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Yield gap analysis of chickpea through front line demonstration in Bastar district of Chhattisgarh

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Abstract
Front line demonstration is an appropriate tool to demonstrate recommended technologies among the farmers. Krishi Vigyan Kendra, Bastar (Chhattisgarh) conducted 286 demonstration on chickpea from 2015-16 to 2018-19 in adopted villages. The critical inputs were identified in existing production technologies through bench mark survey. The recommended packages of practice were adopted by the farmers in all the villages. The training programme on different aspects of crop production technologies were organized among beneficiaries and other participating farmers. Seed yield of chickpea in the demonstration plot varied from 15.70 q/ha during 2018-19 to 12.50 q/ha during 2017-18. Average seed yield under improved practice (IP) (14.01 q/ha) was 51.7% higher over farmer's practice (FP). The per cent increase in yield with IP over FP was recorded in the range of 36.8 to 60.2. The technology gap and extension gap were in the range of 4.30-7.50 q/ha and 3.36-5.90 q/ha respectively. Technology index value varied from 21.5% to 37.5% during the study period. The benefit cost (B: C) ratio was 2.81 to 2.95 under demonstration, while it was 2.15 to 2.57 under control plots. The average B: C ratio under IP (2.86) was 24.9% higher over FP.

Keywords: Chickpea, extension gap, FLD, technological gap, technological index

Introduction
The Chickpea (*Cicer arietinum* L.) is one of the important grain legume crops in Chhattisgarh as well as in India. In India, it occupies about 10.56 million ha area, with a production of 11.23 million tonnes and productivity of 1063 kg/ha. Chhattisgarh is the 8th largest producing state of chickpea in India. In Chhattisgarh, it is grown in 0.32 million hectares area with production of 0.32 million tonnes and productivity of 995 kg/ha (Anonymous, 2018) [1]. Chickpea is not only an important source of protein in the human diet, but also plays an important role in biological nitrogen fixation in the soil. Nutritionally, it contains 24% protein, 59.6% carbohydrates, and 3.2% minerals (Gaur *et al*.,) [2].

There is urgent need to enhance the productivity of chickpea to meet the rising demand, of pulses in India. Majority of farmers in India usually grow pulses on marginal land with indiscriminate use of chemical fertilizers without biofertilizers and other faulty management practices like intensive tillage unscientific application of irrigation etc. that has threatened the sustainability of the crop. There is decline in soil fertility due to reduction of soil organic matter and multi nutrient deficiency. This has become a major limitation for pulse crop production particularly in low-input agricultural systems around the world (Lynch, 2007) [3]. Biofertilizers, a type of organic fertilizers, are emerging as an ecologically safe means of fertilization. Commonly used biofertilizer are *Rhizobium*, phosphate solubilizing bacteria (PSB) and plant growth promoting *Rhizobacteria* (PGPR). Biofertilizer augment the biochemical processes in soil such as nitrogen fixation, phosphorus solubilization and mobilization, zinc solubilization, production of plant growth promoting substances and pathogen control. Biofertilizers provide an economically judicious, attractive and ecologically sound means of fertilization (Patel *et al*., 2013) [4] and are important for making agriculture more sustainable. Therefore, there is a need to find out eco-friendly, feasible and cheaper options to meet the nutrient needs of the chickpea grown in cropping systems for maintaining soil fertility and crop productivity, which is the need of present hour.

Materials and Methods
The study was carried out by Krishi Vigyan Kendra, Bastar, Chhattisgarh, during Rabi season of 2015-16 to 2018-19 (for four consecutive years) in the farmers field of fifteen adopted villages *viz*. Tamakoni, Chapka, Palli, Bade Morathpal, Dhurguda, Kondaloor, Titirgaon, Madhota, Jhartarai, Nadisagar, Parpa, Chhaparbhanpuri, Belar, Badanji and Tikralohanga of Bastar district. The farmers were selected from operational area of KVK, Bastar as per the

annual action plan and allotment of funds from Zonal Project Directorate (Zone IX). During four years of study, a total of 120 ha area was covered under cluster front line demonstrations with active participation of 286 farmers.

The necessary steps for selection of site and farmers, layout of demonstration etc. were followed as suggested by Chowdhary (1999) [5]. After site selection; soil samples were collected from farmer's field by KVK technical team. Critical inputs related to the technology were provided by KVK to the farmers. The specific skill training was imparted to the selected farmers on package of practices and other aspects of chickpea cultivation by the KVK scientists. Besides these, regular visits of demonstration field were done by KVK scientists in order to ensure day to day guidance to the farmers at different crop growth stages. Group meeting during crop growth period and field days at crop maturity stage were also organized at demonstration field to share the experience and to provide opportunities to other farmers to observe the benefit of demonstration technologies. The difference in cultivation practices among demonstration field and farmer's field are presented in Table-1.

In general the soil of demonstration field was alfisol and vertisol with a pH ranging from 6.2 to 8.0. In demonstration field, improved variety of chickpea namely JAKI 9218 and JG-14 were sown by line sowing method. Balanced fertilization was done on the basis of soil test. Timely weeding and need based pesticide applications were emphasized. The traditional package of practices was followed in case of local checks. Observations were collected from both FLD plots as well as control plots and finally the technology gap, extension gap and technology index along with the benefit: cost ratio were worked out as suggested by Samui *et al.* (2000) [6].

Technology gap = Potential yield-Demonstration yield

Extension gap = Demonstration yield-Farmers yield

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

Table 1: Comparison between demonstration packages and existing practice under chickpea FLDs

S. No.	Chickpea		
	Particulars	**Demonstration package**	**Farmers practice**
1.	Farming situation	Rainfed	Rainfed
2.	Variety	JAKI 9218, JG-14	JG-315
3.	Time of sowing	First week of November	First week of December
4.	Method of sowing	Line sowing	Broadcasting
5.	Seed treatment	With *Trichoderma harzianum* @10 gm/kg seed	Without seed treatment
6.	Fertilizer dose	20 kg N + 40 kg P_2O_5 + 20 kg K_2O/ha	Without fertilizer
7.	Seed inoculation	Seed inoculation with Rhizobium 5 g + PSB 5 g/kg of seed	Generally not inoculated
8.	Weed management	Use of pre and post emergence herbicide	No weeding
9.	Plant protection	Need based application	Non judicious use of pesticides
10.	Harvesting	Crop was harvested at physiological maturity	Majority of the farmers unaware about exact maturity symptoms; resulting in shattering of grain.

Result and Discussion

The perusal of the data in Table 2 indicated that the yield of chickpea fluctuated successively over the years. Seed yield of chickpea in the demonstration plot varied from 15.70 q/ha during 2018-19 to 12.50 q/ha during 2017-18. Average seed yield in the demonstration plot (14.01 q/ha) was 51.7% higher over control plot (9.24 q/ha). Highest increase in seed yield in the demonstration plot was recorded during 2018-19 (60.2%), while the lowest yield increase (36.8%) was observed in 2017-18. The results are in conformity with the finding of Tiwari *et al.* (2003) [7], Singh *et al.* (2019) [8]. The finding clearly indicates the positive effects of FLD_S over the existing farmer's practices towards the yield enhancement of chickpea. Benefit- cost ratio was recorded to be higher under demonstration against control during all the years of study. The average B: C ratio under demonstration (2.86) was 24.9% higher over farmer's practices. Technology gap varied in the range of 4.3 q/ha in 2018-19 to 7.5 q/ha in 2017-18; which reflects the farmer's co-operation in carrying out such demonstrations with encouraging results in subsequent years. The technology gap observed may be attributing to the dissimilarity in soil fertility status and weather conditions similar findings was recorded by Katare *et al.* (2011) and Mitra *et al.* (2010) [9].

The extension gap was in the range of 3.36 q/ha in 2017-18 to 5.90 q/ha in 2018-19. Variation in the extension gap emphasizes the need to educate the farmers through various means for adoption of improved agricultural production to reverse the trend of wide extension gap. The average value of technology gap and technology index during the study period was 5.99 q/ha and 30.0% respectively. The technology index data showed technology feasibility at the farmers' field. The lower value of technology index the more is the feasibility of technology. Technology index value varied from 21.5 to 37.5% during the study period may be attributed to the dissimilarity in soil fertility status, weather conditions and insect-pest attack. Similar findings also reported by Nawange *et al.* (2018) [10].

Table 2: Productivity, technology gap, extension gap, technology index and B: C ratio of chickpea under FLD

Year	Area (ha.)	No. of farmers	Seed yield (q/ha)			% increase over control	Technology gap (q/ha)	Extension gap (q/ha)	Technology index (%)	B:C ratio	
			Potential	Demo	Control					Demo	Check
2015-16	40	100	20	13.50	8.50	58.8	6.50	5.00	32.5	2.86	2.27
2016-17	30	75	20	14.33	9.50	50.8	5.67	4.83	28.4	2.95	2.15
2017-18	30	75	20	12.50	9.14	36.8	7.50	3.36	37.5	2.81	2.16
2018-19	20	36	20	15.70	9.80	60.2	4.30	5.90	21.5	2.82	2.57
Average				14.01	9.24	51.7	5.99	4.77	30.0	2.86	2.29

Conclusion
On the basis of results of study it may be concluded that:

- The yield under demonstration plots was higher than the local check fields.
- There is need to provide technical support to the farmers through different educational and extension agencies to reduce the extension gap
- Farmers can get more income from the cultivation of demonstrated variety instead of local check
- The use of scientific method of chickpea cultivation can reduce the technology gap to a considerable extent thus leading to increased productivity of chickpea in the district.

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