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Impact of technological interventions of Cluster frontline demonstrations (CFLD) pulses on yield enhancement of Chickpea (*Cicer arietinum* L.) in tribal district of Mandla, Madhya Pradesh

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Abstract
The study was carried out by Krishi Vigyan Mandla district of Madhya Pradesh to know the yield gaps between improved package and practices under cluster front line demonstration (CFLD pulses) and farmer's practice (FP) of Chickpea (*Cicer arietinum* L.) crop variety JG14 under rainfed condition. Cluster Front Line Demonstration on Chickpea were conducted on farmer's fields during Rabi season of two sequential years i.e. 2018-2019 and 2019-2020 under National Food Security Mission (NFSM), Govt. of India to demonstrate the impact of enriched agro-techniques on production and economic benefits under rainfed conditions. CFLD's were conducted in 30 ha and 20 ha area for two years with active involvement of 125 farmers and scientific staff of KVK. According to analysis of data the highest grain yield was obtained in demonstrated plots with an average of 13.74 q/ha as compared to local check with an average of 8.15 q/ha. An average mean of extension gap, technology gap and technology index were calculated as 5.60 q/ha, 6.35q/ha, 31.75 percent, respectively. Adoption of improved package of practices in Chickpea cultivation recorded average higher B:C ratio (3.07) as compared to Farmers Practice (1.93) during the period of study. Thus, the productivity of Chickpea could be increased with the adoption of recommended improved package of practices. The study resulted in satisfying the farming community for higher productivity and returns.

Keywords: Chickpea, front line demonstration, technology gap, impact, yield, technology index

Introduction
Tribal district of Mandla, Madhya Pradesh in India situated at an elevation of 1,768 feet (539 meters) above sea level an upland plateau at a U- shaped bend in the Narmada River where it is joined by the Banjar River. Mandla district has an area of 8771 km^2. There are 9 blocks, 4 tehsils and 1214 villages in the district. Chickpea (Cicer arietinum L.) is an important winter season pulse crop cultivated during rabi season under black soils. 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 (Schwenke *et al*., 1998). Its straw is also used as animal feed (Namvar *et al*., 2011 & Singh *et al*., 2015) [14]. In India, it is cultivated in an area of about 106 lakh hectares with an annual production of 11.1 lakh tones and the productivity of 918 kg/ha (Anonymous, 2016-17). It contributes 47% of the total pulse production and about 40% of total pulse growing area in the country. In Mandla district, farmers usually cultivate the chickpea in black soils under rainfed condition during rabi season. Farmers realizing the low yield of chickpea due to use of local or old variety, reuse of their own seeds, occurrence of moisture stress, poor management practices especially no use of fertilizers and pesticides for managing pod borer and fusarium wilt disease incidence. Mehra *et al*., (2018) reported that yield of chickpea is limited due to poor spread of improved varieties and production technologies, imbalanced nutrition, abrupt climatic changes and vulnerability to pests and diseases. Incidences of pod borer causes damage upto 30-40 per cent pods (Rahman, 1990) and root rot and wilt disease causes 10 to 25 per cent yield loss depending upon the stage of the crop (Mahendra, 1998). Chickpea is an important rabi pulses crop of rainfed season of Mandla district of Madhya Pradesh. The productivity 760 kg/ha of pulses in the district is low as compared to National average mainly due to poor crop management practices ultimately and inadequate availability of quality seed of improved Chickpea varieties and other inputs.

KVK's are grass root level organizations meant for spreading of technology through refinement, assessment and demonstration of proven production technologies under different micro-farming situations (Das, 2010) [5]. The main aim of Krishi Vigyan Kendra is to reduce the time lag between generations of technology at the research and its transfer to the farmers for increasing productivity and income from agriculture and allied sectors. The main objective of Cluster Front Line Demonstration under National Food Security Mission was to demonstrate improved crop production technologies of pulses on the farmers field and to popularize the newly notified improved varieties auto technologies for varietal diversification and efficient management of resources the present investigation was undertaken to study the impact of cluster frontline demonstration on yield of Chickpea (*Cicer arietinum* L.) under rainfed condition in Mandla district of Madhya Pradesh with the objective of increasing productivity and executed to narrow down the time lag and insured speedy adoption of technologies in district.

Materials and methods

Cluster Frontline Demonstrations (CFLDs) on improved farm technology (Table 1) were conducted by Krishi Vigyan Kendra Mandla of JNKVV Jabalpur in Chickpea (JG14) during Rabi 2018-2019 and Rabi 2019-2020 under rainfed conditions on 50 ha area of Mandla district covering 125 farmers. The soil of CFLDs was Sandy loam to Sandy clay loam and the pH of soil is near about 6.18 to 7.11. the improved technology such as improved varieties seed (JG14) method of line sowing with Nari plough and seed drill, seed treatment with thirum and biocontrol agents weed management and integrated pest management practices was maintained during period of study seed treatment was done with thirum 3 gm/kg seed Rhizobium, trichoderma and PSB @ 5 gm/kg of seed before sowing to protect the crop against fungal diseases up to 15 - 20 days after sowing the seed rate of Chickpea was kept 75 kg/ha in demonstrations plot the sowing of Chickpea was done during 16th November to 20th November 2018 during the study period the spacing between row to row and plant to plant was kept 30x10 for the Cluster Frontline Demonstrations. The fertilizers were also given in the ratio of 20:40:20:10 kg/ha as basal dose spraying of chloropyriphos+ cypermethrin for controlling of insect and pests like gram pod borer @1250 gm/ha. The data were collected from beneficiary farmers through personal interviews and after that data was tabulated and analysed to find out the findings and conclusions. The yield increase in demonstrations over farmers practice was calculated by using following formula.

$$\text{\% Yield increase over farmer's} = \frac{\text{Demonstration average plot yield} - \text{Famer's average plot yield}}{\text{Farmer's average plot yield}}$$

Estimation of technology gap, extension gap and technology index

Extension gap should be assigned to adoption of improved transfer technology in demonstrations practices resulted in higher grain yield than traditional farmer's practices. The similarly observations were also obtained in black gram crop by Mahalingam *et al*., (2018) Bairwa *et al*., (2013) [2], Hiremath and Nagarju (2010) [7] and also Jamwal Anamika *et al*. (2020). The estimation of technology gap, extension gap and the technology index were worked out by using following formula (Kadian *et al*., (1997) [8] Samui *et al*., 2000) [16]

- Technology yield gap = Potential yield – Demonstration plot average yield
- Extension yield gap = Demonstration plot average yield- Farmer's plot average yield

$$\text{Technology index} = \frac{\text{Technology yield gap}}{\text{Potential Yield}} \times 100$$

Results and Discussion

The findings of the study as well as relevant discussion have been conferred under following points

Grain Yield

Data presented in Table 2 revealed that transfer of improved technology under Cluster Frontline Demonstrations in Chickpea resulted in higher yield as compared to farmer's practice. The higher yield in demonstration plot was due to improved variety of seed, seed treatment with bio control agent, integrated pest management practices. The average seed yield of demonstration plots was 13.74 q/ha (Table 2) which was higher as compared to farmers practice 8.15 q/ha. The increased yield percentage over control was 68.68% in Cluster Frontline Demonstration over local check. However the seed yield of 13.56 q/ha in CFLD's was low as compared to potential yield 20 q/ha of Chickpea variety JG14 due to attack of Chickpea pod borer. The yield enhancement through adoption of improved technology has also been reported in earlier studies of FLD's (Kothyari *et al*. 2018 and Kumar *et al*. 2019 and Jamwal Anamika *et al* 2020) [9]. Yield of the Frontline Demonstration trials and potential yield of the crop was compared to estimate the yield gaps which were further classified into technology and extension gaps (Hiremath & Nagarju; 2009 [7] and Jamwal Anamika *et al* 2020)

Extension Yield gap

An average extension gap between demonstrated practices and farmers practices was recorded 5.60 q/ha (Table2). Higher extension gap in present study suggested that there is a need to motivate and aware the farmers for adoption of improved technologies in Chickpea over existing local farm practices. The similar results were also reported by Bairwa *et al*. 2013 [2] Gangadevi *et al*. 2018 Jamwal Anamika *et al* 2020

Technology Yield gap and Technology Index

The technological gaps generally appear even if the CFLD's were conducted under the strict direction of farm scientists on the farmers field the data presented in table 2 showed that the value of technological gap was higher 6.26 to till per hectare during the year 2019-20 while during 2018-19 the technological gap was 6.44 per ha the technology gap observed may be attributed to the decimal dissimilarity in soil status, lake of irrigation facilities non congenial weather conditions, disease and pest attacks and change in the position of demonstrations plots every year. Technology index specified the feasibility of the generated Technology at the farmer's fields under existing agro climatic conditions (Vedna *et al*. 2007) [15]. The results of table 2 revealed that value of technology index was 32.2% and 31.3% during 2018-2019 and 2019-20 respectively. Whereas the average value of technology index was recorded 31.75%. Lower the value of the technology index more is the feasibility and applicability of the tested technology. This showed that a gap existed between technology evolved and technology adopted at farmer's field. The similar results were also observed by Gangadevi *et al*. 2018, Chaudhari *et al*. 2019 and Jamwal Anamika *et al*. 2020.

Table 1: Technology demonstrated in CFLD's and Farmer's practices

S/No.	Practice	Demonstrated practice	Farmers practice
1	Field preparation	2 ploughings	Single plough
2	Method of sowing	Line sowing by seed drill & Nari	Broad casting
3	Variety	JG14	Local Khajua
4	Seed treatment	Thirum @ 2.5 gm/kg of seed, Rhizobium, PSB & Trichoderma @ 5gm/kg of seed	No seed treatment
5	Seed rate and spacing	75kg/ha	120-140 kg/ha
6	Manures and fertilizers	PSB 500ml, Rhizobium 500gm with 100kg vermicompost and sulphor 20:40:20:10	Nil
7	Weed management	Pendimethaline @ 2,5lit/ha	No pre emergence used
8	IPM measures	IPM practices like spraying of Neem oil need based pesticides and pheromone traps, yellow traps	Indiscriminate usage of pesticides
9	Technical guidance	Time to time	Nil

Table 2: Year wise productivity, extension gap, technology gap and technology index of Chickpea as grown under CFLD's and existing package of practices.

Year	Yield q/ha		Increase yield % over Control	Extension gap (q/ha)	Technology gap (q/ha)	Technology Index %
	Demo	Farmer's Practice				
2018-19	13.56	8.09	67.61%	5.47	6.44	32.2
2019-20	13.92	8.20	69.75%	5.72	6.26	31.3
Mean	13.74	8.15	68.68%	5.60	6.35	31.75

Table 3: Cost of cultivation, Gross return and B:C ratio of Chickpea as grown under CFLD's and existing package of practices.

Year	Cost of Cultivation (Rs/ha)		Gross Return (Rs/ha)		Net Return (Rs/ha)		B:C Ratio	
	Demo	Farmer's Practice	Demo	Farmer's Practice	Demo	Farmer's Practice	Demo	Farmer's Practice
2018-19	20600	18300	62647	37376	42047	19076	3.04	2.04
2019-20	20800	18450	64310	37884	43510	19434	3.09	1.82
Mean	20700	18375	63479	37630	42779	19255	3.07	1.93

Economic analysis of Cluster Front Line Demonstrations

Average cost of cultivation of demonstration plot (Rs 20700/ha) is more as compared to Farmer's practice (Rs 18375/ha). The data in table 3 clearly clarified the implication of Cluster Frontline Demonstration at Farmer's field during the period of study in which higher average net return rupees 42779 were acquired under Demonstration plots as compared to farmer's practice (Rs 19255/ha). Benefit cost ratio recorded was also higher in demonstration plots (3.07) as compared to farmer's practice (1.93) increased monetary returns as well as Benefit cost (B:C) ratio through improved farm technology have also been reported by various scientists (Vedna *et al.* 2007 [15], Bairwa *et al*. 2013 [2] and Jamwal Anamika *et al.* 2020)

Conclusion

The present study indicated that the incorporation of improved farm technology practices along with active participation of farmer's of the area has positive effect on increasing the grain yield and economic return of Chickpea in Mandla district the economic viability of suitable technology for increasing the productivity of Chickpea motivated the farmers towards adoption of technologies demonstrated at farmer's field.

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