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Effect of Technological Interventions of Cluster Frontline Demonstrations (CFLDs) on Productivity and Profitability of Green gram (*Vigna radiata* L.) in Sahibganj, Jharkhand

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ABSTRACT

Present study was carried out for popularization of summer green gram production technologies during 2016-17 to 2019-2020 at farmer's field across five villages of five blocks in Sahibganj district of Jharkhand through Cluster Frontline Demonstrations (CFLDs). A total of 119 demonstrations were conducted involving farmers on a total area of 40 ha with scientific production technologies to evaluate the performance of improved variety of green gram on productivity and profitability. Green gram is an important pulse crop of Sahibganj covering over 5,218 ha with an average productivity of 6.5 q/ha which is lower than the state average (9.25 q/ha) and national average (9.7 q/ha). Unavailability of improved variety as well as non-adoption of scientific cultivation practices in the district is one of the possible reasons for lower average productivity of green gram. Performance of green gram variety IPM 02-3 in 119 locations along with improved cultivation practices like line sowing, treatment of seed with fungicide, insecticide and bio-fertilizer, balanced nutrition and weed management were evaluated. It was found that the yield of green gram in CFLD ranged from 8.5 to 8.9 q ha^{-1} whereas, in Farmer's Practice (FP) it ranged between 5.5 to 5.8 q ha^{-1}. Per cent increase in yield with Improved Practices (IP) over FP was recorded in the range of 52.63 to 57.14. The extension gap and technological index ranged between 2.0 to 3.2 q ha^{-1} and 34.07 to 37.03%, respectively. The trend of technology gap reflected the farmer's cooperation in carrying out demonstrations with encouraging results in subsequent years. Maximum gross return (Rs 62,078 ha^{-1}) and net return (Rs 37,078 ha^{-1}) was fetched during four observation years. The benefit cost ratio varied from 1.83 to 2.48 under demonstration, while it was 1.25 to 1.76 under farmer's practice. Therefore, the results clearly indicate that the use of improved variety and package of practices with scientific interventions under cluster frontline demonstration program contributed to increase the productivity and profitability to a greater extent.

Keywords Extension gap, Technology transfer, Green gram yield, Cluster frontline demonstrations, Technology index, Economics.

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INTRODUCTION

Pulses have great importance in Indian agriculture as they are rich in protein (17 to 25%) compared to that of cereals (6 to 10%) and in addition, their ability to fix atmospheric nitrogen and improve the soil fertility. India being second most populated country in the world with domination of veg-dietary habits still far from achieving sufficiency in pulse production. Pulses are rich and predominating source of protein with Recommended Dietary Allowances (RDA) for adult male and female is 60 g and 55 g per day, while its per capita availability is @ 42 g per day (Anonymous 2019). India is the largest producer and consumer of pulse with maximum area coverage in the world. Yet, with stagnation of production in spite of increase in demand, there has been an increasing demand supply gap for pulse in India which create huge economic loads in term of import to meet out the domestic demands. According to the vision 2030 of ICAR- Indian Institute of Pulse Research, Kanpur growth rate of 4.2 % has to be ensured to meet out projected demand of 32 MT of pulse by 2030 (Tiwari and Shivhare 2017). In order to ensure self- sufficiency, the pulse requirement in the country is projected to be about 39 million tonnes by year 2050 which necessitates adoption of green gram as a suitable option in summer season for higher crop productivity and profitability with improved soil health. Pulses are grown worldwide on an about 85.40 M ha with a production of 87.40 (MT) at 1023 kg ha^{-1} yield level. India, ranks first in term of area (29.3 M ha) and production (245 lakh tones) with 34 % and 26% contribution, respectively (Anonymous 2018). A remarkable increase in productivity of pulses over 11th Plan (662 kg ha^{-1}) and 12th Plan (745 kg ha^{-1}) was reported in 2016-17 (835 kg ha^{-1}). Green gram with 11.5 MT production from 14.56 M ha area and 1266.08 kg ha^{-1} productivity also make a record in 2018-19 in the country.

Green gram (*Vigna radiata* L.) is commonly named as mung bean. It is an important pulse crop in India grown in *kharif* and summer season and it is one of the thirteen food legumes grown in India and the third most important pulse crop after chickpea and pigeonpea. Green gram is a protein rich staple food. Because of its better nutritional quality, it is called as "Queen of pulses". It contains about 25% protein which is almost three times that of cereals. In addition to being an important source of human food and animal feed by virtue of its ability to fix atmospheric nitrogen, green gram is traditionally indispensable components of cropping systems in India and is also climate resilient and can be sown in rainfed areas. In Jharkhand green gram occupies a major position in terms of area, production and productivity among the pulses. The improved variety IPM 02-3 adopted in program is bold seeded crop with a duration of 62-68 days having wide adaptation depending upon the environmental conditions over a period of time, a number of improved green gram varieties and production technologies have been developed, but the full potential of the varieties as well as technologies could not be exploited due to low rate of adoption and low yield and hence factors limiting the productivity cannot be overlooked. Research and extension program need to be diverted to produce value additive pulse. It may emphasize on quality attributes, adoption and popularization of new agricultural technologies, evolving better varieties for stress conditions and improving present yield potential with an aim to raise production through transfer of farm technology.

Cluster front line demonstration (CFLD) is a novel approach to provide a direct interface between researcher and farmer for the transfer of technologies developed by them and to get direct feedback from farming community. To meet the growing demand for food grains, National Development Council (NDC) in its 53rd meeting adopted a resolution to enhance the production of rice, wheat and pulse by 10, 8 and 2 million tons respectively by 2011 with an outlay of Rs. 4,882 corers under National Policy for Farmers in the Eleventh Five Year Plan. The proposed centrally sponsored scheme 'National Food Security Mission (NFSM)' is to operationalize the resolution of NDC and enhance the production of food grains (Anonymous 2011). The concept of Cluster Frontline Demonstration was put forth under this mission. The scheme implemented in a mission mode through a farmer centric approach. The basic strategy of the mission is to promote and extend improved technologies, i.e., seed, micronutrient, soil amendments, integrated pest management, farm machinery and implements, irrigation devices along with capacity building of farmers. The project was implemented by Krishi Vigyan Kendra, Sahibganj with main objective to boost the production and productivity of pulse through CFLD with latest and specific technologies.

MATERIALS AND METHODS

The study was carried out during Summer season from 2016-17 to 2019-20 (4 consecutive years) by the KVK Sahibganj, Jharkhand. The villages covered under CFLDs were Dudhkol (Block – Taljhari) in 2016-17, Kazigaon (Block – Rajmahal), Dighi (Block – Pathna) in 2017-18, Birbalkandar (Block – Borio) in 2018-19 and Panchkathiya (Block – Barheit) in 2019-20 of Sahibganj district of Jharkhand. Number of locations (beneficiaries) during 2016-17, 2017-18, 2018-19 and 2019-20 were 27, 32, 30 and 30, respectively. Beneficiaries (farmers/ farmwomen) were identified through their participation and feedback received during the preliminary survey, awareness program and interactive meetings. Farmers were trained to follow the package and practices for green gram cultivation as recommended by the Birsa Agricultural University and critical inputs for the technologies like seeds, fungicides, insecticide, biofertilizers were distributed to the farmers however balanced plant nutrients on the basis of soil test value were applied by the farmers from their own resources. Detail of technological interventions are presented in Table 1. Regular field visit, monitoring and need based advisories were provided by the scientists of KVK. All 119 demonstration in 40-ha area were conducted by the active participation of the farmers with an objective to demonstrate the improved technologies of green gram production potential in different villages. In case of local check, the traditional practices were followed by using existing variety. In demonstration plots, use of quality seeds of improved variety IPM 02-3 with line sowing, timely application of weedicide and need based pesticide as well as balanced fertilizer were emphasized. In general, the soil of the experimental plots were sandy loam in texture, acidic in soil reaction (pH 5.6 to 6.4), low to medium in organic carbon (0.36 to 0.58 %), medium status in available nitrogen (305 to 350 kg/ha), low to medium in available phosphorus (7.8 to 11.4 kg/ha) and also low to medium in available potassium (104 to 126 kg/ha). The farmers under the programme were facilitated by KVK scientists in performing field operations like sowing, spraying, weedicide application, harvesting. Finally, field day was conducted involving demonstration holding farmers, other farmers in the village, scientist from KVK, officials from Department of Agriculture, local extension functionaries to demonstrate the superiority of technology. The basic information was recorded from the demonstration and control plots and analyzed for comparative performance of the cluster frontline demonstrations (CFLDs) and farmer's practice. The yield data were collected both from the demonstration and farmers practice by random crop cutting method and analyzed by using simple statistical tools. The technology gap and technological index (Yadav *et al.* 2004) along with the benefit cost ratio (Samui *et al.* 2000) were calculated by using following formula as given below.

Extension Gap=Demonstration Yield-Farmers Practice Yield

Technology Gap=Potential Yield-Demonstration Yield

Additional Return=Demonstration Return-Farmers Practice Return

$$\text{Technology Index} = \frac{\text{Potential Yield — Demonstration Yield}}{\text{Demonstration Yield}} \times 100$$

$$\text{Percent increase in yiels} = \frac{\text{Demonstration Yield— Farmer's Practice Yield}}{\text{Farmer's Practice Yield}} \times 100$$

RESULTS AND DISCUSSION

Cluster frontline demonstrations conducted during 2016-17 to 2019-20 in different villages of Sahibganj resulted in increased yield of green gram to a greater extent (Table 2). Effect of technological interventions like improved variety, proper seed rate, seed treatment, sowing method and time and nutrient management may be the probable reasons for increase in yield. The different technological interventions under CFLDs are presented in Table 1. Under demonstration plot recommended improved variety, bio-fertilizers, herbicide and insecticide for plant protection measures were given to the farmers by the KVK and all other package and practices were timely performed by the farmer itself under the supervision of KVK scientist. In case of Farmer's Practice, they generally sow seed of the local varieties of green gram at a higher seed rate without treatment. The result

Table 1. Difference between technological intervention and farmer's practices under CFLD on green gram.

Particulars	Technological intervention in CFLD	Farmers practices	Gap
Variety	IPM 02-3	Local/own seed	Full gap
Seed rate	20 kg/ha	40 kg/ha	High seed rate
Sowing method/ spacing	Line sowing (20 × 10 cm) with seed cum fertilizer drill	Broadcasting, uneven plant population	Partial gap
Time of sowing	15 to 30 March	March to April	Partial gap
Seed Treatment	Seed treatment was done with 2.5 gm of Carbendazim and 5 ml of Imidacloprid per kg seed for diseases and sucking pest, Trichoderma @ 5 g/kg seed to control wilt and with Rhizobium culture+ PSB @ 2 packets each for 10 kg seed	No seed treatment	Full gap
Fertilizer	Balanced fertilizer application as per soil test values, 44 kg of urea and 312.5 kg of SSP as basal dose/ha.	Imbalanced use of fertilizer 50 kg urea as top dressing and 5o kg of DAP as basal dose/ha	Full gap
Weed management	Application of Imazethapyr 10 % SL @ 40 g a.i 3 ha^{-1} as post-emergence and one hand weeding a 30-45 DAS	Manual weeding at 40 DAS	Full gap
Plant Protection	Need based timely spraying.	Injudicious use of insecticides based on advice of input dealers	Partial gap with high cost

obtained during last four years presented in Table 2 revealed that the average grain yield of green gram under cluster frontline demonstrations were ranged from 8.5 to 8.9 q ha^{-1} as compared to 5.5 to 5.8 q ha^{-1} in case of Farmer's Practice during 2016-17 to 2019-20. As far as per cent increase in demonstration yield over yield obtained under Farmers Practice is concern, an average of 54.43% increase was found during the four years of demonstrations. However, the yield obtained in demonstration plots over the year were still lower than potential yield which may be attributed to climatic conditions of the areas during the maturity period. Data presented in Table 2 also indicates that the yield of green gram fluctuate little over the years in demonstration plots. Similar yield enhancement in different crops in cluster frontline demonstrations were documented by Mishra *et al.* (2009) in potato; Kumar et al., (2010) in bajra; Singh *et al.*(2012) in green gram; Jha *et al*. (2020) in black gram, Jha *et al.* (2020) in pigeonpea, Jha *et al.* (2020) in chickpea and Jha *et al*. (2021) in mustard. The increase in percent of yield was ranged from 52.63 to 57.14 during the four years of study. The results were in conformity with the findings of Katare *et al.* (2011), Saikia *et al.* (2018), Jha *et al*. (2020). The extension gap ranging from 2.0 to 3.2 q ha^{-1} over the years of study emphasizes the need to educate the farmers through various means for adoption of improved agriculture practices to reverse the trend of wide extension gap. The trend of technology gap ranging between 4.6 to 5.0 q ha^{-1} reflects the farmers cooperation in carrying out demonstrations with encouraging result in subsequent years. Similar findings were recorded by Katare *et al.* (2011) in oilseeds; Singh *et al*. (2012) in green

Table 2. Grain yield and Gap analysis of cluster frontline demonstration on green gram.

Year	Sample area (ha,	Sample No. of farmers	Average yield (Q/ha) Potential	CFLD	FP	% increase over FP	Technology gap (q/ha)	Extension gap (q/ha)	Technology index (%) CFLD
2016-17	10	27	13.5	8.5	5.5	54.54	5	2	37.03
2017-18	10	32	13.5	8.8	5.6	57.14	4.7	3.2	34.81
2018-19	10	30	13.5	8.9	5.8	53.44	4.6	3.1	34.07
2019-20	10	30	13.5	8.7	5.7	52.63	4.8	3.0	35.55
Average	-	-	13.5	8.72	5.65	54.43	4.77	2.82	35.36

Table 3. Economic analysis of the cluster frontline demonstrations on green gram. Note: Price of Green gram @ Rs.4850.00 qt^{-1} in 2016-17, Rs.4850.00 q^{-1} in 2017-18, Rs.6975.00 qt^{-1} in 2018-19 and Rs.7050.00 qt^{-1} in 2019-20.

Year	Total return (Rs per ha)		Input cost (Rs per ha)		Net return (Rs per ha)		Additiona	B:C ratio	
	Recommended practice (RP)	Farmer's practice (FP)	Recommended practice (RP)	Farmer's practice (FP)	Recommended practice (RP)	Farmer's practice (FP)	return (Rs per ha) CFLD	Recommended practice (RP)	Farmer's practice (FP)
2016-17	41,225	26675	22500	19000	18725	7675	14550	1.83	1.40
2017-18	42680	27160	23000	21600	19680	5560	15520	1.85	1.25
2018-19	62078	40455	25000	22900	30382	17555	21623	2.48	1.76
2019-20	61335	40185	27000	24500	34335	15685	21150	2.27	1.64
Average	51829.5	33618.75	24375	22000	25780.5	11618.75	18211.5	2.10	1.51

gram, Saikia *et al*. (2018) in black gram and Jha *et al.* (2020) in black gram, chickpea and pigeonpea. The technology gap over the years of study may be attributed to dissimilarity in soil fertility status, rainfall distribution, pest infestation, weed intensity and change in locations of cluster frontline demonstration sites. However, the result observed is an evidence of the better performance in varied environmental condition over farmer's practice. The technology index showed the feasibility of the evolved technology at the farmer's field. The technology index ranging from 34.07 to 37.03% during the years of study exhibited a decreasing trend over the years with low fluctuation which may be attributed to the dissimilarity in weather condition, soil fertility status and non-availability of water in the crop. The lower the value of technology index the more is the feasibility of the improved technology. On an average Technology Index was 35.36 per cent during four years (2106-17 to 2019-20) which showed the efficacy of good performance of technical interventions. This may accelerate the adoption of demonstrated technical interventions to increase the yield performance of green gram.

Economic performance of green gram under cluster frontline demonstration presented in Table 3. Results of economic analysis parameter revealed that the green gram recorded higher total return of Rs 41,225/-, Rs 42,680/-, Rs 62,078/- and Rs 61,335/- per ha during 2016-17, 2017-18, 2018-19 and 2019-20, respectively under CFLDs as compared to Rs 26,675/-, Rs 27,160/-, Rs 40,455/- and Rs 40,185/- per ha, respectively under farmers practice. Technologies demonstrated under CFLDs also had positive influence on net return and thereby benefit cost ratio (B:C ration) over farmer's practice. The net return ranged from Rs 18,725/- to Rs 37,078/- per ha under recommended practice as compared to Rs 5,560/- to Rs. 17,555/- per ha in farmer's practice. It was observed that the additional returns ranged from Rs. 14,550/- to Rs. 21,623/- per ha under recommended practices during the years. The higher benefit cost ratio was also recorded under recommended practices and the observed B:C ratio was 1.83, 1.85, 2.48 and 2.27 during 2016-17, 2017-18, 2018-19 and 2019-20, respectively as compared to 1.40, 1.25, 1.76 and 1.64, respectively under farmers practice. These results are in accordance with the findings of Gurumukhi and Mishra (2003), Singh *et al.* (2012), Jayalakshmi *et al.* (2018), Jha *et al*. (2021).

CONCLUSION

The cluster frontline demonstrations (CFLDs) conducted by KVK enhanced the yield of green gram vertically and ensured rapid spread of recommended technologies of green gram production horizontally by implementation of various extension activities like training program, field days, exposure visits organized in farmer's field. The CFLDs made a positive impact on yield of green gram by 54.43 %. It was observed that the potential yield of green gram variety IPM 02-3 can be achieved by imparting scientific knowledge to the farmers, providing the quality need-based inputs and their proper utilization. These demonstration trails also enhanced the relationship and confidence between farmer and KVK scientists. The recipient farmers of CFLD also play an important role as source of information and quality seeds for wider dissemination of the improved varieties of green gram for other nearby farmers.

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