Impact of Cluster Frontline Demonstration (CFLD) on production and productivity ofChickpea(*Cicer arietinum* L.) under Shivalik Foot hills of district Reasi, Jammu andKashmir

Abstract

Chickpea (*Cicer arietinum* L.) is one of the important *rabi* pulse crops cultivated predominantly in northern India. In Jammu, it is grown in 0.11 Mha with total production of 0.11 M tonnes and yield of 1028 kg/ ha. Over the last six years, the on-going National Food Security Mission (NFSM) has been converged with multi-pronged strategies to enhance the production and productivity of pulses in the country, which results in enhanced per hectare productivity. Indian Council of Agricultural Research by taking major big step for the same by introducing conducting Cluster Frontline Demonstrations (CFLD's) nationwide through Krishi Vigyan Kendras (KVKs) with the mandate of out scaling of farm innovations through FLDs to highlight the specific benefits/ worth of technologies on farmer's fields. Krishi Vigyan Kendra, Reasi conducted cluster front line demonstration (CFLD) on chickpea, were conducted in different cluster of district of Reasi.the results reported that 34.06 per cent higher production of maize as compared to prevailing farmers practice (12.74 q/ha). The extension gaps ranged from 359 to 509 kg/ha during the period of demonstration with average 433.4 kg/ha. The technology gap shows the wide gap in the demonstration yield over potential yield of chickpea. The average technology gap was 692 kg/ha with maximum (762 kg/ha) in the year 2019-20 and minimum (611 kg/ha) in the years of 2021-22. which emphasized the need to educate the farmers through various means for the adoption of improved agricultural production technologies to reverse this trend of wide extension gap and concluded that concluded that integrated crop management technology in chickpea has found more productive, profitable and feasible in Trikuta hills of Jammu region of Jammu and Kashmir as compared to prevailing farmers practice. Even though up to 34 per cent yield increase of chickpea crop over farmer's practices are witnessed of creating confidence and friendly relationships between farm scientists and farming community.

Introduction

In terms of agricultural importance, pulses are next to cereal crops and are also known as excellent option for agriculture diversification and intensification in sustainable farming. India is the largest producer and consumer of pulses and contributes in about 35 per cent share in global area and production. India is the largest chickpea producing country, which is accounting for 64% of the global chickpea production (Gaur et al. 2010). In India, chickpea crop was grown in an area of 9.93 million hectares with the production of 9.53 million tons and the productivity of 960 kg/ha (Anonymous, 2014).Chickpea (*Cicer arietinum* L.) is one of the important *rabi* pulse crops cultivated predominantly in northern India. In Jammu, it is grown in 0.11 Mha with total production of 0.11 M tonnes and yield of 1028 kg/ ha. It is the cheapest source of protein (18-22%), carbohydrate (52-70%), Fat (4-10%) and minerals. It also plays an important role in sustainable agriculture to improve soil fertility status through biological nitrogen fixation. Its straw is also used as animal feed (Singh *et al.*, 2015). The per-capita availability of pulses had declined sharply due to the higher growth rate of the population followed by a low growth rate of production and productivity of chickpea.

Over the last six years, the on-going National Food Security Mission (NFSM) has been converged with multi-pronged strategies to enhance the production and productivity of pulses in the country (Anonymous, 2018) which results in enhanced per hectare productivity. The year 2017-18 witnessed a record pulse production of 25.23 million tonnes (Anonymous, 2018), a grand success story and revolution in pulses self-sufficiency. The country is now trying to meet the target of 35 million tonnes by 2030 with the challenging reasons. The improved chickpea production technology which was introduced by the scientists was found suitable for enhancing the total production and productivity per unit of area also (Singh *et al.*, 2014). Hence, it is the prime importance to demonstrate the improved production technology and practices of chickpea on farmers' field so that they can reap the benefit of technology

(Raj *et al.*, 2013). Therefore, it is a great deal for extension scientists, policy makers, and farming community to meet out the pulses availability demand over the country population in terms of household nutritional security. Besides this, various programmes has been started by the government (Kumar et al. 2018) but gap between demand and supply is still bigger and this demand gap is tried to overcome through import of pulses. To overcome the pulses hunger, government tried to improving pulses production and productivity in the country with Indian Council of Agricultural Research by taking major big step for the same by introducing conducting Cluster Frontline Demonstrations (CFLD's) nationwide through Krishi Vigyan Kendras (KVKs) with the mandate of out scaling of farm innovations through FLDs to highlight the specific benefits/ worth of technologies on farmer’s fields. The utmost objective of the frontline demonstration is to large scale technological demonstrate latest technologies of crop production and management practices under diverse climatic conditions as well as farming situations to fill the per cent yield gap. Therefore, the effect of frontline demonstrations on production and productivity of chickpea crop has been studied in Trikuta hills of Jammu region in Jammu and Kashmir.

MATERIALS AND METHODS

Krishi Vigyan Kendra, Reasi conducted cluster front line demonstration (CFLD) on chickpea, were conducted in different cluster at Dadura(N32^0 59.172 E 74-58.289 with elevation of 3061m), Arli Hansali(N32^0 58-90 E 74-56.41 with elevation of 2699m), Maghal (N32^0 57.97E 74-55.79 with elevation of 2460m), Chak Bhagta (N32^0 57.78 E 74-57.45 with elevation of 2465m), Kotli Bajalian (N32^0 58.902 E 74-54.69 with elevation of 2591m), Slal Khad (N33^0 09.410 E 74-48.869 with elevation of 2540m) and Gran Morh (N33^0 05.167 E 74-52.38 with elevation of 2237m)during the year 2017 to 2020 in 28villages.The average rainfall of the zone is 360 mm. In general, soils of the area under study were sandy loam to clay loam in texture with average pH 7.7, organic carbon 0.58 to 0.65, high in nitrogen, phosphorus and potash.Cluster selections, farmer selection, problem diagnosis, layout of demonstration were carried out according to Choudhary (1999). Assessment of gap in adoption of recommended technology was done before laying out FLD’s through personal discussion with selected farmers (Table 1). Trainings were organized about detailed technological intervention with improved package and practice for successful cultivation of pulses. In the demonstrated FLDs the recommended package of practices were followed for crop cultivation and compared with the farmer’s practices (Table 1).In case of farmers practice plots, existing practices being used by farmers were followed. Scientists visited regularly demonstrated fields and farmer’s fields. The feedback information from the farmers was also recorded for further improvement in research and extension programmes. The extension activities i.e. trainings, interaction with farmers and field days were organized at the cluster frontline demonstration sites. The basic information were recorded from the farmer’s field and analyzed to comparative performance of demonstrated plot and local check. Data on yield parameters from demonstrated plots and farmers practices were collected by random crop cutting method. The technology gap, extension gap and technology index were calculated using the following formulae given by (Samui et al., 2000).

Technology gap = Potential yield - Demonstration yield

Extension gap = Demonstration yield - yield under existing practice

Technology index = {(Potential yield - Demonstration yield)/Potential yield} x 100

The satisfaction level of participating as well as neighbouring farmers’ for the performance of improved variety demonstrated was also assessed. In all, 160 participating farmers’ were selected to measure satisfaction level of farmers’ for the performance of improved variety demonstrated. The selected respondents were interviewed personally with the help of a pretested and well structured interview schedule. Client Satisfaction Index was calculated as below.

Client satisfaction index = (Individual score obtained/ Maximum score possible) x 100

The data collected were tabulated and statistically analyzed to interpret the results. The economic-parameters (gross return, net return and C: B ratio) were worked out on the basis of prevailing market prices of inputs and Minimum Support Prices of outputs.

Table 1. Technologies demonstrated under pulses FLDs and farmer's practices

Components	Demonstration of recommended technology	Farmer's practices	Gap analysis (%)
*Variety(s)	GNG-1581, (Ganguar)	Local/old variety	70-80
*Seed rate	75 kg/ha	90-95 kg/ha	50-55
*Seed treatment	*Trichoderma viride* @ 6-8 gm/Carbendazim 50WP @ 2 gm/kg seed, PSB+Rhizobium culture@ 500 gm/ha	10-20 % farmers do seed treatment with Carbendazim	80-79
Sowing method	Line sowing (30 x 10 cm)	Broadcasting/ line sowing	70-80
*Nutrients	N-18 kg/ha; P-46 kg/ha, FYM @ 2.5 tones/ha	Improper use of fertilizers	70-80
*IPM measures	Pendimethalin @ 0.6 kg/ha as pre-emergence, manual weeding @ 30-35 DAS, Emamectin Benzoate 5 SG @ 250 gm/ha for pod borer management.	60-70 % farmers use irrelevant IPM measures	30-40
Trainings	Audio-video On & Off campus training	No training	35

*Demonstrate the technology/ input provided

RESULTS AND DISCUSSION

The performance and extension gap, technology gap and technology index of chickpea crop owing to the adoption of improved technologies was assessed over a period of five years from 2018-2022 and is presented in Table 2 & 3. The economics of the data regarding cost of cultivation, gross return, net return, additional cost, additional return and benefit: cost ratio were analyzed and presented in Table 4 & 5.

The gap analysis (%) between the existing and recommended technologies of chickpea in district Reasi is presented in Table 1. Average 70-80% gap was observed in the case of use of HYV's sowing methods, seed treatment fertilizer dose and plant protection measures, which was the reason for not achieving potential yield. The farmer was not aware of the recommended technology. Farmers, in general, used local or old age varieties- instead of the recommended high yielding resistant varieties. Unavailability of seed in time and lack of awareness were the main reasons farmers followed the broadcast method of sowing against the recommended line sowing and because of this, they applied higher seed rate than recommended.

Table 2. Chickpea yield performance under FLDs and Farmers practice

Year	Area of demo. (ha)	No. of demo.	Variety(s)	Potential yield (q/ha)	Demo. yield (q/ha)	FP yield (q/ha)	% yield increase over FP
2017-18	10	50	GNG-1581	24.0	17.35	12.49	38.91
2018-19	10	50	GNG-1581	24.0	17.28	13.35	29.43

2019-20	10	50	GNG-1581	24.0	16.38	12.79	28.06
2020-21	10	50	GNG-1581	24.0	16.50	12.30	34.14
2021-22	10	50	GNG-1581	24.0	17.89	12.80	39.76
Total	**5 0**	**250**	**Average**	**24.0**	**17.08**	**12.74**	**34.06**

Effect on grain yield:

The grain of chickpea crop owing to the adoption of improved technologies was assessed over a period of five years and is presented in Table 2. Results of front line demonstrations showed that the cultivation practices comprised under FLDs *viz.*, use of improved varieties, seed and soil treatments, optimum seed rate, balanced application of fertilizers, line sowing, timely management weeds, insects and disease, produced on an average 17.08 q/ha grain yield of chickpea, which was 34.06 per cent higher as compared to prevailing farmers practice (12.74 q/ha). The higher grain yield from demonstrated plots was due to use of high yielding varieties and other integrated crop management practices.

Similarly, Kumar *et al*. (2019) also reported 0.83 to 14 q/ha grain yield of different pulse crops under demonstrations as compared to 0.72 to 8.40 q/ha in farmer's practices. The per cent yield increase of chickpea crop was 28.57 to 30.28% in the similar dry areas was also reported by Kumar *et al*. 2018 and Choudhary *et al.*, 2020.

Effect on Extension gap, Technology gap and Technology index:

Extension gap

The extension yield gap was the difference observed between demonstrations technology and farmers practices in the respective crop (Table 3). The extension gaps ranged from 359 to 509 kg/ha during the period of demonstration with average 433.4 kg/ha, which emphasized the need to educate the farmers through various means for the adoption of improved agricultural production technologies to reverse this trend of wide extension gap. More and more use of latest production technologies with high yielding varieties will subsequently change this alarming trend of galloping extension gap. The new technologies will eventually lead to the farmers to discontinuance of old varieties with the new technology.

Table 3. Extension gap, Technology gap and Technology index of chickpea production under FLDs

Year	**Variety(s)**	**Extension gap (kg/ha)**	**Technology gap (kg/ha)**	**Technology index (%)**
2017-18	GNG-1581	486	665	27.70
2018-19	GNG-1581	393	672	28.00
2019-20	GNG-1581	359	762	31.75
2020-21	GNG-1581	420	750	31.25
2021-22	GNG-1581	509	611	25.45
Average		433.4	692	28.83

Technology gap & Technology index

The results (Table 3) 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. The technology gap observed may be attributed to the dissimilarity in the soil fertility status and weather conditions. Hence, variety wise location specific recommendation appears to be necessary to minimize the technology gap for yield level in different situations.

The technology gap shows the wide gap in the demonstration yield over potential yield of chickpea. The average technology gap was 692 kg/ha with maximum (762 kg/ha) in the year 2019-20 and minimum (611 kg/ha) in the years of 2021-22. The observed technology gap may be attributed to dissimilarities in their soil fertility, uneven & erratic rainfall and vagaries of weather conditions in the area as well as management of the farmers. The results are in accordance to the findings of Parihar *et al*. (2018) and Kumar *et al*. (2019), according to them the technology gap in chickpea crop was 9.5 to 13.0q/ha. The data (Table 3) further shows that minimum technology index value 25.45 was noticed in the year 2021-22 followed by 27.70 per cent in 2017-18 whereas, maximum value of technology index of 31.75 % in the year 2019-20 with average value of 28.83 per cent. It is obviously due to uneven & erratic rainfall and vagaries of weather conditions in the area. Technology index also shows the feasibility of the technological package at the farmer's field. The lower the value of technology index more is the feasibility.

Table 4. Economic performance of chickpea cultivation under front line demonstrations and Farmers practice

Year	Cost of Cultivation (Rs./ha)		Gross Return (Rs./ha)		Net Return (Rs./ha)		Benefit: Cost ratio	
	Demo.	**FP**	**Demo.**	**FP**	**Demo.**	**FP**	**Demo.**	**FP**
2017-18	27,853	26,000	104100	74940	76247	48940	2.73	1.88
2018-19	26,545	25,495	103680	80100	77135	54605	2.91	2.1
2019-20	23,740	22,100	97680	76740	73940	54640	3.11	2.47
2020-21	24,500	22,250	98280	73800	73780	51300	3.01	2.30
2021-22	24,800	23,600	99000	76800	74200	53200	2.99	2.25
Average	**25487**	23889	100548	75060	75060	52537	2.94	2.19

Effect on Economics of chickpea:

The economics (Cost of cultivation, gross & net return and B:C ratio) of chickpea under front line demonstrations were estimated and the results have been presented in Table- 4. The front line demonstrations fetched more average gross returns (Rs.100548/ha), net return (Rs. 75060/ha) and B:C ratio (2.94) with slightly higher investment on cost of cultivation (Rs. 1598/ha) as compared to farmers practice. The average increase in gross return, net return, B:C ratio and cost of cultivation was 25.34, 30.00, 25.5 and 0.62 per cent, respectively over farmers practice. The results are the supportive evidences of improved interventions/ technologies under demonstrations practices. Farmers can adopt the demonstrated technology to improve his monetary returns from their fields and leads to improve socio economic status and livelihood under the unpredictable drought conditions of the district.

Increasing in monetary returns and benefit: cost ratio in pulses crops have been also reported by earlier workers (Ram *et al*. 2014; Dayanand *et al*. 2014; Lathwal, 2010). Similarly, demonstrations of improved technologies at farmer's field proven best to a great extent in enhancing the production and productivity of chickpea crop (Singh *et al*. 2017; Tomar, 2010).

Farmer's Satisfaction

The extent of satisfaction level of respondent farmers over performance of demonstrated technology was measured by Client Satisfaction Index (CSI) and results presented in Table 5. It is observed that majority of the respondent farmers expressed high (64%) to the medium

(32.40%) level of satisfaction regarding the performance of chickpea under demonstrations. Whereas, very few (03.60%) of respondents expressed lower level of satisfaction. The higher to medium level of satisfaction with respect to performance of demonstrated technology indicate stronger conviction, physical and mental involvement of in the frontline demonstration which in turn would lead to higher adoption. The results are in close conformity with the results of Kumaran and Vijayaragavan (2005).

Table 5. Extent of farmer's satisfaction over performance of demonstrated technology

Satisfaction level	Number	Per cent
High	160	64.00
Medium	81	32.40
Low	09	03.60

CONCLUSION

It may be concluded that integrated crop management technology in chickpea has found more productive, profitable and feasible in Trikuta hills of Jammu region of Jammu and Kashmir as compared to prevailing farmers practice. Even though up to 34 per cent yield increase of chickpea crop over farmer's practices are witnessed of creating confidence and friendly relationships between farm scientists and farming community. Farmers were motivated by results of demonstrations of integrated crop management practices in chickpea and they would adopt these technologies in the coming years. In Reasi district of Jammu, the production and productivity of pulses was quite low earlier. Now, National Food Security Mission a government initiative tried to bridges a connection to enhance the same due to popularization of improved technologies though KVKs at farmer's fields. But, there is still a wide gap between potential and demo yield which needs more extension service among farming community for better crop production, productivity and net monetary returns of pulses with more emphasis.

REFERENCES

Anonymous (1996). Annual Report. ICRISAT, Patancheru, Hyderabad, Telangana. pp-24-25.

Anonymous (2014). Directorate of economics and statistics, Krishi Bhavan, New Delhi.

Anonymous (2018). Pulses Revolution-From Food to Nutritional Security. Ministry of Agriculture & Farmer Welfare (DAC&FW), Govt. India. pp.-1-115.

Balikai, R.A., Biradar, A.P., Yelshetty, S. and Teggelli, R.G. (2001). Relative efficacy of some insecticides against chickpea pod borer, *Helicoverpa armigera*, *Karnataka Journal of Agricultural Science*. 14: 346-348.

Choudhary, B.N. (1999). Krishi Vigyan Kendra-A guide for KVK managers, Division of Agriculture Extension, ICAR; 73-78.

Choudhary, L.R., Pagaria, P. and Choudhary, H.D. (2020). Impact of front line demonstration on Isabgol crop in Barmer district of Rajasthan. Journal of Plant Development Sciences, Vol. 12(12): 743-745.

Dayanand, Verma, R.K. and Mehta, S.M. (2014). Assessment of technology gap and productivity gain through frontline demonstration in chickpea. *Legume Research*, 37: 430-433.

Dubey, S., Raghav, R.S. and Singh, P. (2017). Enhancement of productivity for chickpea (*Cicer arietinum* L.) through front line demonstration in farmer's fields. *Legume Research*, **40**(2): 335-337.

Gaur, P.M., Tripathi, S., Gowada, C.L.L., Rao, C.V.R., Sharma, H.C., Pande, S. and Sharma M. (2010). Chickpea seed production manual. International Crop Research Institute for Semi Arid Tropics pp-01.

Kumar, M. and Kumawat, S.R. (2019). Knowledge level of farmers about chickpea production technology in Nagaur district of Rajasthan. *Journal of Krishi Vigyan*, **8**(1): 187-190.

Kirar BS, Narshine R, Gupta AK and Mukherji SC. (2016).Demonstration: An effective tools for increasing the productivity of urd. *Ind. Res.J. Ext. Edu*. (**3**): 47-48.

Kumar, S., Khar, S., Sharma, M. and Singh, P. (2014). Stability analysis for seed yield attributing traits in chickpea (*Cicer arietinum*) under Mid Hills of J&K. *Legume Research*, 37: 552-555.

Kumar, S., Mahajan, V., Sharma, P.K. and Parkash, S. (2019). Impact of front line demonstrations on the production and productivity of moong, *Vigna radiata*, mash, *Vigna mungo*, rajmash, *Phaseolus vulgaris*, lentil, *Lens culinaris* and chickpea, *Cicer aeritinum* under rainfed ecology in mid hills of J&K, India. *Legume Research*, 42(1): 127-133.

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

Kumar, U., Patel, G.A., Patel, H.P., Chudhari, R.P. and Darji, S.S. (2018). Impact of front line demonstration programme on the yield of chickpea (*Cicer arietinum* L.) in patan district of Gujarat, India. *Legume Research*, DOI: 10.18805/LR-4081.

Kumaran, M. and Vijayaragavan, K. (2005). Farmers' satisfaction of agricultural extension services in an irrigation command area. *Indian Journal of Extension Education*, **41**(3&4): 8-12.

Lathwal, O.P. (2010). Evaluation of frontline demonstrations on black gram in irrigated agro ecosystem. *Annals of Agricultural Research*, 31(1&2): 24-27.

Mokidue I, Mohanty AK and Sanjay K.(2011).Corelating growth, yield and adoption of Urd bean technologies. *Indian J. Ex. Edu*.**11** (2):20-24.

Parihar, A.K., Dixit, G.P. and Gupta, S. (2018). Assessment of impact of frontline demonstrations in North Eastern-hill region of India. *Indian Journal of Hill Farming*, Special Issue: 40-43.

Ram, B., Dhaka, B.L. and Punia, S.S. (2014). Evaluation of productivity and profitability of urdbean (cv. KU 96-3) under frontline demonstration in humid southeastern plain of Rajasthan. *Journal of Food Legumes*, 27(3): 246-248.

Raj AD, Yadav V and Rathod JH.(2013). Impact of Frontline Demonstration (FLD) on the yield of pulses. *International J.*
Sci. and Res. **9** (3):1-4

Samui, S.K., Maitra, S., Roy, D.K., Mandal, A.K. and Saha, D. (2000). Evaluation of front line demonstration on groundnut, *Arachis hypogeal*. *Journal of Indian Society of Coastal Agricultural Research*, 18(2): 180-183.

Singh AK, Singh SS, Prakash VED, Kumar S and Dwivedi SK .(2015). Pulses Production in India: Present Status, Bottleneck and Way Forward. *Journal of AgriSearch***2** (2): 75-83.

Singh D, Patel AK, Baghel MS, Singh SK, Singh Alka and Singh AK.(2014). Impact of Frontline Demonstration on the yield andeconomics of chickpea (*Cicerarietinum* L.) in Sidhi district of MadhyaPrades. *Journal of AgriSearch***1** (1):22-25.

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 Int. J. Curr. Microbial. App. Sci*.**7** (3): 3606-3610.

Singh, J., Hundal, R.K. and Dhillon, B.S. (2017). Comparison for yield potential of chickpea in frontline demonstrations and farmer's practices in the amritsar district of Punjab. *Current Agriculture Research Journal*, 5(2): 239-243.

Tomar, R.K.S. (2010). Maximization of productivity for chickpea through improved technologies in farmer's field. *Indian Journal of Natural Products and Resources*. 1(4): 515-517.

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