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Research Paper

Enhancing chickpea (*Cicer arietinum* L.) production through front-line demonstration in sub mountainous region of Punjab, India

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ABSTRACT

In the present study, 38 frontline demonstrations (FLDs) on chickpea variety (PBG-7) were conducted in an area of 15 ha during *Rabi* 2021-22 and 2022-23 for demonstrating improved cultivation technologies to the farmers. Results of front-line demonstrations showed that the cultivation practices comprised under FLDs *viz.*, use of improved varieties, optimum seed rate, balanced application of fertilizers, line sowing, timely management of weeds, insects and disease, produced grain yield of 13.2 q ha^{-1} and 13.1q ha^{-1} during *Rabi* 2021-22 and 2022-23 respectively which was 53.8% higher as compared to the prevailing farmers practice. The findings of the study showed that the technology gap for chickpea was 6.8 q ha^{-1} and 6.9 q ha^{-1} during *Rabi* 2021-22 and 2022-23 with an average of 6.85 q ha^{-1} over the two years. The technology index was 34.0 and 34.5 percent during *Rabi* 2021-22 and 2022-23, respectively with a mean value of 34.2%. The extension gap was 4.5 q ha^{-1} and 4.7 q ha^{-1} for the years 2021 and 2022 with the average value of 4.6 q ha^{-1} over the two years. The data reported that the technology demonstrated fetched more average gross returns (Rs. 92,050 ha^{-1}), net return (Rs. 70,050 ha^{-1}) and B:C ratio (4.1) over two years compared to farmers practice. On the other hand, under farmers' practice, the average gross returns was Rs. 59,850 ha^{-1}, average net profit to the tune was Rs. 37,250 ha^{-1} and the average B: C ratio was 2.6 over two years.

Key words : Cluster front line demonstrations, Chickpea, Economic performance

INTRODUCTION

Chickpea is the most important *Rabi* pulse crop of India cultivated predominantly in northern India. India is the largest chickpea-producing country, which is accounting for 64% of the global chickpea production (Gaur *et al*. 2010). During 2021-22, chickpea production of India was 13.75 million tonnes from an acreage of 10.91 million ha with a productivity of 12.6 q/ha (DES 2023, MoAF&W, GoI). In order to ensure self sufficiency, the pulse requirement in the country is projected at 39 million tonnes by the year 2050 which necessitates an annual growth rate of 2.14% (IIPR 2015). Amongst the leguminous crops, chickpea occupies an important position due to its nutritious value (17-23% protein) in the large vegetarian population of the country (Ali and Kumar 2006). Pulses are significant sources of protein, fatty and essential amino acids, minerals, fibres, high-quality carbohydrates in the human diet for the impoverished, as well as a vegetarian way of life in the country (Bairwa *et al*. 2020, Verma *et al*. 2021). Apart from this, pulses are also good sources of the B-group vitamins apart from riboflavin, and are capable of alleviation of increasing protein hunger and malnutrition that is prevalent amongst the poorer section of society (Kumar *et al*. 2018, 2019). With the increasing irrigation facilities in north India, the larger area of the region is replaced with other winter crops like wheat and mustard which resulted in the decline of the area of chickpea from 3.2 m ha to 1.0 m ha in northern states.

Chickpea is mainly cultivated on marginal land just to fulfill the domestic needs of the farmers in Punjab. Despite new improved varieties of chickpea, the adoption of these improved varieties amongst the farmers is low as the gap between new technology demonstrated and actual adoption of the technology by farmers is frequently encountered. To address these challenges, there is a dire need to transfer effective farm technology to the end users for wider adoption among farmers to raise their productivity, farm gains, and livelihood (Choudhary *et al*. 2009). Thus, there is a huge challenge for extension and agricultural scientists, to encourage pulse productivity and its enhancement with a main focus on narrowing the yield gaps, with appropriate pulse production technology already generated by the research institutions through appropriate technology transfer programs to harness improved technological advancements.

The frontline demonstration in pulses is an initiative by the Ministry of Agriculture under the guidance of the government of India. As the front-line demonstration works on the principle of learning by doing seeing and believing is one of the most effective extension tools. Front-line demonstration provides the exact view of the limitations of the existing farm practices and the advantages of the improved farm technology at farmers' fields under varying farming situations. The main objective of the frontline demonstration is to demonstrate and popularize the improved technologies in farmers' fields and to fill the yield gap by transferring recommended technology for their adoption to enhance productivity and farm income (Choudhary *et al*. 2009). Keeping in view the importance of pulses in sustainable farming systems the present study was conducted to demonstrate and transfer improved farm technology through front-line demonstrations in pulses with the objectives of increasing the productivity and profitability of farmers along with bridging the gaps in extension for pulse production system sustainability in Punjab.

MATERIALS AND METHODS

The present study was conducted in district Pathankot, 32.3143°N, 75.5975°E during *Rabi* 2021-22 and 2022-23. During the period of study, 38 frontline demonstrations were conducted in an area of 15 ha by Krishi Vigyan Kendra, Pathankot on chickpea variety (PBG-7) and improved cultivation technologies were demonstrated to the farmers. Before conducting FLDs, a list of farmers was prepared from group meetings and specific skill training was imparted to the selected farmers regarding different aspects of cultivation (Venkattakumar *et al*. 2010). The main objective of FLDs was to transfer the improved varietal technology to framers for increasing the productivity of chickpeas. The differences between demonstration packages under front-line demonstrations and existing farmer's practices are given in Table 1. Regular visits by the KVK team were conducted at the farmer's field and regular advisory by the KVK team was also ensured to the farmer. Existing local cultivation practices were followed in the case of check plots. Extension activities like group meetings and field days were also organized at the demonstration sites to provide opportunities for other farmers in the area to interact and seek benefits from these demonstrations. Grain yields were recorded from the demonstration fields and check plots at the time of harvest. The data were collected both in FLDs as well as check plots and the extension gap, technology gap, technology index, and benefit-cost ratio were worked out by using the formula as suggested by Samui *et al*. (2000).

Extension gap = Demonstration yield - Farmers yield

Technology gap = Potential yield - Demonstration yield

$$\text{Technology index (\%)} = \frac{Potential\ yield - demonstration\ yield}{Potential\ yield} x100$$

RESULTS AND DISCUSSION

Effect on grain yield

The grain yield of chickpea crops owing to the adoption of improved technologies was assessed over 2 years and the results are presented in the Table 2 and 3. Results of front-line demonstrations showed that the cultivation practices including use of improved varieties of seed, optimum seed rate, balanced application of fertilizers, line sowing,

Table 1. Comparison between the packages of practices followed under the frontline demonstrations and by the farmer's for chickpea fields

Technology component	Frontline demonstrations	Farmer's practice
Improved variety	PBG 7	Local variety
Seed rate	40 kg ha^{-1}	50 kg ha^{-1}
Time of sowing	25 October-10 November	1-30 November
Method of sowing	Line sowing (30 cm)	Broadcast
Use of biofertilizer	Mesorhizobium+ rhizobacterium	None
Basal application of fertilizers	As per recommendation of PAU or on soil test based (32.5 Kg Urea+ 125 kg SSP per ha)	Irrational use of Urea
Plant protection measures	Need-based spray of pesticides and use of resistant variety	Overdose and use of unrecommended pesticides

timely management of weeds, insects, and disease under FLDs produced grain yield of 13. 2 q ha $^{-1}$ and 13.1 q ha^{-1} during Rabi 2021-22 and 2022-23, respectively and an average grain yield of 13.1q ha^{-1} over two years which was 53.8 percent higher as compared to the prevailing farmers practice (Table 3). Higher grain yield under demonstration plots may be due to the adoption of new recommended technologies by the farmers under the demonstration plots. Higher weed infestation, and injudicious use of nutrients under farmers' practices led to lower yields. The results corroborate with the findings of Singh *et al*. (2017) who reported the superiority of row planting over broadcasting to control weeds, which resulted in a considerable yield increase. Moreover, the application of balanced fertilizers contributed towards the improvement in yield over farmer's practice, where only urea fertilizer was applied. Similar results were reported by Singh *et al* (2014) as they reported an increase in the yield of pulses through improved fertilizer application practices. An increase in yield with the adoption of recommended agro-technologies under frontline demonstrations was also reported by Singh *et al.* (2020b), Dwivedi *et al.* (2019), Kumar *et al.* (2016) and Sharma *et al*. (2012). Frontline demonstrations act as a bridge between scientists and farmers as the scientists are directly involved in planning, execution, and monitoring of the demonstrations for the technologies developed by them. The enhancement of yield by adopting improved farm technology has also been reported in earlier studies (Shivran *et al*. 2020, Kumar *et al*. 2019, Mishra *et al.* 2017, Teggelli *et al*. 2015, Choudhary *et al*. 2014, Sharma *et al*. 2012).

Technology Gap

The results of front-line demonstrations and potential yield of chickpea varieties were compared to estimate the yield gaps which were further categorized into technology gap and technology index (Table 3). The findings of the study showed that the technology gap for chickpeas was 6.8 q ha^{-1} and 6.9 q ha^{-1} during Rabi 2021-22 and 2022-23, respectively and the average yield was 6.85 q ha^{-1} over the two years (Table 3). The technology gap exists even if the demonstrations were conducted under the direct supervision of scientists. The technology gap may be attributed to the variation in the soil fertility status, erratic rainfall patterns, location-specific crop management problems, local weather conditions as well as the different locations of demonstration plots every year (Unhad *et al*. 2019, Cramb 2003).

Technology Index

The technology index shows the feasibility of the improved 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 data presented in Table 3 reveals that the technology index was 34.0 and 34.5 percent during Rabi 2021-22 and 2022-23, respectively and the mean value was 34.2 percent (Table 3). It is due to uneven and erratic rainfall and uncertainty of the weather conditions in the area. The technology index also shows the feasibility of the technological package at the farmer's field. The lower the value of the technology index more is the feasibility. The data shows the possibilities to quicken the adoption of demonstrated technical intervention to increase yield performance. A similar opinion was also reported by Dhakad *et al.* (2018) and Singh *et al*. (2015) that there is a tremendous opportunity for increasing the productivity of pulses by adopting improved technologies.

Extension gap

Extension yield gaps signify unawareness among the farmers for the adoption of new and improved technologies (Kumar *et al.* 2019, Choudhary *et al.* 2014, Vedna *et al*. 2007). The extension gap was 4.5 q ha^{-1} and 4.7 q ha^{-1} for the years 2021 and 2022, respectively and the average value was 4.6 q ha^{-1} over the two years (Table 3). The successful development, dissemination, and adoption of new technologies for small landholders depends on more than careful planning of research and the use of appropriate methodologies in extension (Cramb 2003, Biggs and Smith, 1998). To minimize this extension gap, there is a need to educate the farmers through various extension measures like awareness camps, training, and kisan goshti that can play crucial role in bridging this extension gap . The higher profit with the adoption of improved technologies will eventually lead to the farmers' discontinuance of the use of old technology and replace them with the new technology (Hiremath and Nagaraju 2010). Avoiding the adoption of improved crop production technology by the farmers for better production results in extension yield gaps (Vedna *et al*. 2007).

Economic performance

The economic analysis of chickpea under cluster frontline demonstrations was presented in the Table 4. The data reported that the technology demonstrated fetched more average gross returns

Table 2. Grain yield analysis of frontline demonstrations on chickpea

Year	Variety	Number of trials conducted	Total area (ha)	Average yield (q ha^{-1})	Minimum yield (q ha^{-1})	Maximum yield (q ha^{-1})
2021-22	PBG-7	25	10	13.2	8	15
2022-23	PBG-7	13	5	13.1	7.5	17

Table 3: Yield performance, yield gap and technological index analysis of chickpea under frontline demonstrations

Year	Potential yield	Yield q ha^{-1}		% increase	Technology gap (q ha^{-1})	Technology index (%)	Extension gap (q ha^{-1})
		DP	FP				
2021-22	20	13.2	8.7	51.7	6.8	34	4.5
2022-23	20	13.1	8.4	55.9	6.9	34.5	4.7
Mean	20	13.1	8.5	53.8	6.85	34.2	4.6

Table 4: Economic performance of cluster frontline demonstration plots and local check plots of chickpea

Period of cultivation	Average cost of cultivation (Rs ha^{-1})		Average gross return (Rs ha^{-1})		Average net return (Rs ha^{-1})		B: C Ratio	
	DP	FP	DP	FP	DP	FP	DP	FP
2021-22	22000	22500	92400	60900	70400	38400	4.2	2.7
2022-23	22000	22700	91700	58800	69700	36100	4.1	2.5
Mean	22000	22,600	92,050	59,850	70,050	37,250	4.1	2.6

(Rs. 92,050 ha^{-1}), net return (Rs. 70,050 ha^{-1}) and B: C ratio (4.1) over two years (2020-2022) compared to farmers' practice (Table 4). On the other hand, under farmers' practice, average gross returns was Rs. 59,850 ha^{-1}, the average net profit was Rs.37250 ha^{-1} and the average B: C ratio was 2.6 over two years (Table 4). The average benefit-cost ratio was higher under chickpea demonstration plots as compared to farmers' practice during the years of the study (Table 4). The benefit-cost ratio under demonstration was 4.2 and 4.1 and the average benefit-cost ratio was 4.1 during the years of study (Table 4). However, the benefit-cost ratio under farmers' practice was 2.7 and 2.5 and the average benefit-cost ratio was 2.6 (Table 4). The high net return and B: C ratio in chickpea demonstration plots are due to higher grain yield obtained under demonstration as compared to farmers' practice. These finding are supported by earlier studies (Mokidue *et al.* 2011, Singh *et al.* 2018).

CONCLUSION

It can be concluded that the CFLD program is an efficient tool for enhancing the production and productivity of pulses as well as changing the knowledge, perception, skill of farmers. The use of improved variety and improved cultivation practices for chickpea cultivation can lower the technology gap to a greater extent which will lead to an increase in the productivity of chickpea. This study reveals that the higher yield of demonstration plot over check plots is attributed to the use of all the farming practices like improved variety, sowing method, fertilizer application, plant protection measures according to the recommended package of practices. Low yield in farmers practice may be attributed to the use of local variety. Lack of knowledge of improved farming practices, which include improper use of fertilizers, lack of awareness regarding the plant protection measures as there is severe attack of gram caterpillar at pod initiation stage that decreases the yield and reduces the net return as well as benefit cost ratio under farmers practice. During this study, it can also be concluded that various extension activities like trainings, awareness camps, field days and farmer scientist interaction etc and higher yield obtained from demonstration plots motivated other farmers to adopt recommended farming practices and new technologies.

REFERENCES

Ali M and Kumar S. 2006. Pulse production in India. Yojana, September, 13-15

Bairwa KC, Balai HK, Meena GL, Prasad D, Kumari Y, Singh H and Yadav A. 2020. Intertemporal production performance of pulse crops: In Indian context. Econ. Aff.,65(3): 01-08.

Biggs SD and Smith G. 1998. Beyond methodologies: Coalition-building for participatory technology development. World Development **26** : 239–248.

Choudhary A and Suri VK. 2014. Scaling up of pulse production under frontline demonstration technology transfer program in Himachal Himalayas, India. Communication in Soil Science and Plant Analysis **45**(14): 1934-1948

Choudhary AK, Yadav DS and Singh A. 2009. Technological and extension yield gaps in oilseeds in Mandi District of Himachal Pradesh. Indian Journal of Soil Conservation **37** (3): 224–229.

Cramb RA. 2003. Processes affecting the successful adoption of new technologies by small holders. In Working with farmers: The key to the adoption of forage technologies, ed. ed. B. Hacker, 11–22. Caberra: Australian Centre for International Agricultural Research (ACIAR).

Dhakad SS, Asati KP, Chouhan SS, Badaya AK, Kirar KS and Ambawatia GR.2018. Impact of front line demonstration on the yield and economics of chickpea (*Cicer arietinum* L.) in tribal area of Madhya Pradesh, India. International Journal of Current Microbiology and Applied Sciences **7**(5): 3662-3666.

DES, MOAF&W. (2023). Directorate of economics and statistics. Crop production statistics information system, Ministry of Agriculture & Farmers Welfare, India.

Dwivedi RK, Tiwari BK, Tiwari DK, Baghel KS and Patel AK. 2019. Role of cluster frontline demonstration in enhancement of chickpea (*Cicer arientinum*) production. Plant Archives **19**: 1360-1362.

Gaur PM, Tripathi S, Gowada CLL, Rao CVR, Sharma HC, Pande S and Sharma M. 2010. Chickpea seed production manual. International Crop Research Institute for Semi Arid Tropics pp-01.

Hiremath SM and Nagaraju MV. 2010. Evaluation of on farm front line demonstrations on the yield of chilli. Karnataka Journal of Agriultural Sciences **23**(2): 341-342.

IIPR. 2015.Vision 2050.Indian Institute of PulseResearch. Kanpur, Uttar Pradesh

Jeengar KL, Panwar P and Pareek OP. 2006. Front linedemonstration on maize in Bhilwara district of Rajsthan. Curent Agriculture **30**(1/2): 115-116.

Kumar S, Singh P, Khar S and Sharma M. 2016. Variability association studies screening of genotypes against pea seed borne mosaic virus (psmv) in lentil (lens culinaris medik) under NW Himalayas of Jammu Kashmir. Legume Research **39**(1): 26-30.

Kumar U, Patel GA, Patel HP, Chudhari, RP and Darji SS. 2019. Impact of frontline demonstration programme on the yield of chickpea (*Cicer arietinum L.*) in Patan District of Gujarat, India. Legume Research **44**(2): 221-224.

Kumar N, Hazra KK, Nath CP, Praharaj CS and Singh U. 2018. Grain Legumes for Resource Conservation and Agricultural Sustainability in South Asia. In: Meena R., Das A., Yadav G., Lal R. (eds) Legumes for Soil Health and Sustainable Management. Springer, Singapore. PP. 77-107.

Kumar N, Nath CP, Hazra KK, Das K, Venkatesh MS, Singh MK, Singh SS, Praharaj CS and Singh NP. 2019. Impact of zero-till residue management and crop diversification with legumes on soil aggregation and carbon sequestration. Soil & Tillage Research **189**(6): 158–167

Mishra PK and Khare YR. 2017. Impact of front line demonstartion on yield and profitability of chickpea (*Cicer arietinum*) in sagar district of bundelkhand region of Madhya Pradesh, India. Plant Archives **1**: 463-466.

Mokidue I, Mohanty AK and Sanjay K. 2011. Corelating growth, yield and adoption of urd bean technologies. Indian Journal of Extension Education **11**(2): 20-24.

Raj AD, Yadav V and Rathod HJ. 2013. Impact of Front-Line Demonstrations (FLD) on the yield of pulses. International Journal of Scientific and Research Publications **3**(9): 1-4.

Samui SK, Maitra S, Roy DK, Mondal AK and Saha D. 2000. Evaluation on frontline demonstration on groundnut. Journal of the Indian Society of Coastal Agricultural Research **18**(2): 180-183.

Sharma PK, Kumar S, Ishar AK, Parkash S and Jamwal SS. 2012. Economic impact of front line demonstrations (FLD's) in Poonch district of Jammu & Kashmir. Economic Affairs **57**(1): 99-106.

Shivran RK, Kumar R, Singh U and Praharaj CS. 2020. Gap analysis and economics of front line demonstrations in chickpea (*Cicer arietinum* L.) under humid south eastern plain zone of Rajasthan. International Journal of Bio-Resource Stress Management **11**(3): 258-263.

Singh NK, Kumar S, Singh BK and Hasan W. 2020b. Impact of cluster frontline demonstration on yield of chickpea in Nalanda, Bihar. Journal of Agricultural Search **7**(1): 44-46

Singh AK, Manibhushan, Bhatt BP, Singh KM and Upadjaya A. 2013. An analysis of oil seeds and Pulses scenario in Eastern India during 2050-51. Journal of Agricultural Science **5**(1): 241-249.

Singh AK, Singh SS, Ved Prakash, Kumar S and Dwivedi SK. 2015. Pulses production in India: Present status, Bottlenecks and Way Forward. Journal of Agri Search **2**(2): 75-83.

Singh B, Singh YK and Panigarhi TK. 2014. Extent of adoption of recommended practices of pulses through FLD..*IOSR* Journal of Agriculture and Veterinary Science **7**(12) : 71-72 .

Singh D, Singh KB, Gill, NS and Grewal IS. 2017. Impact analysis of frontline demonstrations on pulses in Punjab. International Journal of Farm Sciences **7**(1): 190-194.

Singh S, Singh G and Kumar R. 2020a. Economic evaluation of cluster front line demonstrations on chickpea (*Cicer arietinum* L.) in Faridkot district of South Western Punjab. International Journal of Agricultural Sciences **16**(2): 254-259.

Singh NK, Kumar S, Hasanwajid and Kumar A. 2018.

Impact of Frontline demonstration of KVK on the yield of paddy (Sahbhagi dhan) in Nalanda district of Bihar. India. International Journal of Current Microbiology and Applied Sciences **7**(3): 3606-3610.

Teggelli, Raju G, Patil DH, Naik Ananda, Zaheer Ahamed B and Patil MC. 2015. Impact of front line demonstration on the yield and economics of pigeonpea in Kalaburgi district of Karnataka State. International Journal of Science and Nature **6**(2): 224-227.

Undhad SV, Prajapati VS, Sharma PS and Jadav NB. 2019. Impact of frontline demonstration on the yield and economics of chickpea (*Cicer arietinum* L.) production in rajkot district of Gujarat. International Journal of Current Microbioloy and Applied Sciences **8**(08): 95-100.

Verma DK, Singh H, Meena GL, Suman J and Sachan. S. 2021. Factors affecting production of important pulse crops in Rajasthan: A cobb douglas analysis. Legume Research **46**(3): 364-367

Vedna K, Kumar A, Kumar A, Bhateria S. 2007. Demonstration - an effective tool for increasing productivity of rapeseedmustard in Kangra district of Himachal Pradesh. Journal of Oilseeds Research **33**(2): 257-261.

Venkattakumar R, Ramana Rao SV, Padmaiah M and Madhuri P. 2010. Production constraints and information needs of oilseeds growers in Andhra Pradesh. Agricultural Extension Review **22**(2): 25-28.