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A Comprehensive Evaluation of Cluster Frontline Demonstration (CFLD) on Field Pea *(Pisum sativum* L.) in Baksa District, Assam

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ABSTRACT

Background: India is a leading global producer, consumer and importer of pulses, contributing significantly to food security, especially in vegetarian diets. Despite an annual production of 25 million tonnes, domestic consumption surpasses supply, driving imports. Assam, particularly Baksa district, cultivates field pea, but productivity remains low due to outdated farming practices. The cluster frontline demonstration program, introduced in 2015-16, aims to bridge the technology gap and enhance yields through improved agro-technologies and farmer awareness. Hence, the present study was undertaken to analyse the impact of CFLD on Field pea in Baksa district of Assam.

Methods: The study was conducted in Baksa district during 2024 and assessed the impact of the CFLD-Pulses programme on field pea cultivation. Implemented across 150 hectares, it benefited 375 farmers between 2019-2023, with scientists providing technical support. Data from three selected villages were analyzed using statistical tools, focusing on yield variations, economic viability, extension and technology gaps and the benefit-cost ratio. Findings were derived from personal interviews, PRA techniques and pre-tested schedules to ensure reliability.

Result: The results revealed that there is a declining trend in technology gap and extension gap and an increase in average yield of field pea of beneficiaries over the years, approximately ten quintals per hectare as compared to early seven quintas per hectare of non-beneficiaries. The mean gross return, net return and B:C ratio from pea cultivation was found higher in beneficiaries as compared to non-beneficiaries.

Key words: CFLD-field pea, Economic analysis, Impact, Improved technologies.

INTRODUCTION

India is one of the leading producer and consumer of pulses, accounting for about 25 percent of production, 27 per cent of total consumption and 14 per cent of imports globally (Agarwal *et al.,* 2024). Pulses play a crucial role in India's food security, providing essential proteins, especially in vegetarian diets. The total area under pulse cultivation in India is around 30 million hectares with an annual production of approximately 25 million tonnes (Kumar, 2021) and (Mohare, 2022).

The annual pulse consumption is estimated to be 28 million tonnes in India which is exceeding the domestic production levels. This gap has led to increased imports, particularly of field peas (*Pisum sativum* L.), which accounted for 31 per cent of total pulse imports in FY25. The rising demand is driven by population growth, dietary shifts and government initiatives promoting pulse-based nutrition. Field pea is extensively grown in Assam, especially in districts like Baksa, owing to its suitability for the Lower Brahmaputra Valley Zone. Assam, with a larger cultivation area of 12,500 hectares, produces approximately 10,650 tonnes of field pea. The productivity, measured at 852 kg/ha, indicates the average yield obtained per hectare across the state. Baksa district, a smaller region within Assam, has 850 hectares under cultivation, yielding 726 tonnes of field pea, with a slightly higher productivity of 855 kg/ha.

The productivity of field pea in Assam remains significantly lower compared to other states, primarily due to the prevalence of outdated seed varieties, excessive seed rates, traditional broadcasting sowing methods and

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various biotic and abiotic stresses (Deka *et al.,* 2021). Addressing these challenges requires heightened awareness among farmers and the promotion of location-specific improved varieties to enhance both production and productivity across the state (Gogoi *et al.,* 2022).

Therefore, the initiative taken by MoA, GOI implement CFLD programme aims to popularize improved agro-technologies by showcasing them on farmers' fields, adapting them to diverse farming conditions and effectively bridging the gap between indigenous and modern technologies to boost pulse yield, particularly under rainfed conditions (Tiwari *et al.,* 2017). To implement CFLDs across India, the Division of Agricultural Extension, Indian Council of Agricultural Research (ICAR), New Delhi entrusted Krishi Vigyan Kendras with the responsibility of conducting demonstrations on critical pulse crops**.** These efforts are overseen by eleven ICAR-Agricultural Technology Application Research Institutes (ATARI) nationwide to systematically improve productivity.

In Assam, the Krishi Vigyan Kendra, Baksa**,** initiated CFLDs on field pea in 2017-18, recognizing the effectiveness of this extension approach. To assess its impact, a study was undertaken, focusing on key evaluation parameters such as changes in yield, economic viability, extension gap, technology gap, technology index and the benefit-cost ratio**.**

MATERIALS AND METHODS

The study was conducted in Krishi Vigyan Kendra of Baksa district located in the Lower Brahmaputra Valley Zone of Assam, during the month of June, 2024. Before initiating the Cluster Frontline Demonstration programme, scientists from Krishi Vigyan Kendra gathered baseline data from selected villages. Through group meetings, farmers were identified and a structured training programme was conducted to familiarize them with the recommended package of practices for field pea cultivation as prescribed by Assam Agricultural University. The CFLD-Pulses programme was then implemented across 150 hectares, benefiting 375 farmers between 2019-20 and 2022-23. Essential inputs were provided based on specific requirements and KVK scientists supervised demonstration plots, ensuring farmers received the necessary technical support.

To evaluate the programme's impact, the study focused on three purposively selected villages *viz*., *Bunbari, Barimakha* and *Kharua* involving 100 beneficiaries and 100 non-beneficiaries. The impact assessment utilized various parameters such as yield variations, economic analysis, extension gap, technology gap, technology index and the benefit-cost (B:C) ratio. Data collection followed both personal interview methods and Participatory Rural Appraisal techniques with pre-tested schedules. Various statistical tools were used to analyse the data. The extension gap (EG), technology gap (TG) and technology index (TI) were calculated as suggested by Singh *et al.* (2022) and Dayanand *et al.* (2012).

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

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

Technology index (TI in %) =

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

Impact change (%) =

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

Benefit-cost ratio =

$$\frac{\text{Gross monetary returns per ha}}{\text{Gross Monetary expenditure per ha}}$$

RESULTS AND DISCUSSION

Technological intervention in CFLD-field pea

To uplift the production and productivity of field pea, both Krishi Vigyan Kendra and the farmers made collaborative efforts. A recommended packages of practices on field pea were followed to conduct the CFLDs at the farmers' fields. Table 1 shows that the CFLD programme introduced various technological interventions to enhance field pea cultivation at Baksa district. One of the key improvements was the use of high-yielding variety '*Aman*', replacing traditional local varieties which had lower productivity and disease resistance. Farmers traditionally sowed field pea later in the season (November-December), whereas CFLD recommended variety sowed during middle of October to middle of November for optimal crop establishment, minimizing yield loss due to delayed germination. Additionally, CFLD promoted line sowing, ensuring uniform spacing and efficient nutrient uptake, whereas traditional farming relied on broadcasting, which resulted in irregular plant distribution. The seed rate was also optimized with CFLD, recommending only 60 kg/ha, significantly lower than the 80 kg/ha used by farmers with traditional practices, reducing overcrowding and enhancing growth conditions. One of the critical improvements was seed treatment, where CFLD introduced treatment with carboxin @ 2 g/kg of seed, protecting against fungal infections. Farmers, however, did not practice seed treatment, exposing crops to higher disease risks. Fertilizer management under CFLD followed a balanced application of 20:46:10 (N:P: K) kg/ha along with Borax @10 kg/ha, whereas traditional farming involved random fertilizer application without precise dosage, often leading to either nutrient deficiency or excess. Finally, plant protection practices were introduced in CFLD based on need-based pesticide application, while traditional methods lacked of pest management measures, increasing susceptibility to pest and disease outbreaks.

Similar findings were revealed in the research findings of Shukla *et al.* (2022); Kumar *et al.* (2018); Mauriya *et al.* (2024); Hooda *et al.* (2006) and Raghav *et al.* (2020).

Extent of adoption of recommended package of practices of field pea

It can be concluded from Table 2 that, before implementation of CFLD programme, no farmers used improved variety of seeds. Then later after CFLD implementation, 159 farmers (80%) adopted it. CFLD provided demonstrations showcasing the advantages of improved cultivars in terms of yield stability, pest resistance and market value. Initially, 22 farmers (37%) followed the recommended sowing method, but after CFLD, 150 farmers (75%) adopted it. The CFLD programme educated the farmers on these benefits and give demonstrations how shifting of the sowing period could improve productivity. Before CFLD, no farmers followed the correct seed rate, whereas 148 farmers (74%) adopted it after CFLD. Farmers had lacked knowledge about the ideal plant population for optimal yield. CFLD guided them on the precise seed quantity per hectare, improving spacing and reducing competition among plants. These findings are in line with the findings of Jena *et al*. (2024) and Singh *et al*. (2023). Farmers often neglect seed treatment due to lack of awareness or unavailability of treatment materials. No farmers practiced Integrated Nutrient Management programmes before CFLD, but 145 farmers (73%) adopted it afterwards. CFLD introduced balanced nutrient applications by integrating organic and inorganic inputs, enhancing soil health and crop productivity. Further, for plant protection measures, the adoption rose from 19 farmers (32%) to 147 farmers (74%). CFLD provided practical demonstrations of effective pest management techniques, making farmers more willing to implement them.

Impact of technological intervention on crop yield

The data in Table 3 illustrates the significant impact of technological interventions on the yield of the *Aman* variety of field pea over three consecutive years. Before the intervention, farmers' fields yielded between 7.0 to 8.2 q/ha, while in the demonstration fields, benefiting from improved agronomic practices under CFLD, the achieved yields range from 10 to 11.5 q/ha. This consistent increase in yield, averaging 37 per cent across the three years, highlights the effectiveness of improved seed selection, optimized nutrient management and better pest control. The highest increase was observed during 2021-22 season, where yield rose by 40 per cent, reflecting the gradual adoption and refinement of scientific techniques. Similar results had

Table 1: Technological intervention in CFLD-field pea.

Particulars	Demonstrated technologies	Farmers practice	Technology gap
Farming situation	Well drained light soil	Well drained light soil	No gap
Variety	Improved varieties (*Aman*)	Local traditional varieties	Full gap
Time of sowing	Mid of October-mid of November	November-December	Partial gap
Method of sowing	Line sowing	Broadcasting	Full gap
Seed rate	60 kg/ha or 10 kg/bigha	80 kg/ha	Full gap
Seed treatment	Seed treatment with carboxin @ 2 g/kg of seed	Nil	Full gap
Fertilizer management (INM)	20:46:10 (N:P: K) kg/ha and Borax@10 kg/ha	Random use of chemical fertilizers without following the proper dose	Full gap
Plant protection	Tebuconazole or propiconazole @2 g/lt against rust disease. Wettable Sulphur @ 2.5-3.5 kg in 500-700 ltr of water against powdery mildew disease.	Nil	Full gap

Table 2: Extent of adoption of recommended package of practices of field pea. (N=200)

Technology	Adoption (Before CFLD)	Adoption (After CFLD)	Change in no. of adopters	Impact change (%)
Variety	0 (0.00)	159 (79.5)	159	79.5
Time of sowing	22 (36.66)	150 (75.0)	128	64.0
Method of sowing				
Seed rate	0 (0.00)	148 (74.0)	148	74.0
Seed treatment	0 (0.00)	153 (76.5)	153	76.5
Fertilizer management (INM)	0 (0.00)	145 (72.5)	145	72.5
Plant protection	19 (31.66)	147 (73.5)	128	64.0

been disclosed in the research findings of Suresh *et al*. (2020), Kumar *et al*. (2023) and Das *et al*. (2021). However, despite notable improvements, the yields still fell short of the potential 18 q/ha, indicating that external factors such as soil conditions, climatic variability and farm level management practices may have constrained on maximum yield. This trend indicates the importance of sustained farmer education, enhanced resource accessibility and continuous refinement of interventions to bridge the gap between actual and potential yields.

Impact of CFLD- pulse on yield, technology gap, extension gap and technology index

Table 4 and Fig 1 illustrates the impact of the CFLD program, highlighting the variations in yield, extension gap and technology gap.

Yield performance

The analysis of the data presented in Table 4 revealed that the adoption of improved practices in demonstration plots increased the grain yield of field pea over farmer's practice in all the years of study period. The mean grain yield recorded in demonstrations was 10.43 q/ha with a range of 9.8 q/ha in 2019-20 to 1115 q/ha in 2021-22. Whereases, in case of farmer's practice, the mean grain yield recorded was 7.63 q/ha with the range from 7 q/ha to 8.2 q/ha only.

The enhanced crop yield observed in demonstration plots compared to traditional farmer practices can be attributed to the adoption of recommended agronomic techniques. These include improved planting methods, utilization of high yielding varieties, disease resistant varieties, optimized irrigation strategies and precisely calibrated

Table 3: Impact of technological intervention on crop yield.

Year	Variety	Area (ha)	Yield (q/ha) Farmers field (before intervention)	Yield (q/ha) Demonstration field (after intervention)	Potential yield (q/ha)	% Increase in yield
2019-20	Aman	20	7.7	9.8	18	29.87
2020-21	Aman	20	7.0	10	18	40.00
2021-22	Aman	20	8.2	11.5	18	40.24
Average		20	7.63	10.43	18	36.69 (37%)

Table 4: Impact of CFLD-pulse on yield, technology gap, extension gap and technology index. (N=200)

Year	Potential yield (q/ha)	Demonstration field yield (q/ha)	Farmers field yield (q/ha)	Technology gap (q/ha)	Extension gap (q/ha)	Technology index (%)
2019-20	18	9.8	7.0	8.2	2.8	45.55
2020-21	18	10	7.7	8	2.3	44.44
2021-22	18	11.5	8.2	6.5	3.3	36.11
Average	18	10.43	7.63	7.57	2.8	42.05

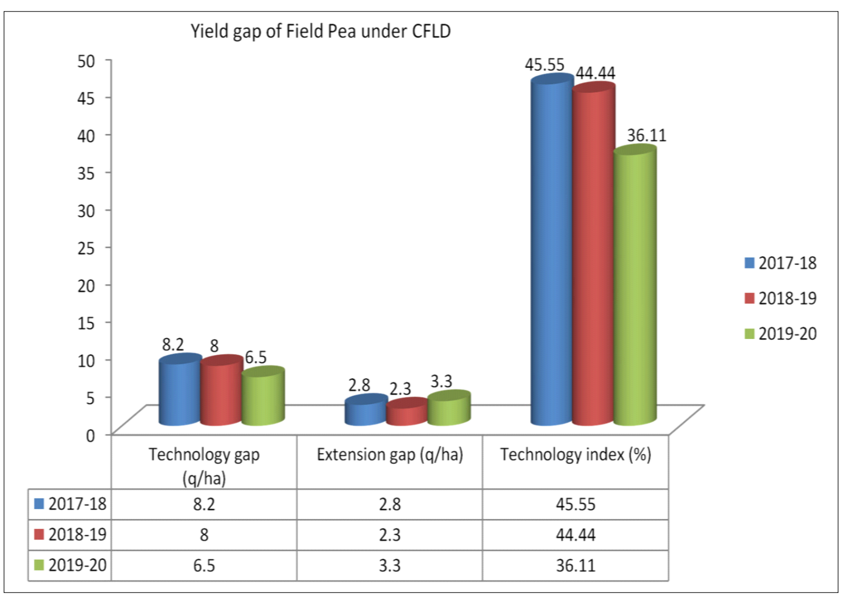

Fig 1: Yield gap of field pea under CFLD.

fertilization schedules, all contributing to superior agricultural performance in the demonstration plots. Singh *et al.* (2021); Yadav *et al.* (2022); Balai *et al*. (2012) and Kumar *et al.* (2021) also obtained similar findings from their studies.

Technology gap

It was evident from Table 4 that the technology gap ranged from 8.2 q/ha in 2019-20 to 6.5 q/ha in 2021-22 with an average of 7.6 q/ha in three years. The disparity between potential yield and demonstration yield highlights the need for further refinement of technologies developed by researchers. To minimize this technology gap, it is essential to implement location specific technology packages tailored to regional agricultural conditions (Malik *et al.,* 2021). Similar results were achieved by Vishwatej *et al.* (2023) and Meshram *et al.* (2022).

Extension gap

It was predicted from the Table 4 that the extension gap in the yield ranged from 2.8 q/ha in 2019-20 to 3.3 q/ha in 2021-22 with an average of 2.8 q/ha. The extension gap arises from inconsistencies in the adoption of recommended technologies and can be effectively reduced through coordinated efforts among researchers, extension personnel and farmers. Deka *et al.* (2024) and Singh *et al.* (2020) have reported comparable findings.

Technology index

The technology index serves as a metric for assessing the adoption and effectiveness of technologies across various conditions. It reflects the demonstrated utility of a technology, along with its observability and feasibility in real world farming scenarios. A lower Technology Index value signifies greater utility and practical applicability of the presented technology. For the crop Field pea, it was delineated from Table 4, that with a mean value of 42 per cent, the technology index ranged from 36 per cent in 2021-22 to 44 per cent in 2020-21.

The three years study period shows a downward trend in the Technology Index, indicating the impact of CFLD activities. It underscores the effectiveness of technical interventions in facilitating the adoption of improved technologies, ultimately enhancing yield performance on farmers' fields. These results are line with the findings of Meena *et al.* (2017); Reager *et al.* (2020) and Devi *et al.* (2023).

Economic analysis among the demonstration plot and farmer's plot

Fig 2 exhibits the economic performance of demonstration plots compared to farmers' fields through cost of cultivation, gross income, net income and the benefit-cost (B:C) ratio over three consecutive years.

In the 2019-20 period, the cost of cultivation in demonstration plots was Rs. 20,350 per hectare, higher than Rs. 18,050 in farmers' fields. However, the gross income from demonstration plots reached Rs. 39,200 per hectare, substantially exceeding Rs. 28,000 in farmers' fields. This resulted in a net income of Rs. 18,850 in demonstration plots, nearly double the Rs. 9,950 seen in farmers' fields. The benefit-cost ratio followed the same trend, with demonstration plots showing a ratio of 1.92 compared to 1.55 in farmers' fields. In 2020-21, the cost of cultivation increased slightly in both demonstration plots

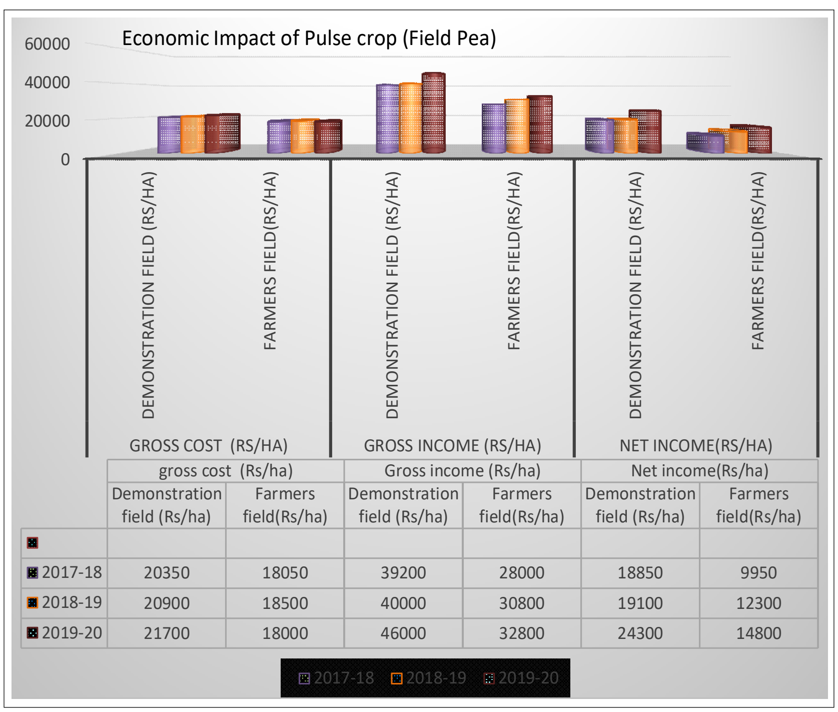

Fig 2: Economic analysis between demonstration plot of beneficiaries and farmer's plot (non-beneficiaries).

(Rs. 20,900 per hectare) and farmers' fields (Rs. 18,500 per hectare). Gross income improved further, with demonstration plots generating Rs. 40,000 per hectare while farmers' fields yielded Rs. 30,800 per hectare. This led to a net income of Rs. 19,100 in demonstration plots, compared to Rs. 12,300 in farmers' fields. The B:C ratio for demonstration plots remained high at 1.91, while farmers' fields showed a moderate increase to 1.66. By 2021-22, the cost of cultivation rose to Rs. 21,700 in demonstration plots and Rs. 18,000 in farmers' fields, reflecting increased investment in agronomic practices. Gross income peaked at Rs. 46,000 per hectare in demonstration plots, whereas farmers' fields showed a more modest gain of Rs. 32,800 per hectare. The net income from demonstration plots climbed to Rs. 24,300, surpassing Rs. 14,800 in farmers' fields. The B:C ratio reached 2.11 in demonstration plots, indicating superior economic returns compared to 1.82 in farmers' fields. Similar trend of findings has been reported by Sorokhaibam *et al.* (2023) and Roy *et al.* (2010).

On average, the cost of cultivation in demonstration plots was Rs. 20,983.33 per hectare, while farmers' fields required Rs. 18,183.33 per hectare. Gross income was significantly higher in demonstration plots at Rs. 41,733.33 per hectare, compared to Rs. 30,533.33 per hectare in farmers' fields. Consequently, net income averaged Rs. 20,750 per hectare for demonstration plots, while farmers' fields generated a lower Rs. 12,350 per hectare. The overall B:C ratio stood at 1.98 for demonstration plots, significantly outperforming farmers' fields at 1.67. The results are in line with the results achieved by Kumar *et al*. (2023) and Rajashekar *et al.* (2022).

CONCLUSION

The present study revealed a positive and impactful influence of the CFLD programme on farmers. The demonstrations introduced the improved cultivation practices, which proved to be more effective than traditional farmer's methods. While the crop yield showed notable enhancement, certain extension and technological gaps persisted, directly affecting productivity. Addressing these gaps through increased extension efforts is crucial. Economic indicators including gross returns, net returns and the B:C ratio were consistently higher in demonstrations compared to farmers' conventional practices. Overall, the CFLD programme contributed to enhanced production, improved productivity and increased farmer income, ultimately reinforcing food and nutritional security at a national level.

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Disclaimers

The perspectives and findings presented in this research article reflect the authors' own viewpoints and do not necessarily align with those of their affiliated institutions. While the authors ensure the accuracy and completeness of the information provided, they disclaim any liability for direct or indirect losses that may arise from its use.

Conflict of interest

There is no conflict of interest among the authors.

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