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Research Paper

Impact of cluster frontline demonstrations on pulse productivity and technology adoption in Raebareli district of Uttar Pradesh

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ABSTRACT

The Cluster Frontline Demonstrations (CFLDs) on pulse crops were randomly carried out in 45 villages of 7 blocks in Raebareli district of Uttar Pradesh. A total of 647 demonstrations on pigeonpea, urd, chickpea, fieldpea and lentil crops were carried out in an area of 135.0 ha with the active participation of farmers. The results of CFLD indicated cultivation of high yielding varieties of pulses i.e. pigeonpea variety 'NA- 2' (14%), 'IPA-203' (16%), urd variety 'VU-1' (11%), fieldpea variety 'KPMR-400' (16%), chickpea variety 'RVG-202' (15%) and lentil varieties 'KLS-122' (13%) and 'KLS09-3' (15%) resulted in more yield as compared to local check. The productivity gains achieved under the Front Line Demonstration (FLD) program, compared to traditional farming practices, have created awareness and motivated other farmers to adopt scientific crop production and management techniques. The use of improved varieties and best practices resulted in higher yields compared to conventional methods. The improved technologies gave higher gross return, net return, with a higher benefit-cost ratio compared to farmers' practices.

***Key words*: CFLD, Demonstration yield, Extension gap, Economic returns, Pulses, Technology gap, Technology index**

INTRODUCTION

Pulses are a rich source of protein and constitute a basic ingredient in the diet of the vast majority of poor and vegetarian populations in India. The per capita net availability of pulses in the country was 70.3 g/day/capita in 1956, which has reduced to 37.5 g/day/capita in the year 1981 and further dropped to 29.1 g/day/capita in the year 2003. However, with the increase in production of pulses particularly in the recent decade mainly owing to yield increase supported with the policy and programmes to boost domestic production and increased imports, availability of pulses in the country has started improving and presently reached 47.2 g/day/capita (GoI 2016). Demand of pulses upto 39 mt by 2050 has been projected by ICAR-Indian Institute of Pulses Research, Kanpur in the country which will require pulses production to grow at an annual rate of 2.2% (IIPR 2015). To supplement the above growing requirement, the country has to produce enough pulses with the protection of domestic production. For achieving this goal, we require efficient crop production technologies supplemented with favorable government policies, with better market facilities to encourage farmers to adopt more area under pulses. Total Pulses production during 2022-23 was estimated at 26 mt, which is higher by 1.4 mt than the five-year average production of 24.6 mt (DD News 2023). India is the largest producer and consumer of pulses in the world, accounting for about 29 per cent of the world's area and 19 per cent of the world's production. Even more importantly, India is also the largest importer and processor of pulses in the world. The average productivity of the country is about 841 kg/ha against the average global productivity of 1023 kg/ha (DES 2018). The average productivity of pulses in Uttar Pradesh was 1033 kg/ha in 2019-20 (Agricultural Statistics at a Glance 2021). The area, production and productivity of pulses of Uttar Pradesh and in district Raebareli are also quite low as compared to other states, national average and production. The cause of low productivity of pulses is due to the use of old varieties, higher seed rate, broadcasting method of sowing and biotic/abiotic stresses in the district. Thus, there is a need to create awareness among the farming community to popularize the location-specific improved varieties to increase the production and productivity of pulse crops in the district. In this line, the cluster frontline demonstration program (CFLDs) in pulses is one of the important programs started by the Ministry of Agriculture, Govt. of India, to conduct field demonstrations under the close supervision of scientists. The main objective of CFLDs in pulses is to demonstrate improved technologies on farmers' fields under varied farming situations for effective transfer of improved technology and narrow down the gap between improved technology adopted and farmers' practice, resulting increase in pulse productivity and sustaining the production systems. Keeping in view the above facts, an intensive intervention such as cluster front-line demonstrations was conducted to transfer the improved technologies through FLDs in pulses in Raebareli district of Uttar Pradesh with the objectives of enhancing productivity, profitability and reducing extension yield gaps.

MATERIALS AND METHODS

A purposive study under the Cluster Frontline Demonstrations (CFLDs) on improved production technologies for pulse crops was conducted by Krishi Vigyan Kendra, Dariyapur, Raebareli-I, during the Rabi seasons of 2022–23 and 2023–24. The demonstrations were carried out in randomly selected 45 villages across all 7 blocks of Raebareli district, namely: Rahi, Deenshah Gaura, Salon, Amawan, Jagatpur and Uchahar. The district is situated in the Central Plain Zone of Uttar Pradesh and is characterized by silt to loam soils. The CFLD plot soils were found to be low in available nitrogen, medium in phosphorus and high in potassium content. The organic carbon content ranged between 0.2–0.3 percent. The CFLDs covered five major pulse crops: pigeonpea, urd (black gram), fieldpea, chickpea and lentil. A total of 135 hectares of area was brought under demonstration, involving 647 farmers (Table 1). The demonstrations were laid out in farmers' fields following two treatments:

- Demonstration Plot (Improved Practice): Cultivation was done using the recommended package of practices (RPP) as per guidelines provided by research institutions and ICAR.
- Control Plot (Farmer's Practice): Cultivation was carried out using traditional/local practices generally adopted by the respective farmers.

Primary data on grain yield and farmer practices were collected using the crop cutting method, followed by personal interviews with participating farmers. This helped to assess the performance of improved technologies over traditional farming practices. The yield increase in demonstrations over farmers' practice was calculated by using the following formula:

% Yield increase over farmers' practice = (Demo avgerage plot yield—farmers' average plot yield) /Farmers' average plot yield × 100

Estimation of the technology gap, extension gap technology index

The estimation of the technology gap, extension gap technology index was done using the following formula (Kadian *et al*. 1997, Samui *et al*. 2000) :

Technology gap = Potential yield-Demonstration plot average yield

Extension gap = Demonstration plot average yield - Farmer's plot average yield

Technology Index = (Pi–Di)/Pi x 100

Where, Pi = Potential yield of ith crop Di =Average demonstration plot yield of ith crop.

Economic analysis of front line demonstration's (CFLDs) on pulses was done using existing price of inputs while gross return was calculated as per sale price of the produce.

RESULTS AND DISCUSSION

Effect of technologies used

The average yield of pulses [pigeonpea ('NA-2', 15.4 q/ha and 'IPA-203', 16.8 q/ha), urdbean (6.1 q/ha), chickpea (17.0 q/ha), fieldpea (17.7 q / ha), lentil (14.8 q/ha) and mungbean (7.5 q/ha)] were much higher as compared to average yield of farmers practices [Pigeonpea (11.8 q/ha), chickpea (14.9 q/ha), fieldpea (15.6 q /ha), lentil ('KLS-122' variety 13.0 q/ha and 'KLS09-3' variety 14.4 q/ha)]. The average percentage increase in the yield over farmers' practices was 14% in the 'NA-2' variety and 16% in the 'IPA-203' variety of pigeonpea, 11% in urd, 15% in chickpea, 16% in fieldpea, 13% in the 'KLS-122' variety and 15% in 'KLS 09-3' variety of lentil. The results indicated that the cluster front-line demonstrations have had a good impact on the farming community of Raebareli district, as they were motivated by the new agricultural technologies applied in the CFLD plots (Table 2). This finding is in accordance with the findings of Singh *et al* (2020).

Technological gap

The highest technological gap was recorded in pigeonpea variety 'IPA-203' (8.2 q/ha), followed

Table 1. Variation between improved technologies under CFLD and existing farmers' practice

Crop	Particular	Improved technologies under CFLD	Farmers Practice
Pigeonpea	Variety	'NA-2', 'IPA 203' (Wilt and sterility mosaic resistant)	'Bahar'
	Seed rate	15 kg/ha	12 kg/ha
	Seed treatment	seed treatment with carbendazim @ 2g/kg seed + *Rhizobium* culture + PSB @ 200g/10 kg seed	No seed treatment
	Sowing method	Raised bed	Sowing Broadcasting
	Fertilizer	100 kg DAP/ha + 20 kg Sulphur/ha	100 kg DAP/ha
	Weed management	Pendimethalin 30% EC @ 3.3 lit./ha as pre-emergence + Imazethapyr 10% SL @ 1000 ml/ha	Manual Weeding at 35 to 45 days after sowing
	Plant protection	Indoxacarb 15.8% E.C. @ 500 ml/ha at 50% flowering and pod filling stage	Imidachloprid @ 250 ml/ha after incidence of insect
	Technical guidance	Time to time	Attend Kisan gosthi
Urdbean	Variety	'Vallabh Urd-1' (YMV resistant)	'T-9'
	Seed rate	15 kg/ha	15 kg/ha
	Seed treatment	Seed treatment with carbendazim @ 2g/kg seed + *Rhizobium* culture + PSB @ 200g/10 kg seed	No seed treatment
	Sowing method	Line Sowing	Sowing Broadcasting
	Fertilizer	100 kg DAP/ha + 20 kg Sulphur/ha	100 kg DAP/ha
	Weed management	Pendimethalin 30% EC @ 3.3 lit./ha as pre-emergence + Imazethapyr 10% SL @ 1000 ml/ha	Manual Weeding at 35 to 45 days after sowing
	Plant protection	Imidachloprid @ 250 ml/ha after incidence of insect	Quinolphos 25 % EC@ 1.5 l/ha
	Technical guidance	Time to time	Attend Kisan gosthi
Chickpea	Variety	'RVG 202'	'Avarodhi'
	Seed rate	40 kg/ha	40 kg/ha
	Seed treatment	Seed treatment with carbendazim @ 2 g/kg seed + *Rhizobium* culture + PSB @ 200g/10 kg seed	No seed treatment
	Sowing method	Line sowing	Broadcasting
	Fertilizer	100 kg DAP/ha + 20 kg Sulphur/ha	100 kg DAP/ha
	Weed management	Pendimethalin 30% EC @ 3.3 lit./ha as pre-emergence + Hand weeding at 45 days	Manual Weeding at 35 to 45 days after sowing
	Plant protection	Indoxacarb 15.8% E.C. @ 500 ml/ha at 50% flowering and pod filling stage	Imidachloprid @ 250 ml/ha after incidence of insect
	Technical guidance	Time to time	Attend Kisan gosthi
Fieldpea	Variety	'KPMR-400'	'Rachna'
	Seed rate	100 kg/ha	100 kg/ha
	Seed treatment	Seed treatment with carbendazim @ 2g/kg seed + *Rhizobium* culture + PSB @ 200g/10 kg seed	No seed treatment
	Sowing method	Line sowing	Broadcasting
	Fertilizer	100 kg DAP/ha DAP+ 20 kg Sulphur/ha	100 kg DAP/ha DAP
	Weed management	Pendimethalin 30% EC @ 3.3 lit./ha as pre-emergence + Hand weeding at 45 days	Manual Weeding at 35 to 45 days after sowing
	Plant protection	Indoxacarb 15.8% E.C. @ 500 ml/ha pod filling stage	Imidachloprid @ 250 ml/ha after incidence of insect
	Technical guidance	Time to time	Attend Kisan gosthi
Lentil	Variety	'KLS 122', 'KLS 09-3'	'K-78'
	Seed rate	45 kg/ha	50 kg/ha
	Seed treatment	Seed treatment with carbendazim @ 2g/kg seed + *Rhizobium* culture + PSB @ 200g/10 kg seed	No seed treatment
	Sowing method	Line sowing	Broadcasting
	Fertilizer	100 kg DAP/ha DAP+ 20 kg Sulphur/ha	100 kg DAP/ha DAP
	Weed management	Pendimethalin 30% EC @ 3.3 lit./ha as pre-emergence + Hand weeding at 45 days	Manual Weeding at 35 to 45 days after sowing
	Plant protection	Ememectin benzoate 5% SG @ 300g /ha pod filling stage	No use
	Technical guidance	Time to time	Attended Kisan gosthi

by lentil variety 'KLS 09-3' (5.6 q/ha) and field pea (3.3 q/ha), while the lowest was in urd (3.9 q/ha) during 2022-23 and 2023-24 (Table 2). This might be attributed mainly to a lack of irrigation infrastructure, ill distribution of rainfall, variation in soil fertility, cultivation on marginal soils and non-congenial weather conditions, local specific crop management problems faced to harness the yield potential of specific crop varieties under demonstration plots. These observations indicate that location-specific crop management is needed at the hour to bridge the gap in potential demonstration yields (Kumari *et al* 2007).

Extension yield gap

Maximum extension yield gap of 2.3 q/ha was observed in pigeonpea variety 'IPA-203', followed by fieldpea l (2.1 q/ha), while the lowest extension yield gap was recorded in urdbean (0.6 q/ha) during 2022-23 and 2023-24. Higher extension gap in pigeonpea and fieldpea indicates that there is a

Table 2. Effect of technologies used on pulses yield, different gaps in yield and technology index

Year	Crop	Variety	Area	No. of FLD	Yield (q/ha)			% increase over FP	Techno-logy gap (q/ha)	Extension gap (q/ha)	Technology index (%)
					Potential	FLD	FP				
2022-23	Pigeonpea	'NA-2'	20	113	19.5	15.4	13.5	14	4.1	1.9	21.0
2023-24	Pigeonpea	'IPA-203'	25	63	25.0	16.8	14.5	16	8.2	2.3	32.8
2023-24	Urd	'VU-1'	10	25	10.0	6.1	5.5	11	3.9	0.6	39.0
2022-23	Fieldpea	'KPMR 400'	20	151	21.0	15.6	13.5	16	5.4	2.1	25.7
2022-23	Chickpea	'RVG 202'	20	100	19.0	14.9	13.0	15	4.1	1.9	21.6
2022-23	Lentil	'KLS-122'	20	115	17.0	13.0	11.5	13	4.0	1.5	23.5
2023-24	Lentil	'KLS-09-3'	20	80	19.0	14.4	12.5	15	5.6	1.9	24.2
Total			**135**	**647**							

Demo= Demonstration, FP= Farmers practice

strong need to raise awareness and motivate the farmers for adoption of improved farm technologies to minimize the extension gap. More and more use of the latest production technologies with high-yielding varieties will subsequently change this alarming trend of the galloping extension gap. The new technologies will eventually lead the farmers to discontinue the existing local practices and to adopt new technologies (Table 2) in pulses. Refinement in the local farmers' practices for higher adoption of location-specific farm technology for sustaining crop productivity is another option open for the research scientists (Kumar *et al*. 2019). This study clearly speaks that extension functionaries of district Raebareli have to strictly focus on the dissemination of proven farm technologies in pulse production systems to enhance the pulse productivity over existing levels.

Technology Index

The technology index shows the feasibility of the evolved technology at the farmer's fields, and the lower the value of the technology index more is the feasibility of the technology (Jeengar *et al*. 2006). The lowest technology index was recorded in pigeonpea variety (21%), which indicates that technology dissemination through CFLD was very much feasible for the district Raebareli and was adopted magnificently by the farmers. Overall mean technology index varied from 21.0 to 39.0% which shows the effectiveness of the technology demonstrated through CFLD. It may be attributed to the selection of varieties suitable for the area, coupled with proven location-specific pulse production technology and an intensive awareness campaign by the scientists of KVK Raebareli-I.

Effect on economics

Table 3 indicates the results of primary research on the effect of technologies used on the economics (economic returns) of CFLD on pulses. The economics of improved production practice under front-line demonstrations were estimated on the basis of prevailing market rates. Highest gross return (Rs. 1,17,250/ha), net return (Rs. 81,650/ha) and benefit cost ratio (3.3) was recorded with pigeonpea variety 'IPA-203' demonstration followed by pigeonpea variety 'NA-2' and Lentil variety 'KLS 09-3' while lowest gross return (Rs. 42,395/ha), net return (Rs.11,895 /ha) and benefit cost ratio (1.4) was recorded with urd which was markedly higher than the returns obtained in plots of farmers practice (Table 3). Higher monetary returns as well as B:C ratio through improved pulse production technologies have also been reported by Kumar *et al*. (2019) and Singh *et al*. (2020).

Table 3. Effect of technologies used on economics of CFLD on pulses at Raebareli

Year	Crop	Variety	Gross cost (Rs/ha)		Gross return (Rs./ha)		Net return (Rs./ha)		B:C ratio	
			Demo	FP	Demo	FP	Demo	FP	Demo	FP
2022-23	Pigeonpea	'NA-2'	33500	31400	101640	89100	52540	31100	3.0	2.8
2023-24	Pigeonpea	'IPA-203'	35600	33200	117250	101500	81650	68300	3.3	3.1
2023-24	Urdbean	'VU-1'	30500	28400	42395	38225	11895	9825	1.4	1.3
2022-23	Fieldpea	'KPMR 400'	22800	21200	67080	58050	44280	36850	2.9	2.7
2022-23	Chickpea	'RVG 202'	24500	23400	77927	67990	53427	44590	3.2	2.9
2022-23	Lentil	'KLS-122'	23600	22300	71500	63250	47900	40950	3.0	2.8
2023-24	Lentil	'KLS-09-3'	25900	23500	86400	75000	60500	51500	3.3	3.2

CONCLUSION

The Cluster Frontline Demonstrations (CFLDs) conducted in Raebareli district during 2022–23 and 2023–24 clearly demonstrate that the adoption of improved pulse production technologies significantly enhances both grain yield and economic returns. Higher monetary benefits and Benefit-Cost (B:C) ratios were consistently observed in demonstration plots compared to traditional farmer practices. The success of these demonstrations was further strengthened by intensive awareness campaigns and regular field interventions conducted by the scientists of Krishi Vigyan Kendra (KVK), Dariyapur. These efforts played a crucial role in motivating farmers to adopt new agricultural technologies, thereby improving overall productivity in pulse crops. This study strongly indicates that the extension functionaries in the district must place greater emphasis on the dissemination of location-specific, proven technologies to narrow the gap between potential and actual yields. There is a clear need to promote crop-specific and site-specific management practices to optimize resource use and achieve sustainable productivity gains. Overall, the CFLDs proved to be an effective extension strategy for technology transfer, farmer motivation and productivity enhancement in pulse-based farming systems. The positive response from the farming community affirms the impact and relevance of frontline demonstrations in strengthening pulse production in the district.

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