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Evaluation of yield level in pigeonpea crop under cluster frontline demonstration on Pulses in Buldhana district of Maharashtra

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Abstract
The field study on Demonstrations was carried out by Krishi Vigyan Kendra, Buldhana II to evaluate of yield gap of Pigeon Pea through Cluster frontline demonstration. Demonstrations on improved technologies were conducted in 230 ha at 575 framers' fields of Buldhana district during Kharif season of 2019-20 to 2024-25. A total of 575 demonstrations were conducted on farmers' fields using improved varieties BDN-716 under recommended production practices. Results revealed that the yield of pigeon pea in CFLD under rain fed conditions of Improved Practices yield mean is 15.08q/ha and in Farmers practices is 11.78 q/ha. The Percent increase in yield with Improved Practices over Farmers practices was recorded in the mean of 28.05%. The technology gap and extension gap from 2019-20 to 2024-25 averaged 3.91 and 3.18 q ha^{-1}, respectively, with a mean technology index of 20.60%. Economic analysis revealed higher profitability in demonstration plots, with mean net returns of ₹ 63269 ha^{-1} and a benefit-cost ratio of 2.83, compared to ₹ 44616 ha^{-1} and 2.39 in local practices. Due to adoption of improved package of practices, demonstration plots recorded higher average seed yield over local check. The present study resulted to convincing the farming community for higher productivity and returns.

Keywords: Cluster frontline demonstration, pigeonpea and yield

Introduction
Pigeonpea (*Cajanus cajan* L.) is one of the major grain legume (pulse) crop of the tropics and subtropics, endowed with several unique characteristics. It finds an important place in the farming system adopted by small holder farmer in a large number of developing countries. Although, globally pigeon pea ranks sixth in area and production in comparison to other grain legumes such as beans, peas and chickpeas, it is used in more diversified ways than other.

Pulses play a vital role in Indian agriculture as they not only serve as an affordable source of dietary protein but also improve soil fertility through biological nitrogen fixation. Among them, Red gram (*Cajanus cajan* L.) holds a prominent position in the rainfed cropping systems of Maharashtra due to its drought tolerance and suitability to varied soil conditions. However, its productivity often remains low because of poor crop management practices, improper nutrient application, and inadequate pest control.

Pigeonpea is a vital source of protein (20-22%) and contributing to soil fertility through biological nitrogen fixation of about 45-40 kg N/ha. India contributes more than 90% of the global pigeonpea production, with an acre 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 state of Pigeonpea growing, 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, a Cluster Frontline Demonstration (CFLD) on Pulses was conducted during 2019-20 to 2024-25 in 23 villages of Buldhana district. The demonstration aimed to showcase the potential of the improved Redgram variety BDN-716 under Integrated Crop Management (ICM) practices. The objective was to enhance productivity and profitability through adoption of scientific methods such as line sowing, soil test-based nutrient management, timely irrigation, and effective pest control measures.

Materials and Methods

The present field study was conducted in Buldhana district of Maharashtra during six consecutive *Kharif* seasons (2019-20-2024-25) under the Cluster Frontline Demonstration (CFLD) programme on farmers' fields to evaluate the performance of improved varieties under real farming situations. The Pigeonpea variety BDN-716 used in demonstration developed by VNMKV, Parbhani (2016).

Farmers are planting the old cultures or traditional varieties Maruti and private variety of pigeonpea which are susceptible to major pests and diseases specially wilt and collar rot. Pigeonpea Seed was sown without treating bio fertilizer and seed treatment material and imbalanced fertilizer application. Soybean + Pigeonpea predominant intercropping system in this area, pigeonpea used as intercrop in soybean, so that all crop management practices was adopted by considering soybean crops and disregard intentionally at initial stage of crop growing period of pigeonpea crop. Lack of water management and in situ soil moisture conservation practices that responsible to reduce the productivity of Pigeonpea in this region. Therefore it is essential to demonstrate the new high yielding and wilt resistance variety of Pigeonpea BDN-716 under full package of practices in the district.

Demonstrations were laid out on rainfed fields with soils ranging from medium to heavy texture and medium fertility status. Farmers' practice plots, where local varieties and traditional management practices were followed, served as local checks for comparison. The data were collected through personal contacts with the help of well structured interview schedule. The gathered data were processed, tabulated, classified and analyzed in terms of mean Percent score and ranks in the light of objectives of the study. More than 10 Percent difference between beneficiary and non beneficiary farmers' was considered as significant difference. The extension gap, technology gap and technology index were calculated using the formula as suggested by Samui *et al.*, (2000) [4].

Extension gap (qha^{-1}) = Demonstration yield-Farmer's yield

Technology gap (qha^{-1}) = Potential yield-Demonstration yield

Technology index (%) = [Potential yield-Demo yield/Potential yield] x 100

Benefit-Cost ratio (B:C) = Gross return ÷ 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. Similar technology adopted by Taru *et al.* 2025 [7]

Results and Discussion

Yield performance of CFLDs on pegionpea variety BDN-716 consistently conquered farmers' traditional practices across all six years of study (Table 1). The average yield of CFLD plots was 15.08 q ha^{-1}, compared with 11.78 qha^{-1} in local checks, resulting in an average yield over the farmer practices and local variety of 3.81 qha^{-1} (28.05%). Similarly, yield enhancement in different crops in cluster front line demonstrations were documented by Kumar *et al.*, (2010). The decreasing trend in Percent increasing over control is indicating the suitability and adoptability of improved variety and technology by Garud *et al.* 2023.

Table 1: Yield performance of pigeonpea under CFLDs compared with farmers' practice during 2019-20 to 2024-25.

Year	No. of FLDs	Area covered (ha)	Yield (q/ha)		Additional yield over local check (q/ha)	Percent increase yield over Local Check FLD
			FLD	Local check		
2019-20	50	20	17.02	12.22	4.80	39.27 %
2020-21	50	20	14.66	12.03	2.63	21.86%
2021-22	50	20	13.86	11.13	2.73	24.52%
2022-23	50	20	14.44	10.78	3.66	33.95%
2023-24	125	50	15.30	12.34	2.96	23.98%
2024-25	250	100	15.23	12.21	3.02	24.73%
Total	575	230	90.51	70.71	19.08	
Mean			15.08	11.78	3.18	28.05%

Table 2: Yield gaps and technology index of pigeonpea under CFLDs compared with farmers' practice during 2019-20 to 2024-25.

Year	No. of FLDs	Technology gap (q/ha)	Extension Gap (q/ha)	Technology Index (%)
2019-20	50	1.98	4.80	10.42
2020-21	50	4.34	2.63	22.84
2021-22	50	5.14	2.73	27.05
2022-23	50	4.56	3.66	24.00
2023-24	125	3.70	2.96	19.47
2024-25	250	3.77	3.02	19.84
Total	575	23.49	19.08	123.62
Mean		3.91	3.18	20.60

Table 3: Economic performance of pigeonpea under CFLDs compared with farmers' practice during 2019-20 to 2024-25.

Year	Cost of Cultivation (Rs/ha)		Gross return (Rs/ha)		Net return (Rs/ha)		B:C ratio	
	FLD	Local check	FLD	Local check	FLD	Local check	FLD	Local check
2019-20	31950	30334	98350	72986	66400	42652	3.08	2.41
2020-21	32095	30123	87761	70677	55666	40554	2.73	2.35
2021-22	34390	31410	89318	70119	54928	38709	2.60	2.23
2022-23	32530	29785	95304	72148	62774	42363	2.93	2.42
2023-24	35530	32785	106335	85763	70805	52978	3.01	2.62
2024-25	41370	38080	110417	88522	69043	50442	2.67	2.32
Mean	34645	32086	97914	76703	63269	44616	2.83	2.39

The technology gap means the difference between potential yield and yield of demonstration plot. The differences between potential yield and yield of demonstration plots was 1.98 (2019-20), 4.34(2020-21), 5.14(2021-22), 4.56 (2022-23), 3.70 (2023-24) and 3.77 (2024-25) q/ha respectively (Table 2) The technology gap reflects farmer's cooperation in carrying out such demonstration with encouraging results from 2019-20-2024-25 and location specific recommendations are necessary to bridge this gap, These findings corroborate the reports of Sing *et al.* (2014) [5] and Sing *et al.* (2020) [6].

As average extension gap is 3.18 q/ha it was4.80(2019-20), 2.63(2020-21), 2.73(2021-22), 3.66 (2022-23), 2.96 (2023-24) and 3.02 (2024-25) q/ha respectively (Table 2) It show the positive trends as impact of adoption of technology by farmers with the need to educate the farmers through various extension means i.e. front line demonstration for adoption of improve production and protection technology to reverse this trend of wide extension gap Similarly, Dwivedi *et al.* (2018) [2] and Saikia *et al.* (2018) [3].

Technology Index it is shows the feasibility of the demonstrated technology at the farmer's field. Lower the value of technology index, higher is the feasibility of the improved technology average 20.60 percent from 2019-20 to 2024-25 (Table 2) which shows the effectiveness of technical interventions given to farmers by KVK.

Economic analysis showed that CFLDs were more profitable than local checks (Table 3). The average net return from demonstration plots was ₹ 63269 ha^{-1}, compared with ₹ 44616 ha^{-1} in local checks. The mean B:C ratio was 2.83 for CFLDs, higher than 2.39 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, Verma *et al.* (2023) [8]. Highlighted that adoption of high-yielding varieties coupled with IPM practices significantly enhances farmers' income.

Conclusion

These trends of increase in yield levels can be attributed to adoption of improved technology as well as improved varieties. The yield levels were considerably low under local practices because of variations in adoption of recommended package of practices depending upon the amount of risk involved in terms of cost, convenience, skill and knowledge about the concerned practice. The productivity was better over local practice under demonstrations. Hence, pulses production technology have a broad scope for increasing the area and production of pulses at each and every level i.e., Farmers, State and National level. However there were fluctuations noticed in both the crops regarding yield and net returns due to rainfall and price fluctuations.

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.

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