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Impact of Cluster Frontline Demonstrations on Promotion of Pulse Crops in Farmers Fields of Telangana, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Cluster Frontline Demonstrations (CFLDs) were conducted in Nagarkurnool district of Telangana state in the operational areas KVK Palem to assess the productivity and profitability of improved rabi pulse varieties—green gram (WGG-42) and black gram (PU-31)—using scientific production

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technologies from 2018–19 to 2020–21. Conducted across 150 farmer fields covering 60 hectares, the demonstrations revealed average yields of 16.7 q/ha for black gram and 14.2 q/ha for green gram, representing yield increase of 15.2–16.1% and 12.5–13.8% respectively over traditional practices. The extension gap was 4.0 q/ha for black gram and 2.8 q/ha for green gram, while the technology gap was 8.3 q/ha and 7.8 q/ha, with technology indices of 33.20% and 35.61%, respectively. Economic analysis showed that the demonstrations generated significantly higher returns, with net increase of Rs. 15,365/ha for black gram and Rs. 18,785/ha for green gram, and benefit-cost ratio of 2.80 and 2.81, respectively.

Keywords: CFLDs; green gram; black gram; yield; farmers; impact technologies.

1. INTRODUCTION

“Pulses are the rich source of vegetable protein thus, called as poor man’s meat for the under privileged people who cannot afford animal proteins or particularly in regions where meat and dairy are not physically or economically accessible. Because they are low in fat and high in soluble fiber, pulses can reduce cholesterol and aid in blood sugar regulation. In addition to serving as a source of nutrition, pulses are an essential crops for family usage because they give economic stability, sell well, and maintain food security. Furthermore, pulses has the capacity to fix atmospheric nitrogen via rhizobium bacteria, which can increase soil fertility, improving and extending the production of the fields. Crop rotation with pulses can boost farm and soil biodiversity. Pulses can significantly reduce the use of synthetic fertilizers because they are a nitrogen fixer and, in some cases, a source of free soil-bound phosphorus. India is the leading producer, consumer, and importer of pulses in the world, accounting for 25% of overall output and 27% of total consumption (14 percent). Food grains are grown on around 20% of the country's land, and between 7-10% of the nation's food grains are produced by pulses. Although both the kharif and the rabi seasons are used for cultivating pulses, more than 60% of the overall production occurs during the rabi season” [1]. India contributes more than 70% of world’s greengram & blackgram production. In India during 2023-24, about 31.94 lakh ha (78.93 lakh acres) area was covered under greengram as against 33.99 lakh ha (83.99 lakh acres) during the same period in 2022-23. Black gram area is down by 1.28% at 33.08 lakh ha (81.75 lakh acres) as against 33.51 lakh ha (82.83 lakh acres) last year [2] (http://agricoop.nic.in).

In order to maintain this system of production and consumption, the Department of Agriculture Cooperation and Farmers Welfare approved the project, "Cluster Frontline Demonstrations on Rabi Pulses from 2015-16," which is being carried out by ICAR-ATARI in Hyderabad with the help of a network of Telangana State KVKs under the auspices of the National Food Security Mission. The main goal of the mission is to spread new technologies, such as improved seed, micronutrients, soil amendments, integrated pest control, farm equipment & tools, and irrigation systems, while also enhancing yield of the pulses. The KVK, Palem in the Nagarkurnool district adopted both the Blackgram and Greengram pulses with the primary goal of increasing the production and productivity of pulses using CFLDs with cutting-edge and novel innovative technologies. So that present investigation was taken up in cluster mode to strengthening the forward and backward linkages in the larger interest of the farming community to attain the self sufficiency in pulses production.

2. MATERIALS AND METHODS

CFLDs are among the most effective extension strategies because, in general, farmers are motivated by the idea that "Seeing is believing." In order to evaluate the performance of new varieties and package practises on production and productivity of pulses demonstrations were conducted on Green gram and Black gram with 65 to 90 days duration varieties KVK, Palem, Nagarkurnool district of Telangana state, India. These varieties were identified based on Participatory Rural Appraisal (PRA) technique. Based on their participation and feedback from the preliminary survey and interactive discussion, a group of cooperative farmers was identified. Farmers actively participated in all 150 demonstrations over a 60 ha area, which had the goal of showcasing the increased production potential of pulses in various villages. Each year, a total of 10–20 hectares was set aside for the technology demonstrations for Green gram and Black gram, along with farmers' practises as a control plot. Before setting up the CFLDs, the acceptance of recommended technology was evaluated through direct conversations with a few chosen farmers [3]. The preseason training programme (awareness campaign) was set up to help farmers choose the right technologies succesfully and to increase their skills. Following the training, farmers were provided with essential inputs for the technologies being demonstrated (Tables 1 & 2), including improved high yielding varieties, suggested chemicals, literature, regular visits, monitoring, and pest and disease advisory services managed by KVK scientists to the demo farmers. In order to demonstrate the superiority of the technology for each crop, a field day was finally held with the participation of farmers who were holding demonstrations, other farmers in the village, scientists from the university, ATARI, Department of Agriculture officials, and local extension functionaries.

When the crop was harvested, the demonstration and control plots crop yields were recorded. The most practical method for achieving this is to carry out front-line demonstrations of the suggested improved technology on farmer fields with the goals of calculating input costs and financial returns and identifying yield gaps between farmer practises and front-line demonstrations. To find adoption gaps, farmer methods were contrasted with better management approaches.

The gaps were categorized into three groups as no gap given a score of 1, partial gap given a score of 2 and full gap given a score of 3 [4]. Based on the scores obtained by the individuals, considering mean and standard deviation the respondents were categorized as low (Mean – 0.5 SD), medium (Mean + 0.5 SD) and high (Mean + 0.5 SD) presented in (Table 3).

The formula used for calculating the adoption gap index. The adoption gap index measures the percentage difference between farmers practise (FP) and the improved ones.

$$\text{Adoption gap index} = \frac{(R - A)}{R} \times 100$$

Where
R = Total no. of improved practices
A = No. of improved practices actually adopted by the farmer

Per cent increase in yield (%) = Yield gain in demo plot (q/ha) - Yield gain in FP plot (q/ha)/Yield gain in FP plot (q/ha) x 100

Yield parameters of both demonstrations and check involving farmers practices were recorded. Using the yield parameters extension gap, technology gap, yield gap, technology index was calculated as procedure suggested by Rajashekhar et al. [5].

Extension gap (q/ha) = Demonstrations yield – Yield under existing farmers practice

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

$$\text{Yield Gap (\%)} = \frac{\text{Extension gap}}{\text{Yield under farmers practice}} \times 100$$

$$\text{Technology Index (\%)} = \frac{\text{Technology gap}}{\text{Potential yield}} \times 100$$

Economics of the demos and check were recorded.
Based on economics additional cost and additional returns were calculated.
Additional cost (Rs.) = Demonstration Cost (Rs.) - Farmers’ Practice Cost (Rs.)
Additional returns (Rs.) = Demonstration returns (Rs.) - Farmers’ Practice returns (Rs.)

3. RESULTS AND DISCUSSION

Better management practices are more essential for the production and profitability of pulses because of technology demonstrations. Furthermore, it was observed that farmers generally avoided usage of fungicides and applied insecticides indiscriminately against recommended practices. Our findings are in lined with earlier reported by Singh et al. [6].

Technological adoption gap: Full gap was identified for in usage of high yielding varieties, seed rate, seed treatment and sowing methods. Nutrient management, weed management, irrigation and plant protection measure showed partial adoption gap, which definitely was the reason for not achieving potential yield. Land preparation and time of sowing showed no adoption gap as presented in Table 1. Farmers in general used local or traditional varieties instead of the recommended high yielding resistant varieties. Non availability of seed in time and lack of awareness were the main reasons for the farmers. Farmers applied higher seed rate than the recommended and they were not following seed treatment technique for wilt and collar rot management and to get the better nodulation for biological nitrogen fixation (BNF) of the plants because of lack of knowledge and interest in adoption of improved technologies in lined with earlier findings of Shankar et al. [7]. The farmers were much concerned about importance of sowing method and land preparation. Burman et al. [8] reported that there is a gap in adoption of technology in major pulse crops both in rain fed and irrigated cropping system.

Table 1. Differences between technological intervention and farmers practices under CFLDs on Black gram

Black gram		
Particulars	**Demonstration**	**Farmers Practice**
Farming situation	Rainfed medium soils	Rainfed medium soils
Variety	PU-31	Local variety
Time of sowing	Mid August to mid September	September to first week of October
Method of sowing	Line sowing	Broad casting
Seed rate	20.25 kg/ha	24 kg/ha
Fertilizer	N P K-15: 35: 00 kg/ha/ vermicompost @ 30kg/ha	FYM lower N P K dose
Fertilizer/vermincompost	With Rhizobium and Thiram	Nil
Seed treatment	Need based	Nil
Intercultivation	Provided pre emergence herbicide (24-48 hours) Pendimethalin @ 1 L /acre and post emergence herbicide (20 days after sowing) Imazythpyr @ 250ml/acre after sowing	No weeding
IPM practices	Installed yellow sticky traps @ 10 and pheromone traps @ 4/acre. Prophylactic spray with Azadiractin 1500ppm @ 5ml/L at vegetative stage and need based spray with Emamectin benzoate @ 0.4g/L of water at flowering to pod formation stage.	Calendar based spraying of pesticides

Table 2. Differences between technological intervention and farmers practices under CFLDs on Green gram

Green gram		
Particulars	**Demonstration**	**Farmers Practice**
Farming situation	Rainfed medium soils	Rainfed medium soils
Variety	WGG-42	Local variety
Time of sowing	Mid August to mid September	September to first week of October
Method of sowing	Line sowing	Broadcasting
Seed rate	20.25 kg/ha	24 kg/ha
Fertilizer recommendation	N P K 15: 35: 00 kg/ha/ vermicompost@30kg/ha	FYM lower N P K dose
Seed treatment	With Rhizobium and Thiram	Not practiced
IPM practices	Installed yellow sticky traps@ 10 and pheromone traps @ 4/acre. Prophylactic spray with Azadiractin 1500ppm @ 5ml/L at vegetative stage and need based spray with Emamectin benzoate @ 0.4g/L of water at flowering to pod formation stage.	Calendar based spraying of pesticides
Inter cultivation	Provided pre emergence herbicide (24-48 hours) Pendimethalin @ 1 L /acre and post emergence herbicide (20 days after sowing) Imazythpyr @ 250ml/acre after sowing	No weeding

Table 3. Distribution of respondents based on adoption levels

S.No	Category	Frequency	Percentage
1	Low (Mean-0.5SD)	26	17.30
2	Medium (Mean + 0.5 SD)	75	50.00
3	High (Mean +SD)	49	32.70

Impact of CFLDs on insect-pest reduction and crop yield: “The performance of improved technology was found most effective in controlling sucking pest like white flies, hoppers and aphids least number of affected plants/m^{2}was observed. The average per cent reduction in affected plant/m^{2}was recorded 23.75 in black gram and 24.50 in green gram, respectively. The average yield was 16.7 q/ha and 14.2 q/ha in black gram and green gram demonstrated plots respectively as well as control plot was 12.7 q/ha and 11.4 q/ha. Our results are in lined with” Singh et al. [9]. “The results clearly indicate the positive effect of frontline demonstration over existing practice towards enhancement of the yield of pulses in demonstrated area. The similar trends of yield enhancement in front line demonstration of pulse crops have been documented” by Dwivedi, et al. [10]. Integrated pest management practices in chickpea Sakti et al. [11] Saravanakumar et al. [12] and Rajashekhar et al. [13] in cotton through frontline demonstration were popularized and also reported higher yield and economic performance with use of improved technological interventions for effective management of pest & diseases by using low cost critical interventions.

Extension gap: The extension gap refers to the difference between the yield achieved with current farming practices and the production demonstrated, which is 4.0 quintals per hectare for black gram and 2.8 quintals per hectare for green gram (Table 4), it has to be filled using a variety of expansion techniques. It is necessary to communicate information on better practises through print and electronic media, training programmes, awareness campaigns, and other means. To close this gap, extension personnel intervention is necessary. Farmers would adopt better practices as a result of the enhanced awareness that the extension workers had helped to develop, which would bridge the extension gap. The results were consistent with earlier findings of Kulkarni et al. [14].

Technology gap: The technology gap between the demonstration yield and the variety's potential yield was 8.3 and 7.8 q/ha in black gram and green gram respectively (Table 4). It shows that there is still a gap in technological demonstration, which prevented the participating farmers from reaping the full benefits of the improved methods. It might also be brought on by unavoidable changes in soil and climatic circumstances. The conclusions are consistent with earlier reported by Vijaya Lakshmi et al. [3].

Yield gap: Yield gap is the ratio between farmers' yield and the extension gap, represented as a percentage. In black gram and green gram, it is noted as 31.49 and 24.56 percent respectively. The yield gap can be closed by extension interventions that raise public awareness of the improved practises.

Technology index: The technology index, expressed as a percentage, represents the ratio between the technology gap and the potential yield. For black gram and green gram, the technology index stands at 33.20% and 35.61%, respectively. This is due to the existing technology gap. By adopting improved practices, the technology gap can be reduced, leading to a corresponding decrease in the technology index. The findings are in line with Balai et al. [15] & Raj et al. [16].

Economics: The economics of the demonstrations as presented in (Table 5) indicated that in the demonstration plot the average gross cost recorded was Rs. 40,741/- per hectare, with an average gross return of Rs. 1,14,280/- per hectare, accounting to the average net return of Rs. 73,538/- per hectare with a benefit cost ratio of 2.8: 1 compared with check plot average gross cost recorded was Rs. 48,550/- per hectare, with an average gross return of Rs. 86,760/- per hectare, accounting to the average net return of Rs. 38,210/- per hectare with a benefit cost ratio of 1.79:1 in black gram. Whereas in green gram demonstration plot the average gross cost recorded was Rs. 36,366/- per hectare, with an average gross return of Rs. 1,02,631/- per hectare, accounting to the average net return of Rs. 66,265/- per hectare with a benefit cost ratio of 2.81: 1 compared with check plot average gross cost recorded was Rs. 45,572/- per hectare, with an average gross return of Rs. 82,390/- per hectare, accounting to the average net return of Rs. 36,817/- per hectare with a benefit cost ratio of 1.8:1 respectively.

Table 4. Grain yield and gap analysis of cluster frontline demonstrations on Black gram & Green gram

Year	No. of Demonstrations	Area (ha)	Average yield Q ha^{-1}		% Increase in Recommended Practice (RP)	Extension gap (Q ha^{-1})	Technology gap (Q ha^{-1})	Technology Index
			Demonstration	Farmers				
				Black gram				
2018-19	25	10	16.2	13.5	15.2	2.7	8.8	35.20
2019-20	25	10	16.8	12.6	15.8	4.2	8.2	32.80
2020-21	25	10	17.1	12.1	16.1	5.0	7.9	31.60
Average	**25**	**10**	**16.7**	**12.7**	**15.7**	**4.0**	**8.3**	**33.20**
Mean			16.7	12.73				
Variance			0.21	0.50				
P<0.05			0.2944					
				Green gram				
2018-19	25	10	14.8	11.5	13.8	3.3	7.2	32.73
2019-20	25	10	14.2	11.4	13.2	2.8	7.8	35.45
2020-21	25	10	13.5	11.2	12.5	2.3	8.5	38.64
Average	**25**	**10**	**14.2**	**11.4**	**13.1**	**2.8**	**7.8**	**35.61**
Mean			14.167	11.367				
Variance			0.423	0.023				
P<0.05			0.0522					

Table 5. Economic analysis Black gram

s. no		Total returns (Rs.ha^{-1})		Input cost (Rs.ha^{-1})		Net return (Rs.ha^{-1})		Additional return (Rs.ha^{-1}) FLD's	B:C ratio	
1	Year	Recommended Practice (RP)	Farmer's Practice (FP)	Recommended Practice (RP)	Farmer's Practice (FP)	Recommended Practice (RP)	Farmer's Practice (FP)		Recommended Practice (RP)	Farmer's Practice (FP)
2	2018-19	100440	83700	36300	46300	64140	37400	26740	2.77	1.81
3	2019-20	119280	89460	43800	50250	75480	39210	36270	2.72	1.78
4	2020-21	123120	87120	42125	49100	80995	38020	42975	2.92	1.77
5	**Average**	**114280**	**86760**	**40741**	**48550**	**73538**	**38210**	**35328**	**2.80**	**1.79**

Table 6. Economic analysis Green gram

s. no		Total returns ($Rs.ha^{-1}$)		Input cost ($Rs.ha^{-1}$)		Net return ($Rs.ha^{-1}$)		Additional return ($Rs.ha^{-1}$) FLD's	B:C ratio	
1	Year	Recommended Practice (RP)	Farmer's Practice (FP)	Recommended Practice (RP)	Farmer's Practice (FP)	Recommended Practice (RP)	Farmer's Practice (FP)		Recommended Practice (RP)	Farmer's Practice (FP)
2	2018-19	105080	81650	38000	46255	67080	35395	31685	2.77	1.77
3	2019-20	102240	82080	35525	44962	66715	37117	29597	2.88	1.83
4	2020-21	100575	83440	35575	45500	65000	37940	27060	2.83	1.83
5	**Average**	**102631**	**82390**	**36366**	**45572**	**66265**	**36817**	**29447**	**2.81**	**1.80**

Additional cost and additional returns were calculated and found that farmers practice incurred an additional cost of Rs.7,809/- per hectare compared to demonstration. As a result of the demonstrations an additional return of Rs.35,328/- per hectare was recorded in demo of black gram where in green gram an additional cost of Rs.9,206/- per hectare compared to demonstration. As a result of the demonstrations an additional return of Rs.29,448/- per hectare respectively.

4. CONCLUSION

The implementation of frontline demonstrations using a cluster approach has been shown to effectively influence both participating and neighbouring farmers, demonstrating significant potential for widespread agricultural improvement. These demonstrations were conducted under the supervision of agricultural scientists, yielding robust, region-specific data that validate the superiority of improved agronomic practices over traditional methods. Despite initial skepticism among farmers, exposure to the demonstrations has led to a marked shift in perception, with increasing acceptance of the demonstrated technologies. To maximize the impact, it is imperative to intensify efforts to disseminate these technologies, thereby reducing extension gaps, technology gaps, technology indices, and adoption gaps. This will contribute to closing the yield gap and enhancing farm profitability. The favourable economic outcomes observed in these demonstrations underscore the need for their broader adoption across the agricultural sector.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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