



Boosting Productivity and Profitability of Chickpea through Cluster Front Line Demonstration (CFLD) in Churu District of Rajasthan

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ABSTRACT

The present study was conducted during *rabi* season (October to April) of four consecutive years from 2018–19 to 2021–22 at 175 selected farmer's field in Dhani Gangajal, Kalana Tal, Bas Mamraj, Bhamra, Nethwa, Sahawa and Dingli villages of Churu District, Rajasthan, India. A total of 175 Cluster Front Line Demonstrations (CFLD) on chickpea was conducted. The farming situation was both irrigated and rainfed while, soil was sandy to sandy loam low in nitrogen, medium in phosphorus and medium to high in potash. Gap assessment was done and on the basis of gap assessment, improved recommended technologies were demonstrated. On four-year average basis, higher grain yield was recorded under demonstration field (1714 kg ha⁻¹) as compared to farmers practices (1379 kg ha⁻¹) which was 24.30% higher than farmer's practices (Local check). The average extension gap, technology gap and technology index were 336 kg ha⁻¹, 849 kg ha⁻¹ and 20.12%, respectively. The higher average total returns was also recorded in demonstration plot which was ₹ 86721 ha⁻¹ as compared to farmer's practices (₹ 86721 ha⁻¹). There was no much difference in cost of cultivation for demonstration plot (₹ 24980 ha⁻¹) and farmers practices (₹ 22980 ha⁻¹). An additional investment of ₹ 2000 ha⁻¹ consists with scientific monitoring of demonstration and non-monetary factors resulted in additional return of ₹ 16,939 ha⁻¹. Due to higher additional return farmers got ₹ 14939 ha⁻¹ as effective gain. On four-year average basis, incremental benefit:cost ratio was recorded 8.45.

KEYWORDS: Additional return, CFLD, extension gap, technology gap

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1. INTRODUCTION

Pulses or 'Dal' are important meal of the average Indian population. A large population of India is vegetarian and pulses are the main source of protein for those people (Ali and Singh, 2021). Pulses are one of the cheapest sources of protein for human consumption as they content about 18–25% of protein (Dayanand et al., 2014). Additionally, compared with animal protein, chickpea is the major and cheap source of protein especially for vegetarian population (Sigh et al., 2016). Pulse crops can be grown under rainfed condition, low fertile soil and climatic conditions as it is tolerant to drought (Malik et al., 2006). The capita⁻¹ availability of pulses has declined from 60.55 g day⁻¹ in 1951 to 44.93 g day⁻¹ in 2021 (Anonymous, 2021). The productivity of pulses is very low in India is 697 kg ha⁻¹, as compared to highest 2050 kg ha⁻¹ in Canada during 2021 (Anonymous, 2021).

Chickpea is most important and extensively grown *rabi* pulse crop and it is the fourth largest grain legume crop in the world (Randhawa et al., 2014) and it is the most important pulse crop among the different pulses grown in the Indian subcontinent. The total area under chickpea cultivation is 21.13 lha with production of 22.65 lt in Rajasthan. The average productivity of chickpea in Rajasthan is 1072 kg ha⁻¹ (Anonymous, 2020–21). As far as Churu district of Rajasthan is concerned total area under chickpea cultivation 1.80 l ha with productivity of 156 kg ha⁻¹ (Anonymous, 2020–21), which is much lower than the its potential.

The productivity of chickpea can be further increased by adopting improved high yielding varieties and scientific crop management practices (Kumar et al., 2016, Shivran et al., 2020). Cluster Front line demonstration is the new concept of the field demonstration with main objectives to demonstrate newly released high yielding variety with improved agro techniques at farmer's field. Chickpea is established as major *rabi* crop in northern (Singh et al., 2020) and central part of India. Survey of technology adoption levels of package of practices in Rajasthan indicated that there was either lack of adoption or partial adoption of improved practices resulting in lower productivity levels as compared to their potential yield levels (Ali and Singh, 2022). Least use of improved varieties, higher seed rate, lack of seed treatment with chemical and bio-agents (*Rhizobium*), inadequate and imbalanced fertilizer use, lack of use of plant protection measures were some of the critical production factors contributed to the poor and stable yield (Shivran et al., 2020). Beside this, several biotic and abiotic stresses, unavailability of quality seeds of improved varieties in time and poor crop management practices due to unawareness and non-adoption of recommended production and plant protection technologies is also responsible for poor

productivity of chickpea (Ali and Singh, 2021).

To enhance the yield of chickpea, it is necessary to cultivate chickpea in scientific manner along with newly developed production technologies at farmer's field. Therefore, Cluster Front Line Demonstration on chickpea at farmer's field may be helpful to establish the technology at farming community. The basic objective of this programme is to demonstrate recently released, short duration, high yielding, and disease resistant varieties in compact block with full recommended package of practices i.e. INM, IWM and IPM at farmer's field (Table 1) through Krishi Vigyan Kendra to enhanced adoption of modern technologies for generation of yield data with farmer's feedback for further improvement in research (Verma et al., 2014). Keeping this in view, the study was conducted to demonstrate the impact of newly developed production technologies on chickpea productivity.

2. MATERIALS AND METHODS

The experiment was conducted at KVK, Chandgothi, Churu, Rajasthan, India during *rabi* season (October to April) of four consecutive years from 2018–19 to 2021–22. A total 175 Cluster Front Line Demonstrations (CFLD) on chickpea varieties i.e. GNG 1581, GNG 1958, GNG 2144 and GNG 2171 were conducted in Dhani Gangajal, Kalana Tal, Bas Mamraj, Bhamra, Nethwa, Sahawa and Dingli villages of Churu District, Rajasthan, India. The selection of villages was done on basis of non-adoption of improved and recommended varieties (GNG 1581, GNG 1958, GNG 2144 and GNG 2171). After the selection of villages, most approachable side of farmer's field was selected, so that the performance of demonstrated technology can be seen by other farmers to motivate them for adoption of newly improved technologies. The farming situation was rainfed and soil was sandy loam low in nitrogen, medium in phosphorus and medium to high in potash. The area for demonstration was 0.4 ha each (1 a) and were conducted by using recommended package of practices. The KVK provided high quality seed of chickpea varieties i.e. GNG 1581, GNG 1958, GNG 2144 and GNG 2171 @ 60 kg ha⁻¹, micro-nutrients, bio fertilizers, trichoderma, herbicide and pesticides. Other critical input like DAP was purchased and used by the farmers with the guidance of KVK during all four years. The sowing of chickpea crop was done in the months of October and harvested during first week of April during all the four years. The scientist of KVK, Chandgothi, Churu regularly visited and monitored demonstrations on farmers fields from sowing to harvesting. The grain yield of demonstration and local check was recorded and analyzed. Other parameters as suggested by Verma et al. (2014) were used for calculating gap analysis, cost and returns. The details of different parameters are as follows:

Extension gap=Demonstration yield (D_1)-Farmers practices yield (F_1)(1)	Additional return=Demonstration return (Dr)-Farmers practices return (Fr)(4)
Technology gap = Potential yield (P_1)-Demonstration yield (D_1)(2)	Effective gain =Additional return (Ar)-Additional cost (Dc)(5)
Technology index=(Potential yield (P_1)-Demonstration yield (D_1))/Potential yield (P_1)) $\times 100$(3)	Incremental B:C ratio=(Additional return (Ar))/(Additional cost (Dc))(6)

Table 1: Comparison between technological intervention and local check and gap analysis under CFLDs on chickpea

Sl. No.	Particulars	Technological intervention (Demonstration practices)	Farmers practices (Local Check)	Technological gap
1.	Farming situation	Irrigated	Irrigated	No Gap
2.	Variety	Improved varieties i.e. GNG 1581, GNG 1958, GNG 2144 and GNG 2171	Locally available or self procured seeds	Full gap (100%)
3.	Seed Rate	60 kg ha ⁻¹	48 kg ha ⁻¹	12 kg less then recommendation
4.	Sowing dates	IIInd week of October	1 st week of november	Full gap (100%)
5.	Seed inoculation	<i>Rhizobium</i> and PSB	No seed inoculation	Full gap (100%)
6.	Sowing method	Line Sowing (30 \times 10 cm ²)	Line sowing (30 \times 10 cm ²)	No gap
7.	Fertilizer	10 kg N, 25 kg P ₂ O ₅	No use of fertilizer	Full gap (100%)
8.	Seed treatment	Bio-fungicide -Trichoderma	No Seed treatment	Full gap (100%)
9.	Micro-nutrients	Use of micro nutrients mixture for balance fertilizer (75 g 15 l ⁻¹ of water as foliar spray)	No use of micronutrients	Full gap (100%)
10.	Weed control	Herbicide application (Pendimethalin 30 EC @ 2 l ha ⁻¹ as PE)	Hand weeding at 25–30 DAS	No herbicide use Full gap (100%)
11.	Plant protection	Need based spray of Insecticides i.e. Emamactin Benzoate, Quinalphos and Chloropyrphos	No spray	Full gap (100%)

3. RESULTS AND DISCUSSION

3.1. Grain yield

The results of four year (2018–19 to 2021–22) of cluster frontline demonstrations (CFLD) conducted on farmer's field under real farm conditions in Churu districts of Rajasthan indicated that improved technologies could lead to grain yield levels in the range of 1036 to 2045 kg ha⁻¹ as compared to 785 kg ha⁻¹ to 1659 kg ha⁻¹ under farmers practice (Table 3 and Figure 2). Average yield of 175 demonstrations worked out to 1714 kg ha⁻¹ from improved technologies (Demo) whereas, the average yield obtained in case of farmers practice was 1379 kg ha⁻¹ (Table 3 and Figure 2). During *rabi* 2020–21 variety GNG-2144 was grown under demonstration and this variety recorded the highest grain yield 2045 kg ha⁻¹ under demonstrations plot

as compared to farmers practices plot (Table 3). This reveals that improved recommended technologies of chickpea cultivation enhanced in average yield by 24.3% (Table 2) over farmers practice. The range of increase in yield during the study period was 20.51 to 31.97% under demonstrations plot. The adoption of improved production technology of chickpea cultivation enhanced in average yield by 53.1%, 56.6% and 511.1% over national, state and district yield, respectively (Table 2 and Figure 1). After improvement in grain yield of chickpea there is still scope to increase further because grain yield in demo was found 32.1% less as compared to potential yield. This results indicated that higher average grain yield in demonstration plots compare to farmers practice over the four years was due to the knowledge and adoption of improved technologies *i e* Improved high yielding varieties with more potential yield

Table 2: Comparison of yields of chickpea (Average of 2018–19 and 2021–22)

	National*	State**	District**	Potential	Demonstration	Farmers practices
Average yield (kg ha ⁻¹)	1120	1094	281	2525	1714	1379
percentage increased	53.1	56.6	511.1	-32.1	--	24.3

*: Anonymous (2021); **: Anonymous (2018–19 and 2020–21)



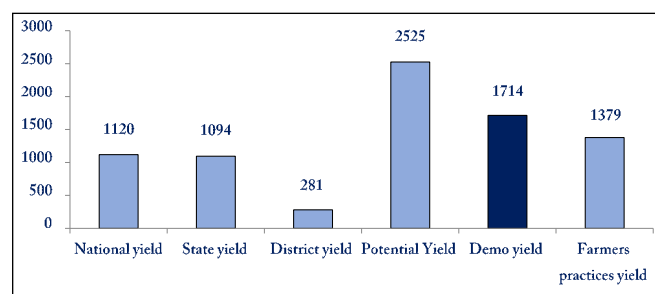


Figure 1: Comparison of chickpea yields kg ha⁻¹ (Average of 2018–19 and 2021–22)

such as GNG 1581, GNG 1958, GNG 2144 and GNG 2171, proper seed rate, timely sowing, seed inoculation with rhizobium and PSB culture, weed management i.e. Pendimethalin 30 EC, balanced fertilization and need based plant protection measures such as Emamactin Benzoate, Quinalphos & Chloropyrifos. Ali and Singh (2021) also reported that improved high yielding varieties and balanced fertilization increased the yield of greengram in Churu district of Rajasthan. Above findings are in close conformity with the results reported by Kumar (2014), Meena (2017), Shivran et al. (2020) and Ali and Singh (2020). They also found the higher grain yield of chickpea in front line demonstration plot as compared to farmer's practices plot.

3.2. Yield gap analysis

On four-year average basis, extension gap of total 175 demonstrations was obtained 336 kg ha⁻¹ (Table 3). An

extension gap between demonstrated technology and farmer's practices was ranged from 251 kg ha⁻¹ to 386 kg ha⁻¹ during all four the year. Such big extension gap in yield might be due to adoption of new improved technologies in demonstration plot which resulted in higher grain yield as compared to non-adaption new improved technologies in traditional farmer's practices. Wide technology gap (555 to 1264 kg ha⁻¹) in yield was also observed during the four years of demonstration. Average technology gap of 175 demonstrations was found 849 kg ha⁻¹. Lower technology gap during all the years indicated more feasibility of recommended technologies during study periods. Lower technology gap showed (Table 3) that combination of improved varieties with recommended package of practices perform better than the potential yield of varieties. Similarly, the technology index for all the demonstrations during the study period were in accordance with technology gap. The range of technology index was from 17.02% to 24.23% during four year and an average of technology index was found 20.12%. Lower technology index reflected the adequate proven technology for transferring to farmers and sufficient extension services for transfer of technology. The results confirm with the finding of front line demonstration on chickpea, cowpea, groundnut and clusterbean by Tiwari and Tripathi (2014), Kaur et al. (2019), Ali and Singh (2020) and Ali et al. (2022). They also found big extension gap in yield of chickpea, cowpea, groundnut as well as in clusterbean.

Table 3: Grain yield, gap analysis and technology index of cluster front line demonstration (CFLD) on chickpea at farmer's field

Year of demonstration	No. of demo	Variety	Potential yield (kg ha ⁻¹)	Demo yield (kg ha ⁻¹)	Farmers practices yield (kg ha ⁻¹)	Increased over farmers practices (%)	Extension gap (kg ha ⁻¹)	Technology gap (kg ha ⁻¹)	Technology index (%)
Rabi 2018–19	75	GNG 1581	2300	1036	785	31.97	251	1264	24.23
Rabi 2019–20	50	GNG 1958	2600	1871	1490	25.57	381	729	20.36
Rabi 2020–21	25	GNG 2144	2600	2045	1659	23.27	386	555	18.88
Rabi 2021–22	25	GNG 2171	2600	1904	1580	20.51	324	696	17.02
Average	--	--	2525	1714	1379	24.34	336	849	20.12

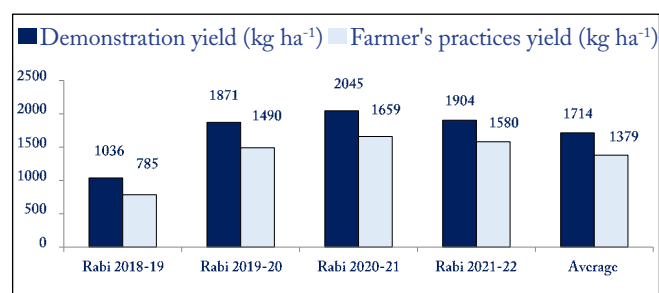


Figure 2: Grain yield of chickpea in demonstration and farmer's practices plot

3.3. Economics analysis

The cash inputs for the demonstrations as well as farmers practices were improved varieties seed, fertilizers, bio fertilizers, herbicides, bio fungicide and pesticides. On an average additional investment of ₹ 2,000 ha⁻¹ was made under demonstration resulted in additional return of ₹ 16,939 ha⁻¹ which is huge amount by investing less additional amount (Table 4). Economics returns as a function of grain yield and selling price varied during all the four years. The gross return under demonstration plot were ranged from ₹ 51,800 ha⁻¹ to ₹ 1,04,295 ha⁻¹ with an average

Table 4: Economics analysis of cluster front line demonstration (CFLD) on chickpea at farmer's field

Year of demonstration	Cost of cultivation (₹ ha ⁻¹)		Additional cost in demo (₹ ha ⁻¹)	Sale price of grain (₹ kg ⁻¹)	Total return (₹ ha ⁻¹)		Additional return in demo (₹ ha ⁻¹)	Effective gain (₹ ha ⁻¹)	Incremental B:C ratio (IBCR)
	Demo	Farmers practices			Demo	Farmers practices			
Rabi 2018–19	22920	21120	1800	50.00	51800	39250	12550	10750	6.97
Rabi 2019–20	25000	23000	2000	48.75	91211	72638	18574	16574	9.29
Rabi 2020–21	25500	23500	2000	51.00	104295	84609	19686	17686	9.84
Rabi 2021–22	26500	24300	2200	52.30	99579	82634	16945	14745	7.70
Average	24980	22980	2000	51.51	86721	69783	16939	14939	8.45

1 US\$= INR 76.1962 (average value of the harvesting month April 2022)

of ₹ 86,721 ha⁻¹. The highest gross return was obtained during year 2020–21 due to higher grain yield with higher selling price. The less gross return was observed in farmer's practices plot due to less grain yield which was ₹ 69,783 ha⁻¹ on average basis. The higher effective gain of ₹ 14,939 ha⁻¹ was obtained under demonstration. The higher effective gain and additional returns could be due to adaption of improved new technologies, non-monetary factors, timely operations of crop cultivation and scientific monitoring. The range of incremental B:C ratio (IBCR) during all four years was found between 6.97 to 9.84. On the average of four years, IBCR was found 8.45. Higher IBCR could be due to higher additional return with less additional cost in demonstration. The results confirm with the finding of front line demonstration on chickpea and clusterbean crops by Poonia and Pithia (2011), Dayanand et al. (2014), Dwivedi et al. (2014), Gorfad et al. (2016), Parmar et al. (2017) and Ali and Singh (2020). They found higher gross return, net return and IBCR in demonstration plot as compared to farmers plot in chickpea and clusterbean crop.

4. CONCLUSION

Adopting recommended package of practices under demonstration increased 24.34% yield of chickpea over farmer's practices. Extension gap might be minimized by adopting such technology under CFLD. The IBCR (8.45) was found high to motivate the farmers for adoption of technology.

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