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Promotion of lentil cultivation in rice fallow areas under CFLD programme by Cooch Behar Krishi Vigyan Kendra

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Abstract
Background: Lentil (*Lens culinaris* L.) is a pulse crop belonging to the family leguminosae. The nutritious density and adaptability of lentils in a variety of cuisines make them highly valued. Lentils are a vital and affordable source of protein in many regions of the world, particularly in West Asia and the Indian subcontinent. The main causes of the low lentil production are lack of knowledge, the unavailability of improved seeds, inadequate technical guidance and poor crop management.
Methods: The present study was undertaken by Cooch Behar Krishi Vigyan Kendra under Uttar Banga Krishi Viswavidyalaya during the rabi season of 2019-20, 2020-21 and 2021-22 through organisation of frontline demonstration on scientific cultivation methods of lentil under CFLD on pulses programme in a cluster approach. Use of improved variety IPL-220, rhizobium inoculation, application of boron (20%) and need based application of fungicides was advocated in the demonstration plots.
Result: Lentil yield was 24.46% higher in demonstration plots in comparison to farmer’s practice. On an average of three years, technology gap in the CFLD programme was 701.33 kg/ha. The benefit cost ratio from demonstration plots was higher comparison to farmers practice in all the three study years. An average benefit cost ratio of 3.07 was recorded from demonstration plots and it was recorded 2.91 in farmers practice. The results clearly indicate the positive effects of FLDs over the existing practices.

Keywords: Frontline demonstration, lentil, yield

Introduction
The Department of Agriculture and Cooperation, Ministry of Agriculture & Farmers Welfare recognized the need to expand the area under pulse cultivation and boost pulse production, so they approved the "Cluster Front Line Demonstrations (CFLD) on Pulses 2015-16" project under the National Food Security Mission (NFSM) to the Indian Council of Agricultural Research. Through Krishi Vigyan Kendras (KVKs), the project aims to highlight the application of contemporary technology to address the problems associated with the production of pulses in the nation by showing the production potential of new technologies and types of pulse crops at farmers' fields. This approach is appropriate in strengthening of forward and backward linkages in the larger interest of the farming community. This project is being implemented out by ICAR-ATARI, Zone-V, Kolkata, using a network of KVKs in the state of West Bengal. Since the program's start, Cooch Behar Krishi Vigyan Kendra, operating under the aegis of Uttar Banga Krishi Viswavidyalaya, has been allotted with the CFLD program. Lentil (*Lens culinaris* L.) is a pulse crop belonging to the family leguminosae. With roots in the ancient Middle Eastern and Asian civilizations, they are among the oldest cultivated crops. The nutritious density and adaptability of lentils in a variety of cuisines make them highly valued. The color spectrum of lentils includes yellow, reddish-orange, green, brown, and black. The size of lentils varies as well, and they can be purchased whole, divided, or without the skins. Lentils are the third-highest protein-containing legume or nut by weight, behind hemp and soybeans, with roughly 30% of their calories coming from protein. Lentils are a vital and affordable source of protein in many regions of the world, particularly in West Asia and the Indian subcontinent, where a significant portion of the population is vegetarian. Proteins contain the important amino acids isoleucine and lysine. Methionine and cysteine are two important amino acids that are lacking in lentils. However, sprouted lentils contain sufficient levels of all essential amino acids, including methionine and cysteine. Minerals, vitamin B1, dietary fiber, and folate are also present in lentils. Compared to green lentils, red (or pink) lentils have a lower fiber content (11% versus 31%). Lentils are among the top five healthiest foods according to Health magazine.

People with diabetes should be particularly interested in lentils because of their low amounts of RDS (readily digestible starch) (5%), high levels of SDS (30%), and both. (Singh and Singh, 2014) [3]. As to the fourth advanced estimate from DES, MoAF & W, Government of India, India's lentil production was 1.28 million tonnes in 2022, with a productivity of 904 kg/ha, on an acreage of 1.42 million ha. In 2021, India was the leading importer of lentils, while Canada was the top exporter. The main legume crop grown by farmers in central and eastern India's rice-fallow regions is lentil. The highest producing state in India for lentils, according to the fourth advanced estimate from DES, MoAF&W, Govt. of India, 2022, is Uttar Pradesh (0.47 million tonnes from 0.49 million ha. acreage, 36.43% of national production). Madhya Pradesh (0.44 million tonnes from 0.49 million ha. acreage, 34.55% of national production), West Bengal (10.53%), and Bihar are next in line. The main causes of the low lentil production are lack of knowledge, the unavailability of improved seeds, inadequate technical guidance and poor crop management (Singh *et al*. 2020) [7]. In contrast, poor seed storage, inadequate irrigation, and inadequate marketing are socioeconomic infrastructure constraints in the production of pulses (Singh and Singh, 2014) [3]. Reddy (2004) [10] listed some of the major obstacles to improved pulse farming, including lack of technical competence, lack of knowledge, and seed availability. The absence of appropriate agricultural chemicals and inputs is the next major institutional restriction. In this regard, Cooch Behar Krishi Vigyan Kendra is promoting the scientific methods of lentil production by holding demonstrations in the rice-fallow areas of the Cooch Behar district in west Bengal as part of the CFLD Pulses initiative.

Materials and Methods

The study was conducted by Cooch Behar Krishi Vigyan Kendra under Uttar Banga Krishi Viswavidyalaya, Post-Pundibari, District- Cooch Behar and State- West Bengal in different villages under Cooch Behar-I block of Cooch Behar district in cluster approach. The district lies in between 25°57'47" & 26°36'20" North Latitude and 88°47'44" & 89°54'35" East Longitude. The total area of the district is 3387 sq. KMs, contributing 3.82% of the total land mass of the West Bengal state. The Frontline demonstrations on Scientific cultivation methods of lentil were organised in the pre selected farmers belonging to the villages of Chhat Singhimari, Sonari, Chakchaka and Kaljani of Cooch Behar-II Block during 2019-20, 2020-21 and 2021-22 respectively. Mainly rice-fallow areas were chosen for the study. The lentil growing season was rabi. The year wise area coverage under CFLD Pulses programme on lentil is given below:

Table1: Demonstration area of lentil under CFLD programme to Cooch Behar Krishi Vigyan Kendra

Sl. No.	Year	Area (Ha)	No. of demonstration	No. of cluster	area utilization under rice fallow (ha)
01	2019-20	20	50	2	12.8
02	2020-21	80	200	4	57.6
03	2021-22	30	75	3	22.2

Each demonstration plot was 0.4 hectares in size in accordance with the CFLD program criteria, and the same area served as the comparison control (Farmer's practice). Prior to carrying out the field demonstration, the cluster's beneficiary farmers received training on various aspects of scientific lentil cultivation techniques such as the necessity of rhizobium inoculation, timely micronutrient application, timely disease management, and timely harvesting. The soil under demonstration plot was sandy loam soil with ph ranging from 5.8 to 6.7. The improved variety IPL-220 was used during the study which has been released from ICAR-IIPR, Kanpur in 2018. The potential yield of the variety is 18 quintal/ha. The seed rate was 22.5 kg/ha. Rhizobium (Charcoal based) was applied @ 26.25 kg/ha along with FYM. The rhizobium was sourced from the company Leela Agrotech Pvt. Ltd, Madhyamgram, Kolkata. Recommended dose of fertilizer was given as per soil test value. The soil testing of the plots were done at Soil Lab of Cooch Behar Krishi Vigyan Kendra well ahead of initiation of demonstration. Line sowing method with 30 cm x 10 cm row to row and plant to plant spacing was followed to raise the crop. The application of pre-emergence herbicide Pendimethalin 30% EC @ 10 ml/litre was done to check weed infestation. The plants were sprayed with 20% Boron @ 2 gms/litre of water at 25 and 45 days after sowing (DAS). Need based application of fungicides were done. Various scientists from Cooch Behar KVK conducted periodic monitoring visits for field inspections. In each cluster, field days were arranged with KVK scientists, district line department officials, progressive farmers, and beneficiary farmers to showcase the technology for its further dissemination among the other lentil farmers of the village.

The yield data was collected from fields under farmers practice and demonstration fields by random crop cutting method. The data was then tabulated and analyzed to find out the findings and conclusion. The statistical tool like percentage used in this study for analyzed data. The economic parameters of the demonstration like cost of cultivation, gross return, net return, and benefit cost ratio were calculated by using prevailing prices of inputs and outputs. Other parameters like yield increasement (%), technology gap (%), extension gap (%) and technology index were worked out as suggested by Kumar *et al*. (2023) [4].

$$\text{Increasing yield (\%)} = \frac{\text{Demo yield} - \text{farmers yield}}{\text{Farmers yield}} \times 100$$

Technology gap = Potential yield – Demonstration yield
Extension gap = Demonstration yield – farmers yield

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

Increase in grain Yield = Grain yield from Demo plot– Grain yield from FP plot /Grain yield from Demo plot X 100

Net Return = Gross Return – Cost of cultivation

Benefit/ Cost Ratio = Gross Return / Cost of Cultivation X 100 (Singh *et al*. 2020) [7].

Results and Discussion

The results from the study indicated that the frontline demonstration has given a good impact over the farmers as they were motivated for adoption of new technology showcased in the CFLD plots of lentil. Farmers obtained greater yield from demo plots in comparison with farmers practice in all the study years.

Table 2: Grain yield, technology gap, extension gap and technology index of lentil var. IPL-220

Year	Crop	Variety	Potential yield (kg/ha)	Demo yield (kg/ha)	Farmers yield (kg/ha)	% increase	Technology Gap (kg/ha)	Extension Gap (kg/ha)	Technology Index
2019-20	Lentil	IPL-220	1800	1110	840	32.14	690	270	38.33
2020-21	Lentil	IPL-220	1800	1064	890	19.55	736	174	40.88
2021-22	Lentil	IPL-220	1800	1122	922	21.69	678	200	37.66
Average	-	-	-	1098.67	884	24.46	701.33	214.67	38.96

The yield data from demonstration plots and farmers practice, technology gap, extension gap and technology index has been depicted in table 2. The results indicated that during 2019-20, 2020-21 and 2021-22 higher yield was obtained in demonstration plots in comparison to plots with farmers practice. In 2019-20, 2020-21 and 2021-22, the percent yield increased was 32.14, 19.55 and 21.69% over farmers practice. An average 24.46% increased yield was noted over the study years. This is mainly due to use of scientific production methods.

The technology gap of demo plots were recorded as 690, 736 and 678 kg/ha respectively during the study period. On an average of three years, technology gap in the CFLD programme was 701.33 kg/ha. The technology gap is the difference between potential yield and yield obtained from demonstration plots. Lower the technology gap better will be its adoption. The technology gap observed at farm level is usually accredited to difference in the soil fertility status, agriculture practices and local climatic situation (Mishra *et al*. 2007) [5]. This gap is caused by the differences in climate, soil and other physical environ-ment factors, which are difficult to manage in demonstration farmer's field. Similar findings were also reported by Jopir and Bera (2017) [6].

Extension gap means the differences between demonstration plot yield and farmers yield. An extension gap of 270, 174 and 200 kg/ha was recorded during the rabi season of 2019-20, 2020-21 and 2021-22 respectively (Table 2). During the years period an average extension gap of 214.67 kg/ha was recorded. In order to reverse the trend of a large extension gap, it is imperative that farmers be educated through a variety of extension programs, such as front-line demonstrations for the adoption of enhanced production and protection technologies. An increasing number of people utilizing the most recent technology developments to produce better lentils through upgraded varieties may ultimately reverse the worrying trend of the widening extension gap. Farmers will gradually stop using their outdated technologies as a result of the new ones, and new and promising technologies will eventually be adopted more widely. (Kumar *et al*, 2023) [4]. Similar kind of technology gap was also reported by Singh *et al*. 2020 [7].

The technology index shows the feasibility of the evolved technology at the farmer's fields. The lower the value of technology index more is the feasibility of the technology. The technology index was 38.33, 40.88 and 37.66 percent during 2019-20, 2020-21 and 2021-22 respectively (Table- 2). Average of the three years recorded technology index was 38.96 percent. The technology demonstrated was suitable for cultivation in all the plot size and beneficiary farmers obtained higher yield with full package demonstration under CFLD programme. The technology was also affordable to the farmers.

Table 3: Economics of the CFLD on Lentil programme

Year	Gross expenditure (Rs/ha)		Addtl. Cost (Rs/ha)	Gross Return (Rs/ha)		Addtl. Cost (Rs/ha)	Net Return (Rs/ha)		Additional Cost (Rs/ha)	Benefit cost ratio (B:C)	
	DP	FP		DP	FP		DP	FP		DP	FP
2019-20	22729	19619	3110	72150	54600	17550	49421	34981	14440	3.17	2.78
2020-21	24675	20717	3958	74480	62300	12180	49805	41583	8222	3.02	3.00
2021-22	25800	21749	4051	78540	64540	14000	52740	42791	9949	3.04	2.97
Avearge	24401.33	20695	3706.33	75056.67	60480	14576.67	50655.33	39785	10870.33	3.07	2.91

The economics of the demonstration was depicted in Table 3. The existing price of commodities of inputs and outputs were taken during the study period of 2019-20, 2020-21 and 2021-22 to calculate the gross cost and gross return. The results indicated that farmers were needed an additional average amount of Rs. 3706.33/ha to go with the new package demonstration of lentil under CFLD programme. In return the beneficiary farmers were benefitted with additional average amount of Rs. 14576.67 in gross return. An additional net return of Rs. 10870.33 was received which was in turn utilized as savings or investment for the next crop by the beneficiary farmers under FLD programme.

The benefit cost ratio from demonstration plots was higher comparison to farmers practice in all the three study years. An average benefit cost ratio of 3.07 was recorded from demonstration plots and it was recorded 2.91 in farmers practice. The results clearly indicate the positive effects of FLDs over the existing practices. The superiority of recommended package of practices under frontline demonstration over farmers' practice was also reported by Mitra and Samajdar, 2010 [8], Singh *et al*. 2018 [9].

Conclusion

The Clustered frontline demonstration on lentil crop conducted by Cooch Behar Krishi Vigyan Kendra during 2019-20, 2020-21 and 2021-22. Mainly rice fallow areas were selected for the study. The lentil variety IPL-220 gave consistent higher yield and net return under the recommended package of practices during the study period. Utilizing the most recent technologies in the field of lentil farming can close the technology gap to a significant degree, increasing lentil yield in the West Bengal state's Cooch Behar district. On the other hand, timely availability of improved cultivars must be guaranteed. To improve technology dissemination and increase the nation's pulse production to self-sufficiency, scientists and extension agents are essential in showcasing cutting edge innovations to farmers.

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