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Demonstration of lentil cultivation in rice fallow under CFLD programme by Krishi Vigyan Kendra - Tirap, Arunachal Pradesh

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Abstract
Lentil (*Lens culinaris* L.) is a significant pulse crop, member of the leguminosae family. Lentils are an essential and reasonably priced source of protein. The primary reasons for the low productivity of lentils includes: negligence, a lack of good quality seeds, a lack of proper technical assistance and improper crop management. The Krishi Vigyan Kendra - Tirap, Arunachal Pradesh organized frontline demonstrations on scientific lentil farming practices under the CFLD on Pulses initiative in a cluster strategy during the Rabi seasons of 2015–16, 2016-17 and 2017–18. In the demonstration plots, the use of the improved variety HUL-57, rhizobium inoculation, treatment of boron (20%) and need-based fungicide application were recommended. The demonstration plots resulted 30.56% higher yield over farmer's practice. During the three years period of demonstration; technology gap was 599 kg/ha. In each of the research years, the benefit-cost ratio of the demonstration plots was greater than that of the farmers' practices. The benefit-cost ratio was 2.41 in farmers' practices and 2.66 on average in demonstration plots. The outcomes unequivocally show that FLDs are superior to the current approaches in terms of benefits.

Keywords: Frontline demonstration, Tirap, lentil, yield

Introduction
In order to increase the area under pulse cultivation and increase pulse production, the Department of Agriculture and Cooperation, Ministry of Agriculture & Farmers Welfare, approved the "Cluster Front Line Demonstrations (CFLD) on Pulses 2015-16" project to the Indian Council of Agricultural Research under the National Food Security Mission (NFSM). By demonstrating the production potential of new technologies and varieties of pulse crops at farmers' fields, the project hopes to emphasize the application of modern technology to address the issues related to the nation's pulse production through Krishi Vigyan Kendras (KVKs). This strategy makes sense for bolstering both forward and backward connections in the farming community's overall interest. Krishi Vigyan Kendra-Tirap has been assigned the CFLD program since its inception.

Leguminosae is a family of pulse crops that includes lentil (*Lens culinaris L.*). They are among the oldest cultivated crops, having origins in the ancient Middle Eastern and Asian civilizations. Lentils are highly appreciated because of their nutritional density and versatility in a wide range of culinary styles. Lentils come in a variety of colors, including yellow, brown, reddish-orange, green, and black. Lentils come in different sizes and can be bought whole, split, or without the skins. Roughly 30% of the calories in lentils come from protein, making them the third-highest protein-containing legume or nut by weight, after hemp and soybeans.

In many parts of the world, especially West Asia and the Indian subcontinent, where a sizable majority of the populace is vegetarian, lentils constitute an essential and reasonably priced source of protein. Isoleucine and lysine are two essential amino acids found in proteins. Lentils are deficient in two essential amino acids: cysteine and methionine. Nonetheless, methionine and cysteine, among other necessary amino acids, are present in significant amounts in sprouted lentils. Lentils are a good source of minerals, vitamin B1, dietary fiber, and folate. Red (or pink)

lentils contain less fiber (11% versus 31%) than green lentils. Health magazine ranked lentils as one of the five healthiest foods.

Lentils are a particularly good option for people with diabetes because of their high SDS (30%) and low RDS (readily digested starch) (5%). According to Kumar U *et al* 2022 [2], lentil productivity was 904 kg/ha and total area was 1.42 million ha. Canada was the top exporter of lentils in 2021, while India was the biggest buyer. Lentils are the primary legume crop farmed by farmers in the rice-fallow regions of central and eastern India. The fourth advanced estimate from DES, MoAF&W, Govt. of India, 2022 states that Uttar Pradesh is the state that produces the most lentils in India (0.47 million tons from 0.49 million ha. area, 36.43% of national production). Next in line are West Bengal (10.53%), Bihar, and Madhya Pradesh (0.44 million tons from 0.49 million ha of area, or 34.55% of the national production). Tiwari *et al*. 2017 [9], the primary reasons for the low output of lentils include ignorance, a lack of improved seeds, a lack of professional assistance, and ineffective crop management.

On the other hand, socioeconomic infrastructure limitations on pulse production include inadequate irrigation, poor seed storage, and inadequate marketing (Jopir *et al* 2017) [1]. Another researcher- Mitnala *et al.* 2018) [3] had also identified a number of significant barriers to more effective pulse farming, such as a lack of information, technical proficiency, and seed availability. The second significant institutional limitation is the lack of suitable agricultural inputs and chemicals. To overcome these limitations, KVK Tirap is promoting the scientific methods of lentil cultivation in the district.

Materials and Methods

The study was carried out using a cluster strategy in several villages within the Namsang and Khonsa block by Krishi Vigyan Kendra - Tirap, Arunachal Pradesh. The district is located between latitudes 26°38' and 27°47' and longitudes 96°16' and 95°40'. The district is 2 3 6 2 sq. KMs in total size. In 2015–16, 2016-17 and 2017-18, respectively, pre-selected farmers from the villages of Lekhi pathar, Deomali, Sipini under Namsang block and Bera, Lathum, Tupi under Khonsa block participated in frontline demonstrations on scientific lentil farming techniques. For the study, primarily rice-fallow areas were selected. Rabi was the season for planting lentils.

As per CFLD program guidelines, each demonstration plot measured 0.4 hectares and the identical region functioned as the comparative control (Farmer's practice). The cluster's beneficiary farmers were trained by organizing trainings on different cultivation aspect of lentil, *viz*. importance of rhizobium inoculation, timely micronutrient treatment, timely disease management and timely harvesting, before the field demonstration. The soil under demonstration was: sandy loam; had a pH range of 4.4 to 4.9. During the investigation, the improved variety HUL-57 was demonstrated. The variety has a potential yield of 18 quintal/ha. A seed rate of 22.5 kg/ha was used. A 26.25 kg/ha application of charcoal-based rhizobium was made in addition to FYM. The soils of selected plots of farmers were tested at Krishi Vigyan Kendra - Tirap's Soil Lab. To increase the crop, a line sowing technique was used with a 30 cm x 10 cm (row to row and plant to plant) spacing. To control weed infestation, pre-emergence herbicide Pendimethalin 30% EC @ 10 ml/liter was applied. At 25 and 45 days after sowing (DAS), the plants were sprayed with 20% boron at a rate of 2 gm/liter of water. Fungicides were applied according to need. Periodic monitoring visits for field inspections were carried out by a variety of scientists from KVK- Tirap. Field days were organized in each cluster with KVK scientists, district line department officials, progressive farmers and benefit farmers to present the technique and encourage wider adoption of it by the village's other lentil growers.

The random crop cutting technique was used for the yield's data for farmers' practice and demonstration. After that, the data was compared and examined to determine the results and conclusion. The study employed a statistical instrument, such as percentages, to assess the data. Using the current input and output prices, the demonstration's economic parameters—such as the cost of cultivation, gross return, net return, and benefit cost ratio were computed. As recommended by Kumar *et al.* (2023) [2] and Tiwari *et al*. (2017) [9], additional factors such as yield increasement (%), technology gap (%), extension gap (%) and technology index were calculated.

$$\text{Yield incensement (\%)} = \frac{\text{Demo yield} - \text{farmers yield}}{\text{Farmers yield}}$$

Technology gap = Potential yield – Demonstration yield

Extension gap = Demonstration yield – farmers yield

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

Net Return = Gross Return – Cost of cultivation

$$\text{B : C ratio} = \frac{\text{Gross return}}{\text{Cost of cultivation}} \times 100$$

Table 1: Area of lentil under demonstration

Sl. No.	Year	Area (Ha)	No. of demonstration	No. of cluster	Area utilization under rice fallow (ha)
01	2015-16	10	32	2	6
02	2016-17	20	50	3	14
03	2017-18	30	75	4	24

Table 2: Grain yield, technology gap, extension gap and technology index of lentil var. HUL-57

Year	Potential Yield (kg/ha)	Demo. yield (kg/ha)	Farmers Yield (kg/ha)	Yield increase (%)	Technology gap (kg/ha)	Extension gap (kg/ha)	Technology index
2015-16	1200	744	580	28.27	456	164	38.00
2016-17	1200	698	551	26.67	464	147	41.83
2017-18	1200	826	604	36.75	596	222	31.16
Average		829	578	30.56	599	177.67	37.00

Table 3: Economical parameters of lentil var. HUL-57

Year	Gross cost (Rs/ha)		Gross Return (Rs/ha)		Net Return (Rs/ha)		Benefit cost ratio (B:C)	
	Demo.	Check	Demo.	Check	Demo.	Check	Demo.	Check
2015-16	28172	24781	111600	87000	89600	67381	3.18	2.71
2016-17	29857	25782	104700	82650	69853	56869	2.33	2.20
2017-18	35784	26890	123900	90600	88116	63710	2.46	2.36
Average	31271	38726	113400	86750	82523	62653	2.66	2.41

Results and Discussion

The results from study revealed that the farmers were positively impacted by the frontline demonstration, which encouraged them to embrace the new technology displayed in the CFLD lentil patches. When comparing the yield from demo plots to farmers' practices across the whole trial period, demo plots were produced higher yields.

It is clear from table no 2 that demonstration plot's yielded 744 kg/ha as compared 580 kg/ha from farmers plot during 2015-16. The demonstrations produced 28.27% more than farmers plot. Similarly, during 2016-17, 698 kg recorded from demo plot as compared 551 kg/ha from farmers plot; which was 26.67% higher. In 2017-18, the demo yield was 826 kg/ha over 604 kg/ha from farmers plot; which was 36.75% higher. The finding is confirming by Prharaj *et al.* 2018 [4] and Tiwari *et al*. (2017) [9]; Who had revealed that the dissemination of improved production technologies among farmers field had gradually increased the pulse production NE region of India.

From table no 3; calculation of gross cost and gross return, the current prices of input and output commodities were obtained throughout the study periods of 2015-16, 2016-17 and 2017-18, respectively. During the study period; the different values of economic parameters under demo plots vs farmers plots are: In 2015-16 - cost of cultivation Rs 28172, gross return Rs 1,11,600 and net return of Rs 89,600 and B:C ration were 3.18 as compared farmers practice – Rs 24,781, Rs 87,000, Rs 67,381, 2.71 respectively. In 2016-17- cost of cultivation Rs 29,857, gross return Rs 1, 4,700 and net return of Rs 69,853 and B: C ration were 2.33 as compared farmers practice – Rs 25,782, Rs 82,650, Rs 56,869, 2.20 respectively. In 2017-18- cost of cultivation Rs 35,784, gross return Rs 1,23,900 and net return of Rs 88,116 and B:C ration were 2.46 as compared farmers practice – Rs 26,890, Rs 90,600, Rs 63,710, 2.36 respectively. Saikia *et al.* 2018 [5] the technogical interventions had enhanced the net return and benefit cost ratio under pulse cultivation. Singh *et al.* 2017 [6] and Singh *et al.* 2018 [8] had also supported the same intervention.

In all years research programme, the benefit: cost ratio of demonstration plots was greater than that of farmers' practices. The benefit-cost ratio was 2.41 in farmers' practices and 2.66 on average in demonstration plots. The outcomes unequivocally show that FLDs are superior to the current approaches in terms of benefits. The numerous researchers e.g. Singh *et al.*, 2020 [7], Vijay *et al*. 2017 [10] likewise reported on the superiority of the proposed package of techniques under frontline demonstration over farmers' practices.

Conclusion

The Krishi Vigyan Kendra - Tirap conducted frontline cluster demonstration on lentil crop in 2015–16, 2016-17 and 2017–18. The rice-fallow areas were chosen for the study. Throughout the trial period, the lentil variety HUL-57 consistently produced higher yield and net return when following the suggested package of techniques. In the Tirap area of Arunachal Pradesh, using the newest technologies in lentil cultivation can close the technology gap to a considerable extent and increase lentil yield. However, it is imperative to ensure the timely availability of better cultivars. Scientists and extension agents play a important role in dissemination of technology at farmers field in order to enhance horizontal spread of technology and boost the country's pulse production.

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