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The economic effects of the cluster front line demonstration (CFLD pulses) on pigeonpea in Madhya Pradesh's Balaghat District

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Abstract
The current study was carried out by Krishi Vigyan Kendra in the Balaghat district of Madhya Pradesh to compare the yields of the Rajeshwari variety of pigeonpea (*Cicer arietinum* L.) grown in a rainfed environment and the scientific package and practices used in the cluster front line demonstration (CFLD pulses). The National Food Security Mission (NFSM), run by the Indian government, conducted CFLD on pigeonpea during the Kharif season from 2016 to 2021 to demonstrate the effects of better agro-techniques on productivity and financial rewards. 275 farmers actively participated in CFLDs throughout a 10 to 20 ha region for five years, along with the technical team from Krishi Vigyan Kendra Balaghat. The observed data showed that experimental plots had grain yields.

Keywords: Pigeonpea, frontline demonstration, technological gap, procedures, output, agriculture, and production

Introduction
It is high in protein and meets a substantial portion of the country's vegetarian population's protein needs. Dal is the most common form in which it is consumed. Along with important amino acids including lycine, tyrocene, cyctine, and arginine, seeds are high in iron and iodine. For milch cattle, the seed's outer layer and some of the kernel make a rich meal. One of the crucial areas of Indian agriculture is pulse production. Pigeonpea (45.53%), urdbean (13.40%), mungbean (7.76%), lentil (5%), and field pea (5%) are the principal pulse crops. Madhya Pradesh (33%), Maharashtra (13%), Rajasthan (12%), and Uttar Pradesh (9%), which together account for about 91% of the total production, are the states that produce the most pulses.Due to inadequate adoption of new varieties and production techniques, unbalanced dietary patterns, rapid climatic fluctuations, and susceptibility to pests and illnesses, the pigeonpea has a limited supply. Pod borer outbreaks can result in damage to up to 30–40% of the pods (Rahman, 1990) [13]. One important kharif pulse crop in Madhya Pradesh's Balaghat district is pigeonpea. When compared to the national average, the district's pulse productivity is as low as 760 kg/ha, and this is largely because of subpar crop management techniques, a lack of quality seed of improved varieties of pigeonpea, and other input shortages. KVKs are community-based organizations designed to propagate technology through evaluation, improvement, and demonstration of proven production techniques in a variety of microfarming environments. The fundamental objective of Krishi Vigyan Kendra is to close the technological generational gap in research and dissemination to the farmer community in order to enhance production, income, and social position. The National Food Security Mission's main objective for CFLD was to promote recently discovered, superior cultivars for varietal diversification and efficient resource management. In order to improve food security throughout the nation, the current study examined the impact of cluster frontline demonstration on pigeonpea (*Cajanus cajan* L.) yield growth in the tribal district of Balaghat, Madhya Pradesh. Up to 30–40% of the pods may be damaged during pod borer epidemics (Rahman, 1990) [13]. The pigeonpea is a crucial kharif pulse crop in Madhya Pradesh.

Materials and Methods
Krishi Vigyan Kendra Balaghat of JNKVV Jabalpur conducted Cluster Frontline Demonstrations (CFLDs) on better agriculture technology during Kharif 2016–2021 under rainfed circumstances on 10–22 hectares in the Balaghat district, covering 25–55 farmers.

Improved seed varieties (Rajeshwari) and other scientific techniques were used during the investigation period. Krishi Vigyan Kendra Balaghat of JNKVV Jabalpur conducted Cluster Frontline Demonstrations (CFLDs) on better agriculture technology during Kharif 2016–2021 under rainfed circumstances on 10–22 hectares in the Balaghat district, covering 25–55 farmers. The experiment era saw the use of improved seed varieties (Rajeshwari), line sowing with a nari plough and seed drill, seed treatment with biocontrol agents, weed control, and integrated insect pest and integrated disease management strategies.

$$\text{\% Yield increase over farmer's} = \frac{\text{Demonstration average plot yield} - \text{Famer's average plot yield}}{\text{Farmer's average plot yield}}$$

Estimation of technology gap, extension gap and technology index

The extension gap is the difference between demonstration operations that used superior transfer technology and conventional agricultural practices that produced higher grain yields. The same observations were also found in the black gram crop, according to Bairwa *et al*. (2013) [2], Hiremath and Nagarju (2010) [5], and JamwalAnamika *et al*. (2020) [14]. The technology gap, extension gap, and technology index were calculated using the methods described in Kadian*et al*. (1997) [6]. Extension yield gap = Demonstration plot average yield- Farmer's plot average yield.

$$\text{Technology index} = \frac{\text{Technology yield gap}}{\text{Potential Y}} \times 100$$

Table 1: Utilizing technology in CFLD and farmer practices

S/No.	Demonstrated intervention	Intervention	Farmers involvement
1	fieldwork	ploughing	Local single-plough
2	Technique for Planting Seed Variety	Line sowing by seed drill &Nari	Broadcasting
3	treatment of seeds	Rajeshwari	Local
4	rate of sown	Thirum @ 2.5 gm/kg of seed, Rhizobium, PSB &Trichoderma @ 5 gm/kg of seed	Nil
5	Fertilizers and manures	20 kg/ha	35-40 kg/ha
6	weed control	PSB 500ml, Rhizobium 500 gm with 100 kg vermicompost and sulphor 20:40:20:10	Nil
7	IPM metrics	Pendimethaline @ 2,5lit/ha	There was no preemergence.

The Findings and Discussion

Crop Yield

According to the study's conclusions, CFLD's transmission of developed technology to the pigeonpea crop resulted in higher grain yields than farmer methods (Table 2). Adding a more diverse selection of seeds, treating the seeds, and using integrated pest managementtechniques may have contributed to the demonstration plot's higher yield. Between 2016 and 2021, the demonstration plots' and farmers' plots' average grain yields were 7.3 q/ha and 7.9 q/ha, respectively. The presented plot outperformed the control by an enhanced yield percentage of 36.6 to 96%. However, compared to the anticipated yield of 20 q/ha of the pigeonpea variety Rajeshwari, the seed production of 10.93, 14.27 to q/ha in Cluster Demonstrations was low.

Table 2: Year wise productivity, extension gap, and technology gap and technology indexof Pigeonpea under CFLD's and farmer's practices.

Years	Yield q/ ha		Increase yield (%) over Control	Extension gap (q/ha)	Technology gap (q/ha)	Technology Index (%)
	Demo	Farmer's Practice				
2016	14.27	7.3	96	7.4	3.73	21
2017	13.3	7.5	77	5.8	6.7	33.5
2018	10.93	7.5	45.7	3.43	7.07	39.27
2019	11.26	7.5	50	3.76	6.74	33.7
2020	11.62	7.8	49	3.82	8.38	41.9
2021	10.52	7.7	36.6	2.82	9.48	47.4
2022	11.46	7.9	45	3.56	8.44	42.2

Increased Yield Gap

There was a 2.82 q/ha extension gap on average between farmers' practices and those that had been demonstrated (Table 2). There is a need to promote and inform farmers to accept developed technologies in Pigeonpea over present local agricultural methods due to the increased extension gap in the current study. Bairwa *et al*. 2013 [2] also reported comparable outcomes. JamwalAnamika *et al*. 2020 [14].

The Technology Yield Gap and the Technology Index

According to Table 2, over the study period, the technology gap's value ranged from 3.73 to 9.48 till per hectare. The decimal range in soil status, lack of irrigation infrastructure, disease, poor weather, pest infestations, and change may all be to blame for the technology gap that has been observed. Even though there are usually technology limitations, CFLDs were carried out on the farmers' fields under the watchful supervision of farm scientists. The produced Technology could be applied in farmer's fields in the current agroclimatic conditions, per the Technology Index (Vedna *et al*. 2007) [11]. The data in Table 2 revealed a value of technology index of 38.19%.

Table 3: Pigeonpea cultivation costs, gross returns, and the B:C ratio were examined in conjunction with farmer techniques.

Year	Cost of Cultivation (Rs/ha)		Gross Return (Rs/ha)		Net Return (Rs/ha)		B:C Ratio	
	Demo	Farmer's Practice	Demo	Farmer's Practice	Demo	Farmer's Practice	Demo	Farmer's Practice
2016	18500	16000	50435	29280	31935	22320	2:5:1	1:8:1
2017	18500	18000	54226	30000	35726	23600	2:8:1	1:6:1
2018	20500	18500	61234	42000	40734	22900	2:9:1	2:2:1
2019	21000	19000	61930	41250	40930	22250	2:9:1	2:7:1
2020	21500	20000	63888	42900	42388	23500	2:9:1	2:1:1
2021	22000	21000	60993	44660	38993	12000	2:9:1	2:1:1
2022	25000	23500	64445	45820	41445	13280	2:7:1	1:9:1

Cluster Front Line Demonstrations Economic Analysis

In the present study average cost of cultivation of Farmer's practice (Rs 29280 to 458/20 /ha) was lesser as compare to demonstration plot (Rs 50435 to 6444/ha) and the finding shown in table 3 which clarified the implication of Cluster Frontline Demonstration at Farmer's field during the period of investigation in which higher average net return rupees 31935 to 42388 were found under Demonstration plots as compared to farmer's practice (Rs 13280 to 22900 /ha). The benefit-cost ratio was larger in demonstration plots (varying from 2.5:1 to 2:9:1) than in farmer's practice (1:6:1 to 2:7:1). Improvements in agricultural technology have been noted by several scientists to boost financial gains and the Benefit Cost (B:C) ratio.

Conclusion

Increasing the yield and financial return of pigeonpea in the Balaghat district has a favorable effect on the integration of scientific farming knowledge and methods with active engagement from local farmers. Farmers were compelled to adopt the technologies exhibited in their fields by the economic viability of using them to increase pigeonpea output.

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