**Effect of Advanced Production Technologies (CFLD) on Summer Green gram Yield through Cluster Frontline Demonstrations in Bihar, India**

**ABSTRACT**

The study was conducted to promote summer greengram production technologies from 2018-19 to 2020-21 in farmer’s fields across the agro-climatic regions of Bihar through Cluster Frontline Demonstrations (CFLDs). A total of 4,075 demonstrations were conducted on an area of 1,548 ha using scientific production technologies to evaluate the performance of improved greengram varieties on productivity and profitability. Greengram is a vital pulse crop in Bihar, cultivated on over 156,772 ha with an average productivity of 6.95 q/ha, lower than the state average of 9.25 q/ha and the national average of 9.7 q/ha. The unavailability of improved varieties and non-adoption of scientific cultivation practices are among the reasons for this low productivity. Improved varieties such as IPM 02-03, HUM-16, PDM-139, Pusa Vishal, Samrat, IPM-2-14, IPM 205-07, and SML 668 were evaluated alongside practices such as line sowing, seed treatment with fungicides and insecticides, Integrated Nutrient Management (INM), Integrated Crop Management (ICM), Integrated Pest Management (IPM) and seed inoculation with Rhizobium culture and phosphorus-solubilizing bacteria (PSB).

The yield of greengram under CFLD ranged from 8.5 to 8.9 q/ha, while the extension gap and technological index ranged between 2.0 to 3.2 q/ha and 34.07 to 37.03%, respectively. The technology gap highlighted the encouraging cooperation of farmers in adopting the demonstrated practices, leading to improved results in subsequent years. The maximum gross return (INR 51,949/ha) and net return (INR 32,088/ha) were achieved during the observation years. The benefit-cost ratio ranged from 2.5 to 2.7 under demonstration, indicating that improved varieties and scientific practices significantly enhanced productivity and profitability. These results emphasize the need for disseminating improved technologies through training and demonstrations to encourage farmers to adopt recommended practices for higher returns.

**Keywords:** Adoption, frontline demonstration, greengram, gap analysis

**INTRODUCTION**

“Greengram (*Vignaradiata* L.), commonly known as moong, is an important pulse crop that requires minimal water and has a short growing duration. It is adaptable to rainfed and irrigated conditions, making it an ideal contingent crop during the early Southwest monsoon. Proper irrigation during flowering and pod-filling stages significantly enhances yield” (Kumar et al., 2016). Cultivated primarily in Asia, Australia, and the Americas, greengram is a significant legume crop in India, particularly in Uttar Pradesh, Punjab, Rajasthan, Tamil Nadu, Bihar, and Karnataka.

“In India, greengram occupies an area of 4.24 million ha with a production of 2.02 million tonnes and productivity of 477 kg/ha” (Anonymous, 2022-23). In Bihar, it is primarily a summer crop, grown on 156,772 ha, producing 108,955 tonnes with a productivity of 695 kg/ha (Anon., 2022-23). Greengram contributes to soil health by fixing atmospheric nitrogen and is grown for seeds, green manure, and forage. Despite its versatility, production and productivity remain low due to resource-poor lands, minimal inputs, and susceptibility to pests and diseases such as yellow mosaic virus (YMV) and Cercospora leaf spot (CLS).

Frontline Demonstration (FLD) is a important method for transferring advanced technologies to farmers. This approach aims to demonstrate improved crop production and protection practices in real farming situations. FLDs also study factors contributing to higher crop production and constraints, providing valuable feedback for further improvements.

**MATERIALS AND METHODS**

A total of 4,075 frontline demonstrations were conducted in Bihar during the summer seasons of 2018 to 2021 under irrigated conditions. Each demonstration covered an area of 0.4 ha, with an adjacent 1.0 ha plot maintained under farmers’ practices for comparison. Improved production technologies included:

* Line sowing with a spacing of 30 cm x 10 cm.
* Seed treatment using Bavistin (2 g/kg of seed), insecticides, and inoculation with Rhizobium and PSB.
* Nutrient management and weed management practices.
* Improved varieties such as IPM 02-03, HUM-16, PDM-139, and Samrat.

Soils were sandy loam with medium to low fertility. Sowing was done in the first week of Aprilusing a seed rate of 15-20 kg/ha. Data on grain yield from both FLD and farmers’ plots were collected and analyzed for yield gaps and economics using standard methodologies (Yadav *et al*., 2004).

The details of different parameters and formula adopted for analysis are as under:

Extension gap = Demonstration yield Farmers’ practice yield



Technology gap = Potential yield Demonstration yield



Technology index = 100

Incremental B: C ratio =

**RESULTS AND DISCUSSION**

**Yield Attributes:**

Under improved technology, the number of productive pods per plant was 24.2 as compared to 18.6 under farmers’ practices, representing a 29.8% increase. The findings align with those of Yadav et al. (2022) and Meena *et al.* (2019).

**Seed Yield:**

The mean productivity under improved technology was 9.3 q/ha, ranging between 8.5-10.0 q/ha over the years, compared to 6.3-7.0 q/ha under farmers’ practices. Yield increased by 43.9%, 36.8%, and 34.9% during 2019, 2020, and 2021, respectively, confirming findings by Singh and Meena (2011) and Gaur and Jadav (2020).

**Gap Analysis:**

The extension gap ranged from 2.2 to 3.0 q/ha, with an average of 2.6 q/ha, indicating the need for better dissemination of proven technologies. The technology gap varied from 3.5 to 5.0 q/ha, with an average of 4.2 q/ha, reflecting differences in adoption and performance of improved practices. The average technology index was 31.1%, indicating scope for technology transfer.

**Economics:**

It is clear from the table 5 and fig 1 that demonstration plots recorded a maximum gross return of INR 51,949/ha and a net return of INR 32,088/ha. The average BCR was 2.6, demonstrating economic feasibility. The findings align with studies by Yadav et al. (2004) and Parashar *et al.* (2022).

**CONCLUSION**

Frontline demonstrations revealed that adopting improved technologies significantly enhanced greengram yield, yield attributes, and economic returns. Therefore, these technologies should be disseminated widely through training and extension activities. Farmers must be encouraged to adopt scientific practices to achieve higher productivity and profitability.

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**REFERENCES**

Chandra, G. 2010. Evaluation of frontline demonstrations of greengram in Sunderban, West Bengal. *Journal of Indian Society of Costal Agricultural Research* 28:12-15.

Chaudhary, S. 2012. Impact of front lie demonstration on adoption of improved greengram production technology in Nagaur district of Rajasthan. M.Sc. Thesis, SKRAU, Bikaner.

Dayanand, Verma, R.k. and Mahta, S.M. (2012). Boosting the mustard production through front line demonstrations. *Indian Research Journal of Extension Education***12**(3):121-123.

DOA, 2013. Production and productivity of kharif pulses in Agro-climatic zone of Rajasthan. Pp 122-128.

Gauttam, U.S., Paliwal, D.K. and Singh, S.R.K. 2011. Impact of frontline demonstrations on productivity inhancement of chickpea. *Indian Journal of Extension Education*, 48 (3&4): 10-13.

GOR, 2013. Vital Agricultural Statistics, Govt. of Rajasthan, *Pant KrashiBhawan*, Jaipur. Pp 23-27.

Lothwal, O.P. 2010. Evaluation of front-line demonstrations on blackgram in irrigated agro-ecosystem. *Annals of Agricultural Research*, 31 (1&3):24-27.

Math, G., Vijayakumar, A.G., Hegde, Y. and Basamma, K. 2014: Impact of improved technologies on productivity enhancement of sesame (*Sesamumindicum* L.). *Indian Journal of Dryland Agricultural Research and Development* **29** (2):41-44.

Meena, M.L. and Dudi, A. 2012. On farm testing of chickpea cultivars for site specific assessment under rainfed condition of western Rajasthan. *Indian Journal of Extension Education*, 48 (3&4): 93-97.

Meena, O.P., Sharma K.C., Meena, R.H. and Mitharwal, B.S. 2012. Technology transfer through FLDs on mung bean in semi-arid rgion of Rajasthan. *Rajasthan Journal of extension Education***20**:182-186.

Parasar, A. P., Chandawat, M.S., KaminiParashar, K., R.., JetawatJetawat, R.P.S. and Sharma, A. (2022). Impact of Yield, Yield Gap and Economics of Cluster Front-line Demonstration on Green Gram (*Vigna radiata* L.) in Sirohi, Rajasthan. *Biological Forum – An International Journal***14**(1): 623-626.

Poonia, T.C. and Pithia, M.S. 2011. Impact of front-line demonstrations on chickpea in Gujrat. *Legume Research***34**(4):304-307.

Raj, A.D., Yadav, V. and Rathod, J.H. 2013. Impact of front-line demonstrations (FLD) on the yield of pulses. *International Journal of Scientific and Research***3**(9):1-4.

Rajni, Singh, N.P. and Singh, P. 2014. Evaluation of frontline Demonstrations on yield and economic analysis of summer moong in Amritsar district of Punjab. *Indian Journal of Extension Education.* 50 (1&2):87-89.

RanjitaBezbaruah, R. and Sharma, R. (2020).Impact of Cluster Frontline Demonstration on Productivity and Profitability of Greengram in Morigaon District of Assam.*JKrishiVigyan*., 9 (1): 164-169.

Singh, B.S. and Chauhan, T.R. 2010. Adoption of mungbean production technology in arid zone of Rajasthan. *Indian Research Journal of Extension***10**(2):73-77.

Singh, D. and Meena, M.L. 2011. Boosting seed spices production technology through front line demonstrations. *International Journal of Seed Spices***1**(1):81-85.

Singh, J. B, Singh, N. K., and Tripathi, C. K. (2019). Impact Assessment of Cluster Frontline Demonstration on Mustard Crops in Sultanpur district of U.P. Global Journal of Research Analysis, 8(1): 17-19.

Singh, N. and Singh, A. K. (2020). Yield gap and economics of cluster front line demonstrations (CFLD) on pulses under rainfed condition of Bundelkhand in U.P. *International Journal of Advanced Research in Biological Sciences*, 7(8):17-22.

Yadav, D.B, Kambhoj, B.K. and Garg, R.B. 2004. Increasing the productivity and profitability of sunflowers through frontline demonstrations in irrigated agro-ecosystem of eastern Haryana. *Haryana Journal of Agronomy***20**(1):33-35.

Yadav, V.P.S., Kumar, R., Deshwal, A.K., Raman, R.S., Sharma, B.K. and Bhela, S.L. 2007. Boosting pulse production through frontline demonstration. *Indian Journal of Extension Education* **7** (2):12-14.

Gaur Vinay and Jadav P. (2020). Impact of demonstrations on productivity and profitability of greengram in Gandhinagar district of Gujarat. *J Krishi Vigyan* 8 (2): 174-177

**Table 1: Technological gap between FLDs and farmers practices on green gram**

|  |  |  |
| --- | --- | --- |
| **Operation** | **Existing practice** | **Improved practices demonstrated** |
| Line sowing | Broad casting of seed | Spacing 30 cm between rows and 10 cm between plants in the rows |
| Seed rate (kg/ha) | 25-30 | 20 |
| Seed treatment | No seed treatment | Seed treatment with *Bavistin* 2gm/kg seed |
| Variety | Desi Moong | IPM 02-03, HUM-16, PDM-139, PUSAVISHAL SAMARAT, VIRAT, IPM 02-14, IPM 205-07 |
| Weed management | No weed management | Weeds control by using herbicide *Pendimethaline* 1kg/ha in 500 liter of water as pre-emergence treatment for effective control of weeds within two days after sowing. |
| Nutrient management | Imbalance uses of fertilizer application | RDF |
| Whole package | Farmers are cultivating the greengram crop without adoption of any improved technology | All the crop (production and protection) management practices as per the package of practices for summer crop by DAO, Bihar, were followed for raising the crop |
| Plant protection | Indiscriminate uses of insecticide and fungicides as well as growth promoters | * Pendimethaline @ 3 ml/L pre emergence for weed control * Trichogrammachlionis @1.5 lakh/ha/ week at weekly intervals * Oxyflurofen 23.5 EC @ 400 ml/ha at 2 to 3 DAS * Quizalofopethyal 5%EC @ 1 ltr/ha at 20 DAS.For control of Bihar hairy caterpillar * Imidachlopid 17.8 SL @ 0.5 ml/L For control of whitefly, aphids and hopper |

**Table 2: Impact of demonstrations on Yield attributes of green gram**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year** | **Number of pods/plant**~~s~~ | | | **Number of seeds/pod~~s~~** | | | **Test weight**  **(1000 grains)** | | |
| **IT** | **FP** | **% increased** | **IT** | **FP** | **% increased** | **IT** | **FP** | **% increased** |
| 2019 | 25.8 | 19.7 | 30.9 | 10.5 | 6.7 | 56.7 | 55.7 | 39.8 | 39.9 |
| 2020 | 22.6 | 17.3 | 30.6 | 9.0 | 5.9 | 52.5 | 60.0 | 42.7 | 40.5 |
| 2021 | 24.2 | 18.9 | 28.0 | 9.5 | 6.5 | 46.1 | 55.0 | 35.4 | 55.4 |
| **Average** | **24.2** | **18.6** | **29.8** | **9.7** | **6.4** | **51.8** | **56.9** | **39.3** | **45.3** |

IT= Improved Technology; FP = Farmers Practice

**Table 3 Impact of demonstrations on yield of green gram**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Year** | **Area (ha)** | **Demonstration (No.)** | **Yield q/ha** | | **Additional yield (Q/ha) over farmers’ practice** | **% increase in yield over farmers’ practice** |
| **TI** | **FP** |
| 2019 | 1756 | 640 | 10.0 | 7.0 | 3.0 | 42.9 |
| 2020 | 1398 | 568 | 9.3 | 6.8 | 2.5 | 36.8 |
| 2021 | 921 | 340 | 8.5 | 6.3 | 2.2 | 34.9 |
| **Average** | **1358** | **516** | **9.3** | **6.7** | **2.6** | **38.2** |

**Table 4: Impact of technological on gap recovery**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Years** | **Number of FLDs** | **Potential yield**  **(Qha-1)** | **FLD**  **yield**  **(Qha-1)** | **FP**  **yield (Qha-1)** | **% increased** | **EG**  **(Qha-1)** | **TG (Qha-1)** | **TI**  **(Qha-1)** |
| 2019 | 640 | 13.5 | 10.0 | 7.0 | 42.9 | 3.0 | 3.5 | 25.9 |
| 2020 | 568 | 13.5 | 9.3 | 6.8 | 36.8 | 2.5 | 4.2 | 31.1 |
| 2021 | 340 | 13.5 | 8.5 | 6.3 | 34.9 | 2.2 | 5.0 | 37.0 |
| **Average** | **516** | **13.5** | **9.3** | **6.7** | **38.2** | **2.6** | **4.2** | **31.1** |

EG= Extension gap; TG= Technology gap; TI= Technology index; FP= Farmers practices

**Table 5 Impact of demonstrations on Economical status**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Years** | **Gross cost**  **(Rs. /ha)** | | **Additional cost in demo.**  **(Rs. /ha)** | **Gross returns**  **(Rs. /ha)** | | **Net Return**  **(Rs. /ha)** | | **BC Ration** | |
| **IT** | **FP** | **IT** | **FP** | **IT** | **FP** | **IT** | **FP** |
| 2019 | 19860 | 18112 | 1748 | 51949 | 36529 | 32088 | 18418 | 2.6 | 1.9 |
| 2020 | 19746 | 18518 | 1228 | 49739 | 37085 | 29993 | 18567 | 2.5 | 1.8 |
| 2021 | 19154 | 17914 | 1240 | 51186 | 37981 | 32016 | 20067 | 2.7 | 1.7 |
| **Average** | **19587** | **18181** | **1406** | **50958** | **37198** | **31366** | **19017** | **2.6** | **1.8** |

IT= Improved Technology; FP= Farmers Practices

**Fig 1: Impact of Technology on Net income of farmers**