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Impact of Technological Interventions on Pigeon Pea for Enhancing Income through Cluster Front Line Demonstrations

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aims: The area and production of pigeon pea in Bhadohi are still significantly lower than in other districts of other states. There is a significant yield gap between the potential output and the yield under current farming conditions. To study the impact of technological interventions on the pigeon pea crop for increasing income through Cluster Front Line Demonstrations was the goal of the current study.

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Place and Duration of Study: Cluster front line demonstrations on improved pigeon pea technologies were carried out by ICAR-IIVR-Krishi Vigyan Kendra, Bhadohi, at farmers' fields from 2015–16 to 2019–20.

Methodology: A total of 155 pigeon pea cluster front line demonstrations on improved pigeon pea technologies covering a 45.70 hectare area were held in one hundred eighteen localities. Field days, training and group meetings were also organized to provide opportunities for other farmers to witness the benefits of demonstrated technologies. The output data were collected from CFLD plots as well as control plots (farmers practice) by random crop cutting method and analyzed using simple statistical tools such as per cent change in yield, cost of cultivation, net income, and benefit cost ratio etc.

Results: In the experimental plots, the mean yield over five years was 15.44 q/ha, while it was only 11.21 q/ha in the control plots. Over the course of the five years of the study, the yield development varied, though on average, it was measured at 42.49 percent. When compared to the farmer's practice (28,463/ha), the average net return for the demonstration plots at the farmer's field over the investigation period was greater at 56,611/ha. Additionally, the demonstration plots' benefit-cost ratio was larger (2.32) than the farmer's practice's (1.69).

Conclusion: From the aforementioned findings, it can be concluded that using modern technologies for pigeon pea cultivation may significantly close the extension and technology gap, increasing pigeon pea yield in the area. It requires collaborative extension efforts to enhance the adoption of location and crop specific technologies among the farmers to bridge these gaps.

Keywords: Impact; pigeon pea; cluster front line demonstration; technology gap.

1. INTRODUCTION

The primary source of dietary protein, pulses are a staple of many farms' daily diets and serve a significant role in terms of food and nutritional security. Pulses are recognized for lowering various non-communicable diseases like colon cancer and cardiovascular disorders and offer considerable nutritional and health benefits. In addition to providing nutrients, grain legumes also help to fix atmospheric nitrogen and increase the amount of organic matter in the soil. To make soil-bound phosphorus available for plant growth, its roots aid in releasing it. Pigeon peas are a perfect crop for sustainable agricultural systems in rain-dependent regions since they offer so many advantages at a low cost. The pigeon pea (*Cajanus cajan* L.) are also called red gram, tur, or arhar, classified as a legume by the FAO (1982) is an ancient and second-most significant pulse crop in the nation, after the gram, the crop in this nation. Pigeon peas include 20–22% protein, 1.2% fat, 65% carbohydrates, and 3.8% ash. Its capacity to add high-quality protein to meals, especially for the vegetarian population, has it in great demand in India. Due to poor crop yield and a lack of understanding of appropriate protection and post-harvest methods, the area, production, and productivity of pulses in Uttar Pradesh, as well as district Bhadohi are relatively low in comparison to other states. Pigeon pea is an important kharif pulse crop planted in India and ranks first globally for both area (80%) and production (67%). It is grown on more than 5.05 million hectares and produces 4.34 million tons annually, with a productivity of 8.59 q/ha. Pigeon peas are grown on 0.29 million hectares in Uttar Pradesh, where they yield 11.96 q/ha and produce 0.35 million tons [1]. Farmers in the Bhadohi district typically grow pigeon pea under rainfed conditions during the Kharif season, but they have recently become aware of the low yield of pigeon pea due to the use of traditional varieties, use of their own seeds, the occurrence of moisture stress, poor management practices, particularly the lack of fertilizers and the use of pesticides to control pod borer and fusarium wilt disease. The pigeon pea's productivity is constrained by inadequate adoption of improved varieties and production techniques, unbalanced dietary patterns, sudden environmental fluctuations, and susceptibility to pests and diseases. Up to 30 to 40 percent of pods might be damaged by pod borer infestations.

Pigeon peas were grown on just 3875 hectares in the Bhadohi district in 2020–21, yielding 4677metric tons with a productivity of 11.63 q/ha. Due to the farmers' resistance to good scientific management of the crop, the area and production of pigeon pea in Bhadohi are still significantly lower than in other districts of other states. However, the government has prioritized the pigeon pea crop because there is a significant yield gap between the potential output and the yield under current farming conditions. KVK Bhadohi made significant efforts in the areas of technical interventions, scientific cultivation training, and varietal demonstrations. The impact of technological interventions on the pigeon pea crop for increasing income through Cluster Front Line Demonstrations was the goal of the current study.

2. MATERIALS AND METHODS

Cluster front line demonstrations of improved pigeon pea variety (N A-2) with proven technologies were carried out by Krishi Vigyan Kendra, Bhadohi, in farmer's fields from 2015–16 to 2019–20. Over the course of five years, 155 pigeon pea demonstrations were held in 118 villages spread throughout six blocks of the Bhadohi District, covering a total area of 45.70 hectares. Farmers were recognized, as Choudhary [2] had urged. The necessary inputs were provided, and KVK specialists regularly visited the demonstration fields to verify that the farmers were given the right direction. The text box below illustrates the suggested set of farmer-specific practices and CFLDs. The seeds were sown under rainfed between the second fortnight of June to the second fortnight of July, and they were harvested during the first fortnight of April. However, the common practices adopted by farmers include the use of a regional cultivar (Bahar), a seed rate of 15-20 kg/ha, no seed treatment, broadcast sowing from the last week of June to the last week of July, only the use of DAP as a fertilizer, and no use of recommended weed, water, or plant protection measures. Field days, training and group meetings were also organized to provide opportunities for other farmers to witness the benefits of demonstrated technologies. The output data were collected from both CFLD plots as well as control plots (farmers practice) by random crop cutting method and analyzed using simple statistical tools as per cent change in yield, cost of cultivation, net income, and benefit cost ratio etc. were worked out [3]. The technology gap extension gap and technological index were calculated using the following formula as given in Yadav et al. [4].

Extension gap = Demonstrated plot yield (DP)- Farmer's practice (FP) yield
Technology gap = Potential yield - Demonstration yield
Net return = Demonstration return – Farmer's practice return
Per cent increase yield = (DP - FP / FP) x 100
Technology index = Potential yield of variety - Demonstration yield X 100 /Potential yield

Chart 1. Technological interventions against farmers practices of Pigeon pea cultivation under CFLD

Package of practices	Pigeon pea	
	Technological Interventions	**Farmer's practices**
Variety	Narendra Arhar -2	Local cultivar (Bahar)
Seed rate	12 kg/ha	15-20 kg/ha
Seed treatment	*Trichoderma* @ 8-10 gm/kg + *Rhizobium* culture @ 200 gm/10 kg	Not aapplied
Time of sowing	Second fortnight of June to first fortnight of July	Last week of June to last week of July
Method of sowing	60 cm (row to row), 25 cm (plant to plant) and east west direction of sowing	Broadcasting, no direction of sowing methods
Fertilizer management	20: 50: 20 (N:P:S) kg/ha	Either no use of fertilizers or use only DAP (40-50 kg/ha)
Weed management	Pre-emergence application of Pendimethalin 30 EC 3.3 l/ha followed by manual weeding at 30 days after sowing	No use of herbicide and proper weeding was not done
Water management	Light irrigation at flowering (at the time of no rainfall)	No Irrigation
Plant protection	Need based application of Indoxacarb @ 0.75 ml / liter of water for the management of Pod borer	No use or untiely and injudicios use of pesticides

3. RESULTS AND DISCUSSION

3.1 Yield Performance

The yield performance of pigeon peas is shown in Table 1. It is clear that NA-2 pigeon peas yield performance using proven technology, is 11.40, 19.20, 20.20, and 07.20 q/ha, however, the average yield under farmer approaches was 6.21, 14.75, 15.30, and 14.40 q/ha in the same years, representing an increase of 83.57, 30.16, 32.06, 33.33, 32.06, 33.33, 32 percent over lacal variety Bahar in 2015-16, 2016-17, 2017-18, 2018-19, and 2019-20, respectively. In the demonstration plots, the five-year mean yield was 15.44 q/ha, while it was only 11.21 q/ha in the control plots. Over the course of the five years of the study, the yield growth varied, although on average, it was measured at 42.49 percent (Fig. 1).

3.2 Technology Gap

The yield discrepancy between the demonstration plot's yield and prospective yield is known as the technological gap. Technology gaps have been trending between 4.8 and 17.8 q/ha from 2015–16 to 2019–20 (Table 2). The farmer's collaboration in putting out demonstrations with good results in succeeding years is reflected in the average technology gap, which was 9.56 q/ha. Both Saikia et al. [5] and Katare et al. [6] reported similar results in their studies with oilseed and black gram. The differences in soil fertility levels, rainfall patterns, pest and weed infestation rates, changes in the placement of cluster frontline demonstration sites, local climatic conditions, etc. may be the reason for the technological gap throughout the years of study. The outcome, however, shows that farmers' practices do not always work as well in a variety of environmental conditions.

3.3 Extension Gap

It illustrates the distinction between farmer practices yield and yield used in demonstrations. During 2015–16 and 2019-20, a range of 1.8–5.19 q/ha between farmers' practices and those that have been proven was noted (Table 2). It indicates the positive trends as a result of farmers adopting technology and the necessity of educating farmers using a variety of extension methods, such as front-line demonstrations for the adoption of improved production and protection technologies, in order to counter the trend of a large extension gap. Singh et al. [7] discovered similar results with chickpeas.

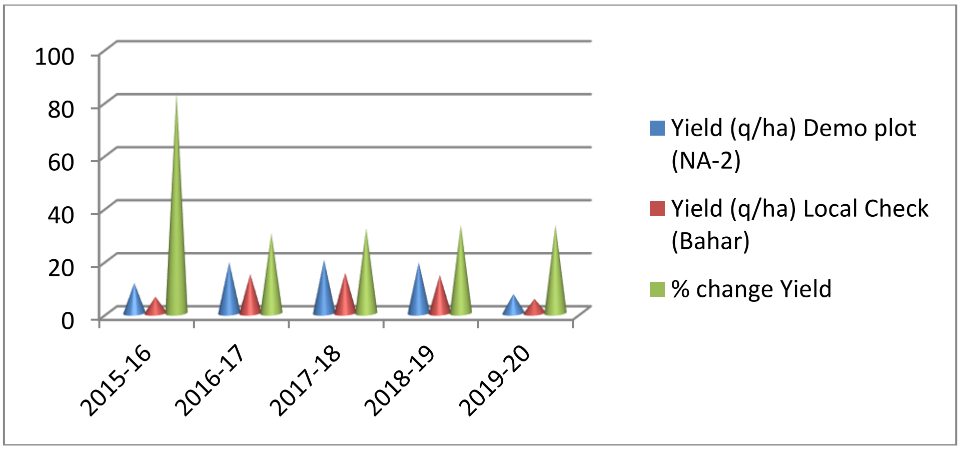

Fig. 1. yield performance of pigeon Pea under CFLD during five years

Table 1. Technical Impact on pigeon pea crop under CFLD

Year	No. of Farmers	Area	Yield of the crop (q/ha)		Per cent change in yield
			Demo	Local	
2015-16	41	05.0	11.40	06.21	83.57
2016-17	29	10.1	19.20	14.75	30.16
2017-18	34	10.0	20.20	15.30	32.06
2018-19	21	10.0	19.20	14.40	33.33
2019-20	30	10.6	07.20	05.40	33.33
Total/Average	**155**	**45.7**	**15.44**	**11.21**	**42.49**

3.4 Technology Index

It demonstrates the viability of the technique that was tested in the farmer's field associated with lower technology index values. The technology index fluctuated significantly during the course of the study's years (19.2 to 71.2%), which can be linked to differences in weather patterns, soil fertility levels, and biotic and abiotic stresses on the crop. During the years of investigation, it noticed an average technology index of 38.34%, demonstrating the usefulness of technology. Similar findings are reported by Dwivedi et al., [8] and Srivastava et al. [9] for several crops.

3.5 Economic Impact

Table 3 provides the economic analysis of the demonstration as well as Farmer's practices. Gross costs for pigeon pea growing in the demonstration were, respectively, 42560, 42870, 42920, 43730, and 44100 per hectare in 2015–16, 2016–17, 2017–18, 2018–19, and 2019–20. However, the total costs that were kept under control over successive years were 41200, 41400, 41800, 42520, and 43200 per hectare. The data also shows that under demonstration plot conditions, net returns were 64600, 69930, 73634, 72910, and 1980 per ha in 2015–16, 2016–17, 2017–18, 2018–19, and 2019–20, respectively. However, under farmer's practices, net returns were 17260, 42256, 46481, 44960, and 8640 per ha in the corresponding years. The superiority of recommended package of practices under frontline demonstration over farmers' practice was also reported by Mitra and Samajdar [10], Balai et al. [11] and Dhaka et al., [12]. The finding shown in Table 2 which clarified the implication of Cluster Front line When compared to the farmer's practice (Rs. 28,463/ha), the average net return for the demonstration plots at the farmer's field over the investigation period was greater at 56,611/ha. Additionally, the demonstration plots' benefit-cost ratio was larger (2.32) than the farmer's practice's (1.69). Increased monetary returns as well as Benefit cost (B:C) ratio through upgraded farm technology have also been reported by various scientists [13,14, and 9].

Table 2. Technology gap, Extension gap and Technology index of Pigeon pea during investigation year

Years	Potential Yield (q/ha)	Technology gap	Extension gap	Technology index (%)
2015-16	25	13.60	5.19	54.4
2016-17	25	05.80	4.45	23.2
2017-18	25	04.80	4.9	19.2
2018-19	25	5.80	4.8	23.2
2019-20	25	17.80	1.8	71.2
Average	**25**	**9.56**	**4.228**	**38.24**

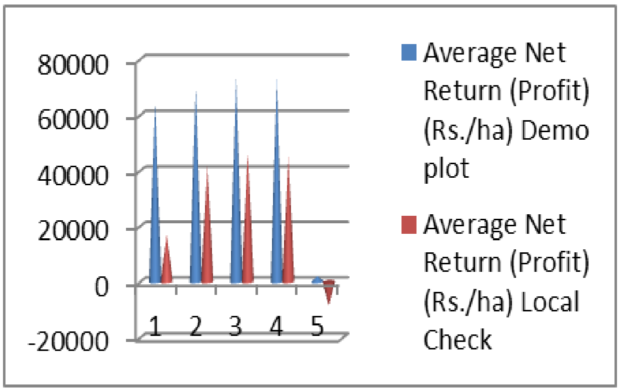

Fig. 2. Economical performance of pigeon under CFLD during five years

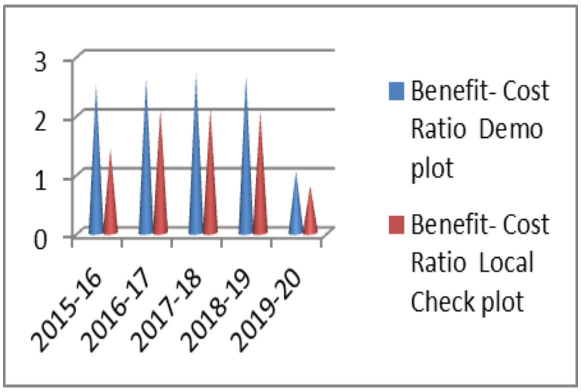

Fig. 3. Economical performance of pigeon pea under CFLD during five years

Table 3. Economic Analysis of Pigeon pea crop under CFLD

Year	Average Cost of Cultivation (Rs./ha)		Average Gross Return (Rs./ha)		Average Net Return (Profit) (Rs./ha)		Benefit- Cost Ratio	
	Demo plot	Local Check (Bahar)	Demo plot	Local Check plot	Demo plot	Local Check plot	Demo plot	Local Check plot
2015-16	42560	41200	107160	58460	64600	17260	2.52	1.42
2016-17	42870	41400	112800	86,656	69930	42256	2.63	2.09
2017-18	42920	41800	116554	88,281	73634	46481	2.71	2.11
2018-19	43730	42520	116640	87,480	72910	44960	2.67	2.06
2019-20	44100	43200	46080	34560	1980	-8640	1.05	0.80
Average	**43,236**	**42,024**	**99,847**	**71,087**	**56,611**	**28,463**	**2.32**	**1.69**

4. CONCUSION

From the aforementioned findings, it can be concluded that after interventions through the Cluster front line demonstration (CFLD), the KVK scientist may change the district farmers' knowledge, attitude, and skills in order to increase crop production and productivity. Pigeon pea farmers have also adopted a better set of growing techniques, resulting in a higher net return per unit area. According to the data above, using modern technologies for pigeon pea cultivation may significantly close the extension and technology gap, increasing pigeon pea yield in the area. It requires collaborative extension efforts to enhance the adoption of location and crop specific technologies among the farmers to bridge these gaps.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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