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## IMPACT OF CLUSTER FRONTLINE DEMONSTRATIONS ON PRODUCTIVITY AND PROFITABILITY OF BLACKGRAM (VBN 8): MULTI-STATE EVIDENCE FROM ICAR - ATARI ZONE-X

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### ABSTRACT

Blackgram (*Vigna mungo* L.) is a major pulse crop contributing significantly to food and nutritional security in India, where productivity remains constrained due to limited adoption of improved technologies and the predominance of local varieties. To address the prevailing yield gaps, Cluster Frontline Demonstrations (CFLDs) were conducted over five consecutive years (2019-20 to 2023-24) across Andhra Pradesh, Tamil Nadu, Telangana, and Puducherry through Krishi Vigyan Kendras (KVKs) using the high-yielding variety VBN 8. A total of 4,889 demonstrations were implemented covering 2,050 hectares. The results revealed that the demonstrated technologies recorded higher yields (7.25-11.33 q/ha, average 8.50 q/ha) compared to farmer's practices (average 6.71 q/ha), with an average yield increase of 26.68%. The five-year average data on the extension, technology gaps and technology index were found to be 1.79 q/ha and 0.50 q/ha and 5.58% respectively. The improved practices gave highest net returns and benefit-cost ratio in demonstrations of Rs.35528/ha and 2.55 compared to Rs.21733/ha and 2.02 under farmer's practice due to adoption of improved variety and recommended agronomic practices.

**Keywords:** Cluster frontline demonstrations, Blackgram, Yield, Extension gap, Technology index.

### Introduction

Blackgram (*Vigna mungo* L.) commonly known as urd bean is one of the most important grain legumes among pulse crops and belongs to the family Fabaceae. It plays a significant role in ensuring food and nutritional security. Blackgram is a short duration, indeterminate and self-pollinated pulse crop cultivated across all seasons, either as a sole crop, as an intercrop, or under fallow conditions. It is valued for its high protein content, carbohydrates (60%), fat (1.5%), minerals, amino acids and vitamins, as well as its wide adaptability to a range of soils types, and its role in crop rotations and integrated farming systems (Devaraju and Senthivel, 2018).

India stands as the leading producer and consumer of blackgram accounting for more than 70% of the global production, contributing approximately 21.06 lakh tonnes annually from around 30.23 lakh hectares, with an average productivity of 697 kg/ha (Directorate of Economics and Statistics, 2024). Blackgram contributes nearly 13 per cent of the total area under pulses and about 10 per cent of the total pulse production in the country.

According to the Unified Portal for Agricultural Statistics (UPAg), 2024-25 notable variations exist in the area, production, and productivity of blackgram across the southern states of India. Andhra Pradesh recorded a production of 3.93 lakh tonnes from 3.21

lakh hectares with an average productivity of 1,225 kg/ha. In Tamil Nadu, blackgram is cultivated on 3.58 lakh hectares, producing 1.66 lakh tonnes with a yield level of 465 kg/ha. Telangana reported a production of 0.43 lakh tonnes from 0.30 lakh hectares, achieving the highest productivity among the states at 1462 kg/ha. In the Union Territory of Puducherry, the crop recorded a yield level of 667 kg/ha.

To address the existing yield gaps in blackgram, the implementation of Cluster Frontline Demonstrations (CFLDs) has emerged as an effective strategy for promoting the adoption of modern agro-technologies among farmers. The CFLD programme, initiated by the Indian Council of Agricultural Research (ICAR) and the Ministry of Agriculture and farmer's welfare under the National Food Security Mission-Pulses (NFSM-Pulses). The main objective of front line demonstrations is to demonstrate newly released varieties, improved crop production and protection technologies, and recommended management practices directly on farmer's fields under diverse agro-climatic regions.

These demonstrations serve as practical models for showcasing the impact of improved production technologies such as high-yielding varieties, balanced nutrient management, integrated pest and disease management, and efficient water use practices. By conducting demonstrations under real farming situations, CFLDs aim to bridge the gap between research recommendations and farmer's existing practices. This initiative not only enhances productivity and profitability but also strengthens farmer's confidence in scientific interventions, thereby contributing to sustainable pulse production and improved livelihood security, particularly in rainfed regions (Jayaramasoundari, 2024). In this context, the present investigation was undertaken to assess the effectiveness and performance of Cluster Frontline Demonstrations on blackgram cultivation.

### Materials and Methods

Cluster Frontline Demonstrations (CFLDs) on blackgram crop were conducted during the *Kharij*, *Rabi*, and *Summer* seasons from 2019-20 to 2023-24 (5 consecutive years) across four southern states, namely Andhra Pradesh, Tamil Nadu, Telangana, and Puducherry through various Krishi Vigyan Kendras (KVKs). A total of 4,889 demonstrations were implemented, covering an area of 2,050 hectares, using the high-yielding blackgram variety VBN 8.

Prior to implementation of demonstrations, participating farmers were trained on recommended production and protection practices and were provided

with critical inputs, including quality seed of the improved variety, recommended pesticides, and relevant extension literature. Regular field visits, monitoring, and timely advisories on pest and disease management advisories during different stages of crop growth were provided by KVK scientists to ensure effective implementation and adoption of the demonstrated technologies.

Yield data were collected from the participating KVKs. Basic agronomic and yield-related information was recorded from the farmers' fields to evaluate the comparative performance between the Cluster Frontline Demonstrations (CFLDs) and farmers' practices over five-year period. Various parameters, such as yield advantage, technology gap, extension gap, and technology index, were computed using the standard methodology suggested by Samui *et al.* (2000) as given below:

$$\text{Extension gap (q/ha)} = \text{Demonstrated yield} \\ - \text{Yield under farmer's practice}$$

$$\text{Technology gap (q/ha)} = \text{Potential yield} \\ - \text{Demonstration yield}$$

$$\text{Technology index (\%)} \\ = \frac{\text{Potential yield} - \text{Demonstration yield}}{\text{Potential yield}} \times 100$$

$$\% \text{ Increase yield over farmer's Practice} \\ = \frac{\text{Demonstration yield} - \text{farmer's yield}}{\text{farmer's yield}} \times 100$$

$$\text{Additional Return} = \text{Demonstration return} \\ - \text{Farmer's practice return}$$

$$\text{Benefit-Cost Ratio} = \frac{\text{Gross Return}}{\text{Gross Cost}}$$

### Results and Discussion

A perusal of the data, as shown in the Table 1, revealed that the adoption of an improved package of practices integrated with suitable technological interventions plays a crucial role in enhancing the productivity and profitability of pulse crops (Table 1). It was clearly indicated that farmers generally did not use recommended and improved technologies which left a significant gap in the use of improved varieties. This was primarily due to the non-availability of quality seed resulting in the continued use of local varieties. Similar findings were also reported by Singh *et al.* (2018).

Table 1 reflects a clear technological gap between the recommended package of practices demonstrated under CFLDs and the existing farmers' practices in blackgram cultivation. The interventions focused on

scientific crop management and balanced input use, whereas farmers largely followed traditional, input-imbalanced, and less systematic practices. The absence of quality seed, inadequate crop establishment methods, imbalanced nutrient application, and non-judicious pest and weed management under farmers' practices emerged as major constraints limiting

productivity. In contrast, the integrated and need-based technological interventions under CFLDs, supported by regular technical guidance, were designed to address these constraints and promote efficient resource use, thereby creating favourable conditions for improved yield, profitability, and sustainability in blackgram production.

**Table 1:** Differences between technological interventions and farmer's practices under CFLD in Black gram

Particulars	Technology Intervention	Farmer's practice
Variety	VBN 8	Local
Land Preparation	Two or three ploughings followed by Levelling	One or two ploughings
Seed rate	20 Kg/ha	22-25 Kg/ha
Sowing method	Seed drill line sowing (30 × 10 cm)	Broadcasting, un even plant population
Seed treatment	Soil application of <i>Trichoderma viridii</i> @ 2 kg/ acre along with 100kg FYM. Seed treatment with imidacholoprid 6 ml/kg of seed	No seed treatment
Fertilizer dose	20:50:25 kg N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O Kg/ha + Sulphur @ 40 kg/ha	Imbalance use of fertilizer 20 Kg urea as basal and 50 Kg DAP as top dressing
Weed management	Integrated weed management - pendimethalin 30 EC @ 3.3 l/ha (pre-emergence) and manual weeding at 15 and 35 DAS	Manual weeding
Plant protection	Need based application, Installation of Yellow sticky traps @ 12 Nos/ha, Neem oil @ 5 ml/ha and Chlorpyrifos 2.5 ml/lit of water for control of sucking pest	Non judicious use of pesticides
Technical guidance	Regular technical guidance provided through through trainings and field visits	Nil

### Yield performance

The grain yield of black gram in the demonstration plots was significantly higher as compared to the farmer's practice (Table 2). The results clearly indicated that the productivity of high yielding blackgram variety with improved practices under demonstration plots were recorded the yield ranges from 7.25 to 11.33 q/ha with an average yield of 8.650 q/ha, whereas the farmer's practice recorded an average yield of 6.71 q/ha. The percent increase in yield over farmer's practice ranged from 21.05 to 38.80 percent. These results are in close agreement with the findings of Singh *et al.* (2018) and Amuthaselvi *et al.* (2023).

From the results it is evident that the use of the improved black gram variety VBN 8, along with timely sowing, proper seed treatment, line sowing, balanced fertilizer application, and integrated weed and pest management practices under the CFLDs collectively contributed to the substantial yield enhancement. In contrast, farmer's practice such as the use of local varieties, broadcasting method of sowing, application

of only urea, and the absence of plant protection measures resulted in comparatively lower yields.

The results presented in Table 2 clearly demonstrate the positive impact of Cluster Frontline Demonstrations (CFLDs) on blackgram productivity over a five-year period (2019-20 to 2023-24). Across all the years, demonstration plots consistently outperformed farmers' practices, indicating the effectiveness of the improved package of practices promoted under CFLDs. The average yield recorded under demonstration plots was 8.50 q/ha, compared to 6.71 q/ha under farmers' practices, resulting in a mean yield increase of 26.68 per cent. Year-wise analysis revealed that yields under demonstrations ranged from 7.25 to 11.33 q/ha, while those under farmers' practices varied from 5.69 to 9.36 q/ha. The percentage increase in yield over farmers' practices ranged from 21.05 to 38.80 per cent, with the highest yield advantage observed during 2022-23 and the lowest during 2023-24. However, the obtained yield in CFLDs was lower than the potential yield of the variety VBN 8. This variation can be attributed to differences in

seasonal conditions, rainfall distribution like drought/excessive rainfall at the time of flowering and pod formation stage of the crop and field-level management practices across years. Similar results were reported by Dubey *et al.*, (2010) and Poonia and Pithia, (2010). and are in close agreement with the findings of Singh *et al.* (2018) and Amuthaselvi *et al.* (2023).

The consistent yield superiority of CFLD plots across diverse seasons and locations highlights the effectiveness of adopting improved varieties, balanced

nutrient management, scientific crop establishment, and integrated pest and weed management practices. The sustained yield gains achieved under real farm conditions indicate that CFLDs play a crucial role in bridging the yield gap between recommended technologies and existing farmers' practices. Overall, the findings affirm the relevance of CFLDs as an effective extension approach for enhancing blackgram productivity and promoting the adoption of improved technologies under farmers' field conditions.

**Table 2:** Yield Performance of Blackgram under CFLD and farmer's practices:

Year	Area (ha)	Demo (No.)	Yield under demonstration (q/ha)	Farmer's practice (q/ha)	% Increase in yield
2019-20	416	1040	7.90	6.35	24.41
2020-21	356	825	7.89	6.29	25.44
2021-22	298	746	7.25	5.69	27.42
2022-23	440	1084	8.12	5.85	38.80
2023-24	540	1194	11.33	9.36	21.05
<b>Total</b>	<b>2050</b>	<b>4889</b>	-	-	-
<b>Average</b>	-	-	<b>8.50</b>	<b>6.71</b>	<b>26.68</b>

### Yield Gap Analysis

The yield obtained from the demonstration plots were compared with the potential yield to estimate the yield gap in black gram. The overall the yield gaps were categorized into three components: Extension gap, Technology gap, and Technology index to assess the scope for improvement and the effectiveness of technology transfer (Table 3).

#### Extension gap

The extension gap represents the difference between the yields obtained from CFLD demonstration plots and farmer's traditional practices (Table 3). ranged from 1.55 to 2.27 q/ha, with an average of 1.79 q/ha over the five-year period. This indicates that despite the availability of improved technologies, farmer's practices continue to lag behind, primarily due to limited awareness, lack of technical guidance,

and non-adoption of recommended management practices.

The CFLDs effectively addressed this gap by providing hands-on exposure to high-yielding varieties, scientific crop management, integrated nutrient and pest management, and optimal agronomic practices under real farm conditions. The observed extension gap underscores the importance of sustained field-level demonstrations, training sessions, and on-site technical guidance to encourage farmers to adopt improved practices. By bridging this gap, CFLDs not only enhance productivity but also strengthen farmer's confidence in scientific interventions, promoting wider adoption of recommended technologies and contributing to sustainable blackgram cultivation. These findings align with the observations of Sharma and Singh (2024), Kanojia *et al.* (2019), and also Hiremath and Nagaraju, (2010).

**Table 3:** Extension gap, Technology gap and Technology index in Blackgram (VBN 8) under CFLD

Year	Potential yield	Demo yield (q/ha)	Farmer's practice (q/ha)	Extension gap (q/ha)	Technology gap (q/ha)	Technology index %
2019-20	9.0	7.90	6.35	1.55	1.10	12.22
2020-21	9.0	7.89	6.29	1.60	1.11	12.33
2021-22	9.0	7.25	5.69	1.56	1.75	19.44
2022-23	9.0	8.12	5.85	2.27	0.88	9.78
2023-24	9.0	11.33	9.36	1.97	-2.33	-25.89
<b>Average</b>	<b>9.0</b>	<b>8.50</b>	<b>6.71</b>	<b>1.79</b>	<b>0.50</b>	<b>5.58</b>

## Technology gap

The technology gap represents the difference between the potential yield and the yield achieved under demonstration plots, where a positive gap indicates yields below potential and a negative gap shows yields exceeding potential, reflecting the effectiveness of CFLD interventions in improving crop management and promoting adoption of recommended technologies. The average technology gap between the potential yield and the demonstrated yield of blackgram was observed to be 0.50 q/ha, with the gap ranging from -2.33 to 1.75 q/ha (Table 3). The observed gap may be attributed to the dissimilarity in soil fertility status, climatic conditions, and management practices across locations. Therefore, variety-specific and location-specific recommendations are necessary to reduce the technology gap and to achieve the potential yield under diverse agro-ecological conditions. Similar findings were reported by Kothyari *et al.* (2018) and Rachhoya *et al.* (2018).

## Technology index

The technology index serves as an important tool for assessing the impact and level of adoption of improved agricultural technologies. In the present study, the technology index ranged from -25.8% to 19.44% (average 5.58% in Table 3). The negative value of the technology index indicates the effectiveness of technological intervention and better adoption at the farmer's field level. The observed variation in the technology index could be attributed to differences in weather conditions, soil fertility status, and incidence of insect-pest infestation. The

technology index also reflects the feasibility of a technology under farmer's field conditions, with a lower value indicating greater feasibility and suitability of the demonstrated variety. Similar findings were reported in blackgram in which the technology index ranged from -1.90 to 24.18% (Hanif *et al.* 2025). There is a need to reduce the gap by introducing high-yielding varieties and location-specific farm technologies under CFLDs.

## Economics analysis

The economics of chickpea cultivation including cost of cultivation, gross return, net return, and benefit-cost (B:C) ratio under CFLDs were estimated and the results are presented in the table 4. The demonstration plots recorded a higher average gross cost of cultivation (Rs. 22,896/ha), along with increased gross returns (Rs. 58,424/ha), higher net returns (Rs. 35,528/ha), and a B:C ratio of 2.55, compared to farmer's practice of Rs.21,386/ha, Rs.43,119/ha, and Rs.21,733/ha, respectively, with an average B:C ratio of 2.02.

Adoption of improved production technologies under CFLDs resulted in an additional return of Rs. 13,796/ha over farmer's practice during the five-year study period. The higher net return and B:C ratio can be attributed to the increased grain yield resulting from the improved variety VBN 8. These findings are in agreement with the results of Sreelakshmi *et al.* (2012) and Saravanakumar *et al.* (2020), who also reported higher net returns and B:C ratio in blackgram under CFLDs as compared to farmer's practices.

**Table 4:** Comparative Economic Analysis of Blackgram under CFLDs and Farmer's Practices

Year	Demonstration plot				Farmers practice				Additional returns (Rs/ha)
	Gross Cost (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio	Gross Cost (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio	
2019-20	24650	58848	34198	2.39	22949	41425	18476	1.81	15722
2020-21	19777	49228	29451	2.49	19764	36354	16590	1.84	12861
2021-22	18761	47717	28956	2.54	16838	33753	16914	2.00	12042
2022-23	23339	54618	31279	2.34	21891	40492	18601	1.85	12678
2023-24	27953	81710	53757	2.92	25488	63570	38082	2.49	15675
<b>Average</b>	<b>22896</b>	<b>58424</b>	<b>35528</b>	<b>2.55</b>	<b>21386</b>	<b>43119</b>	<b>21733</b>	<b>2.02</b>	<b>13796</b>

## Conclusion

The present study clearly demonstrated the effectiveness of Cluster Frontline Demonstrations (CFLDs) in enhancing the productivity and profitability of blackgram cultivation across southern India. The adoption of improved production technologies, including the high-yielding variety VBN

8, balanced nutrient management, scientific crop establishment, and integrated pest and weed management, resulted in a consistent yield advantage over farmers' practices. On average, demonstration plots recorded a yield of 8.50 q ha<sup>-1</sup>, which was 26.68 per cent higher than that of farmers' practices,

highlighting the role of CFLDs in narrowing the yield gap.

The analysis of extension and technology gaps further emphasized the importance of effective technology dissemination and field-level guidance, as positive extension gaps indicated considerable scope for improving farmers' adoption of recommended practices. Economic evaluation revealed that CFLD interventions significantly improved net returns (Rs.35,528/ha) and benefit-cost ratio (2.55) compared to farmers' practices, generating an additional return of Rs.13,796/ha. These findings underscore that CFLDs not only improve crop productivity but also enhance farmers' income and confidence in scientific farming practices. Overall, the study confirms CFLDs as an effective extension approach for promoting sustainable blackgram production and strengthening livelihood security under diverse agro-climatic conditions.

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### References

- Amuthaselvi, G., Anand, G., Vijayalakshmi, R., Kanif, N. A., Dhanushkodi, V., Gayathri, M., & Ravi, M. (2023). Yield gap analysis through cluster front line demonstration in blackgram at Tiruchirapalli District. *Legume Research-An International Journal*, **46**(7): 898-901.
- Department of Agriculture & Farmers Welfare. (2025). Unified Portal for Agricultural Statistics (UPAg). Ministry of Agriculture & Farmers Welfare, Government of India. Retrieved November 13, 2025, from <https://upag.gov.in>
- Devaraju, B. and Senthivel, T. 2018. Effect of Foliar Application of Different Sources of Nutrients on Growth and Yield of Blackgram under Irrigated Conditions. *Int. J. Curr. Microbiol. App. Sci.* **7**(01): 3105-3109. doi:<https://doi.org/10.20546/ijemas.2018.701.368>
- Dubey, S., S. Tripathi, P. Singh and R.K. Sharma (2010). Yield gap analysis of black gram production through frontline demonstration, *J. Prog. Agric.*, **1**(1): 42-44.
- Hanif, N. A. K. A., Albert, V. A., Amuthaselvi, G., Ravi, M., Saranraj, T., & Easwaran, S. (2025). Sustainability of yield and value in blackgram (*Vigna mungo*) through frontline demonstrations, *Plant Science Today.*, **12**(1): 1-7
- Hiremath, S.M. and M.V. Nagaraju (2010). Evaluation of on front line demonstrations on the yield of chilli, *Karnataka J. Agric. Sci.*, **23**(2): 341-342.
- Jayaramasoundari, R. (2024). Enhancing Productivity and Profitability of Black Gram (*Vigna mungo*) Through Cluster Front Line Demonstrations. *Indian Journal of Agricultural Research*, **58**(5): 806-810.
- Kanojia, Y., Damor, R. K., & Singh, H. C. (2019). Impact assessment of front line demonstrations on black gram: an experience from Pratapgarh tribal district of Rajasthan, India. *Plant Archives* (09725210), **19**(2): 4532-4533.
- Kothiyari, H. S., Meena, K. C., Meena, B. L., & Aseray, R. (2018). Evaluation of cluster front line demonstration on black gram in Sawai Madhopur district of Rajasthan, India. *Int. J. Curr. Microbiol. App. Sci.*, **7**(1): 1569-1573.
- Ministry of Agriculture & Farmer's Welfare, Government of India. (2025, May 28). Third advance estimates of production of foodgrains, oilseeds and other commercial crops for 2024-25. *Directorate of Economics & Statistics*.
- Poonia, T.C. and M.S. Pithia (2011). Impact of front line demonstrations of chickpea in Gujarat. *Legume Reserach*, **34**(4): 304-307.
- Samui SK, Maitra S, Roy DK, Mondal AK, Saha D. (2000). Evaluation of front line Demonstration on groundnut (*Arachis hypogea* L.) in Sundarbans. *Journal of Indian Society of Coastal Agriculture Resource*, **18**(2): 180-183.
- Saravanakumar, S., Premalatha, A., John Prabakaran, D., & Thirumoorthi, M. (2020). Evaluation of Cluster Frontline Demonstration on Urd for Enhancing Productivity. *Indian Journal of Extension Education*, **56**(3): 101-103.
- Sharma, S., & Singh, N. D. (2024). Impact assessment of cluster frontline demonstration in enhancing productivity of kharif blackgram in sub-mountainous region of Punjab, India. *Journal of Food Legumes*, **37**(4): 455-461.
- Singh, S. P., Paikra, K. K., & Patel, C. R. (2018). Performance of cluster frontline demonstration on productivity and profitability of Black gram (*Vigna mungo*) in Raigarh District of Chhattisgarh, India. *International Journal of Current Microbiology and Applied Sciences*, **7**(6): 1325-1330.
- Sreelakshmi, C. H., Kumar, C. S., & Shivani, D. (2012). Productivity enhancement of pigeonpea (*Cajanus cajan* L.) through improved production technologies. *Madras Agric. J.*, **99** (4-6): 248-250.