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Impact of cluster frontline demonstrations on productivity and profitability of kharif pulses (Black gram, green gram, horse gram and pigeon pea) in Chhattisgarh

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Abstract
Cluster Frontline Demonstration is a form of applied research to demonstrate the latest high yielding varieties along with critical inputs on cluster basis in farmers' fields with a view to show the potentiality of the technologies to the participating farmers, neighbouring farmers and to analyse the production performance of the technologies for scientific feedback. Cluster Frontline Demonstrations on Pulses (Black gram, Green gram, Horse gram and Pigeon pea) were conducted by 27 KVKs in Chhattisgarh from 2017-18 to 2021-22 across three seasons. A total of 6049 CFLDs were conducted covering an area of 2518 ha under pulses. Productivity of pulses obtained in FLDs was higher than the district average indicating potential for bridging the yield gap. Results of CFLDs on pulses have shown encouraging potentials. It will also help in breaking yield plateau to achieve production of sufficient quantity of pulses to meet per capita availability of pulses for ensuring nutritional security and agro- ecological sustainability. Total 27 KVKs of Chhattisgarh were actively involved in conduction of CFLDs. The major technologies focused in the demonstration were introduction of suitable crops and their high yielding varieties, method of sowing, seed treatment, line sowing, integrated nutrient management and integrated pest management. Under this programme 2518 ha area was covered with demonstration of pulses across 27 districts from 2017-18 to 2021-22. During 2017-18, a total of 1574 CFLDs were laid out in 670 ha area, in 2018-19, 1803 CFLDs were laid out in 768 ha area, during 2019-20, 1050 CFLDs were laid out in 420 ha area, in 2020-21, 783 CFLDs were laid out in 400 ha area and in 2021-22, 837 CFLDs were laid out in 340 ha area. Under the C.F.L.Ds on pulses Black gram, Green gram, Horse gram and Pigeon pea, demonstrations were conducted in 2518 ha area in Kharif season during the last 5 years.

Keywords: Cluster frontline demonstrations (CFLD), benefit cost ratio (BCR), minimum support price (MSP), Krishi Vigyan Kendra (KVK), phosphate solubilising bacteria (PSB), integrated nutrient management (INM), agricultural technology application research institute (ATARI)

Introduction
Indian agriculture has made considerable progress, particularly in respect of food crops such as wheat and rice in irrigated areas; however, performance has not been so good in case of other crops particularly pulses. Therefore, after achieving self sufficiency in food grains, more attention is required towards enhancement of pulses production to fulfil the domestic demand. In the wake of Green Revolution, India has been able to prove the doomsayers wrong regarding their forecast of an imminent food crisis. But pulse production remains our weak area. Though some progress has been made in recent years, much has to be done to achieve self-sufficiency in pulses production.

India is also a leading producer of pulses. Though India is a major pulse growing country in the world, it has faced the problem of supply-demand gap in respect of pulses since the mid-seventies. The country has been importing considerable quantities of pulses to meet the domestic demand.

Pulse cultivation is faced with myriad problems. Once pulses were grown in irrigated areas prior to Green Revolution but have now been shifted to rain fed areas which accounts for 84 per cent pulse production. Both organic and inorganic factors ranging from insects, high temperature and

lack of irrigation are responsible for low productivity. They make pulse cultivation a risky proposition. Development and acceptance of new varieties is also very limited.

India is the largest producer, processor and importer of pulses in the world and also enjoys distinction of being largest consumer as well. The country is growing pulses in an area of about 24 to 25 million hectares of land with productivity of about 780 kg a hectare which is less than the global average and a major cause of concern. Currently, daily per capita availability of pulses is 37 gram which is considerably lower than the ICMR recommendation of 52 grams. Considering the current domestic production levels i.e. 25.46 million tonnes (Anonymous 2024), there is a huge gap that needs to be addressed if India has to become self-sufficient in pulses. If we dream of a healthy India in 2050, the requirement of pulses will be 39 million tonnes which necessitates an annual growth rate of 2.14 per cent. To meet the projected demand, productivity must be enhanced to a level of 1200 kg per hectare and about 3 to 5 million hectares additional area has to be brought under pulses across the country. But the pathway to achieve the target has many inherent technical and socio-challenges and problems.

Presently, more than 92 per cent of the area under pulses is confined to unirrigated areas where farming chiefly depends on monsoon rains. Drought or drought like conditions, coupled with heat stress may reduce seed yields by 50 per cent, especially in arid and semi-arid regions. Most of the pulses are grown in low fertility and problematic soils struggling with salinity and alkalinity. In the current climatic change scenario, pulses are likely to be drastically affected by temperature extremes. Poor drainage and water logging during rainy season may cause heavy losses to pulses, especially in pigeon pea due to low plant stand and increased incidence of diseases. Pod borers, aphids, cutworm, powdery mildew, rust and wilt are the major pests and diseases affecting many pulses, especially lentil. According to experts, the richness of pulse legumes in nitrogen and phosphorous, makes them attractive and vulnerable to pests and diseases. Generally, pulses are grown by resource poor farmers and treated as secondary crops with finest productivity to staple cereals and other cash crops. As a consequence, pulses are generally deprived of essential inputs, due care and latest technologies. Availability of quality seed of improved varieties is one of the major constraints in increasing productivity of pulses.

More and more people becoming health cautious is another reason for growing demand for proteins and hence pulses. Pulses are usually cultivated as mixed crops along with crops such as cotton, mustard, or as catch crops between two cereal crops. Susceptibility to pests and diseases and low yield as compared to other grains etc. are some of the reasons that pulses have not been preferred crop for farmers. To boost pulses production, Government of India has started National Food Security Mission in 2013-14. Under NFSM, financial assistance is given for various interventions like demonstration of improved technology, distribution of quality seeds of new varieties, integrated pest management, water saving devices and capacity building of farmers. Steps are being taken to expand the scope of National Food Security Mission (NFSM) from 2016-17 so that additional interventions for increasing production of pulses may be initiated.

Area under cereals, pulses and oilseeds has increased significantly in Chhattisgarh. In cereal crops the area under summer paddy and wheat has increased significantly, in case of pulses horse gram and green gram has increased significantly. Productivity of field pea, lathyrus and lentil has decreased over the years. Maize, horse gram, mustard are the major crops in Bastar plateau, while wheat, mustard, linseed & black gram are the major crops in northern hill zone. In case of Chhattisgarh Plains, lathyrus, horse gram, and lentil are the major crops. Sugarcane followed by groundnut and maize are the major Zaid (summer) crops in Chhattisgarh.

Till date, the productivity level of pulses is not sufficient on account of several biotic and abiotic stresses besides unavailability of quality seeds of improved varieties in time and poor crop management practices due to unawareness and non-adoption of recommended production and plant protection technologies. Therefore, it is essential to demonstrate the high yielding varieties, resistant to biotic and abiotic stresses and other production technologies to which the farmers generally do not adopt. A wide gap exists between the available techniques and its actual implementation by the farmers which is reflected through poor yield in the farmers' fields. There are so many appropriate technologies generated at agricultural universities and research stations but the productivity of pulses and oilseeds is still very low due to poor transfer of technology from the points of its development to the points of its utilization and only a little new knowledge percolates to the farmers fields hence, a vast gap has been observed between knowledge production and knowledge utilization. To achieve target of additional production of pulses, Cluster Frontline Demonstration (CFLD) of pulses on farmer's field may be helpful. The basic objective of this programme is to demonstrate improved proven technologies of recently released, early maturing, high yielding, varieties in a clusters with nutrient management, weed management and pest management at farmers field to bring in enhanced application of modern technologies to show high yield. Keeping this in view, demonstrations were conducted in 0.4 ha each to assess technological gap and production gain on some selected oilseed and pulse crops as per the suitability of district needs and farmer's choice.

Frontline Demonstrations in pulses under CFLD programme have been initiated involving all 27 KVKs working under Indira Gandhi Krishi Vishwavidyalaya across the state. Farmers are realizing potential of pulse crops through these demonstrations and are adopting these remunerative crops in large scale.

Materials and Methods

India’s economy has been dominated by agriculture. However, Indian agriculture fiercely depends on monsoons to yield sufficient agricultural returns. India’s major food crops rice and wheat have been heavily incentivized with MSP in addition to preferential treatment of Public Distribution System to benefit the Indian poor. Hence, Indian farmers are motivated to grow either these crops or cash crops like cotton, sugarcane etc. Pulses and oilseeds have been a second choice for the farmers for cultivation.

Over a period of time, a number of improved pulse varieties and production technologies have been developed, but full potential of these varieties as well as technologies could not be exploited due to low rate of adoption and low yields. Thus, factors limiting the productivity cannot be overlooked. It may emphasize on quality attributes, adoption and popularization of new agro technology, evolving better varieties for stress conditions and improving present yield potential. The aim of these demonstrations in general is to raise production through transfer of farm technology.

Cluster front line demonstrations (CFLDs) is one of the most powerful tool of extension because farmers, in general, are driven by the perception that “Seeing is believing”. Cluster

Front Line demonstrations (CFLDs) is a unique approach to provide direct interface between scientist and farmers as the scientists are directly involved in planning, execution and monitoring of the demonstrations for the technologies developed by them and get direct feedback from the farmers about the crops in general and technology being demonstrated in particular. This enables the scientists to improvise upon the research programme accordingly. CFLDs provide an opportunity to researchers and extension personnel for understanding the farmer's resources and requirement to fine tune and/or modify the technologies for easy adaptability at farmers' fields.

Frontline Demonstration is a form of applied research through university system on latest released varieties along with critical inputs on selected farmers' fields with a view to demonstrate the potentiality of the technologies to (a) participating farmers (b) neighbouring farmers and other agencies; (c) to analyse the production (d) performance of the technologies for scientific feedback.

Objectives

The main objective of cluster frontline demonstrations is to demonstrate newly released crop production and protection technologies and its management practices in the farmer's field under the micro-farming situation.

Selection of site and beneficiary

- The sites of demonstrations selected were easily accessible to attract large number of farmers for more impact, easy monitoring and feedback.
- Technologies selected were of paramount importance and preferred by farmers.
- To create better and visible impact of a technology, the demonstrations were conducted in cluster approach of at least cluster of 10.0 hectares. One demonstration at individual farmer was not less than 0.4 hectare and not exceeding to one hectare.
- Demonstrations of improved variety and technology were planned well before time.
- Demonstrations were conducted on farming situations for scientific interpretation.

Under the ICAR sponsored scheme on pulses production and protection technology, KVKs of Indira Gandhi Krishi Vishwavidyalaya, Raipur conducted cluster front line demonstrations on pulse crops during *kharif, rabi* and *Zaid* season from 2017-18 to 2021-22. The Krishi Vigyan Kendra's organized CFLDs in various villages of concerned districts of KVKs. A list of farmers was prepared from group meeting and training was imparted to the selected farmers regarding different aspects of recommended production and protection technologies. Assessment of gap in adoption of recommended technology were also identified before laying out the cluster frontline demonstrations (CFLD's) through personal discussion with selected farmers.

The technological interventions on pulse crops were comprised of suitable improved varieties and demonstrated role of critical inputs *viz*. proper tillage, proper seed rate, time of sowing and sowing method, seed treatment, application of biofertilizers, weed management and improved plant protection measure were applied at farmers' fields. Control plot (farmers practice) was also kept where farmers practices were carried out (use of non-descriptive varieties, broadcasting sowing method, no use of fertilizer and seed treating chemicals, no hand weeding and indiscriminate use of plant protection measures). Critical inputs for the technologies to be demonstrated were distributed to the farmers after the training like improved high yielding variety, recommended chemicals and literature etc and regular visit, monitoring and pest and disease advisory services management by the KVK scientist to the demonstration farmers.

The demonstrations on farmers' fields were monitored by scientists of Krishi Vigyan Kendra and officials of Director Extension Services, IGKV, Raipur right from sowing to harvesting and made to guide them. Finally, field day was conducted involving demonstration holding farmers, other farmers in the village, and scientists from university and officials from Department of Agriculture to demonstrate the superiority of the technology for each crop. These visits were also utilized to collect feedback information for further improvement in research and extension programme. The yield data were collected from the demonstrations and control plots and analysed with the suitable tools for different parameters.

Crop yield was recorded from the demonstration and control plots for the crops at the time of harvest. The most feasible way by which this could be achieved is by demonstrating the recommended improved technology on the farmer's fields through front line demonstrations with the objectives to work out the input cost and monetary returns between front line demonstration and farmers methods, to identify the yield gaps between farmer's practices and frontline demonstrations. The basic information was recorded from the farmer's field and analysed to comparative performance of cluster frontline demonstrations (CFLD's) and farmer's practice. The yield data were collected from both the demonstration and farmers' practice.

Results and Discussion

CFLDs on black gram were conducted from year 2017-18 to 2021-22 in selected districts of Chhattisgarh. Number of demonstrations for different districts ranged between 15 in Bemetara to 132 in Kanker and demonstration area also ranged from 10 to 70 ha in different districts. Results reveal that highest yield of black gram 10.98q/ha of variety PU-31 was found in demonstration plot and average productivity in 5 years ranges between 8.01 to 8.56 q/ha as compared to 6.93 q/ha in farmers practice plot and productivity ranges between 4.72 to 5.3q/ha under traditional / farmers practice treatment. The yield increase ranged between 33 to 112% due to improved variety and package of practices. Use of high yielding variety and proper package of practices has increased the net monetary returns Rs 33264/- in demonstration plots as compared to farmers practice Rs. 18698/- ha. Average Benefit Cost ratio of 5 years for demonstration and farmers practice was 3.22 and 1.60, respectively. There is wide gap in productivity of black gram in these districts. This clearly indicates that there is wide possibility to provide suitable crop variety and package of practices which may enhance the productivity of black gram in these districts. Based on 5 years observations it is observed that supply of improved variety of black gram and proper package of practices may increase the productivity of black gram in the state which can full fill the pulse requirement of the region.

Cluster Frontline Demonstrations on green gram were conducted from year 2017-18 to 2021-22 in Raipur, Dhamtari, Rajnandgaon, Bastar, Surguja and Mungeli districts of Chhattisgarh. Results on the basis of average of five years data indicate that highest average yield was 8.11 q/ha and lowest yield of 4.87 q/ha was found in control plot. The yield increase over the years was 69% as compared to farmer's varieties. Highest net return was Rs 41479/- in demonstration plot whereas

lowest was Rs. 22841/- ha for control plot . Highest benefit cost ratio for demonstration and control was 3.93 and 3.10, respectively. The yield gap on the basis of five years data was 38.84%. Horizontal spread of green gram varieties 46 ha whereas it ranged between 15 to 78 ha over the years. In terms of varietal performance, Shikha and HUM-16 were found better than other varieties.

Demonstrations on horse gram variety Indira Kulthi – 1 was laid in Bastar, Jashpur, Kanker, Mainpat and Dantewada districts during the year 2017-18 to 2021-22. Results on the basis of five years average concluded that the highest average yield was 5.17 q/ha and lowest yield was 3.18 q/ha in control plot. The yield increase over the years was 53% as compared to farmer's varieties. Highest net return was Rs 11546/- in demonstration plot whereas lowest was Rs. 5829/- ha for control plot in. Highest benefit cost ratio for demonstration and control was 2.14 and 1.78, respectively. The yield gap on the basis of five years data was 30.30%. Horizontal spread of horse gram variety Indira Kulthi-1 variety was 1157 ha whereas it ranged from 28 to 144 ha over the years.

Cluster Frontline Demonstrations constitute 1 acre land and on average of five years data, 42 demonstrations in 18 hectares were conducted in different districts of Chhattisgarh. Results stated that highest average yield was 9.95 q/ha and 6.11 q/ha recorded as average yield of farmers' plot. Results revealed that Rajeev Lochan variety of pigeon pea developed by Indira Gandhi Krishi Vishwavidyalaya, Raipur outperformed all the varieties during last five years. The yield increase ranged between 15 to 110%. Highest average net return was Rs 37800/- in demonstration plot whereas lowest was Rs. 19733/- ha for control plot. Highest average benefit cost ratio for demonstration and control was 2.86 and 2.25, respectively. The yield gap ranged between 5.30 to 64.81%. Horizontal spread of pigeon pea varieties ranged between 19 to 105 ha for different varieties.

Table 1: Performance of CFLD (Pulse) on Black Gram during Kharif 2017-18 to 2021-22

Year	KVK's	Variety	No. of Demos	Area (Ha)	Yield (q/ha)		Yield increase in (%)	Net Returns (Rs/ha)		B:C ratio		District Yield (q/ha)	Yield gap in (%)	Horizontal spread of technology (Ha)
					FP	Demo		FP	Demo	FP	Demo			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2017_18	Balrampur	Azad-3	50	20	4.92	7.08	44%	16008	24342	1.66	2.75	3.00	57.63	30
	Bastar	PU-31	75	30	4.68	6.70	43%	14712	22290	1.72	2.60	4.46	33.43	32
	Bijapur	PU-31	70	20	4.76	7.62	60%	15144	27258	1.70	2.96	4.16	45.41	18
	Bilaspur	Pratap Urad-1	54	30	5.50	7.29	33%	19140	25476	1.55	2.83	4.68	35.80	41
	Dhamtari	PU-31	60	30	3.50	7.29	108%	8900	24866	2.12	2.71	3.79	48.01	35
	Jashpur	Birsa Urad	75	30	5.15	9.62	87%	17250	37448	1.61	3.58	6.05	37.11	37
	Kanker	PU-31	48	30	4.60	7.24	57%	14280	25206	1.74	2.81	5.00	30.94	34
	Mahasamund	PU-31	125	50	4.76	7.56	59%	16704	26934	1.54	2.94	4.06	46.30	42
	Raigarh	PU-31	64	30	4.79	9.25	93%	15306	34700	1.69	3.28	4.66	49.62	28
	Rajnandgaon	PU-31	75	30	4.50	9.55	112%	13740	36290	1.77	3.38	3.20	66.49	38
	Surguja	AZAD-3	79	30	4.72	8.95	90%	14928	32550	1.71	3.06	4.60	48.60	45
Tot./Avg.			775	330	4.72	8.01	71%	15101	28851	1.71	2.99	4.33	45.39	380
2018_19	Bastar	PU-31	50	20	5.43	7.80	44%	19848	29790	1.53	3.14	5.25	32.69	48
	Dhamtari	PU-31	75	30	4.50	9.22	105%	14640	37742	1.72	3.72	5.65	38.72	46
	Jashpur	Birsa Urad	75	30	5.65	9.50	68%	21080	38200	1.50	3.55	6.05	36.32	58
	Kanker	PU-31	132	70	4.60	7.85	71%	15200	30070	1.69	3.16	5.50	29.94	52
	Koriya	MASH-479	75	30	4.25	7.31	72%	13240	27046	1.80	2.95	5.00	31.60	42
	Mahasamund	PU-31	50	20	4.83	8.13	68%	16488	32728	1.64	3.56	4.50	44.65	64
	Mainpat	Indira Urad-1	50	20	3.84	7.55	97%	10944	27780	1.96	2.92	4.90	35.10	35
	Mungeli	PU-31	18	10	4.85	9.65	99%	16600	37740	1.64	3.32	4.20	56.48	24
	Raigarh	Azad Urad-3	89	40	6.25	9.75	56%	24440	37600	1.43	3.21	5.70	41.54	56
	Raipur	PU-31	25	10	6.40	9.94	55%	25280	39864	1.42	3.52	5.14	48.29	36
	Rajnandgaon	PU-31	25	10	4.10	8.65	111%	12400	31940	1.85	2.94	3.90	54.91	76
	Surguja	AZAD-3	45	20	4.50	7.30	62%	14640	26380	1.72	2.82	4.75	34.93	61
Tot./Avg.			709	310	4.93	8.55	76%	17067	33073	1.66	3.23	5.05	40.43	598
2019_20	Bastar	MASH-479	25	10	5.85	9.93	70%	22785	39101	1.46	3.23	6.90	30.51	59
	Bemetara	MASH-479	15	10	5.96	9.50	59%	23412	36650	1.45	3.09	6.45	32.11	25
	Bilaspur	MASH-479	18	10	5.00	9.10	82%	17940	36370	1.59	3.35	7.35	19.23	71
	Dhamtari	Pratap Urad-1	25	10	4.60	8.15	77%	15660	31455	1.67	3.10	5.65	30.67	79
	Gariaband	TPU-1	75	30	4.10	6.35	55%	12810	22305	1.82	2.61	3.40	46.46	23
	Jashpur	Birsa Urad	25	10	5.98	8.53	43%	23526	34731	1.45	3.50	6.05	29.07	81
	kanker	Pratap Urad-1	50	20	4.60	7.93	72%	15660	31311	1.67	3.25	6.50	18.03	79
	Korba	MASH-479	27	10	4.10	6.30	54%	12810	22020	1.82	2.59	5.80	7.94	34
	Koriya	MASH-479	25	10	4.40	6.82	55%	15580	24984	1.61	2.80	5.00	26.69	55
	Mahasamund	MASH-479	25	10	6.40	9.49	48%	25920	38493	1.41	3.47	6.00	36.78	82
	Mainpat	Indira Urad-1	25	10	4.50	8.05	79%	15090	31995	1.70	3.30	4.90	39.13	34
	Mungeli	MASH-479	25	10	5.60	8.17	46%	21360	32679	1.49	3.35	4.50	44.92	38
	Raigarh	MASH-479	42	20	6.83	10.23	50%	28371	42311	1.37	3.64	6.12	40.18	65
	Raipur	PU-31	25	10	6.97	10.98	58%	29169	46586	1.36	3.91	5.86	46.63	74
	Surguja	PU-31	22	10	4.96	8.91	80%	19272	35287	1.47	3.28	5.96	33.11	83
Tot./Avg.			449	190	5.32	8.56	62%	19958	33752	1.56	3.23	5.76	32.10	882
2020_21	Bastar	Pratap Urad-1	25	10	6.07	10.05	66%	25860	44520	1.41	3.82	7.20	28.36	76

	Bilaspur	Pratap Urad-1	25	10	5.23	9.45	81%	20820	40700	1.51	3.54	8.00	15.34	92
	Dhamtari	Pratap Urad-1	25	10	4.61	7.24	57%	17100	29550	1.62	3.13	5.65	21.96	96
	Gariaband	Indira Urad	25	10	4.00	6.59	65%	13440	25650	1.79	2.85	4.15	37.03	33
	Kanker	Pratap Urad-1	25	10	4.60	6.98	52%	17040	27990	1.62	3.02	6.50	6.88	98
	Korba	Pratap Urad-1	26	10	4.70	6.48	38%	17640	24990	1.60	2.80	5.80	10.49	56
	Mahasamund	Pratap Urad-1	25	10	6.23	9.82	58%	26820	41920	1.39	3.47	6.30	35.85	102
	Mainpat	Indira Urad-1	25	10	4.40	7.42	69%	15840	30630	1.67	3.21	4.90	33.96	56
	Mungeli	Indira Urad	25	10	5.20	8.65	66%	20640	36900	1.51	3.46	5.65	34.68	66
	Raigarh	MASH-479	50	20	6.72	9.94	48%	29760	44140	1.35	3.85	6.12	38.43	72
Tot./Avg.			276	110	5.18	8.26	60%	20496	34699	1.55	3.31	6.03	26.30	747
2021_22	Balrampur	Pratap Urad-1	25	10	4.50	9.04	101%	17790	39952	1.59	3.35	4.01	55.64	46
	Bastar	Pratap Urad-1	25	10	6.07	10.68	76%	27681	49784	1.38	3.84	7.86	26.40	95
	Dantewada	MU-2	25	10	4.50	6.95	54%	17790	29895	1.59	3.15	1.40	79.86	31
	Dhamtari	Pratap Urad-1	25	10	4.86	8.05	66%	20058	35215	1.53	3.27	6.50	19.25	105
	Gariaband	Indira Urad Pratham	25	10	4.70	7.05	50%	19050	30525	1.55	3.20	4.20	40.43	48
	Jashpur	Pratap Urad-1	25	10	5.50	8.99	63%	24090	40837	1.44	3.58	6.55	27.14	97
	Kanker	Pratap Urad-1	25	10	4.50	6.18	37%	17790	25044	1.59	2.80	6.00	2.91	118
	Korba	Pratap Urad-1	64	20	4.80	6.60	38%	19680	27080	1.54	2.87	2.97	55.00	76
	Koriya	Indira Urad-1	25	10	4.20	6.45	54%	15900	26745	1.66	2.93	5.10	20.93	79
	Mahasamund	Pratap Urad-1	25	10	6.40	9.96	56%	29760	46248	1.35	3.80	6.52	34.54	115
	Mainpat	Indira Pratap	25	10	4.40	7.80	77%	17160	35250	1.62	3.54	5.25	32.69	81
	Mungeli	Indira Urad Pratham	25	10	5.60	8.95	60%	24720	40785	1.43	3.61	6.01	32.85	83
	Narayanpur	Pratap Urad-1	50	20	4.50	7.85	74%	17790	35565	1.59	3.56	4.85	38.22	28
	Surguja	Indira Urad-1	24	10	5.31	9.17	73%	22893	40271	1.46	3.30	6.45	29.66	102
Tot./Avg.			413	160	4.99	8.12	63%	20868	35943	1.52	3.34	5.26	35.39	1104
G.Tot./Avg.			2622	1100	5.03	8.30	66%	18698	33264	1.60	3.22	5.29	35.92	3711

Table 2: Year wise summary of CFLDS on black gram during kharif season

Year	No. of Demos	Area (Ha)	Yield (q/ha)		Yield Increase (%)	Net Returns (Rs/ha)		B:C ratio		District Yield (q/ha)	Yield Gap in (%)	Hori-Zontal spread (ha)
			FP	Demo		FP	Demo	FP	Demo			
2017_18	775	330	4.72	8.01	71%	15101	28851	1.71	2.99	4.33	45.39	380
2018_19	709	310	4.93	8.55	76%	17067	33073	1.66	3.23	5.05	40.43	598
2019_20	449	190	5.32	8.56	62%	19958	33752	1.56	3.23	5.76	32.10	882
2020_21	276	110	5.18	8.26	60%	20496	34699	1.55	3.31	6.03	26.30	747
2021_22	413	160	4.99	8.12	63%	20868	35943	1.52	3.34	5.26	35.39	1104

Fig 1: Year wise Yield (q/ha) of Black Gram during Kharif

Fig 2: Year wise Net Returns (Rs/ha) **of Black Gram during Kharif**

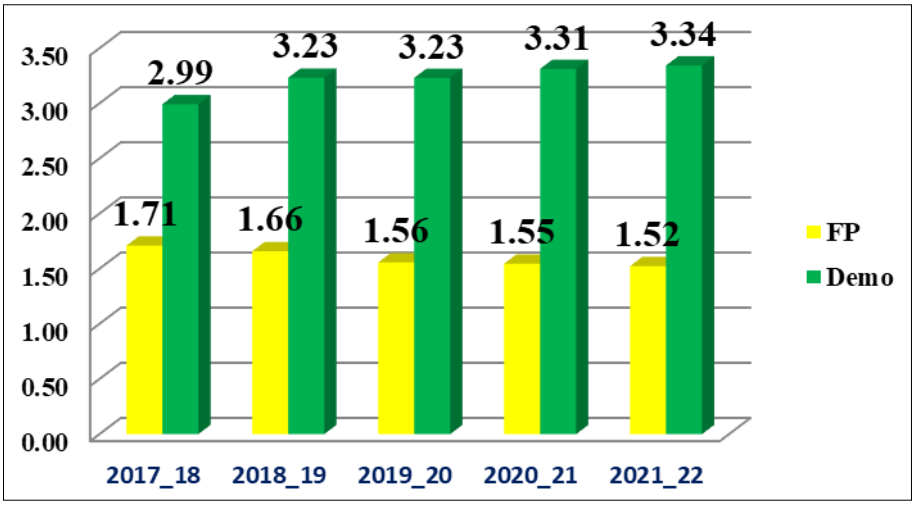

Fig 3: Year wise B:C ratio of Black Gram during Kharif

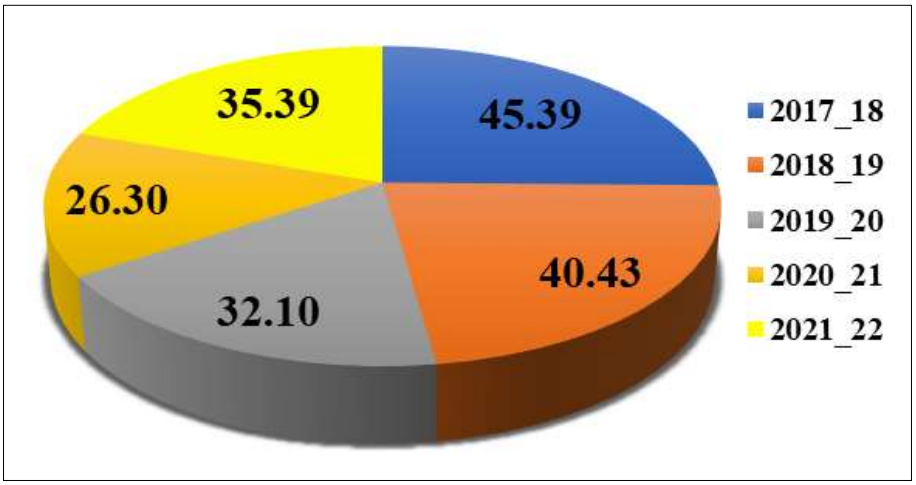

Fig 4: Year wise average Yield gap (%) of Black Gram during Kharif

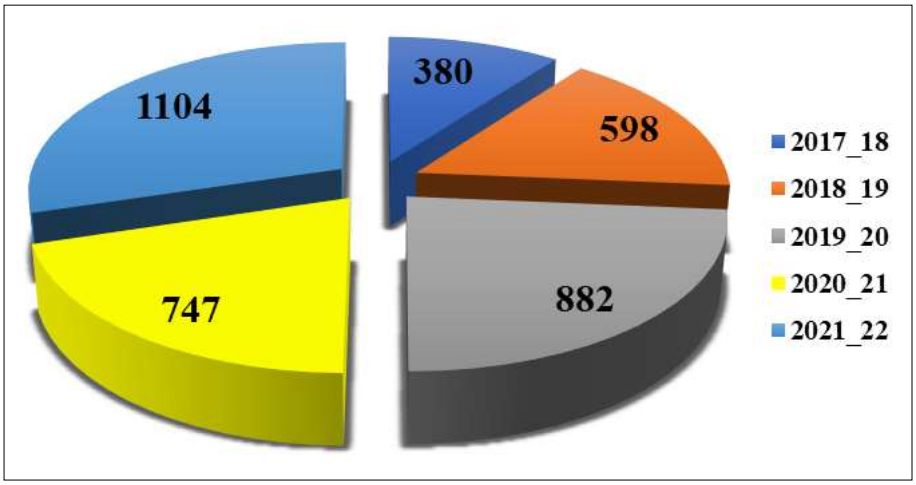

Fig 5: Year wise Horizontal Spread (ha) of Technology of Black Gram during Kharif

Table 3: Performance of CFLD (Pulse) on Green Gram during Kharif 2017-18 to 2021-22

Year	KVK's	Variety	No. of Demos	Area (Ha)	Yield (q/ha)		Yield increase in (%)	Net Returns (Rs/ha)		B:C ratio		District Yield (q/ha)	Yield gap in (%)	Horizontal spread of technology (Ha)
					FP	Demo		FP	Demo	FP	Demo			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2017_18	Dhamtari	Hum-16	21	10	4.15	8.01	93%	13486	31156	2.40	3.31	5.38	32.83	21
	Rajnandgaon	Sweta Swati	25	10	4.20	6.85	63%	13765	25689	2.43	3.06	3.10	54.74	15
	Surguja	HUM-1	38	20	3.96	7.43	88%	12427	28922	2.29	3.31	3.54	52.36	27
Tot./Avg.			84	40	4.10	7.43	81%	13226	28589	2.37	3.23	4.01	46.64	63
2018_19	Bastar	HUM-12	50	20	4.52	8.15	80%	21027	42346	3.00	3.92	6.00	26.38	24
	Raipur	HUM-12	25	10	4.40	8.24	87%	20190	42974	2.92	3.96	4.98	39.56	26
	Rajnandgaon	IPM-02-03	50	20	3.90	7.42	90%	16703	37255	2.59	3.57	3.50	52.83	34
	Surguja	TJM-3	14	10	3.90	6.60	69%	16703	31535	2.59	3.17	4.50	31.82	45
Tot./Avg.			139	60	4.18	7.60	82%	18656	38527	2.78	3.66	4.75	37.65	129
2019_20	Bastar	Hum-16	25	10	4.75	8.41	77%	22988	44791	3.19	4.09	6.30	25.09	41
	Mungeli	Hum-16	25	10	4.50	6.95	54%	21225	35998	3.02	3.77	4.30	38.13	25
	Raipur	Hum-16	25	10	4.40	8.95	103%	20520	47798	2.95	4.12	5.50	38.55	56
	Rajnandgaon	MH-421	25	10	4.00	6.30	58%	18550	31915	2.92	3.55	3.50	44.44	48
Tot./Avg.			100	40	4.41	7.65	73%	20821	40125	3.02	3.88	4.90	36.55	170
2020_21	Bastar	Hum-16	25	10	4.86	8.41	73%	24473	46018	3.33	4.17	6.45	23.31	53
	Raipur	Hum-16	25	10	6.15	8.99	46%	32755	50152	3.85	4.45	5.85	34.93	78
Tot./Avg.			50	20	5.51	8.70	60%	28614	48085	3.59	4.31	6.15	29.12	131
2021_22	Rajnandgaon	Shikha	25	10	6.17	9.15	48%	32887	52066	3.74	4.59	5.10	44.26	68
Tot./Avg.			25	10	6.17	9.15	48%	32887	52066	3.74	4.59	5.10	44.26	68
G.Tot./Avg.			398	170	4.87	8.11	69%	22841	41479	3.10	3.93	4.98	38.84	561

Table 4: Year wise summary of green gram during kharif

Year	No. of Demos	Area (Ha)	Yield (q/ha)		Yield increase in (%)	Net Returns (Rs/ha)		B:C ratio		District yield (q/ha)	Yield gap in (%)	Hori-zontal spread (ha)
			FP	Demo		FP	Demo	FP	Demo			
2017_18	84	40	4.10	7.43	81%	13226	28589	2.37	3.23	4.01	46.64	63
2018_19	139	60	4.18	7.60	82%	18656	38527	2.78	3.66	4.75	37.65	129
2019_20	100	40	4.41	7.65	73%	20821	40125	3.02	3.88	4.90	36.55	170
2020_21	50	20	5.51	8.70	60%	28614	48085	3.59	4.31	6.15	29.12	131
2021_22	25	10	6.17	9.15	48%	32887	52066	3.74	4.59	5.10	44.26	68

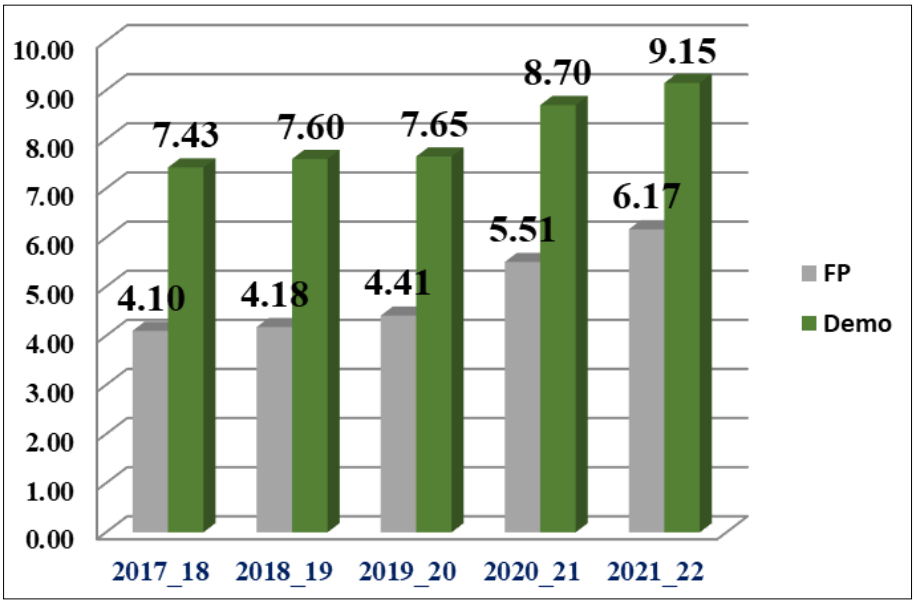

Fig 6: Year wise **Yield (q/ha) of Green Gram during Kharif**

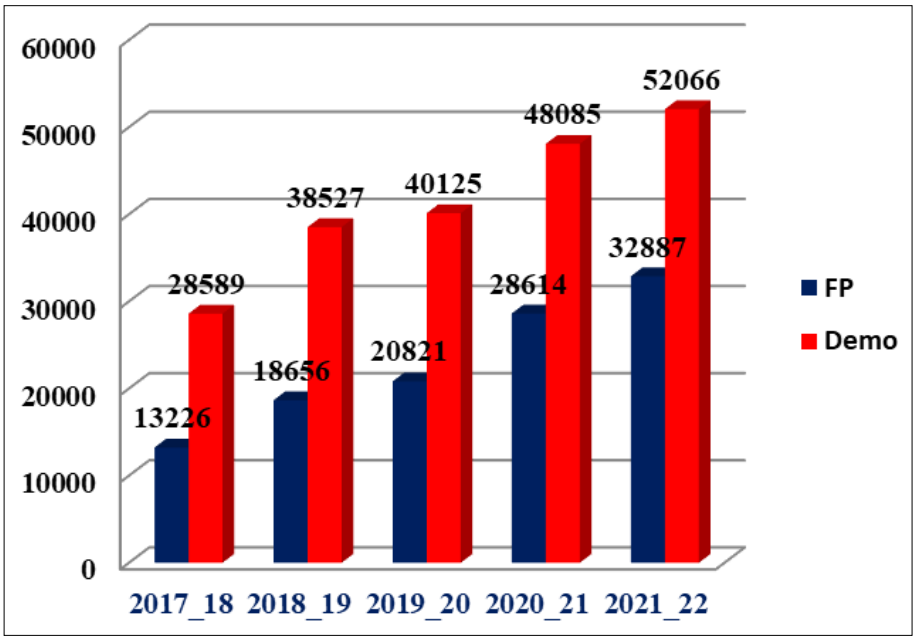

Fig 7: Year wise Net Returns (Rs/ha) **of Green Gram during Kharif**

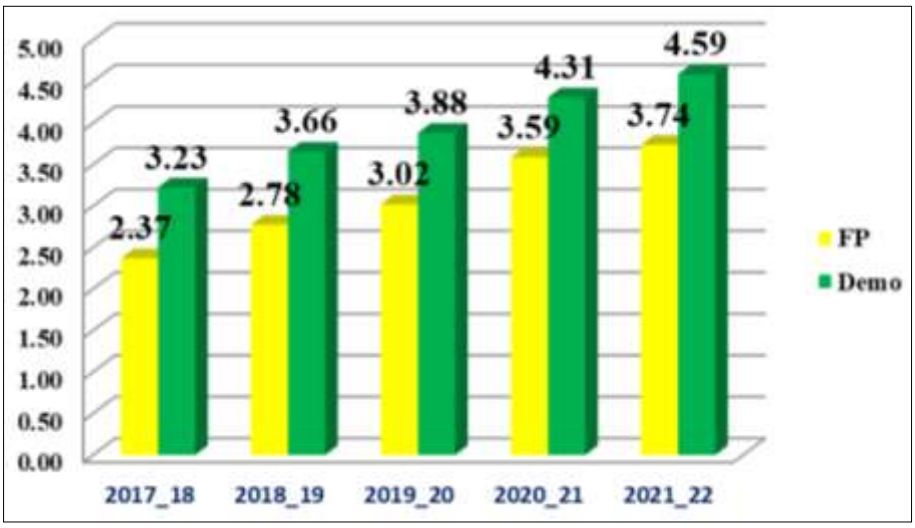

Fig 8: Year wise B:C ratio **of Green Gram during Kharif**

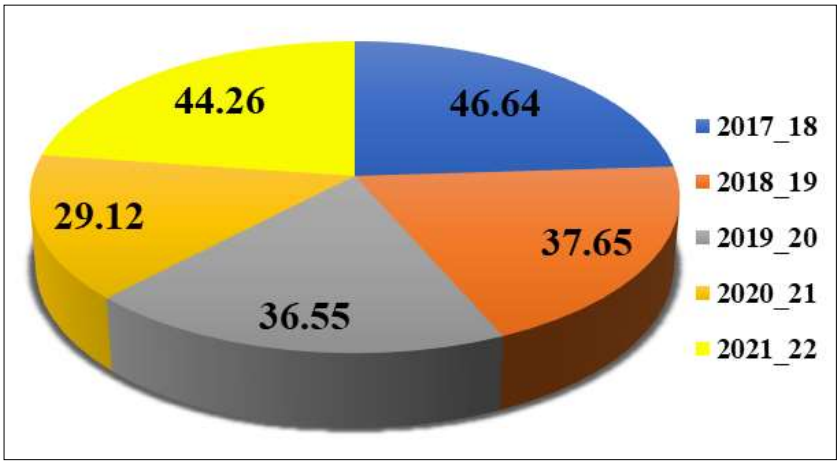

Fig 9: Year wise average Yield gap (%) of Green Gram during Kharif

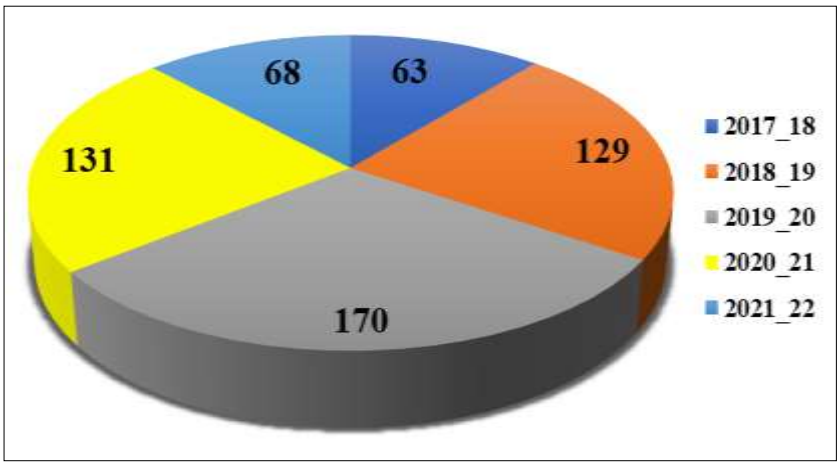

Fig 10: Year wise Horizontal Spread of Technology of Green Gram during Kharif

Table 5: Performance of CFLD (Pulse) on Horse Gram during Kharif 2017-18 to 2021-22

Year	KVK's	Variety	No. of Demos	Area (Ha)	Yield (q/ha)		Yield increase in (%)	Net Returns (Rs/ha)		B:C ratio		District Yield (q/ha)	Yield gap in (%)	Horizontal spread of technology (Ha)
					FP	Demo		FP	Demo	FP	Demo			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2017_18	Bastar	Indira Kulthi-1	50	20	4.98	6.75	36%	6940	10130	1.87	2.00	5.00	25.93	28.0
	Jashpur	Indira Kulthi-1	50	20	3.98	6.54	64%	4440	9500	1.59	1.94	3.50	46.48	26.0
	Kanker	Indira Kulthi-1	46	20	3.80	7.15	88%	4400	11330	1.63	2.12	4.65	34.97	50.0
Tot./Avg.			146	60	4.25	6.81	63%	5260	10320	1.70	2.02	4.38	35.79	104.0
2018_19	Bastar	Indira Kulthi-1	25	10	4.00	6.81	70%	5500	12013	1.73	2.19	5.25	22.91	34.0
	Jashpur	Indira Kulthi-1	50	20	4.10	6.50	59%	5825	11005	1.78	2.09	3.50	46.15	76.0
	Kanker	Indira Kulthi-1	40	20	3.80	6.24	64%	4850	10160	1.65	2.00	4.65	25.48	50.0
	Mainpat	Indira Kulthi-1	50	20	3.14	5.80	85%	2705	8730	1.36	1.86	3.55	38.79	40.0
Tot./Avg.			165	70	3.76	6.34	69%	4720	10477	1.63	2.04	4.24	33.33	200.0
2019_20	Bastar	Indira Kulthi-1	25	10	4.00	6.59	65%	6500	12945	1.87	2.28	5.30	19.58	49.0
	Jashpur	Indira Kulthi-1	25	10	4.12	6.70	63%	6920	13330	1.92	2.32	4.00	40.30	91.5
	Kanker	Indira Kulthi-1	25	10	3.50	5.83	67%	4750	10285	1.63	2.02	4.65	20.24	50.0
	Mainpat	Indira Kulthi-1	25	10	3.14	5.12	63%	3490	7800	1.47	1.77	3.55	30.66	45.0
Tot./Avg.			100	40	3.69	6.06	64%	5415	11090	1.72	2.10	4.38	27.69	235.5
2020_21	Bastar	Indira Kulthi-1	16	10	3.80	6.80	79%	6940	15720	1.93	2.55	5.50	19.12	58.0
	Jashpur	Indira Kulthi-1	25	10	4.72	5.85	24%	10436	12110	2.39	2.20	4.00	31.62	135.6
	Kanker	Indira Kulthi-1	25	10	3.50	5.71	63%	5800	11578	1.77	2.14	4.65	18.56	50.0
	Mainpat	Indira Kulthi-1	25	10	3.64	5.60	54%	6332	11160	1.84	2.10	4.10	26.79	30.0
Tot./Avg.			91	40	3.92	5.99	55%	7377	12642	1.98	2.25	4.56	24.02	273.6
2021_22	Bastar	Indira Kulthi-1	16	10	3.92	6.95	77%	8180	17680	2.09	2.75	5.80	16.55	63.0
	Dantewada	Indira Kulthi-1	25	10	3.00	5.15	72%	4500	10480	1.60	2.04	1.30	74.76	50.0
	Jashpur	Indira Kulthi-1	25	10	3.80	5.96	57%	7700	13720	2.03	2.36	4.15	30.37	143.5
	Kanker	Indira Kulthi-1	25	10	3.50	5.37	53%	6500	11360	1.87	2.12	4.65	13.41	50.0
	Mainpat	Indira Kulthi-1	25	10	3.12	5.72	83%	4980	12760	1.66	2.26	4.25	25.70	37.0
Tot./Avg.			116	50	3.47	5.83	69%	6372	13200	1.85	2.30	4.03	32.16	343.5
G.Tot./Avg.			618	260	3.82	6.21	64%	5829	11546	1.78	2.14	4.32	25.50	1156.6

Table 6: Year wise summary of horse gram during kharif

Year	No. of Demos	Area (Ha)	Yield (q/ha)		Yield increase in (%)	Net Returns (Rs/ha)		B:C ratio		District Yield (q/ha)	Yield Gap in (%)	Hori-Zontal spread (ha)
			FP	Demo		FP	Demo	FP	Demo			
2017_18	146	60	4.25	6.81	63%	5260	10320	1.70	2.02	4.38	35.79	104
2018_19	165	70	3.76	6.34	69%	4720	10477	1.63	2.04	4.24	33.33	200
2019_20	100	40	3.69	6.06	64%	5415	11090	1.72	2.10	4.38	27.69	236
2020_21	91	40	3.92	5.99	55%	7377	12642	1.98	2.25	4.56	24.02	274
2021_22	116	50	3.47	5.83	69%	6372	13200	1.85	2.30	4.03	32.16	344

Fig 11: Year wise Yield (q/ha) of Horse Gram during Kharif

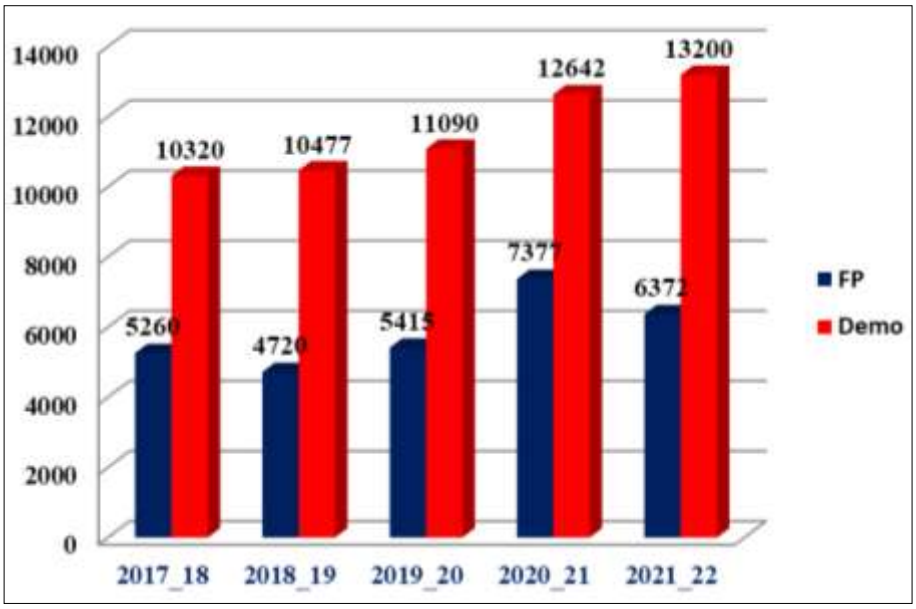

Fig 12: Year wise Net Returns (Rs/ha) of Horse Gram during Kharif

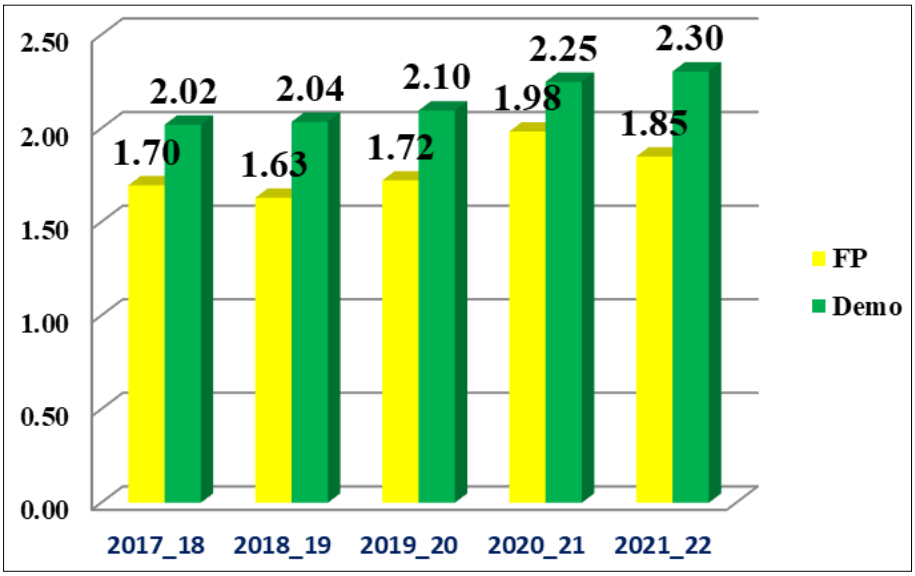

Fig 13: Year wise B:C ratio of Horse Gram during Kharif

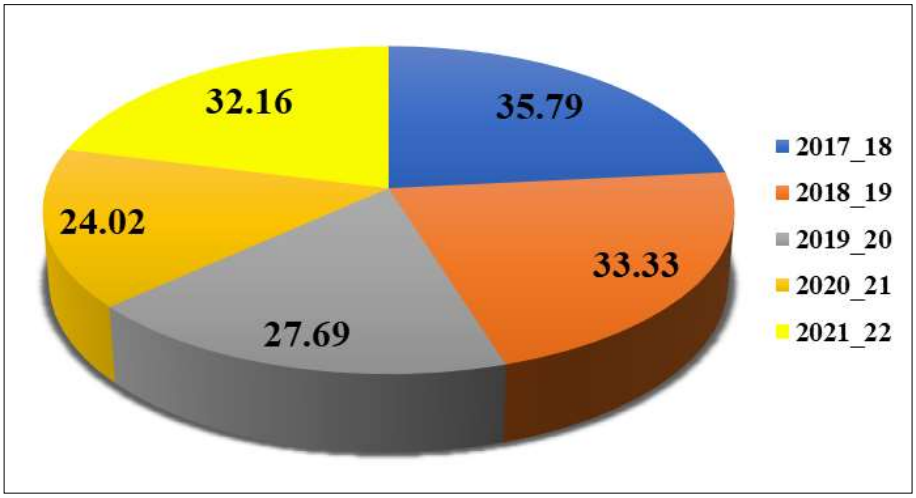

Fig 14: Year wise average Yield gap (%) of Horse Gram during Kharif

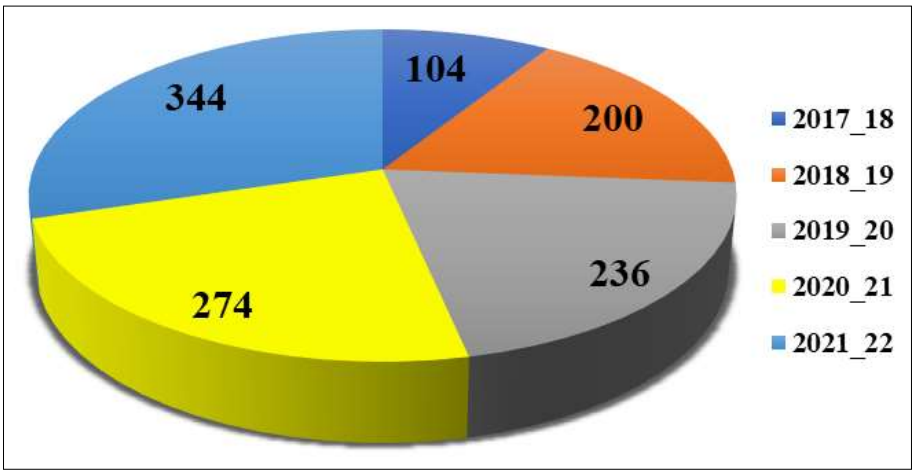

Fig 15: Year wise Horizontal Spread of Technology of Horse Gram during Kharif

Table 7: Performance of CFLD (Pulse) on pigeon pea during kharif 2017-18 to 2021-22

Year	KVK's	Variety	No. of Demos	Area (Ha)	Yield (q/ha)		Yield increase in (%)	Net Returns (Rs/ha)		B:C ratio		District Yield (q/ha)	Yield gap in (%)	Horizontal spread of technology (Ha)
					FP	Demo		FP	Demo	FP	Demo			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2017_18	Balrampur	Rajeev Lochan	75	30	3.75	7.25	93%	7438	21513	1.57	2.20	4.00	44.83	21
	Bilaspur	UPAS-120	37	30	5.15	10.80	110%	14068	38860	2.00	2.94	3.80	64.81	26
	Dantewada	Rajeev Lochan	100	40	6.08	10.65	75%	18636	37543	2.29	2.83	4.00	62.44	20
	Dhamtari	Rajeev Lochan	41	10	6.75	11.07	64%	20788	39832	2.30	2.94	6.50	41.28	34
	Kabirdham	Asha	150	60	7.90	12.66	60%	27055	48497	2.69	3.37	8.50	32.86	42
	Korba	Rajeev Lochan	54	20	6.20	10.93	76%	17790	39069	2.11	2.91	6.01	45.01	34
	Raipur	Asha	25	10	7.00	10.71	53%	21650	37870	2.31	2.85	4.50	57.98	26
	Rajnandgaon	Rajeev Lochan	50	20	8.00	11.00	38%	32600	39450	3.96	2.92	5.83	47.00	21
	Surguja	TJT-501	37	20	5.20	8.27	59%	11840	24572	1.72	2.20	6.50	21.40	19
Tot./Avg.			569	240	6.23	10.37	70%	19096	36356	2.33	2.79	5.52	46.40	243
2018_19	Balrampur	TJT-501	50	28	5.40	9.10	69%	14645	31393	1.92	2.55	5.20	42.86	30
	Bemetara	Rajeev Lochan	75	30	5.20	8.20	58%	13510	26285	1.84	2.30	4.25	48.17	27
	Bilaspur	Rajeev Lochan	46	30	5.38	9.70	80%	14532	34798	1.91	2.72	5.74	40.82	42
	Dhamtari	Rajeev Lochan	80	20	4.35	8.20	89%	8186	25035	1.50	2.16	6.50	20.73	51
	Jashpur	Rajeev Lochan	75	30	6.16	10.42	69%	18458	38884	2.12	2.92	6.50	37.62	31
	Kabirdham	Rajeev Lochan	125	50	5.75	11.30	97%	16131	42628	1.98	2.98	8.75	22.57	54
	Korba	Rajeev Lochan	99	30	6.89	10.52	53%	22601	39451	2.37	2.95	6.39	39.26	42
	Koriya	TJT-501	50	20	4.18	7.39	77%	7222	20438	1.44	1.95	6.80	7.98	21
	Mainpat	TGT-501	50	20	5.50	8.10	47%	14713	25718	1.89	2.27	7.20	11.11	34
	Mungeli	Asha	28	20	6.69	11.08	66%	21466	42879	2.30	3.14	9.50	14.26	28
	Raipur	Asha	25	10	7.00	11.04	58%	23225	42652	2.41	3.13	4.91	55.53	58
	Rajnandgaon	Rajeev Lochan	50	20	6.08	10.30	69%	18004	36453	2.09	2.66	7.70	25.24	42
	Surguja	TJT-501	37	20	5.50	9.30	69%	15213	32528	1.95	2.61	7.50	19.35	39
Tot./Avg.			790	328	5.70	9.59	69%	15993	33780	1.98	2.64	6.69	29.65	499
2019_20	Bemetara	Rajeev Lochan	25	10	7.16	12.70	77%	25028	53410	2.52	3.64	6.16	51.50	56
	Bilaspur	Rajeev Lochan	20	10	8.00	10.74	34%	29900	42042	2.81	3.08	8.70	18.99	72
	Dhamtari	Rajeev Lochan	65	20	7.50	11.54	54%	26500	46682	2.56	3.31	9.50	17.68	68
	Jashpur	TJT-501	25	10	8.03	9.22	15%	30574	37476	2.91	3.34	5.30	42.52	73
	Kabirdham	Rajeev Lochan	50	20	6.80	10.05	48%	22920	37730	2.39	2.84	8.90	11.44	76
	Korba	Rajeev Lochan	94	30	6.14	10.23	67%	19112	38754	2.16	2.88	7.00	31.57	53
	Koriya	Asha	25	10	4.56	6.56	44%	10448	22048	1.65	2.38	6.00	8.54	36
	Mainpat	Rajeev Lochan	25	10	6.00	8.35	39%	17800	27850	2.05	2.35	7.20	13.77	54
	Mungeli	Rajeev Lochan	25	10	5.90	9.50	61%	17220	34600	2.01	2.69	7.80	17.89	46
	Raipur	Rajeev Lochan	25	10	5.80	9.72	68%	17640	35876	2.10	2.75	4.91	49.49	78
	Surguja	TJT-501	24	10	5.30	7.92	49%	14740	25436	1.92	2.24	7.50	5.30	55
Tot./Avg.			403	150	6.47	9.68	51%	21080	36537	2.28	2.86	7.18	24.43	667
2020_21	Balod	Rajeev Lochan	24	10	5.86	9.90	69%	19160	38900	2.20	2.90	12.85	-29.80	21
	Bemetara	Rajeev Lochan	15	10	7.35	10.60	44%	28100	43100	2.76	3.10	6.60	37.74	72
	Bhatapara	Rajeev lochan	10	10	4.50	7.45	66%	11000	24200	1.69	2.18	6.50	12.75	76
	Bilaspur	Rajeev Lochan	15	10	6.00	11.80	97%	20000	50300	2.25	3.45	10.00	15.25	86
	Dhamtari	Rajeev Lochan	65	20	7.31	10.54	44%	27860	42740	2.74	3.08	9.50	9.87	73
	Jashpur	TJT-501	25	10	6.13	9.67	58%	20780	37520	2.30	2.83	5.03	47.98	87
	Kabirdham	Rajeev Lochan	25	10	6.50	10.23	57%	23000	40880	2.44	2.99	9.20	10.07	91
	Korba	Rajeev Lochan	90	30	6.84	11.20	64%	25040	46700	2.57	3.28	7.75	30.80	76
	Mainpat	Rajeev Lochan	25	10	5.80	10.18	76%	18800	40580	2.18	2.98	7.50	26.33	53
	Mungeli	Rajeev Lochan	25	10	6.20	11.20	81%	21200	46700	2.33	3.28	10.50	6.25	58
	Raipur	Rajeev Lochan	25	10	5.78	9.25	60%	18680	35000	2.17	2.71	4.91	46.92	95
	Surguja	TJT-501	22	10	5.10	8.80	73%	14600	32300	1.91	2.58	7.50	14.77	68
Tot./Avg.			366	150	6.11	10.07	66%	20685	39910	2.29	2.95	8.15	19.08	856
2021_22	Balod	Rajeev Lochan	25	10	5.10	9.89	94%	15630	40807	1.95	2.90	6.85	30.74	34
	Balrampur	Rajeev Lochan	25	10	4.18	7.37	76%	10334	25931	1.65	2.26	5.20	29.44	56
	Bilaspur	Rajeev Lochan	15	10	6.15	10.80	76%	22745	46540	2.42	3.16	10.00	7.41	95
	Dhamtari	Rajeev Lochan	25	10	6.65	10.60	59%	25395	45280	2.54	3.11	8.80	16.98	82
	Durg-II	TJT-501	18	10	6.20	10.58	71%	23060	46154	2.44	3.25	9.20	13.04	34
	Jashpur	TJT-501	25	10	6.55	10.94	67%	25265	48422	2.58	3.36	5.08	53.56	102
	Kabirdham	Rajeev Lochan	25	10	6.84	11.10	62%	26592	48430	2.61	3.25	9.10	18.02	115
	Korba	Rajeev Lochan	25	10	6.20	10.24	65%	23060	44012	2.44	3.15	7.75	24.32	82
	Mainpat	Rajeev Lochan	25	10	5.33	8.43	58%	17579	32609	2.10	2.59	7.20	14.59	66
	Mungeli	Rajeev Lochan	25	10	6.56	11.50	75%	25328	51950	2.58	3.53	7.80	32.17	72
	Raipur	Rajeev Lochan	25	10	5.78	9.25	60%	19914	37775	2.21	2.84	5.00	45.95	105
	Surguja	Rajeev Lochan	25	10	6.80	9.78	44%	26840	41114	2.68	3.01	8.50	13.09	73
Tot./Avg.			283	120	6.03	10.04	67%	21812	42419	2.35	3.03	7.54	24.94	916
G.Tot./Avg.			2411	988	6.11	9.95	64%	19733	37800	2.25	2.86	7.02	28.90	3181

Table 8: Year wise summary of pigeon pea during kharif

Year	No. of Demos	Area (Ha)	Yield (q/ha)		Yield Increase in (%)	Net Returns (Rs/ha)		B:C ratio		District Yield (q/ha)	Yield Gap in (%)	Hori-Zontal spread (ha)
			FP	Demo		FP	Demo	FP	Demo			
2017_18	569	240	6.23	10.37	70%	19096	36356	2.33	2.79	5.52	46.40	243
2018_19	746	329	5.70	9.59	69%	15993	33780	1.98	2.64	6.69	29.65	499
2019_20	380	150	6.47	9.68	51%	21080	36537	2.28	2.86	7.18	24.43	667
2020_21	366	150	6.11	10.07	66%	20685	39910	2.29	2.95	8.15	19.08	856
2021_22	283	120	6.03	10.04	67%	21812	42419	2.35	3.03	7.54	24.94	916

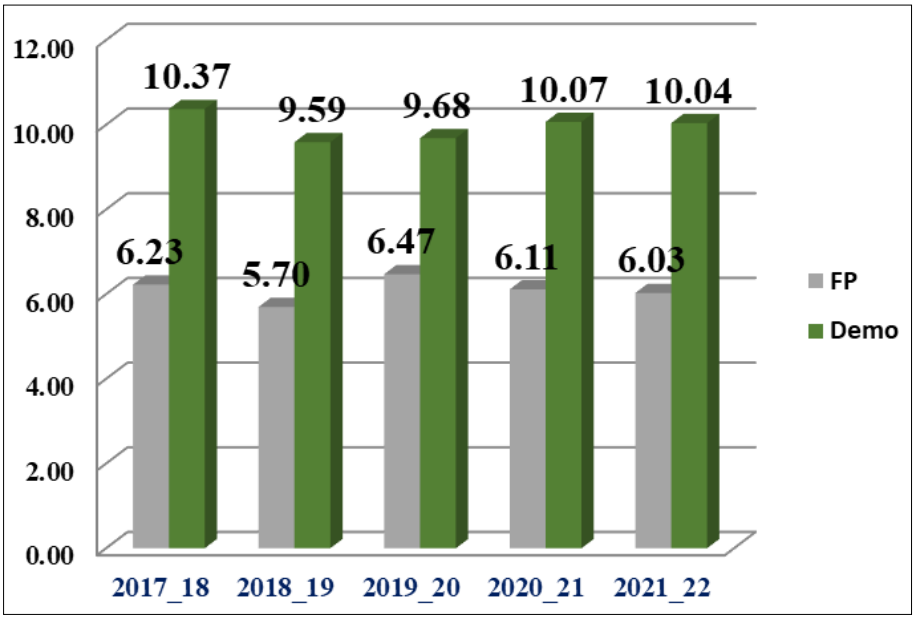

Fig 16: Year wise Yield (q/ha) of Pigeon Pea during Kharif

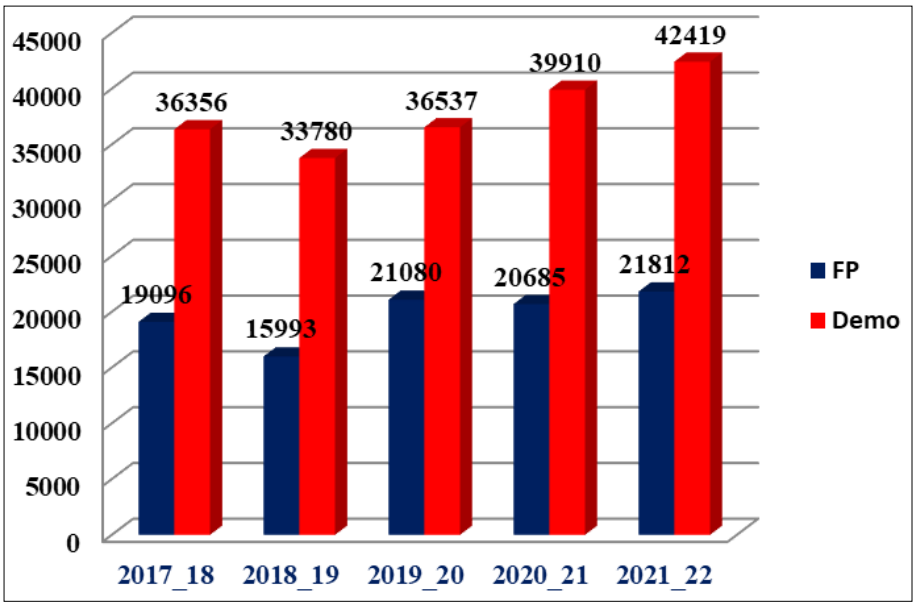

Fig 17: Year wise Net Returns (Rs/ha) **of Pigeon Pea during Kharif**

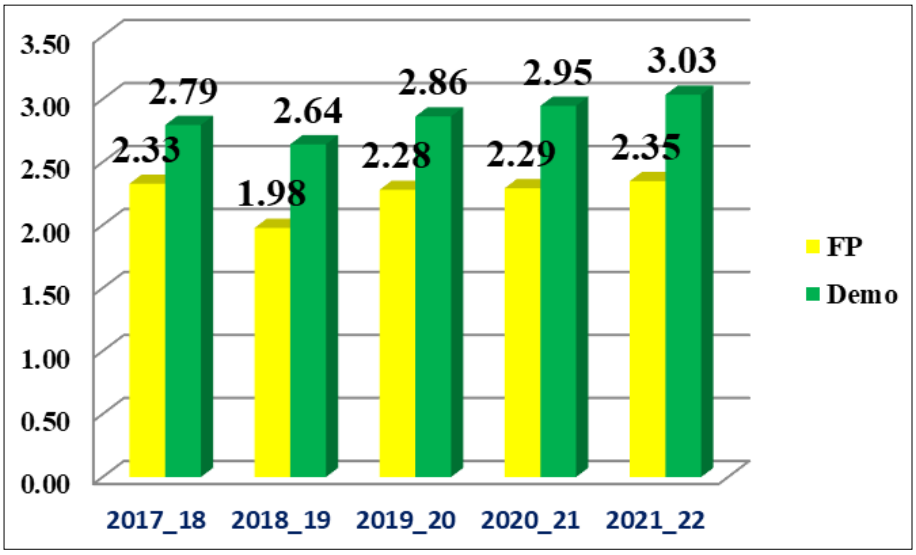

Fig 18: Year wise B:C ratio of Pigeon Pea during Kharif

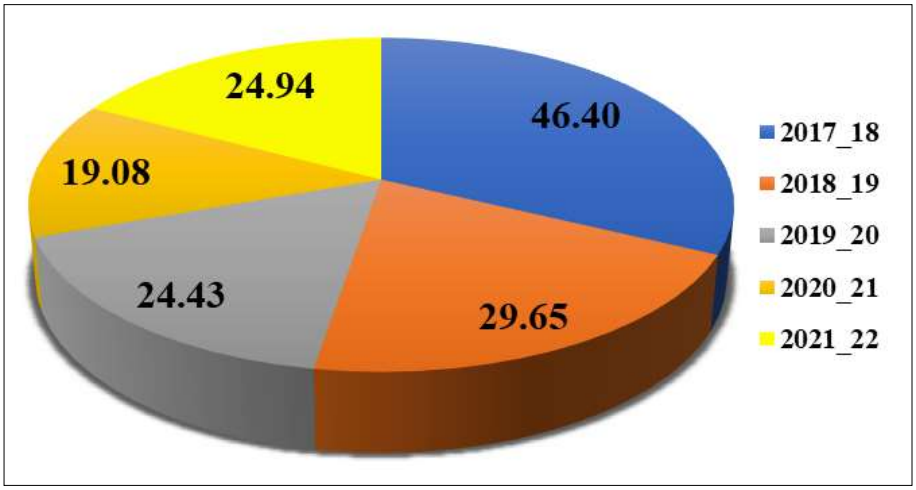

Fig 19: Year wise average Yield gap (%) of Pigeon Pea during Kharif

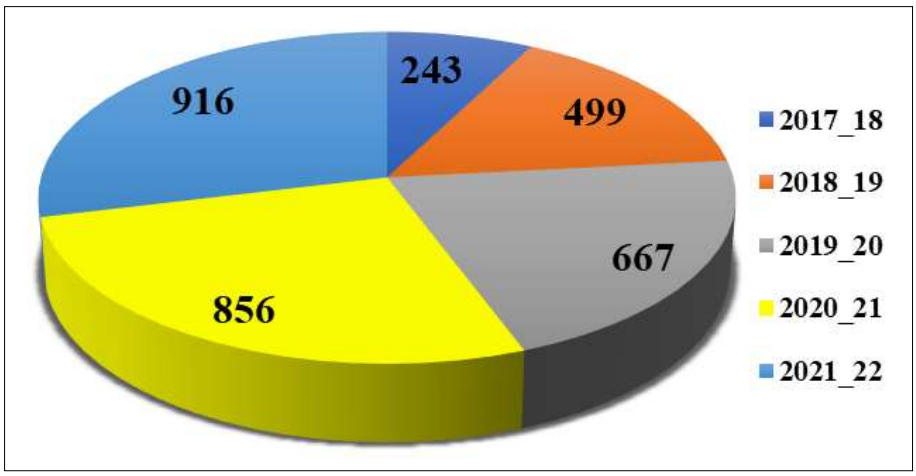

Fig 20: Year wise Horizontal Spread of Technology of Pigeon Pea during Kharif

Conclusion

In conclusion, the Cluster Frontline Demonstrations (CFLDs) conducted on various pulse crops across different districts of Chhattisgarh have yielded valuable insights into enhancing agricultural productivity. Over a span of five years, significant improvements were observed in both yield and economic returns with the adoption of improved varieties and recommended practices. The results underscore the potential for bridging the productivity gap in pulse crops through targeted interventions, such as the dissemination of high-yielding varieties and tailored agronomic techniques. Particularly noteworthy were the substantial yield increases ranging from 33% to 112% in black gram, 69% in green gram, 53% in horse gram, and 15% to 110% in pigeon pea, compared to conventional farming practices. These findings highlight the efficacy of CFLDs in promoting sustainable agriculture and meeting the pulse requirements of

the region. Moving forward, the widespread adoption of improved varieties and best practices holds promise for further enhancing pulse production and bolstering agricultural livelihoods in Chhattisgarh.

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