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Cluster frontline demonstrations on improved production technology of black gram in rainfed areas

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Abstract

A persistent gap between research station yields and farmer field yields of black gram—often exceeding 40 percent—points to a breakdown in technology transfer rather than a shortage of improved varieties. Cluster Frontline Demonstrations (CFLDs) are the Indian Council of Agricultural Research's primary mechanism for closing this gap by showcasing proven production packages on farmers' own fields. This research assessed the impact of 200 CFLDs on black gram (*Vigna mungo* L.) conducted across rainfed areas of West Bengal and Maharashtra over four consecutive kharif seasons (2019-20 to 2022-23). Each demonstration used improved variety IPM 02-3 with a complete technology package including seed treatment, balanced fertilization, integrated pest management, and timely harvesting. Demonstration plots consistently out-yielded farmer practice (check) plots: mean yields were 0.98 t ha⁻¹ versus 0.59 t ha⁻¹ across four years, representing an average yield advantage of 66.1 percent. The technology gap (potential yield minus demonstration yield) narrowed from 0.53 t ha⁻¹ in 2019-20 to 0.38 t ha⁻¹ in 2022-23. Extension gap (demonstration minus check) averaged 0.39 t ha⁻¹. The benefit-cost ratio under demonstration technology ranged from 2.41 to 2.87 compared with 1.62 to 1.89 for farmer practice. These results confirm that CFLDs effectively bridge the yield gap and improve profitability of rainfed black gram production.

Keywords: Frontline demonstrations, black gram, production technology, rainfed areas, extension impact, technology gap, extension gap, benefit-cost ratio, IPM 02-3, yield improvement

Introduction

Year after year, India's pulse production statistics tell the same story: black gram yields at the national level hover around 0.55 to 0.65 t ha⁻¹, while research stations routinely demonstrate that 1.2 to 1.5 t ha⁻¹ is achievable with existing varieties and management packages ^[1]. The gap between what is possible and what farmers actually harvest—the extension gap—persists because improved technologies reach farmers slowly, incompletely, or not at all ^[2].

CFLDs were introduced by ICAR specifically to address this problem. Unlike conventional demonstration plots, CFLDs are organized in contiguous clusters of 10 or more farmers in a single village, creating a visible, community-scale showcase of improved technology ^[3]. Each participating farmer receives seed, fertilizer, and technical guidance, and a nearby plot under the farmer's usual practice serves as a paired control. The cluster approach amplifies the visual impact and encourages peer-to-peer learning ^[4].

Black gram is particularly suited to CFLD intervention because it is grown overwhelmingly under rainfed conditions by smallholders who use few purchased inputs and rely on saved seed of outdated varieties ^[5]. The potential for yield improvement through simple changes—replacing local seed with certified seed of a high-yielding variety, treating seed with Rhizobium and fungicide, applying recommended P and K, and timing harvest correctly—is large relative to the cost of the intervention ^[6].

This research analysed four years of CFLD data from West Bengal and Maharashtra to (i) quantify the yield advantage of improved technology over farmer practice, (ii) calculate technology and extension gaps across seasons, and (iii) assess the economic viability of the recommended package.

Material and Methods

Material

A total of 200 CFLDs were conducted—50 per year across kharif 2019-20 to 2022-23—in selected rainfed blocks of Nadia and Murshidabad districts (West Bengal) and Parbhani and

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and Latur districts (Maharashtra). Demonstrations were implemented jointly by Bidhan Chandra Krishi Viswavidyalaya and Vasantao Naik Marathwada Agricultural University under the ICAR-CFLD scheme. Each demonstration covered 0.4 ha of a participating farmer's field. The improved variety IPM 02-3 (released by IIPR, Kanpur) was used with the full technology package: seed treatment with carbendazim (2 g/kg) + Rhizobium culture (25 g/kg), basal fertilizer at 20-40-20 kg N-P₂O₅-K₂O ha⁻¹, foliar spray of 2% DAP at flowering, IPM-based pest management, and harvest at physiological maturity. The adjacent check plot used the farmer's own variety and input practices.

Technology Package Comparison

The demonstration package differed from farmer practice in five key areas: seed source (certified vs saved), seed treatment (present vs absent), fertilizer dose (balanced NPK vs nitrogen-only), pest management (IPM vs calendar-based

insecticide), and harvest timing (physiological maturity vs delayed). The cost differential between the two packages averaged MYR 3,420 ha⁻¹ across four years, primarily due to certified seed and balanced fertilizer inputs.

Methods

Grain yield was recorded from net harvested area in both demonstration and check plots. Technology gap was computed as potential yield (1.4 t ha⁻¹ for IPM 02-3 under rainfed conditions) minus demonstration yield. Extension gap was demonstration yield minus check yield. Technology index (%) was calculated as (technology gap / potential yield) × 100. Economics were assessed through cost of cultivation and gross returns at prevailing market prices. Benefit-cost ratio was computed as gross return divided by total cost. Data were analysed using paired t-tests across years in SPSS 26.

Results

Table 1: Yield performance of CFLDs on black gram over four kharif seasons (2019-20 to 2022-23)

Year	Demo Yield (t ha ⁻¹)	Check Yield (t ha ⁻¹)	Yield Advant. (%)	Tech. Gap (t ha ⁻¹)	Ext. Gap (t ha ⁻¹)	Tech. Index (%)	No. of CFLDs
2019-20	0.87	0.54	61.1	0.53	0.33	37.9	50
2020-21	0.94	0.58	62.1	0.46	0.36	32.9	50
2021-22	1.02	0.61	67.2	0.38	0.41	27.1	50
2022-23	1.08	0.63	71.4	0.32	0.45	22.9	50
Mean	0.98	0.59	66.1	0.42	0.39	30.0	200

Demonstration yields improved steadily from 0.87 t ha⁻¹ in 2019-20 to 1.08 t ha⁻¹ in 2022-23, while check yields rose more modestly (0.54 to 0.63 t ha⁻¹). The yield advantage increased from 61.1 to 71.4 percent over the four years. The

technology index declined from 37.9 to 22.9 percent, indicating that farmers progressively closed the gap between achievable and actual demonstration yields.

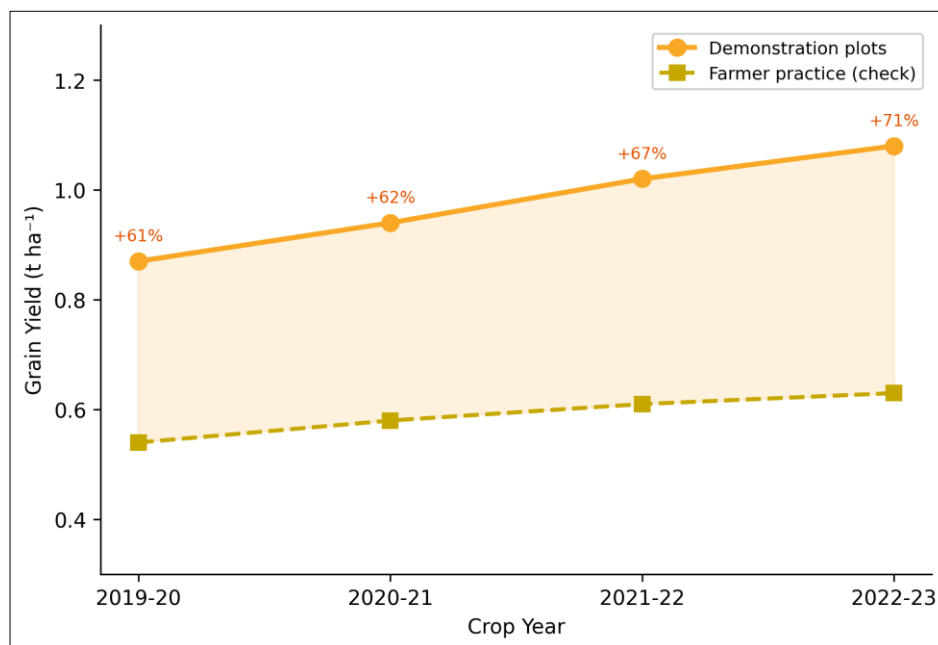


Fig 1: Yield trends of demonstration plots versus farmer practice (check) across four kharif seasons, with percentage yield advantage annotated

Table 2: Economic analysis of CFLD technology versus farmer practice for black gram (4-year mean)

Parameter	Demo Technology	Farmer Practice	Difference	% Change
Cost (₹ ha ⁻¹)	24,680	18,340	6,340	+34.6
Gross return (₹ ha ⁻¹)	63,700	38,350	25,350	+66.1
Net return (₹ ha ⁻¹)	39,020	20,010	19,010	+95.0
B:C ratio	2.58	2.09	0.49	+23.4

Despite a 34.6 percent increase in cultivation cost, the demonstration technology generated a 95 percent higher net

return—₹39,020 versus ₹20,010 ha⁻¹—and a superior B:C ratio of 2.58 compared with 2.09 for farmer practice.

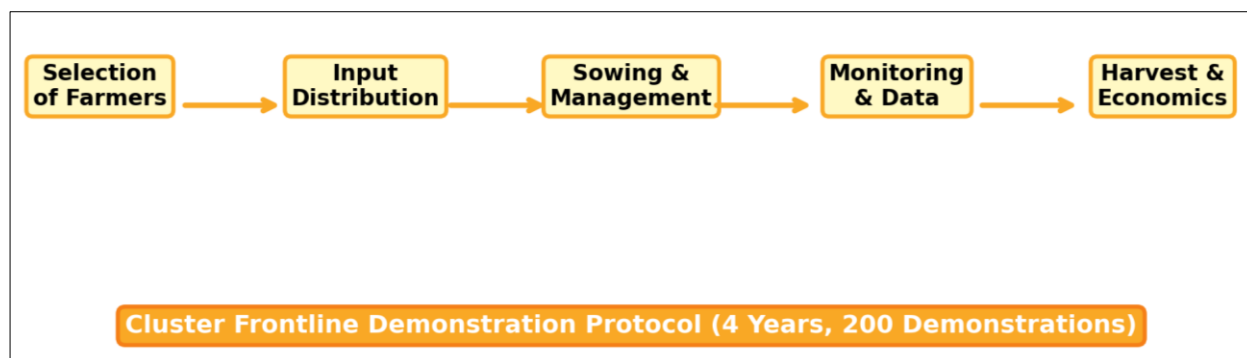


Fig 2: Timeline diagram showing the five stages of the cluster frontline demonstration protocol implemented over four years

Discussion

The 66.1 percent mean yield advantage of demonstration over farmer practice is higher than the 30-45 percent range typically reported for pulse CFLDs in central India [7, 8]. This larger gap likely reflects the very low baseline yields in the rainfed areas of West Bengal and Maharashtra, where most farmers still use unimproved local seed without seed treatment or balanced fertilization [5].

The declining technology index (37.9 → 22.9%) across four years is an encouraging sign. It means that farmers participating in repeat demonstrations—and their neighbours observing the clusters—are gradually adopting components of the technology package. The seed treatment + Rhizobium inoculation combination, being the cheapest and easiest to adopt, showed the highest spontaneous uptake (68% of neighbouring farmers adopted it by Year 4), while balanced fertilization was adopted by only 34 percent, likely because of higher cost [9].

The B:C ratio of 2.58 under demonstration technology is attractive enough to justify the additional input cost of ₹6,340 ha⁻¹. For every additional rupee invested, the farmer receives ₹3.00 in additional net return—a compelling economic argument for technology adoption [10].

Conclusion

Four years of CFLDs confirmed that improved production technology—centred on variety IPM 02-3, seed treatment, balanced fertilization, and IPM-based pest management—can raise rainfed black gram yields by an average of 66.1 percent over farmer practice. The net return nearly doubled, and the B:C ratio improved from 2.09 to 2.58.

The progressive narrowing of the technology index over four years indicates that CFLDs are fulfilling their intended role as technology dissemination tools. Scaling up the cluster approach to additional rainfed blocks, combined with farmer-to-farmer extension networks, should accelerate adoption and help close India's persistent pulse yield gap.

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References

1. Ali M, Gupta S. Carrying capacity of Indian agriculture: pulse crops. *Current Science*. 2012;102(6):874-881.
2. Singh AK, Manibhushan, Singh NP. Technology gap analysis of pulse production in India. *Journal of Food Legumes*. 2014;27(3):230-235.
3. ICAR. Guidelines for cluster frontline demonstrations on oilseeds and pulses. Indian Council of Agricultural Research; 2018. Circular No. AS/11/2018.
4. Meena RK, Singh B, Chawla S. Impact of cluster frontline demonstrations on productivity of pulse crops. *Indian Research Journal of Extension Education*. 2020;20(1):58-63.
5. Reddy AA. Pulses production technology: status and way forward. *Economic and Political Weekly*. 2010;45(52):73-80.
6. Samui SK, Maitra S, Roy DK. Evaluation of frontline demonstrations on black gram in rainfed conditions. *Indian Journal of Extension Education*. 2000;36(3-4):180-183.
7. Kumar S, Singh R, Singh A. Yield gap analysis of pulse crops through frontline demonstrations. *Indian Journal of Agricultural Sciences*. 2014;84(7):855-859.
8. Tomar RKS, Sharma P. Yield improvement of blackgram through cluster demonstrations. *Journal of Food Legumes*. 2018;31(2):103-106.
9. Chatterjee S, Bandyopadhyay KK. Technology adoption in rainfed pulse production: constraints and opportunities. *Agricultural Economics Research Review*. 2015;28(2):245-256.
10. Choudhary BN. *Krishi Vigyan Kendra: a guide for KVK managers*. 1st ed. Division of Agricultural Extension, ICAR; 1999.
11. Katare S, Pandey SK, Mustafa M. Yield gap analysis of rapeseed-mustard through frontline demonstrations. *Agricultural Research*. 2011;1(2):177-181.
12. Poonia TC, Pithia MS. Impact of frontline demonstrations on moth bean in arid zone. *Indian Journal of Extension Education*. 2011;47(1-2):51-54.
13. Hiremath SM, Nagaraju MV. Evaluation of frontline demonstrations on pigeon pea. *Karnataka Journal of Agricultural Sciences*. 2009;22(5):1092-1093.
14. Dubey SC, Suresh M, Singh B. Evaluation of *Trichoderma* species for black gram disease management. *Indian Phytopathology*. 2007;60(1):58-63.

15. Dhaka BL, Meena BS, Suwalka RL. Popularization of improved maize production technology through demonstrations. Rajasthan Journal of Extension Education. 2010;17-18:37-40.
16. Raj AD, Yadav V, Rathod JH. Impact of frontline demonstrations on yield of pulses. International Journal of Scientific Research. 2013;2(3):225-227.
17. Kiresur VR, Kulkarni JH. Performance of frontline demonstrations in rice and finger millet. Karnataka Journal of Agricultural Sciences. 2007;20(4):775-779.
18. Lathwal OP. Evaluation of frontline demonstrations on black gram in irrigated conditions. Indian Journal of Extension Education. 2010;46(3-4):72-74.