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Impact of cluster frontline demonstrations on pigeon pea productivity and profitability

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Abstract

The study evaluated the impact of Cluster Frontline Demonstrations (CFLDs) on pigeon pea (*Cajanus cajan* L.) productivity and profitability in Akola district of Maharashtra during 2020–2024. A total of 200 demonstrations were conducted on farmers' fields using improved varieties PKV-TARA (2020–21) and BDN-716 (2022–24) under recommended production practices. Results showed that CFLD plots consistently outperformed farmers practices, with a mean yield of 1462.6 kg ha⁻¹ compared to 1229.2 kg ha⁻¹ in local checks, registering an average yield advantage of 19%. The technology gap and extension gap averaged 437.4 and 233.4 kg ha⁻¹, respectively, with a mean technology index of 23.0%. Economic analysis revealed higher profitability in demonstration plots, with mean net returns of ₹25,175 ha⁻¹ and a benefit–cost ratio of 1.77, compared to ₹18,658 ha⁻¹ and 1.41 in local practices. Major technological gaps were identified in seed treatment, inoculation, balanced fertilization, and IPM adoption. The findings highlight CFLDs as an effective extension tool for bridging yield gaps, enhancing farmers' income, and promoting sustainable pigeon pea production. Strengthened seed systems, input accessibility, capacity building, and climate-resilient practices are crucial for scaling up the adoption of improved technologies in rainfed agro-ecosystems.

Keywords: Pigeon pea, frontline demonstrations, yield gap, technology index

1. Introduction

Pigeon pea (*Cajanus cajan* L.) is the second most important pulse crop in India after chickpea, predominantly cultivated under rainfed and dryland conditions. It plays a dual role in Indian agriculture: serving as a vital source of dietary protein (20-22%) for the population and contributing to soil fertility through biological nitrogen fixation of about 40 kg N/ha. India contributes more than 90% of the global pigeonpea production, with an acreage of 4.80 million ha and production of 4.28 million tonnes, yet the national average productivity is 850-900 kg ha⁻¹ which remains substantially lower than the potential yield of improved varieties (1900-2000 kg ha⁻¹).

This yield gap is attributed to multiple factors including low adoption of high-yielding and disease-resistant varieties, imbalanced fertilizer use, inadequate seed treatment and inoculation, improper crop geometry, and poor adoption of integrated pest management practices. Biotic stresses such as wilt, sterility mosaic, and pod borer infestation (causing up to 30-40 % yield loss), along with abiotic constraints like terminal drought and erratic monsoon rainfall, further aggravate productivity losses.

Maharashtra is one of the leading pigeonpea-growing states, with 13.35 lakh ha under cultivation, producing 12.36 lakh tonnes at an average productivity of 1012 kg/ha. Despite its importance, productivity levels in the state remain far below potential. To address these challenges, the Government of India launched Cluster Frontline Demonstrations (CFLDs) under the National Food Security Mission (NFSM). These demonstrations serve as farmer-participatory field trials, designed to showcase improved varieties and packages of practices under real farming situations, thereby bridging the yield gap and enhancing technology adoption.

2. Materials and Methods

The present study was conducted in Akola district of Maharashtra during four consecutive Kharif seasons (2020-2024) under the Cluster Frontline Demonstration (CFLD) programme on

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pigeon pea. A total of 200 demonstrations were implemented on farmers' fields to evaluate the performance of improved varieties under real farming situations. The variety PKV-TARA was demonstrated during 2020-21, while BDN-716 was introduced during 2022-24. Demonstrations were laid out on rainfed fields with soils ranging from medium to heavy texture and medium fertility status.

The recommended package of practices was followed in demonstration plots, including

- Timely sowing within the recommended window,
- Seed treatment with fungicides and bio-agents,
- Seed inoculation with *Rhizobium* and PSB cultures,
- Balanced nutrient application as per soil test recommendations,
- Adoption of appropriate crop geometry,
- Integrated weed management, and
- Integrated pest management (IPM) practices.
- Farmers' practice plots, where local varieties and traditional management practices were followed, served as local checks for comparison.

Data collection and analysis

Data on yield and economics were collected from both demonstration and local check plots using the random crop cutting method in the presence of farmers and KVK scientists. The following indicators were computed to assess yield performance and technology gaps (Samui *et al.*, 2000)^[7]

- Extension gap (kg ha^{-1}) = Demonstration yield – Local check yield
- Technology gap (kg ha^{-1}) = Potential yield – Demonstration yield (Potential yield considered as 1900 kg ha^{-1})

- Technology index (%) = $\frac{\text{Technology index (\%)} = [(\text{Potential yield} - \text{Demonstrated yield}) / \text{Potential yield}] \times 100}{100}$
- Benefit-Cost ratio (B:C) = Gross return $\div$ 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.

3. Results and Discussion

3.1 Yield performance

Cluster Frontline Demonstrations (CFLDs) consistently outperformed farmers' traditional practices across all four years of study (Table 1). The mean yield of CFLD plots was $1462.6 \text{ kg ha}^{-1}$, compared with $1229.2 \text{ kg ha}^{-1}$ in local checks, resulting in an average yield advantage of 233.4 kg ha^{-1} (19.0%). Among the tested varieties, BDN-716 (2022-2024) recorded higher yield gains (20-22%) than PKV-TARA (2020-2021; 14-16%), indicating that varietal improvement coupled with recommended practices substantially contributed to yield enhancement.

These results align with earlier reports, where Garud *et al.* (2023)^[3] documented 18-24% yield advantages in pigeonpea CFLDs in Maharashtra, and Singh (2020)^[8] observed 15-20% yield improvements under rainfed conditions in Uttar Pradesh. Similarly, Kumar *et al.* (2021)^[4] reported that adoption of improved varieties and integrated crop management practices enhanced pigeonpea yields by 17-22%. Such findings reaffirm that FLDs are effective tools for reducing yield gaps and motivating farmers toward adoption of improved technologies.

Table 1: Yield performance of pigeonpea under CFLDs compared with farmers' practice.

Year	No. of FLDs	Variety	FLD Yield (kg/ha)	Local Yield (kg/ha)	% Increase over Local
2020	75	PKV-TARA	1459	1259	15.9
2021	25	PKV-TARA	1438	1252	14.9
2022	25	BDN-716	1400	1160	20.7
2023	50	BDN-716	1520	1253	21.3
2024	25	BDN-716	1496	1222	22.4
Mean	40	-	1462.6	1229.2	19.0

3.2 Yield gaps and technology index

The average technology gap across years was 437.4 kg ha^{-1} , reflecting the difference between potential yield (1900 kg ha^{-1}) and observed demonstration yield (Table 2). Although CFLDs 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 CFLD and farmers' yield, averaged 233.4 kg ha^{-1} , showing the practical advantage of improved technologies. The technology index averaged 23.0%, which is comparable to values reported by Garud *et al.* (2023)^[3] in Maharashtra but slightly higher than those observed by Verma *et al.* (2023)^[10] in Uttar Pradesh, suggesting regional variation in technology adoption and agro-ecological response.

Table 2: Yield gaps and technology index of pigeonpea under CFLDs.

Year	Technology Gap (kg/ha)	Extension Gap (kg/ha)	Technology Index (%)
2020	441	200	28.5
2021	462	186	29.6
2022	500	240	26.3
2023	380	267	20.0
2024	404	274	21.3
Mean	437.4	233.4	23.0

3.3 Economics

Economic analysis revealed that FLDs were more profitable than local checks (Table 3). The mean net return from demonstration plots was ₹25,175 ha^{-1} , compared with ₹18,658 ha^{-1} in local checks. The average B:C ratio was 1.77 for FLDs, higher than 1.41 in local practices. These findings corroborate

the reports of Bodakhe *et al.* (2023)^[1], who observed higher profitability with improved pigeonpea technologies in Maharashtra. Similarly, Patil *et al.* (2022)^[5] highlighted that adoption of high-yielding varieties coupled with IPM practices significantly enhances farmers' income.

Table 3: Economic performance of pigeonpea under CFLDs

Year	Cost of cultivation (Rs. /ha)		Gross return (Rs. /ha)		Net return (Rs. /ha)		B:C Ratio	
	Demo.	Check	Demo.	Check	Demo.	Check	Demo.	Check
2020	32823	34432	57999	40394	25175	18496	1.77	1.17
2021	36961	38648	58692	42433	21731	16545	1.59	1.10
2022	30910	32661	56267	51272	25356	18611	1.82	1.57
2023	31209	33177	58033	52437	26823	19259	1.86	1.58
2024	32215	33245	59006	53624	26791	20378	1.83	1.61
Mean	32823.6	34432.6	57999.4	48032	25175.2	18657.8	1.773289	1.406886

3.4 Technological interventions and adoption gaps

The major technological interventions introduced in CFLDs included high-yielding, wilt-resistant varieties (PKV-TARA, BDN-716), balanced fertilization, seed treatment, inoculation with biofertilizers, and IPM-based pest management. In contrast, farmers' practices relied on local varieties, higher seed rates, imbalanced fertilizer use, and indiscriminate pesticide application (Table 4).

Full adoption gaps were observed in seed management, irrigation, weed control, and biofertilizer 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 pigeon pea cultivation.

Table 4: Recommended technological interventions versus farmers' practices in pigeon pea cultivation under CFLDs

Component	Technological intervention	Farmers' practices	Gap level
Variety	PKV-TARA, BDN-716 (high-yielding, wilt resistant)	Local varieties / own seed	Full
Seed rate	7.5-20 kg/ha (as per spacing)	25-30 kg/ha (30-40% higher)	Partial
Seed treatment (wilt & seed-borne pathogens)	<i>Trichoderma viride</i> @ 5 g/kg seed or Carbendazim/Thiram @ 2 g/kg	Rare adoption (20-25%)	Full
Seed treatment (termite)	Fipronil 5% SC @ 10 ml/kg seed	Not adopted	Full
Seed inoculation	<i>Rhizobium</i> + PSB culture @ 10 ml/kg seed	No inoculation	Full
Sowing method	Line sowing with recommended spacing	Broadcasting / mixed cropping	Partial
Spacing	90×20 cm (sole) / 45×30 cm (intercrop)	90×90 cm or broadcasting	Partial
Fertilizer dose	Balanced (25:50:00 NPK + 20 kg S/ha)	Imbalanced (mainly P, little/no N & K)	Partial
Weed management	Pendimethalin + Imazethapyr	Manual weeding only	Full
Irrigation	Supplemental irrigation at flowering/pod filling	Rainfed only	Full
Plant protection	IPM: pheromone traps, bird perches, NSKE 5%, Emamectin, Neem oil		

4. Conclusion

The present study demonstrated that Cluster Frontline Demonstrations (CFLDs) significantly enhanced the productivity and profitability of pigeonpea under rainfed conditions in Akola district. Improved varieties PKV-TARA and BDN-716, coupled with recommended production technologies, recorded an average yield advantage of 19% over farmers' practices, with higher gains consistently achieved by BDN-716. Economic analysis also confirmed the superiority of CFLDs, with substantially higher net returns (₹25,175 ha⁻¹) and B:C ratio (1.77) compared to local practices (₹18,658 ha⁻¹; B:C 1.41). Despite these gains, a considerable technology gap (437.4 kg ha⁻¹) and technology index (23.0%) indicate that further improvements are possible through timely input use, better pest and disease management, and climate-resilient practices. The analysis of adoption gaps revealed that farmers rarely followed seed treatment, seed inoculation, balanced fertilization, or IPM, while continuing with higher seed rates and reliance on indiscriminate pesticide use.

Overall, the study establishes that CFLDs are an effective extension tool for demonstrating the potential of improved technologies under farmers' field conditions. Wider dissemination and adoption of recommended practices, along with assured input supply and capacity building, can play a crucial role in bridging yield gaps and ensuring sustainable pigeonpea production in Maharashtra and similar rainfed agro-ecosystems.

Policy and Extension Implications

- **Strengthening seed systems:** Ensure timely availability of high-yielding, wilt- and drought-tolerant varieties like PKV-TARA and BDN-716 through seed hubs and farmer producer organizations.
- **Capacity building and awareness:** Organize regular training and field demonstrations to enhance farmers' knowledge of seed treatment, inoculation, balanced fertilization, and IPM practices.
- **Input support and accessibility:** Facilitate access to quality bio-fertilizers, plant protection inputs, and weed management solutions at affordable prices through cooperative outlets and KVK linkages.
- **Climate-resilient strategies:** Promote moisture conservation techniques, supplemental irrigation, and location-specific contingency plans to reduce risks from erratic rainfall.
- **Participatory extension approaches:** Involve farmers' groups, self-help groups, and rural youth in demonstrations and knowledge dissemination to accelerate adoption and scaling-up of improved technologies.

References

1. Bodakhe GM, Shelke RD, Kamble SH. An economic analysis of pigeon pea production in Maharashtra State, India. *International Journal of Environment and Climate Change*. 2023;13(12):696-703.

- <https://doi.org/10.9734/ijecc/2023/v13i123731>
2. Department of Agriculture and Farmers Welfare, Economics and Statistics Division. Agriculture Statistics at a Glance. Ministry of Agriculture & Farmers Welfare. Government of India; 2022. Available from: <http://desagri.gov.in>
 3. Garud HS, Gaikwad BB, Surpam TB, Patgaonkar DC, Jagtap KL. Impact of cluster frontline demonstrations on productivity and profitability of pigeonpea under NFSM in Beed district of Maharashtra, India. Legume Research. 2023;46(7):888-892. <https://doi.org/10.18805/LR-5116>
 4. Kumar R, Singh AK, Singh SS, Bhatt BP, Shivani. Impact of improved varieties and management practices on yield enhancement of *Cajanus cajan* in Eastern India. Indian Journal of Extension Education. 2021;57(1):85-90.
 5. Patil JV, Rathod JH, Kshirsagar PJ. Impact of frontline demonstrations on *Cajanus cajan* productivity and profitability in Maharashtra. International Journal of Agricultural Sciences. 2022;14(2):116-120.
 6. Matale RG, Wankhade DJ, Birajdar KV, Tambe DV, Hinge VR, Jadhav PK, et al. Molecular characterization of *Sclerotium rolfsii* causing collar rot disease in soybean using ISSR markers. International Journal of Advance Biochemistry Research. 2025;9(7):1721-1726. <https://doi.org/10.33545/26174693.2025.v9.i7v.5021>
 7. Samui SK, Mitra S, Roy DK, Mandal AK, Saha D. Evaluation of frontline demonstration on groundnut. Journal of the Indian Society of Coastal Agricultural Research. 2000;18(2):180-183.
 8. Singh B. Impact of cluster frontline demonstrations on productivity and profitability of *Cajanus cajan* in rainfed Eastern Uttar Pradesh. International Journal of Current Microbiology and Applied Sciences. 2020;9(6):2315-2321. <https://doi.org/10.20546/ijcmas.2020.906.289>
 9. Thakare UG, Ingle PO. Development and standardization of socio-economic status scale. Indian Journal of Extension Education. 2007;4:8-16.
 10. Verma A, Singh R, Yadav R. Yield gap analysis of *Cajanus cajan* through frontline demonstrations in Eastern Uttar Pradesh. Journal of Food Legumes. 2023;36(1):45-49.