cost ratio of Black gram under CFLD compared to farmers practice in Peddapalli District

Year	Demo			FP			Net returns (Rs./ha) increase over FP	% increase of Net returns over FP	B:C Ration	
	Gross cost (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	Gross cost (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)			Demo	FP
2021-22	24600.00	75000.00	50400.00	26800.00	69000.00	32500.00	8200.00	19.43	3.05	2.57
2022-23	26000.00	87420.00	61420.00	27200.00	69700.00	32100.00	18920.00	44.52	3.36	2.56
2023-24	30000.00	102830.00	72830.00	29500.00	69780.00	36000.00	32550.00	80.81	3.43	2.37
Average	26866.67	88416.67	61550.00	27833.33	69493.33	41660.00	19890.00	48.25	3.28	2.50

technologies, timely crop management practices, conducting field days and consistent field visits. A mean benefit-cost ratio of 3.28 was recorded in demonstrations with an increase of Rs. 19,890.00/- net returns and with a 48.25% increase of net returns over farmers' practices (2.41). The benefit-cost ratio increased from at least 3.05 in 2021-22 to 3.43 in 2023-24, reflecting the positive impact of CFLD on both grain yield and profitability. Amrit *et al*. (2020), also found a net profit of Rs. 25,411.25/- with a benefit-cost ratio of 2.08 and additional income of Rs. 15,671.00/- than the farmers' practice in black gram crop. Garud *et al*. (2023), reported that CFLD on chickpea demonstrations resulted in an average net return of Rs. 56,938/- with a benefit-cost ratio of 1.87 when compared with net returns (Rs. 37,143/-) and benefit-cost ratio (1.43) of farmers' practice. Similar findings were also found with Venkanna and Bhaskar (2020) in Bengal gram, Meena and Dudi (2018) in green gram cultivation.

Farmers obtained improved yields and net returns by implementing the new technologies through Cluster Front Line Demonstrations (CFLDs), which reduced the extension gap per hectare throughout the three years of study. The adoption of recommended technologies in Black gram may be influenced by several factors, including the pre-season training of KVK scientists, the distribution of recommended technologies for farmers to use in demonstrations, the distribution of literature and frequent visits, the monitoring and management of pest and disease advisory services by the KVK scientists to the demo farmers, and the implementation of extension activities such as method demonstration and field day.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest exist (both financial and non-financial).

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