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An appraisal of cluster frontline demonstrations on soybean crop in Bishnupur district of Manipur

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Abstract
Soybean (*Glycine max* L.) is one of the most important oil seed cum pulse crop cultivated in Bishnupur district of Manipur. The production and productivity of soybean in the district is found to be low, therefore constant attempts are being made to improve the productivity and to increase the area under soybean by adopting high yielding variety along with improved cultivation practices. The present study was conducted to analyze the yield gap between improved package of practices and farmers' practice during *rabi* 2018-19 to 2020-21 in CFLDs on soybean. The highest average yield was obtained in CFLDs (1172.5 kg/ha), with 56.7 per cent more against farmers' practice (759.5 kg/ha). On average, extension and technology gaps were recorded as 413 kg/ha and 796.5 kg/ha, respectively. The average technology index was 40.5 per cent, and the lowest was noticed in the last season of the demonstrations, indicating the increased adaptability and efficiency of recommended technologies in field conditions. The average gross returns (Rs. 79,642.5/ha), net returns (Rs. 49,642.5/ha) and benefit-cost ratio (2.61) were higher in improved practice when compared to farmers' practice. The mean of additional gross returns (Rs. 28,195.0/ha), cost of cultivation (Rs. 4,125.0/ha), net returns (Rs. 24,070.0/ha) with incremental benefit-cost ratio of 8.2 was observed in improved practice. Overall, the CFLDs positively impacted the soybean growers of that particular area and motivated them to adopt there commended practises for higher yield and profitability.

Keywords: CFLD, economics, extension gap, farmers's practice, soybean, technology gap, technology index, yield

Introduction

Soybean (*Glycine max* L.) belonging to family Leguminosae is one of the important oil seed crops of the world and has recognized as beneficial source of protein, edible oil and functional food. It is having high nutritive value and used as feed, oil and soy food products. It is rich in oil (18- 22%) and protein (38-42%). Soya oil contains 85% unsaturated fatty acids that include high content of essential fatty acids such as linoleic acid and linolenic acid. As it is a most resilient crop by providing subsistence to small and marginal farmers under erratic monsoon rainfall with improvement of farmer's livelihood in India. It is an exceptional crop among oilseeds attaining an unparallel glory of horizontal expansion in very short span of nearly four decades. It continues to be number one oilseed crop in India, currently occupying 12.81 million ha with an estimated production of 12.90 million tonnes and productivity of 1007 kg ha^{-1}(2020-21). In Manipur it is one of the most important oilseed cum pulse crop cultivated during the *kharif* seasons mostly in those areas where there is unfit for paddy cultivation. Therefore concerted efforts are required to enhance its productivity.

Integrated crop management (ICM) incorporates suitable crop production practices for yield and productivity enhancement, comprising of tillage, integrated nutrient management, integrated weed management, integrated nutrient management, and integrated pest management practices. ICM is mainly beneficial from the perspective of small and marginal farmers as it is a sustainable long-term approach, aiming to utilize the on-farm resources judicially in a suitable and collective manner. The technology gap is a major constraint in increasing yield and sustainability due to poor knowledge on the latest improved technologies among farmers in soybean cultivation. Cluster Frontline Demonstrations (CFLDs) is an unique approach with the main objective of conducting demonstration in larger area on the farmers' field and creating awareness on the latest crop production technologies among the farmers (Swapnil Dubey *et al*. 2011; Raghava & Punnarao, 2013; Shaktawat & Chundawat, 2021) [14, 6, 12].

In keeping view of this, KVK, Bishnupur had planned and executed Cluster Frontline Demonstrations with improved technologies in soybean under different farming situations with closer supervision and monitoring of the KVK Scientists which helps in increasing productivity, economic returns, and sustainability and to analyze yield gap and technology gap and impact of technology in groundnut cultivation with the best management practices.

Methods and Materials

The CFLDs were conducted in 3 blocks (Nambol, Bishnupur and Moirang of the Bishnupur district of Manipur during the 4 consecutive rabi seasons from 2018-19 to 2021-22 as mustard is the major rabi season crop in these blocks. A combination of experimental (control treatment) and before-after research designs was used for the present study. Before conducting the CFLDs, a baseline survey was done in the selected blocks to identify the existing cultivation practises followed by the soybean growers. A total of 135 soybean growers with a cumulated land holding of 60 ha were identified for conducting the CFLDs as per their interest and participation during the baseline survey, interactive meetings, and awareness campaigns. The farmer's existing soybean cultivation practices were considered as the local check plot. In selected plots for CFLDs, the recommended ICM practises were adopted as per the recommended Package of Practices for soybean crop. Each and every one of the selected beneficiaries was trained to adopt the recommended ICM technologies for soybean cultivation, and the demonstrations were laid out in an area adjacent to the plots, where the was being grown with the prevailing cultivation practices/variety by the beneficiaries. The details of the recommended ICM technologies are presented in Table 2. The data regarding the crop yields were immediately collected from the check plots as well as the demonstration plots to identify the yield gaps. The economic parameters were worked out by considering the inputs' prevailing market prices for the particular year. The effectiveness of the conducted CFLDs was assessed by using the formulas suggested by Samui *et al*., (2000) [9]. The information from the beneficiary farmers regarding the adoption of recommended technologies was collected with a structured and pre-tested interview schedule at the end of the four consecutive CFLDs. A two-way ANOVA was used to determine whether the mean results obtained from the demonstrated plots for different parameters (grain yield, cost of cultivation, and net returns) of soybean cultivation, significantly differed from local check plots or not.

Technology gap = Potential yield - Demonstration yield

Extension gap = Demonstration yield - Farmer's yield

$$\text{Technology index} = \frac{\text{Potential yield} - \text{Demontration yield}}{\text{Potential yield}} x\ 100$$

Results and Discussion

Yield performance and gap analysis

Cluster Frontline Demonstrations of recommended technologies covered 10 ha, 20 ha, 20 ha, and 10 ha areas in 2018–19, 2019– 20, 2020–21, and 2021–22 years, respectively. The average yield of Demonstrated plots was 914 kg ha^{-1}, 894 kg ha^{-1}, 1252 kg ha^{-1}, and 1630 kg ha^{-1} for the four consecutive cropping seasons, which was significantly higher than farmers' practice by 68.6 per cent, 63.7 per cent, 37.6 per cent and 56.7 per cent respectively, during this entire period. The average yield of demonstrated plots was higher due to the adaptation of recommended ICM practices like line sowing, seed treatment, weed management, and disease management practices. Such a positive impact on the yield performance of soybean was observed due to the proper adoption of integrated crop management technologies and suitable soybean variety DSb-19. D.V. Lakshmi *et al*., (2021) [3] also reported similar yield enhancement of soybean crops under CFLDs. The study also revealed a wide gap between the potential yield and the yield obtained from the local check plots for the soybean crop. Such yield disparity of mustard in this region was due to a lack of awareness regarding the suitable soybean variety and a lack of knowledge about improved agronomic practices and fertilizer scheduling by the farmers. An extension gap of 372 kg ha^{-1}, 348 kg ha^{-1}, 342 kg ha^{-1} and 590 kg ha^{-1} was observed in the respective years from 2018-19 to 2021-22 (Table 1). Sensitizing the farmers to adopt improved soybean production technologies using extension activities like training, field days, Kisan goshthis, Kisan melas, awareness programmes, result demonstration initiatives, etc., can reduce the galloping trend of the extension gap in soybean production. The resulting technology gap depicted the disparity between the potential yield and the yield obtained from the demonstrated plots of soybean. Table 1 shows that the technology gap was highest in 2019-210, at 1075 q ha^{-1}, and lowest in 2021-22, at 339 kg ha^{-1}. The observed technology gap may be attributed to various factors related to dissimilarity in crop management practices, soil fertility, and climatic factors. In the last year of the demonstration, the technology gap was the least due to the better performance of the improved soybean variety and the adoption of recommended ICM technologies with different interventions. The technology index in Table 1 depicts the feasibility of the adopted ICM technologies in the farmer's field. A higher technology index value indicates the inadequate transfer of proven technology among farmers, and a lower technology index value signifies the greater feasibility of any technology in the farmers' field. In this study, the technology index value ranged from 17.20 to 54.6 per cent. Further, on average, the technology index during these four study years was found to be 40.5 per cent, which shows the efficacy of ICM interventions and the adoption of demonstrated technologies. Overall, the adoption rate was satisfactory for all of the recommended ICM practices after the demonstration period, which was indicative of the beneficiary farmers' positive utility perception and satisfaction level. The results are corroborating with the findings of Simanta *et al.* 2020 [13], Shaktawat, R. P. S., & Chundawat, G. S. (2021) [12] and Manoj *et al.* 2022 [2].

Economic analysis

From the economic analysis of soybean production (Table 2) it can be concluded that due to additional use of herbicide, seed treatment, application of micronutrients, and incorporation of insecticide, the cost of soybean cultivation was higher in demonstrated plots compared to local check plots in all four cropping seasons. Also the values of input cost and labour wages varied from time to time. The average gross and net returns were significantly higher in demonstrated plots compared to local check plots due to higher grain yield, indicating the importance and economic feasibility of the recommended production technologies. An additional return of Rs. 21180 ha^{-1} in 2018-19, Rs. 15880 ha^{-1}

in 2019-20, Rs. 19020 ha^{-1} in 2020-21, and Rs. 40200 ha^{-1} in 2021-22 were recorded from the demonstrated plots. The pattern of benefit-cost ratios of mustard production under CFLDs was recorded as 1.92, 1.95, 2.83 and 3.73 for the consecutive cropping seasons, which were higher in comparison to the local check plots under farmers' practice, i.e., 1.26, 1.46, 2.18 and 2.97, respectively. The higher benefit-cost ratio of the demonstrated plots proved the economic viability of the recommended ICM technological interventions with additional return on each rupee invested for the production purpose, and the farmers were highly convinced regarding the utility of the recommended package of practices for soybean production. The findings is in conformity with Pawar *et al.* 2017&18 [5] and Patil *et al.* 2018 [4], Further, it was observed that on the average of four years, an additional gross returns of Rs. 24,873.0/ha, saving on cost of cultivation for Rs. 4,125.0/ha and net returns of Rs. 24070.0/ha in improved practice were observed against farmer's practice with an incremental benefit-cost ratio of 8.2 (Table 2). These results were in conformity with that of Pawar Yogesh *et al*., (2017) & Saravanan *et al*., (2018) [10]; Reager *et al*., (2020); Rai *et al*., (2020) [6]; who observed higher benefit-cost ratio through improved technologies in groundnut and Layak *et al*., (2021) [1] in mustard and Saravanakumar *et al*., (2020) [11] in urd crop.

Table 1: Performance of improved technology on pod yield, extension gap, technology gap and technology index in blackgram during *kharif* 2016 to 2021

Year	Demonstration	Yield			Per cent increase over local yield	Extension gap (%)	Technology gap (%)	Technology index (%)
		Potential	Improved practice	Farmer's Practice				
2018-19	25	1969	914	542	68.6	372	1055	53.6
2019-20	40	1969	894	546	63.7	348	1075	54.6
2020-21	40	1969	1252	910	37.6	342	717	36.4
2021-22	25	1969	1630	1040	56.7	590	339	17.2
Average			1172.5	759.5	56.7	413.0	796.5	40.5

Table 2: Impact of improved technologies on economics of soybean during *kharif* 2018 to 2021

Year	Gross Cost (Rs./ha)		Gross Return (Rs./ha)		Net Return (Rs./ha)		B:C		Additional Gross Return (Rs/ha)	Additional Cost of Cultivation (Rs/ha)	Additional Net Returns (Rs/ha)	Incremental B:C ratio
	Improved practice	Farmer's Practice	Improved practice	Farmer's Practice	Improved practice	Farmer's Practice	Improved practice	Farmer's Practice				
2018	31000	28000	59410	35230	28410	7230	1.92	1.26	24180	3000	21180	8.06
2019	27500	22500	53640	32760	26140	10260	1.95	1.46	20880	5000	15880	4.18
2020	26500	25000	75120	54600	48620	29600	2.83	2.18	20520	1500	19020	13.68
2021	35000	28000	130400	83200	95400	55200	3.73	2.97	47200	7000	40200	6.74
Average	30000.0	25875.0	79642.5	51447.5	49642.5	25572.5	2.61	2.0	28195.0	4125.0	24070.0	8.2

Conclusion
The Cluster Frontline Demonstrations organized by KVK, Bishnupur had significantly increased yield in soybean. The yield of soybean was increased upto 56.7 per cent in improved practices over the farmers' practice. The gross returns, net returns and benefit-cost ratio were higher in demonstrations as compared to the farmers' practice. The additional gross returns, net returns, additional cost with incremental benefit-cost ratio were high in improved practice. The local varieties of soybean will be replaced by DSb-19 through large scale demonstrations in long run. The results indicated that the cluster frontline demonstration has given a good impact on the farming community of the districts as they were motivated by the new agricultural technology applied in the CFLD plots. More efforts should be made to motivate the farmers for adoption of improved agricultural technologies including HYV to revert the trend of wide extension gap and also increase their family income.

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