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Assessing the effectiveness of CFLD on black gram cultivation and its socio-economic impact on farmers in Malda

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Abstract
Krishi Vigyan Kendra (KVK), Malda, implemented Cluster Front Line Demonstration (CFLD) programs focusing on the black gram variety PU-31, IPU-0243, & VBN-9 in the villages of Balupur and Rukundipur during the Kharif seasons of 2017-2018 and 2018-2019, under the National Food Security Mission of the Government of India. This initiative involved conducting 50 demonstrations across a total area of 20 hectares, with active participation from both farmers and KVK scientific staff. The marked increase in black gram yields from these demonstrations is largely attributed to the application of improved agricultural technologies. Key practices included the use of yellow vein mosaic (YVM) resistant varieties, seed treatment with bio-fertilizers, adherence to recommended seed rates, appropriate fertilizer application, and the implementation of effective plant protection measures. The study revealed a technology gap between potential yields and actual yields observed in the demonstrations. For the Kharif seasons from 2020 to 2022, the technology gap was noted to be 1.4, 3.0, and 3.3 quintals per hectare (q/ha) respectively. Concurrently, an extension gap of 3.5, 3.2, and 2.3 q/ha was recorded over the same period. The findings indicated that the highest innovation index was 9.09% during Kharif 2020, with a lower value of 21.43% observed in Kharif 2022, reflecting variations in farmer engagement and technology adoption over the years. The economic assessment further emphasized the CFLD's impact, as demonstrated by the benefit-cost ratios for the demonstration plots: 4.6 in 2020, rising to 5.4 in 2021, and reaching 6.1 in 2022. These figures underscore the economic viability of the demonstrated practices, showcasing the potential for increased profitability through enhanced agricultural methods. Overall, this study evaluates the effectiveness of the CFLD program on black gram cultivation and its socio-economic benefits for farmers in the Malda district. While black gram (*Vigna mungo*) is recognized for its nutritional value as a significant pulse crop, farmers in this area encounter various challenges, including suboptimal cultivation practices, inferior seed quality, and insufficient technical knowledge. The CFLD initiative aims to address these issues by demonstrating advanced agricultural techniques and facilitating access to improved seed varieties and inputs. Data collected from participating farmers highlighted significant improvements in technical skills, leading to better management practices and increased productivity. As a result, farmers reported substantial increases in black gram production, contributing to enhanced food security and elevated income levels.

Keywords: CFLD, technology demonstrated, technology gap, extension gap, cost benefit ratio, socio-economic gap

Introduction

Low productivity of black gram in the district, as compared to the national average, can primarily be attributed to poor cultivation practices and the inadequate supply of quality seeds and inputs. Additionally, a lack of technical expertise further exacerbates these productivity issues (Kumar *et al*., 2014) [8]. Black gram (*Vigna mungo*) is a widely cultivated legume, particularly as a short-duration crop during the summer months. It has the unique ability to enhance soil fertility through its symbiotic relationship with Rhizobium bacteria, which fix atmospheric nitrogen in root nodules. The variety PU-31 is known for its thick seeds and resistance to yellow vein mosaic virus, with a harvest period of 80-85 days depending on environmental conditions. Krishi Vigyan Kendra (KVKs) serve as grassroots organizations focused on technology dissemination by evaluating, improving, and demonstrating proven production techniques in various micro-agricultural settings. Their primary objective is to minimize the time lag between experimental innovations and their adoption by farmers, thereby enhancing agricultural efficiency and productivity. Legumes, including black gram, play a critical role in Indian agriculture due to their ability to fix nitrogen, enhance soil fertility, and provide a higher protein content (17-25%) compared to cereals (6-10%). Given the prevalent protein deficiency in Indian diets, increasing pulse production is essential, especially for economically and socially disadvantaged populations. Pulses currently account for 11% of total protein intake in India, underscoring their significance in daily nutrition. Despite the importance of legumes, over 92% of black gram cultivation occurs under rain-fed conditions, and India imports about 23 million tonnes of pulses annually to meet domestic demand. The current production levels fall short of the global average, with low adoption rates of improved cultivation techniques. Multiple constraints—both biotic and abiotic—hinder the yield potential of black gram, including poor plant nutrition and inconsistent water availability during the growing cycle.

According to Rabbingen (1995) [5], inadequate management practices can further degrade soil quality and fertility. Challenges such as unbalanced nutrient application, reliance on local or disease-susceptible varieties, lack of seed treatment, and the absence of Integrated Weed Management (IWM) and Integrated Pest Management (IPM) are significant contributors to suboptimal yields (Shetty *et al*., 2013) [9]. To address these issues, Front Line Demonstration (FLD) has emerged as an effective extension method, demonstrating to farmers the practical application of new crop production and protection techniques. It is essential for researchers to identify factors that enhance crop production and the constraints farmers face during the adoption of these technologies. FLDs provide farmers with direct access to scientific knowledge, facilitating a dialogue with researchers and equipping them with practical advice to improve their yields. By conducting frontline demonstrations of black gram cultivation in farmers' fields, the initiative aims to showcase the potential and economic advantages of adopting advanced agricultural practices.

Materials and Methods

During the Kharif seasons of 2019-2020 to 2021-2022, front-line demonstrations were held on 40 farmers' fields in the West Rukundipur and Balupur villages of Malda district using a pulse-based cropping system on old alluvial and loamy soils with low to high fertility. The front line demonstration was designed and carried out in a farmer's field based on the issues farmers faced. Each demonstration covered an area of 1.6 ha, and the farmer's practices were kept in the same area next to the demonstration plot. In the experiment, an YMV-resistant variety with high yields, black gram PU-31, IPU-0243, VBN-9, VBN-11, was used. The improved variety, appropriate season, recommended seed rate, seed treatment with bio agents, appropriate nutrient management, and pest management based on economic threshold level comprised the Integrated Crop Management (ICM) technology (Table 1).

Table 1: Technology demonstrated in CFLD's and Farmer's Practice

S. No	Practice	Demonstrated practice	Farmers Practice
1	Field Preparation	2 Ploughings	Single Plough
2	Method of Sowing	Line Sowing	Broad casting
3	Variety	PU31,IPU0243,VBN9,VBN11	Improved variety
4	Seed treatment	Bavistin @ 5gm/Kg of seed	Seed treatment
5	Seed rate and spacing	21Kg/hectare and 30X10 cm	28 Kg/hectare and 22X8 cm
6	Fertilizer dose	NPK as basal dose Urea 10 kg/ha and DAP 90 Kg/ha, SSP 35 kg/ha	Urea – Nil,DAP- Nil
7	Weed Management	Dichlorvos @ 1ml/L	No Pre emergence Herbicide
8	IPM Measures	IPM practices like use of yellow sticky traps, spraying of neem oil and rouging	More use of pesticides
9	Technical Guidance	time to time	Nil

Table 2: Cost of cultivation, Gross return, Net return and B:C Ratio of Black gram as grown under CFLD's and existing package of practices

Years	Cost of Cultivation (Rs/ha)		Gross return (Rs/ha)		Net Return (Rs/ha)		B:C Ratio	
	Demo	Farmer's practice	Demo	Farmer's practice	Demo	Farmer's practice	Demo	Farmer's practice
2020	30000.00	16500.00	66500.00	31750.00	36500.00	15250.00	2.21	1.92
2021	31000.00	17600.00	69750.00	35750.00	38750.00	18150.00	2.25	2.03
2022	31500.00	19200.00	73250.00	38250.00	41750.00	19050.00	2.32	1.99
Mean	30833.33	17766.66	69833.33	35250.00	39000.00	17483.33	2.26	1.98

Table 3: Indication of potential yield, demonstration yield, farmers yield, technological gap, and extension gap and technology index

SI. No	Potential yield (kg ha)	Demonstration yield (kg ha)	Farmers Yield (kg ha)	Technological gap (q/ha)	Extension gap(q/ha)	Techno logy index
1	1540	1400	1050	1.40	3.50	9.09
2	1540	1240	920	3.00	3.20	19.48
3	1540	1210	980	3.30	2.30	21.43
Average	1540	1283.33	983.33	2.57	3	16.67
Total	460	3850	2950	7.7	9	50

Results and Discussion

Correlation Coefficient of Change in income with 6 causal variables

Variables	Coefficient correlation®
Age	-.54**
Education	.86**
Family size	-.31*
Farm size	.22
Caste	.60
Annually income	-.21

Significant at 5% level

The table reflects the coefficient of correlation analysis result between the change of income and other 6 causal variables. The result shows that the variables family education is positively significantly associated with the variable change in income and the variables family size negatively and significantly associated with the variable change in income of the black gram farmers.

Distribution of the farmers according to their age

Score	Frequency	Percentage	Statistics
Low<35	18	30.1	Range- 45
Medium(36-50)	23	38.3	Mean- 44.16
High>50	19	31.6	S.D.- 12.68 C.V.- 28.71

The table present the distribution of black gram farmers according to their age. The results show that the majority of the respondents (30.10%) are under the age group of <35 years age followed by 35-50 years age group (38.30) >50 years age group (31.60%) respectively. The mean score of the total distribution, age is 44.16 and standard deviation of the distribution is12.68. The coefficient of variation value within the distribution 28.71% signifies the very high consistency level of the distribution for the variable 'age'. It is indicative that mostly the middle aged farmers in the study area are associated with the black gram farmers of Malda district.

Distribution of the farmers according to their education

Score	Frequency	Percentage	Statistics
Low<1	25	41.6	Range- 5
Medium (2-3)	29	48.3	Mean- 1.75
High>3	6	10.1	S.D.- 1.32 C.V.- 75.42

The table present the distribution of the black gram farmers according to their family education status. The result shows that the majority of the respondents' family education status fall under the medium family education status (48.30%) followed by low education status category (41.6%) and high education category (10.10%) respectively. The mean score of the total distribution, family education status is 1.75 and standard deviation of the distribution is 1.32. The coefficient of variation value within the distribution 75.42% signifies the high consistency level of the distribution for the variable 'family education status'. It is indicative that most of the black gram farmers in the study area belong to the families possessing a medium level of educational status.

Distribution of the farmers according to their family size

Score	Frequency	Percentage	Statistics
Low<3	21	35.0	Range- 5
Medium (4-5)	26	43.3	Mean- 4.05
High>5	13	21.7	S.D.- 1.32 C.V.- 32.59

The table present the distribution of the black gram farmers according to their family size status. The results show that majority of the respondents are with the family member of 4 to 5 (43.30%) followed by >3 (35.50%) and <5 (21.70%) respectively. The mean score of the total distribution is 4.05 and standard deviation of the distribution is 1.32. The coefficient of variation value within the distribution 32.59% signifies low consistency level of the distribution for the variable family size. Most of the farmers are coming from a medium size family which is very relevant for the study

Distribution of the farmers according to their farm size

Score	Frequency	Percentage	Statistics
Low<3	22	36.7	Range- 14
Medium (4-8)	25	41.7	Mean- 5.35
High>8	13	21.6	S.D.- 3.11 C.V.- 58.13

The table present the distribution of the black gram farmers according to their farm size status.The results show that majority of the respondents are with the land holding size >3 bigha (36.70%) followed by 4-8 bigha (41.70%) and <8bigha (21.6%) respectively. The mean score of the total distribution is 5.35 and standard deviation of the distribution is 3.11. The coefficient of variation value within the distribution 58.13% signifies low consistency level of the distribution for the variable land holding. The holding status is very low for the family of black gram farmers. Most of the farmers are coming from a very poor land holding family which is very relevant for the study

Distribution of the farmers according to their family annual income

Score	Expenditure in Rs. 10000/-	Frequency	Percentage	Statistics Range- 43.00
Low	35-49	32	53.3	Mean- 50.88
Medium	50-61	18	29.9	S.D.- 9.15
High	62-78	10	16.8	C.V.- 17.98

The table present the distribution of the black gram farmers according to their family annual income. The results show that the majority of the respondents are under the low income group category (53.3%) followed by medium income group category (29.9%) and high income group category (16.80%). The mean score of the total distribution, family annual income is 8.46 and standard deviation of the distribution is 3.62. The coefficient of variation value within the distribution 42.79% signifies the medium consistency level of the distribution for the variable family annual income. It is discernible that mostly black gram farmers are from the low income group family and pro-poor and economically disadvantaged and trying to sustain their livelihood through black gram cultivation.

The findings of the study as well as relevant discussion have been conferred under following points

Technology gap = Potential yield - Demonstration yield

The difference between the potential yield and the yield of the demonstration plot is the technology gap. During Kharif 2020 to 2022, the technology gap between the potential yield and the demonstration yield was 1.4, 3.00 and 3.30 q/ha, respectively (Table 3). The disparity in soil fertility, insect pest infestation, and erratic weather that prevailed during crop season at various locations may have contributed to the observed technological gap. Chandrakar *et al*. (2018) [4] observed similar results. The results were encouraging because the technology gap reflects farmers' cooperation in conducting the CFLDs.

Extension Gap = Demonstration yield - Farmers' yield

It refers to the difference in yield between the farmer's plot and the demonstration plot. During kharif in 2020 to 2022, respectively, an extension gap of 3.50, 3.20 and 2.30 q/ha was observed (Table 3). Rachhoya *et al.*'s 2018 findings were in line with the findings of this study. This alarming trend of galloping extension gap will be reduced if the most recent production technologies and recommended varieties of high-yielding pulse crops are utilized to their full potential. This made it clear that farmers must be educated through a variety of extension methods. The cluster front line demonstration may facilitate the adoption of improved technology for production and protection.

Technology Index = (Technology gap/potential yield) x 100

The developed technology's viability in farmers' fields is demonstrated by the technology index. According to Mishra *et al.* (2007), the technology's feasibility increases with a lower technology index value. The information (Table 3) showed that greatest innovation list esteem 9.09 per cent was seen during kharif 2020 while; and during kharif 2021 it was seen 19.48per cent least worth of innovation file of 21.43 per cent was seen during kharif 2022. Uneven weather in the region over the course of the study could be the cause of this variation in the technology index. In addition, the decrease in the technology index for the black gram crop as a whole over the course of the study year clearly demonstrated the viability of technologies demonstrated in frontline demonstrations. The presence of solid hole in innovation created by the examination organizations and innovation scattering to the ranchers must be overwhelmed by CFLD program which can speed up the degree of reception of further developed advancements and help in achieving independence in beat creation and getting more pay of ranchers

Economic return

The economic analysis of the data for the black gram study period clearly showed that the gross return, net return, and benefit were: cost proportion were higher in bleeding edge showings where prescribed rehearses were followed contrasted with ranchers' work on demonstrating higher productivity. During Kharif 2020, the benefit-cost ratio of demonstration plots was 4.6, while it was 5.4 in 2021 and it was 6.1 in 2022. As a result, the farming community can benefit from increased yield potential and economic returns from black gram cultivation by utilizing tried-and-true methods. These results were consistent with Kumar *et al.* (2014) [8] and Anuratha *et al.* (2018) [2]'s earlier findings.

The study's findings demonstrated that increasing the seed yield and economic return of the black gram crop can be achieved by incorporating improved technology, training, and farmer participation. According to the study, farmers were motivated to implement the demonstrated interventions because of the demonstration's economic viability.

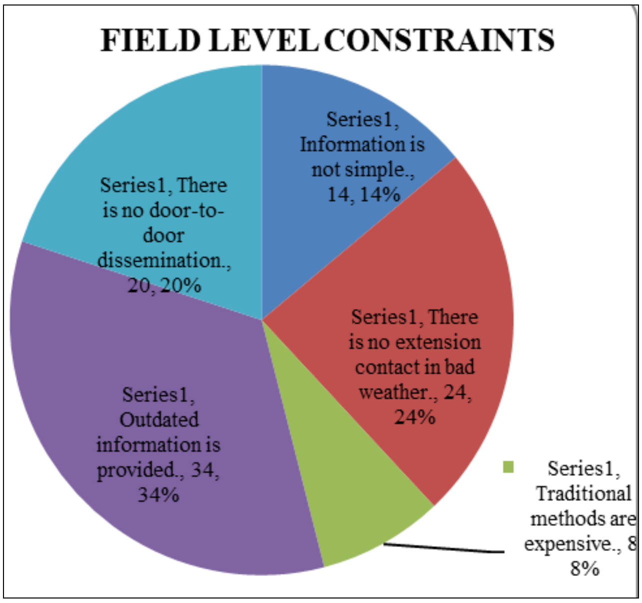
The farming community's income and standard of living will rise as a result, and soil fertility will improve. The demonstration's 41.2 per cent increase in black gram yield over the farmers' practice raised awareness and inspired other farmers to adopt the improved black gram practice package. Farmers and KVK scientists developed a rapport and sense of confidence as a result of these demonstrations. It is concluded that the CFLD program is a useful tool for changing farmers' knowledge, attitude, and skill while also increasing black gram production and productivity. In addition to contributing to the community's food and nutrition security and meeting the needs of farm animals for fodder, this has produced socioeconomic stability.

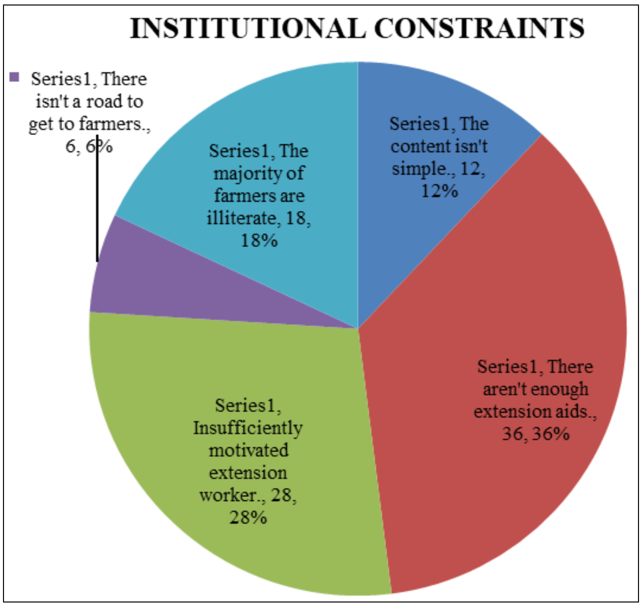
Sl. No.	Statements	Frequency	Percent Rank	Rank
Field level constraints				
1.	Information is not simple.	9	14	IV
2.	There is no extension contact in bad weather.	14	24	II
3.	Traditional methods are expensive.	6	08	V
4.	Lack of Updated information.	19	34	I
5.	There is no door-to-door dissemination of updated service.	12	20	III
Institutional constraints				
1.	The content is complex.	8	12	V
2.	Lack of extension aids.	20	36	I
3.	Insufficiently motivated extension worker.	16	28	II
4.	There isn't a road to get to farmers.	5	06	IV
5.	The majority of farmers are illiterate	11	18	III
Individual constraints				
1.	Inability to obtain timely information.	6	08	V
2.	Extension workers' public relations are poor.	15	26	II
3.	Do not provide the needed information.	18	32	I
4.	Traditional methods of extension take a long time.	12	20	III
5.	Lack of funds to purchase extension literature.	9	14	IV

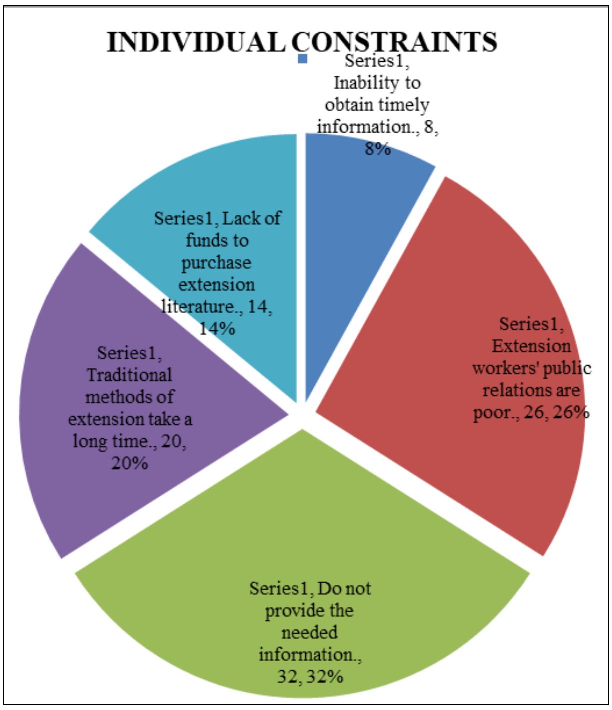
On perusal of Table and Figure, it is clear that under field level constraints majority (34%) of the respondents believed that 'There aren't enough extension aids.' is the major constraint followed by (24%) of respondents thought 'There is no extension contact in bad weather' as constraints in adoption of scientific practices by dairy farmers. Whereas 'There is no door-to-door dissemination' was perceived by only 20% farmers.

On perusal of Table and Figure, it is clear that under field level constraints majority (36%) of the respondents believed that 'outdated information is provided through the traditional methods' is the major constraint followed by (28%) of respondents thought 'Insufficiently motivated extension worker.' as constraints in adoption of scientific practices by dairy farmers. Whereas 'The majority of farmers are illiterate' was perceived by only (18%) farmers.

On perusal of Table and Figure, it is clear that under field level constraints majority (32%) of the respondents believed that 'Do not provide the needed information.' is the major constraint followed by (26%) of respondents thought 'Extension workers' public relations are poor.' as constraints in adoption of scientific practices by dairy farmers. Whereas 'Traditional methods of extension take a long time.' was perceived by only (20%) farmers.







Conclusion

The grain yield of the black gram crop can be increased to a greater extent with the help of improved technology and the practices that are recommended. The FLD yields significant positive results and provided the researcher with the opportunity to demonstrate the long-promised productivity potential and profitability of the most recent technology for farmers. The use of recommended high-yielding varieties, timely sowing, nutrient management, weed management, and plant protection measures taken in accordance with the recommended package and practices were cited as the factors that contributed to the increase in black gram grain yield. Positive benefit: The cluster frontline demonstrations' cost ratio demonstrates the economic viability of the interventions and encouraged farmers to adopt them. As a result, it was also determined that farmers can benefit from scientific intervention to close technology gaps, thereby increasing black gram production and productivity in the district. In addition, the greater extension gap highlighted the necessity of further educating farmers about the adoption of improved technologies through CFLDs on the black gram crop in order to enable poor farmers with limited resources to enhance their means of subsistence and diversify their farming operations. The efficiency gain under FLD over existing acts of dark gram development made more noteworthy mindfulness and roused different ranchers to take on reasonable creation innovation of dark gram.

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