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An Evaluative Study of Cluster Frontline Demonstration (CFLD)-Pulse in Udalguri District of Assam

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ABSTRACT

Background: Pulses are considered the second most important crop next to cereals, but still there is a gap in demand and supply. The programme Cluster Front Line Demonstration (CFLD) was launched by the Ministry of Agriculture and Farmer's Welfare, GOI with the aim of on-site demonstration of newly introduced cropping, production and protection techniques. In this context, KVK, Udalguri, Assam had started conducting CFLDs on black gram and green gram from the year 2018-19. Therefore, the present study was conducted to analyse the impact of CFLD programme on the farmers of the district.

Methods: The impact of CFLD was studied with the parameters *i.e* changes of yield, income, extension gap, technology gap, technology index with 250 beneficiary and 100 nonbeneficiary farmers covering 6 villages of the district which were selected purposively during 2018-19 to 2021-22. Personal Interview method and PRA technique were followed for data collection.

Result: The results revealed that there is an increase in average yield of black gram of beneficiaries over the years, 9.15 q/ha as compared to 6.93 q/ha of non-beneficiaries and for green gram, it was 8.67 q/ha (beneficiaries) and 6.82 q/ha on farmer's practice. The mean gross return (Rs. 45625.00), net return (21125.00), B: C ratio (1.53) for black gram and mean gross return (Rs. 41125.00), net return (19712.00) and B: C ratio (1.74) for green gram was found higher in beneficiaries as compared to non-beneficiaries. Thus, higher B: C ratio proved the economic feasibility of improved technology demonstrated in the district.

Key words: Black gram, Cluster front line demonstration, Economics, Green gram, Impact.

INTRODUCTION

India is one of the main producers of pulses (*Leguminosae*), accounting for 25% of global production and 33% of the world's total area (Annual Report, Directorate of Pulse Development, 2022-23). In terms of area, productivity and economic value, pulses act as a significant factor in the Indian agricultural economy unlike food grains. Pulses like chickpeas, pigeon peas, green gram, black gram, lentils and field peas are among the major pulse crops grown in India.

India, with more than 35 M ha pulses cultivation area, is the largest pulses producing country in the world. The productivity and production of pulses in India has been increasing significantly since 2016-17. The area, production and productivity of pulses in India was 307.31 lakh hectare, 273.02 lakh tones and 888 kg/ha respectively and reaches up to 289.01 lakh hectare, 260.58 lakh tone and 902 kg/ha respectively in the year 2022-23 (Annual Report, Directorate of Pulse Development, 2022-23).

By 2030 the population of India will be expected to touch 1.68 billion and the projected pulses requirement will be around 32 million tonnes with required annual growth rate of 4.2% (Sarkar *et al*., 2018). Graph 1 shows the contribution of pulses to food grain basket in India which shows that the percentage share of pulses in terms of area and production to the food grain basket of India are 24% and 9% respectively during both the years 2021-22 and 2022-23.

Coming to the state of Assam, the area under pulse and its production are also quite low compared to other states. During the year 2021-22, the area, production and productivity of pulses was 1.44 lakh hectare, 1.11 lakh tones and 767 kg/ha respectively and reaches up to the productivity of 774 kg/ha only in the year 2022-23 while the

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area and production remains the same (Economic Survey, 2023-24).

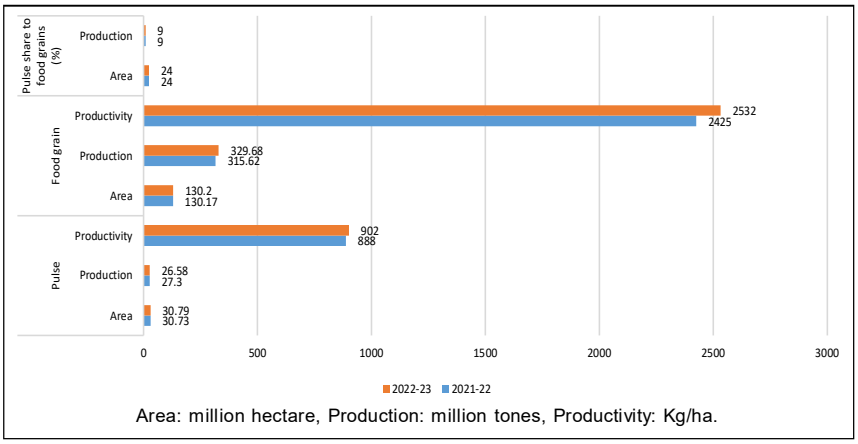
Among the various types of pulses grown in India, green gram (*Vigna radiata*) and black gram (*Vigna mungo*) shares an important place in the diet of Indian population. The given below Graph 2 displays the status of green gram and black gram cultivation in India. Annual report [DES, GoI, Min. of Agri. and FW (DA and FW), 2022-23].

For the state of Assam, the given below Graph 3 displayed the status of Green gram and Black gram cultivation in Assam. Annual report [DES, GoI, Min. of Agri. and FW (DA and FW), 2022-23]. The contribution of Green gram and Black gram to the food grain basket of Assam is given in Table 1.

The data provided in the above Table 1 shows the area, production and productivity of green gram and black gram along with their respective shares in total food grain production for the years 2021-22 and 2022-23. And it had been observed that the area and production of green gram increased slightly in 2022-23 compared to 2021-22. The productivity also improved from 750 kg/ha to 770 kg/ha. green gram's share of the total food grain area and production increased from 0.42% to 0.46% and from 0.32% to 0.34%, respectively.

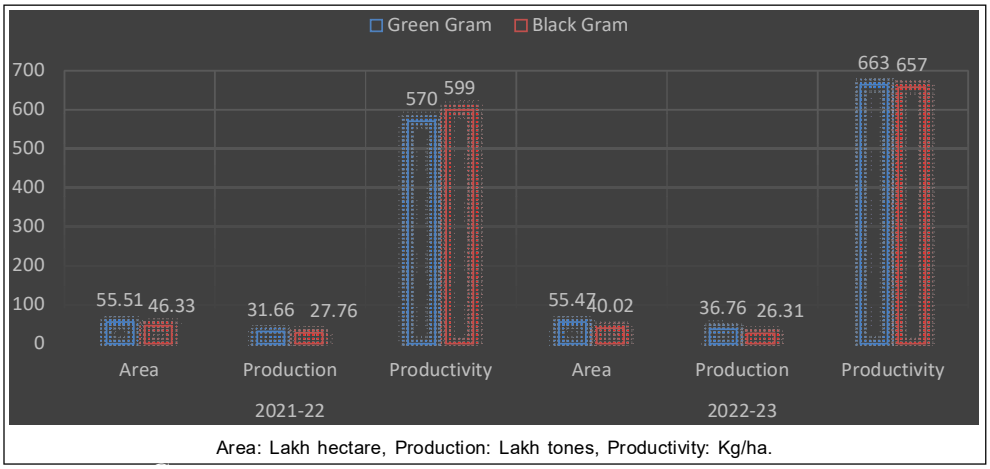
And in case of black gram, both area and production of black gram slightly decreased in 2022-23 compared to 2021-22. The productivity decreased from 661 kg/ha to 645 kg/ha. The share of black gram in the total food grain area and production also reduced from 2.03% to 1.92% for area and from 1.35% to 1.19% for production. Green gram showed a positive trend with an increase in area, production, productivity, and share in the food grain sector. In contrast, black gram experienced a decline in area, production, productivity and its share in total food grain production.

Although pulses *i.e* green gram and black gram have a significant position in consumption shares, farmers and the government have chosen to overlook them. The primary causes of this may be farming in marginal and sub-marginal areas, careless fertilizer use, lack of adoption of crop management techniques and inadequate marketing infrastructure (Choudhary, 2013). Thus, new technologies for a variety of pulse crops are being developed and demonstrated by the National Agricultural Research



Area: million hectare, Production: million tones, Productivity: Kg/ha.

Graph 1: Contribution of pulses to food grain production in India.



Area: Lakh hectare, Production: Lakh tones, Productivity: Kg/ha.

Graph 2: Status of green gram and black gram cultivation in India.

System, which includes ICAR Institutes, Agricultural Universities *etc*.

The cause of the low productivity of pulses is due to the use of old varieties, higher seed rate and broadcasting method of sowing and biotic/abiotic stresses in the district. Thus, there is need to create awareness among the farming community to popularize the location specific improved varieties to increase the production and productivity of pulse crops in the state.

The Cluster Frontline Demonstration programme (CFLDs) in pulses is a unique programme started in the year 2015-16 by the Ministry of Agriculture, Govt. of India. The main objective of CFLDs in pulses is to demonstrate and popularize the improved agro-technology on farmers' fields under varied farming situations for effective transfer of generated technology to fill the gap between improved technology adopted/indigenous technology to enhance pulse productivity farm for sustaining the production systems especially under rainfed farming. CFLDs are demonstrations that take place in farmers' fields, where scientists guide farmers on how to use new technologies. The demonstrations help farmers learn about the potential of new technologies and how to use them to increase production along with it also helps the farmers to update their knowledge, skill and attitude.

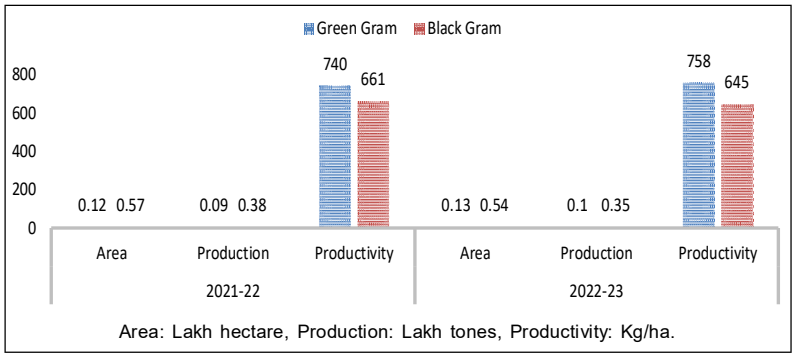
The division of Agricultural Extension, Indian Council Agricultural Research (ICAR), New Delhi put responsibility to lay out CFLDs on important pulse crops such as black gram, green gram, field pea through Krishi Vigyan Kendras (KVK) through eleven ICAR-Agricultural Technology Application Research Institutes (ATARI) all over India with an aim to increase the productivity of pulses throughout the country.

Thus, Krishi Vigyan Kendra, Udalguri, started conducting CFLDs on pulse *i.e* black gram (*Vigna mungo*) and green gram (*Vigna radiata*) from the year 2017-18.

Keeping in view of this effective extension approach, it was thought that the impact of CFLDs conducted by KVK, Udalguri is to be assessed. Therefore, the present study was undertaken with a specific objective to evaluate the impact of CFLD programme with the parameters like changes in yield, economic analysis, extension gap, technology gap, technology index and B: C ratio.

MATERIALS AND METHODS

The present study was conducted during June 2022-23 at Udalguri district situated at North Bank plain zone plain of Assam lies at 26°75′N latitude and 92°10′E longitude. Before conducting the CFLD programme, KVK Scientists had collected baseline information on the villages. A list of farmers was prepared through group meetings and selected farmers were trained to follow the package of practices of Kharif Black gram and Green gram recommended by Assam Agricultural University. After that



Graph 3: Status of green gram and black gram cultivation in Assam.

Table 1: Contribution of green gram and black gram to the food grain basket of Assam.

Year	Green gram			Food grain			Green gram share to food grains (%)	
	Area	Production	Productivity	Area	Production	Productivity	Area	Production
2021-22	0.12	0.09	750	27.98	28	1763	0.42	0.32
2022-23	0.13	0.10	770	28.11	29.30	1840	0.46	0.34
Year	**Black gram**			**Food grain**			**Black gram share to food grains (%)**	
2021-22	0.57	0.38	661	27.98	28	1763	2.03	1.35
2022-23	0.54	0.35	645	28.11	29.30	1840	1.92	1.19

Area: Lakh hectare, Production: Lakh tones, Productivity: Kg/ha.

the KVK conducted the CFLD-Pulses programme in an area of 150 ha covering 375 farmers during the year 2018-19 to 2021-22. The need-based inputs were supplied to the selected farmers and proper monitoring of the demonstration plots by the KVK Scientists ensured proper guidance to the farmers. To analyse the impact of the programme on the farmer's field, the study was conducted in six purposively selected villages of the district *viz*. *Lailangpara (*26.669682°N and 92.1892717°E*), Jarabari (*26.7352211°N and 92.1052917°E*),* Monpur (26.766157°N and 92.087168°E), Chanbari (26.657772°N and 91.881650°E), Kundarbil (26.839969°N and 91.998571°E) and Chutiapara (26.662214°N and 92.188018°E). A total of 250 beneficiaries and 100 non-beneficiaries were considered for the study. To analyse the impact of CFLD programme, parameters like changes of yield, economic analysis, extension gap, technology gap, technology index and B:C ratio were calculated. The schedule was prepared and tested before data collection. Both personal interview method and PRA technique were followed for data collection. Proper statistical tools were used to analyze the data *viz*:

Percentage increase in yield (%) =

$$\frac{\text{Yield gain in assessment year (q/ha) - Yield gain in base year (q/ ha)}}{\text{Yield gain in base year (q/ha)}} \times 100$$

The economic parameters (Gross return, net return and B:C ratio) were worked out based on prevailing market prices of inputs and Minimum Support prices of outputs. The extension gap (EG), technology gap (TG) and technology index (TI) were calculated by using the following formula:

$$\text{Technology gap (TG)} = \frac{\text{Potential yield (Py)}}{\text{Demonstrated yield (Dy)}}$$

$$\text{Extension gap (EG)} = \frac{\text{Demonstration yield (Dy)}}{\text{Farmer's practice yield (Fpy)}}$$

Technology index (TI in %) =

$$\frac{\text{Potential yield (Py) - Demonstrated yield (Dy)}}{\text{Potential yield (Py)}} \times 100$$

Impact change (%) =

$$\frac{\text{Change in no. of adapters}}{\text{No. of adapters before demonstrations}} \times 100$$

Benefit-cost ratio (BCR) =

$$\frac{\text{Gross monetary returns (GMR) in Rs. per ha}}{\text{Gross monetary expenditure (GME) in Rs. per ha}}$$

The logistic regression model was employed to study the effect of independent variables, *i.e.* factors that contributed to farmer's Income. This analysis identifies the factors that influences in increasing farmers' Income.

The model to predict the probability of increase in the progressiveness of farmers is:

$Y = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + \beta 5X5 + \beta 6X6 + \beta 7X7 + \beta 8X8$

X1= Extension contact.
X2= Adoption of innovative practices.
X3= Farm mechanization.
X4= Efficient marketing support.
X5= Institutional support.
X6= Crop diversification.
X7= High remunerative crop.
X8= Hard working.

RESULTS AND DISCUSSION

Technological intervention in CFLD-Pulse *i.e* in black gram and green gram

To uplift the production and productivity of green gram and black gram, both Krishi Vigyan Kendra and the farmers made collaborative efforts. A recommended packages of practices on pulse were followed to conduct the CFLDs at the farmers' fields.

Table 2 shows that improved green gram varieties *viz.,* SCG16 and IPM-02-03 and black gram varities *viz.,* PU-31 and IPU-02-43 were demonstrated at farmers' fields. The gap analysis was done in 2018 at the pre implementation stage of CFLD programme and then in the year 2022. The technological interventions were sowing time, sowing method, varieties, seed treatment, nutrient and plant protection management.

The difference or technological gap between demonstrated practice and farmer's practice is given in Table 2 and it was revealed that there was no technology gap in the farming situation *i.e* rainfed medium land were choose and sowing time were July for black gram and august for green gram in both the interventions, partial gap in taking plant protection measures *i.e* in both the practices, they use COC @0.3% against Cercospora leaf spot and Tebuconazole 25 EC @ 0.1% against Web blight. But to prevent whitefly and aphids, the farmers used Lambda Cyhalothrin 5EC @150-250 ml/ha and in demonstration plot, Thiamethoxam 25WG 0.3 g/lit was used.

A full gap was displayed in sowing methods i.e farmers were used broadcasting method whereas in demonstration practice, line sowing was followed. Seed rate (25 kg/ha in farmer's field and 22.5 kg/ha in case of black gram and for green gram, farmers were using 22 kg/ha, whereas in demonstration practice, only 20 kg/ha was used) and for seed treatment, no treatment was applied in farmer's practice and PSB @ 50 g/kg seed along with rhizobium were used in demonstration practices. The farmers were using local traditional varieties for both green gram and black gram cultivation and for demonstration, varieties like PU-31, IPU-02-43 for black gram and SCG16 and IPM-02-

03 used. In case of nutrient management practices, uncontrolled and imbalanced fertilizer application of Urea with no SSP and Potash were observed in farmer's field whereas, NPK@ 10:35:15 kg/ha; Compost @ 1 t/ha were recommended in demonstration plots.

The gap analysis study established the worth and efficacy of the CFLD programme generating a visible impact.

These results are in contrast with the results of Kantwa *et al*. (2024) and Bhowmik *et al.* (2022). Farmers in general use local traditional varieties due to non-availability and lack of awareness about high-yielding and disease-resistant varieties.

Rank-wise distribution of farmers in adoption of recommended pulse production technology

It was evident from Table 3 that, before KVK's CFLD intervention, out of 250 farmers, only a few sections of farmers adopted recommended pulse production technologies like land preparation (75.60%) followed by selection of land (52.80%), disease management (40.40%), application of fertilizers (31.20%), weed management (27.60%), time of harvesting (26.80%), irrigation management (25.20%) *etc*. and not a single farmer had adopted recommended varieties, spacing and seed treatment methods.

Then, after CFLD intervention, it was observed that there is an increase in number of farmers adopting the recommended pulse production technologies like in selection of varieties, from nil, out of the total 250 farmers, it was increased to 220 no. of farmers (88.0%) with rank-II. In selection of land, it increased to 90.40% (rank-I), application of fertilizers (84.80%, rank-III) followed by disease management practices (80.40%, rank-IV) and irrigation management (65.20%, rank-V), time of harvesting (64.80%, rank-VI), land preparation (61.60%, rank-VI) *etc*. These finding can be supported by the findings of Kadam *et al.* (2014); Suradkar *et al.* (2015); Paradva *et al.* (2019); Kashetti *et al.* (2023) and Nain *et al.* (2015) where it was found that growers go for proper land preparation, applications of manures, fertilizers and pest and disease management *etc*.

Moreover, it was also noticed that 31.20% and 18.00% of farmers had adopted recommended seed treatment technologies and recommended spacing with the ranking of XIII and XIV respectively which was nil before the CFLD intervention from KVK.

This may be because KVK has provided proper awareness, training and on-field demonstrations that increase farmers' awareness and understanding of recommended production technologies. KVKs provide continuous support and technical guidance to farmers. This practical guidance helps farmers implement new technologies correctly and confidently and helps them overcome challenges and refine their practices over time. This ongoing relationship encourages the further use of recommended technologies.

Impact of CFLD programme on yield, technology gap, extension gap and technology index of green gram and black gram

The impact of CFLD programme in terms of changes of yield, extension gap and technology gap, technology index are displayed as below in Table 4.

Table 2: Technological Intervention in CFLD-Pulse *i.e* in black gram and green gram.

Intervention	Demonstration practices		Farmer's practice		Technology gap
	Black gram	Green gram	Black gram	Green gram	
Farming situation	Rainfed medium land		Rainfed medium land		No gap
Time of sowing	July	August	July	August	No gap
Method of sowing	Line sowing		Broadcasting		Full gap
Seed rate	22.5 kg/ha	20 kg/ha	25 Kg/ha	22 Kg/ha	Full gap
Seed treatment	PSB @50 g/Kg seed along with rhizobium		Nil		Full gap
Varieties	PU-31, IPU-02-43	SCG16 & IPM-02-03	Local traditional varieties		Full gap
Manure/fertilizer	NPK@ 10:35:15 Kg/ha; Compost @ 1 t/ha		Uncontrolled and imbalanced application of fertilizer mainly Urea with no SSP and Potash application		Full gap
Plant protection	COC @0.3% against Cercospora leaf spot Tebuconazole 25 EC @ 0.1% against Web blight @ Thiamethoxam 25 WG 0.3 g/lit against Whitefly		COC@0.3% against Cercospora leaf spot Tebuconazole 25 EC @ 0.1% Web blight Lambda Cyhalothrin @150-250 ml/ha 5EC against Whitefly, Aphid *etc*.		Partial gap

Yield performance

In case of black gram (var. *PU-31* and *IPU-02-43*), the analysis of the data presented in Table 4 revealed that adoption of improved practices in demonstration plots increased the grain yield of black gram over farmer's practice in all the four years of the study period. The percentage increase in crop yield in demonstration over farmer's practice ranged from 25.00% in 2018-19 to 33.82% in 2021-22 with an average value of 32.22% in crop yield. The mean grain yield recorded in demonstrations was 9.15 q/ha with a range from 9.0 q/ha to 9.3 q/ha and case of farmer's practice, it was only 6.93 q/ha with a range from 6.8 q/ha to 7.2 q/ha only.

Similarly, in case of green gram (var. *SGC-16* and *IPM-02-3*), the percentage increase in grain yield under demonstration over the farmer's practice ranged from 25.00% to 30.00% with an average value of 27.18%. The mean grain yield recorded in demonstrations was 8.67 q/ha with a range from 7.80 q/ha to 9.50 q/ha. In case of farmers practice, the mean grain yield observed was 6.82 q/ha ranges from 6.0 q/ha to 7.40 q/ha only.

The increase in grain yield in demonstration plots over the farmer's practices could be credited to embracing recommended practices which include better planting methods, the use of high-yielding disease-resistance varieties, optimized irrigation systems and precise fertilization schedules *etc.* in demonstration plots.

Table 3: Rank-wise distribution of farmers in adoption of recommended pulse production technology. (N=250)

Technology	Before CFLD		After CFLD		Rank
	Nos.	%	Nos.	%	
Selection of land	132	52.80	226	90.40	I
Selection of varieties	0	0	220	88.00	II
Application of fertilizers	78	31.20	212	84.80	III
Disease management	101	40.40	201	80.40	IV
Irrigation management	63	25.20	163	65.20	V
Time of harvesting	67	26.80	162	64.80	VI
Land preparation	189	75.60	154	61.60	VII
Sowing method	36	14.40	127	50.80	VIII
Integrated pest management	32	12.80	111	44.40	IX
Crop rotation	12	4.80	109	43.60	X
Precaution before storage	45	18.00	106	42.40	XI
Weed management	69	27.60	86	34.40	XII
Seed treatment	0	0	78	31.20	XIII
Spacing	0	0	45	18.00	XIV

Table 4: Impact of CFLD- pulse on yield, technology gap, extension gap and technology index. (N=350)

Year	Variety	Potential yield (q/ha)	Average yield (q/ha)		% increase over control	TG (q/ha)	EG (q/ha)	TI (%)
			Demo (n=250)	Farmer's practice (n=100)				
Black gram								
2018-19	PU-31	12	9.0	7.2	25.00	3.0	1.8	25.00
2019-20	PU-31	12	9.3	6.9	34.78	2.7	2.4	22.50
2020-21	IPU-02-43	12	9.2	6.8	35.29	2.8	2.4	23.33
2021-22	IPU-02-43	12	9.1	6.8	33.82	2.9	2.3	24.17
Average			9.15	6.93	32.22	2.85	2.22	23.75
Green gram								
2018-19	SGC-16	14	9.5	7.4	28.38	4.5	2.1	32.14
2019-20	SGC-16	14	8.5	6.8	25.00	5.5	1.7	39.29
2020-21	IPM-02-3	12	7.8	6.0	30.00	4.2	1.8	35.00
2021-22	SGC-16	12	8.9	7.1	25.35	3.1	1.8	25.83
Average			8.67	6.82	27.18	4.32	1.85	33.06

These findings are in line with the findings of Kumar and Kispotta (2017); Meena and Singh (2017); Singh *et al.* (2021); Yadav *et al.* (2022); Raghav *et al.* (2022); Garg *et al.* (2023); Kumar *et al.* (2021) and Deka *et al.* (2021).

Technology gap

In case of black gram, it was evident from Table 4 that the technology gap ranged from 2.70 q/ha in 2019-20 to 3.0 q/ha in 2018-19 with an average of 2.85 q/ha in four years.

Similarly for green gram, it ranged from 3.10 q/ha in 2021-22 to 5.50 q/ha in 2019-20 with an average of 4.32 q/ha.

In both cases, the gap between the potential yield and the demonstration yield is indicative of the fact that the technologies flowing from the researchers need refinement.

Technology packages that are location-specific are necessary to reduce the technology gap (Malik *et al.,* 2021). The results are in line with the results achieved by Rachhoya *et al.* (2018); Sandhu and Dhaliwal (2016).

Extension gap

It was predicted from the Table 3 that the extension gap in the yield of black gram ranged from 1.80 q/ha in 2018-19 to 2.40 q/ha in 2020-21 with an average of 2.22 q/ha and in case of green gram, it ranged from 1.70 q/ha in 2019-20 to 2.10 q/ha in 2018-19 with an average of 1.85 q/ha in four years of the study period.

The extension gap is due to the gaps in the adoption of recommended technology and can be minimized by the collaboration among researchers, extension workers and farmers (Meena *et al.,* 2020). Mandal *et al.* (2019) also stated that improved variety of pulses can be used to minimize the yield gap and increase the area for pulse production. The higher value of technology gap and extension gap during 2018-19 to 2021-22 emphasized the need to educate the farmers through various methodologies for increasing the adoption of improved or recommended technology which eventually led to decrease the gap. Similar findings have been reported by Kumar *et al*., 2021 and Leharwan *et al.* (2023).

Technology index

The technology Index is a tool for determining the adoption and impact of technologies in different situations. It shows the utility of the technology demonstrated along with its observability and achievability at the farmer's field. Lower the value of the technology index, the more is the utility of the technology presented.

For the crop black gram, it was delineated from Table 4, that with a mean value of 23.75%, the technology index ranged from 22.50% in 2019-20 to 25.00% in 2018-19, and likewise for green gram, it ranged from 25.83% to 39.29% in the year 2021-22 and 2019-20 respectively with an average of 33.06%.

The diminishing trend in the technology index during the four years of the study period in case of green gram speaks about the impact of CFLD activities. It shows the productiveness of technical interventions which accelerates the adoption of technologies to increase the yield performance in farmer's field. These results are line with the results of study done by Singh *et al.* (2018); Reager *et al.* (2020) and Meena *et al.* (2021).

But at the same time, for the crop black gram, the technology index is quite indistinguishable and it may be due to the unwillingness of the growers to take on the suggested technologies.

Economic analysis between demonstration plot of beneficiaries and farmer's plot (non-beneficiaries)

Economic analysis

The economic analysis of any technology demonstrated is essential and crucial for its adoption because no farmer is going to accept it unless its favorable economics are observable.

It can be seen through Table 5 that the CFLDs on black gram recorded higher average gross returns (Rs. 45625.00/ha) and net return (Rs. 21125.00/ ha) with a mean B: C ratio of 1.53 as compared to farmers practice with average gross returns of Rs. 34625.00/ha and net return (Rs. 12087.50/ ha) with a mean B: C ratio of 1.86 which indicates the economic feasibility of the technology demonstrated for the crop. The same results were found in the study done by Meena *et al.* (2021); Singh *et al.* (2020); Saikia *et al.* (2024); Kantwa *et al.* (2024) and Deka *et al.* (2019).

Table 5 also revealed that the CFLDs on green gram recorded average gross returns (Rs. 41125.00/ha) and net return (Rs. 19712.50.00/ ha) with a mean B: C ratio of 1.56 as compared to farmers practice with average gross returns of Rs. 34125.00/ha and net return (Rs. 10925.00/ ha) with a mean B: C ratio of 1.74. Higher economic returns under CFLD may be because of implementing improved cultivation practices and proper. Similar types of results were obtained by Shah *et al*. (2020) and Yadav *et al*. (2015).

Logistic regression to estimate the factors influencing in increasing farmer's income

The results presented in Table 6 revealed that adoption of recommended practices is highly significant (1.86**) and the most important factor in increasing farmer's income followed by institutional support the farmers are getting (1.598*) and their nature of hardworking (1.42*).

Horizontal expansion of area under Green gram and Black gram

Efforts were made to increase the horizontal spread of area through the impact of CFLDs in black gram and green gram (Table 7). The results revealed that, the programme helped in increasing cultivation area with improved practices within the villages and nearby villages like Gerua, Khusrabari, Dongpara *etc*.

From an area of 5.60 ha in the year 2018-19, it gradually increased up to 8.71 ha in 2022-23 in case of black gram. Equivalently, for green gram also, the area was increased

Table 5: Economic analysis between demonstration plot of beneficiaries and farmer's plot (non-beneficiaries). (N=350)

Year	Demonstration (n=250)				Farmer's practice (n=100)				Additional income (Rs/ha)
	Total cost (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	B:C ratio	Total cost (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	B:C ratio	
Crop: Black gram									
2018-19	24500.00	45000.00	20500.00	1.56	23100.00	36000.00	12900.00	1.84	7600.00
2019-20	24500.00	4600.000	21500.00	1.54	22350.00	34500.00	12150.00	1.88	9350.00
2020-21	24500.00	46000.00	21500.00	1.52	22350.00	34000.00	11650.00	1.88	9850.00
2021-22	24500.00	45500.00	21000.00	1.52	22350.00	34000.00	11650.00	1.85	9350.00
Average	24500.00	45625.00	21125.00	1.53	22537.50	34625.00	12087.50	1.86	9037.50
Crop: Green gram									
2018-19	23600.00	47500.00	23900.00	1.60	23100.00	37000.00	13900.00	2.01	13000.00
2019-20	23600.00	42500.00	18900.00	1.47	23100.00	34000.00	10900.00	1.80	8000.00
2020-21	23600.00	39000.00	15400.00	1.30	23100.00	30000.00	6900.00	1.65	8500.00
2021-22	23850.00	44500.00	20650.00	1.87	23500.00	35500.00	12000.00	1.51	8650.00
Average	23662.50	41125.00	19712.50	1.56	23200.00	34125.00	10925.00	1.74	9537.50

Table 6: Logistic regression to estimate the factors influencing in increasing farmer's income. (N=350)

Factors	Estimate	SE	Z value	P value	Exp
Intercept	-0.396***	0.96	-3.09	0.00	0.01
Extension contact	0.12	0.92	0.14	0.87	1.10
Adoption of recommended practices	1.86**	0.71	2.31	0.01	6.93
Farm mechanization	0.12				
Efficient marketing support	0.23	0.81	0.41	0.68	1.24
Institutional support	1.59**	0.58	1.36	0.01	5.36
Hard working	1.42*	0.65	1.98	0.02	3.12

Note: 0 '***' 0.001 '**' 0.01 '*' 0.05 level of significance

Table 7: Horizontal expansion of area under green gram and black gram.

Year	Black gram		Green gram	
	Area (ha)	Impact (% change)	Area (ha)	Impact (% change)
2018-19	5.60	-	2.66	-
2019-20	7.61	35.71	3.06	15.04
2020-21	8.11	6.58	3.70	20.92
2021-23	8.40	3.70	4.20	13.51
2022-23 (Assessment year)	8.71	3.57	4.53	7.86

from 2.66 ha to 4.53 ha in 2018-19 to 2022-23 respectively. These findings are in line with the findings of Marlabeedu *et al.* (2022) and Singh *et al.* (2022).

CONCLUSION

Based on the analysis of four years of data on CFLDs conducted by KVK, Udalguri, the results indicated that the CFLDs had a constructive and productive impact on the farmers as they were influenced by the new cultivation practices applied in the demonstrations and which were found better as compared to the farmer's own practices. There was a markable improvement in crop yield but somewhere a certain amount of extension and technological gap exist which directly effect on yield of the crop. Therefore, more extension efforts are required to decrease the gap. The gross returns, net returns and B: C ratio was higher in demonstrations as compared to the farmers' practice. Overall, the CFLD programme helped improve production, productivity and farmers' income as well as ensuring food and nutritional security to the nation.

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Disclaimers

The views and conclusions expressed in this research article are solely those of the authors and do not necessarily represent the views of their affiliated institutions. The authors are responsible for the accuracy and completeness of the information provided, but do not accept any liability for any direct or indirect losses resulting from the use of this content.

Conflict of interest

There is no conflict of interest among the authors.

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