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AK Tripathi
Krishi Vigyan Kendra, Bilaspur, Chhattisgarh, India

Rama Mohan Savu
Assistant Professor, Department of Agronomy, IGKV, College of Agriculture, Raipur, Chhattisgarh, India

Deepti Jha
Assistant Professor, IGKV, Directorate of Extension Services, Raipur, Chhattisgarh, India

Corresponding Author:
AK Tripathi
Krishi Vigyan Kendra, Bilaspur, Chhattisgarh, India

Productivity and profitability of Rabi pulses in farmers fields under cluster frontline demonstrations in Chhattisgarh

AK Tripathi, Rama Mohan Savu and Deepti Jha

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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 (Chick pea, Field pea, Lathyrus, and Lentil) were conducted by 27 KVKs in Chhattisgarh from 2017-18 to 2021-22 during rabi season. A total of 5374 CFLDs were conducted covering an area of 2510 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 demonstrations 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 2510 ha area was covered with demonstration of Rabi pulses (Chick pea, Field pea, Lathyrus, and Lentil) across 27 districts from 2017-18 to 2021-22. During 2017-18, a total of 1227 CFLDs were laid out in 597 ha area, in 2018-19, 1505 CFLDs were laid out in 774 ha area, during 2019-20, 772 CFLDs were laid out in 350 ha area, in 2020-21, 1070 CFLDs were laid out in 459 ha area and in 2021-22, 800 CFLDs were laid out in 330 ha area. Under the C.F.L.Ds on pulses Chick pea, Field pea, Lathyrus, and Lentil, demonstrations were conducted in 2510 ha area in Rabi season during 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
Remarkable progress has been made in India 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-reliance 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 percent 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-reliant 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 percent. 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 social challenges and problems.

Presently, more than 92 percent 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 percent, 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 mostly 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

Economy of India is 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 rabi 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 provided to the farmers after the training on improved high yielding variety, recommended chemicals and literature etc and regular visit, monitoring, 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 IGKV, Raipur right from sowing to harvesting and made to guide them. Finally, field day was organized 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 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

Cluster Frontline Demonstrations on Chick pea were conducted from the year 2017-18 to 2021-22 in different villages of selected districts of Chhattisgarh. Chickpea is the major rabi crop in Chhattisgarh which constitutes remarkable area in rabi season. RVG-202 variety was the major test crop across the districts of Chhattisgarh. Number of demonstrations ranged between 10 to 125 in different districts. Average yield data in the demonstration plot was 10.79 and 6.19 q/ha in farmers plot. The yield increase ranged between 41 to 174%. Highest average net return was Rs 30138/- ha in demonstration plot whereas lowest was Rs. 14767/- ha for control plot. Highest average benefit cost ratio for demonstration and control was 2.39 and 1.98, respectively. The yield gap ranged between 2.37 to 72.15 %. Horizontal spread of chickpea varieties ranged between 5 ha for JG-11 variety in Narayanpur to 178 ha for Vaibhav variety in Raipur district.

Field pea performs better in acidic soils therefore farmers in districts of Chhattisgarh plains and Northern hills zone prefer field pea in rabi season but Korea district in Northern hill zone and Narayanpur district in Bastar plateau laid the maximum CFLDs. Paras, Aman and Indira Matar-1 varieties were mostly taken by KVKs as test crop across the districts of Chhattisgarh. Average yield data in the demonstration plot was 6.40 and 3.70 q/ha in farmers plot. The yield increase ranged between 36 to 147%. Highest average net return was Rs 18048/- in demonstration plot whereas lowest was Rs. 8765/- ha for control plot. Highest average benefit cost ratio for demonstration and control was 2.37 and 1.81, respectively. The yield gap ranged between -9.76 to 73.33 %. Horizontal spread of field pea varieties ranged between 7 to 42 ha for different varieties.

Lathyrus (grass pea) is a high-yielding, drought-resistant legume consumed as a food in central and northern India. Its development into an important food legume, and is thought of as an 'insurance crop' as it produces reliable yields when all other crops fail. Recently, some low-toxin lines have been developed that may prove safe for both animal and human foods. In

Chhattisgarh, it is grown in large areas in rabi season as utera crop. Mahatiwda and Prateek varieties were mostly taken by KVKs as test crop across the districts of Chhattisgarh. Average yield data in the demonstration plot was 7.42 and 4.71 q/ha in farmers plot. The yield increase in demonstration plot as compared to farmers plot gives the idea of the promising technology/variety. The average yield increase was 58%. Highest average net return was Rs 9172/- in demonstration plot whereas lowest was Rs. 5230/- ha for control plot. Highest average benefit cost ratio for demonstration and control was 2.35 and 1.65, respectively. The average yield gap over the years was 29.04%. Horizontal spread of lathyrus varieties ranged between 16 to 110 ha for different varieties. CFLDs on lentil were conducted from year 2017-18 to 2021-22 in Raipur, Jashpur, Mungeli, Mainpat, Bemetara and Surguja districts of Chhattisgarh. Results on the basis of average of five years data indicated that highest average yield was 7.24 q/ha and lowest yield of 5.02 q/ha was found in control plot. The average yield increase was 47%. Highest average net return was Rs 20012/- in demonstration plot whereas lowest was Rs. 8072/- ha for control plot. Highest average benefit cost ratio for demonstration and control was 2.31 and 1.68, respectively. The average yield gap over the years was 27.61%. Horizontal spread of lentil varieties ranged between 18 to 71 ha for different varieties.

Table 1: Performance of CFLD on Chickpea during Rabi 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	JG-130	75	30	6.15	12.04	96%	14500	31476	2.15	2.46	9.50	21.10	21
	Bhatapara	JG-14	22	22	6.23	12.34	98%	14852	32796	2.18	2.53	4.23	65.72	28
	Bilaspur	JG-14	43	30	6.12	11.75	92%	14368	30200	2.14	2.40	9.25	21.28	31
	Dantewada	JG- 130	75	30	4.12	8.43	105%	5550	16092	1.44	1.77	5.40	35.94	15
	Durg-II	JG-130	39	20	6.15	12.03	96%	14500	31432	2.15	2.46	3.35	72.15	42
	Janjgir–Champa	JG-14	30	75	6.14	12.50	104%	14236	33500	2.11	2.56	8.54	31.68	24
	Kabirdham	JG-14	125	50	6.20	12.68	105%	14293	32792	2.10	2.43	10.00	21.14	42
	Kanker	JAKI-9218	58	30	5.80	9.98	72%	12644	23412	1.98	2.14	8.00	19.84	38
	Korba	JAKI-9218	52	20	5.67	11.95	111%	12234	30580	1.96	2.39	8.50	28.87	18
	Koriya	JG14,JG11	100	40	5.27	9.55	81%	10188	22020	1.78	2.10	5.80	39.27	21
	Narayanpur	JG11	75	30	5.15	9.54	85%	10160	21976	1.81	2.10	6.50	31.87	5
	Raipur	JAKI-9218	25	10	6.45	12.15	88%	14880	31960	2.10	2.49	8.90	26.75	52
	Rajnandgaon	JAKI-9218	50	20	7.13	12.10	70%	17372	33240	2.24	2.66	7.11	41.24	38
	Surguja	Vaibhav	50	20	3.20	8.78	174%	5080	18132	1.56	1.88	4.40	49.89	24
Tot./Avg.			819	427	5.70	11.13	98%	12490	27829	1.98	2.31	7.11	36.19	399
2018_19	Bastar	JG-14	36	20	5.57	11.29	103%	11087	26958	1.82	2.17	9.80	13.20	24
	Bemetara	JG-14	100	40	5.80	11.60	100%	13165	28770	2.05	2.28	5.70	50.86	17
	Bhatapara	JG-14	75	75	6.17	12.56	104%	13852	32078	2.03	2.37	4.50	64.17	34
	Dhamtari	Vaibhav	25	10	6.24	10.25	64%	13612	24856	1.97	2.21	7.50	26.83	15
	Durg-II	JG-14	38	30	6.90	10.44	51%	15533	26197	2.04	2.31	7.00	32.95	46
	Gariaband	JG-14	40	40	5.10	8.89	74%	8568	19838	1.61	2.02	6.90	22.38	15
	Janjgir–Champa	JG-226	30	75	7.85	11.78	50%	20267	33846	2.27	2.64	8.50	27.84	28
	Kabirdham	JG-14	125	50	6.50	12.89	98%	15030	35052	2.00	2.43	10.50	18.54	51
	Kanker	JAKI-9218	42	20	5.90	10.03	70%	12258	24039	1.82	2.08	8.40	16.25	52
	Korba	JG-14	25	10	6.30	10.20	62%	14106	26124	1.94	2.24	8.50	16.67	26
	Koriya	Jaki-1918	65	27	5.27	8.89	69%	11347	24172	1.87	2.43	5.80	34.76	24
	Mahasamund	JG-130	50	20	6.85	11.50	68%	16647	31570	2.11	2.46	8.00	30.43	25
	Mungeli	JG-14	75	30	6.98	12.15	74%	17248	34783	2.15	2.63	8.50	30.04	21
	Narayanpur	JAKI-9218	75	30	5.50	8.64	57%	10410	21017	1.69	2.11	6.50	24.77	9
	Raipur	Vaibhav	50	20	7.20	13.05	81%	17464	37791	2.11	2.68	9.75	25.29	76
	Rajnandgaon	JG-130	100	40	8.03	13.65	70%	21299	42063	2.35	3.00	8.20	39.93	47
	Surguja	JAKI-9218	24	10	5.10	7.68	51%	9002	18582	1.62	2.10	4.90	36.20	32
Tot./Avg.			975	547	6.31	10.91	73%	14170	28690	1.97	2.36	7.59	30.07	542
2019-20	Bhatapara	JG-14	10	10	6.93	11.08	60%	17394	31455	2.06	2.39	4.65	58.03	54
	Bilaspur	RVG-202	44	20	6.54	11.42	75%	15493	32173	1.95	2.37	9.15	19.88	61
	Dhamtari	RVG-202	50	20	5.89	10.87	85%	12324	30431	1.75	2.35	8.10	25.48	35
	Durg-II	RVG-202	52	30	6.95	11.67	68%	17491	34331	2.07	2.52	8.10	30.59	71
	Gariaband	JG-14	27	20	5.10	8.97	76%	9083	21169	1.58	1.94	7.00	21.96	21
	Kabirdham	RVG-202	50	20	6.78	12.68	87%	16663	37315	2.02	2.52	10.50	17.19	77
	Kanker	RVG-202	25	10	5.80	9.67	67%	11885	24581	1.73	2.09	8.40	13.13	58
	Koriya	JG-11	35	15	5.78	8.89	54%	11788	22339	1.72	2.06	5.90	33.63	33
	Mahasamund	RVG-202	50	20	6.80	11.67	72%	16760	33391	2.02	2.42	8.18	29.91	52
	Narayanpur	JAKI-9218	50	20	5.80	8.40	45%	11775	20450	1.71	2.00	6.50	22.62	9
	Raipur	Vaibhav	25	10	7.50	13.56	81%	20173	43545	2.23	2.93	10.15	25.15	92
Tot./Avg.			418	195	6.35	10.81	70%	14621	30107	1.89	2.33	7.88	27.05	563
2020_21	Bastar	RVG-201	25	10	5.98	9.70	62%	14998	27970	1.97	2.30	8.80	9.28	45
	Bemetara	RVG-202	17	10	5.25	8.25	57%	11275	22075	1.73	2.10	5.70	30.91	32
	Bhatapara	Rajeev Lochan	10	10	5.15	8.89	73%	10765	23839	1.69	2.11	5.45	38.70	71

	Bilaspur	RVG-202	75	20	6.40	9.90	55%	16640	28990	2.04	2.35	9.15	7.58	84
	Dhamtari	RVG-202	50	10	6.02	10.98	82%	15202	33498	1.98	2.49	8.50	22.59	47
	Durg-II	RVG-202	38	20	6.88	11.69	70%	19588	38119	2.26	2.77	8.66	25.92	95
	Gariaband	RVG-201	50	20	5.78	10.02	73%	13978	28602	1.90	2.27	8.10	19.16	29
	Kabirdham	RVG-202	50	20	7.09	11.98	69%	19579	38098	2.18	2.66	10.50	12.35	82
	Kanker	RVG-203	25	10	5.80	9.95	72%	14080	29245	1.91	2.36	8.65	13.07	71
	Koriya	JG-14, GJG-2144	60	25	4.48	9.14	104%	10348	25114	1.83	2.17	6.15	32.71	48
	Mahasamund	RVG-202	50	20	6.95	11.67	68%	18945	36017	2.15	2.53	8.50	27.16	72
	Mungeli	RVG-202	25	10	6.14	10.52	71%	14814	30652	1.90	2.33	8.50	19.20	25
	Narayanpur	RVG-202	50	20	5.12	9.03	76%	10312	25053	1.65	2.19	7.15	20.82	9
	Raipur	Vaibhav	25	10	8.32	12.73	53%	26932	43423	2.74	3.02	10.89	14.45	132
Tot./Avg.			550	215	6.10	10.32	70%	15533	30764	1.99	2.40	8.19	20.99	842
2021_22	Balod	NBeG-47	19	10	7.50	12.52	67%	21650	42352	2.30	2.97	10.30	17.73	18
	Bemetara	RVG-201	15	10	5.30	8.60	62%	11530	22360	1.74	2.04	6.15	28.49	45
	Bilaspur	RVG-202	75	20	6.85	9.90	45%	18435	30990	2.12	2.59	9.15	7.58	97
	Dantewada	RVG-202	25	10	5.60	10.58	89%	13060	30458	1.84	2.30	6.90	34.78	24
	Dhamtari	RVG-202	50	20	7.30	10.30	41%	20730	32030	2.26	2.56	8.50	17.48	64
	Durg-II	RVG-202	43	20	6.18	10.12	64%	16018	31612	2.03	2.58	8.66	14.43	132
	Gariaband	RVG-202	50	20	6.80	11.90	75%	18180	37190	2.10	2.58	10.82	9.08	42
	Kabirdham	RVG-202	50	20	7.59	12.46	64%	21209	42046	2.21	2.96	11.73	5.86	91
	Mainpat	RVG-202	25	10	6.15	10.56	72%	15865	31356	2.02	2.39	10.31	2.37	19
	Narayanpur	RVG-202	50	20	4.30	9.13	112%	10430	25063	1.91	2.17	8.00	12.38	14
	Raipur	Vaibhav	50	20	7.14	12.15	70%	18914	38465	2.08	2.64	10.89	10.37	178
	Rajnandgaon	RVG-202	50	20	6.89	11.10	61%	18639	35110	2.13	2.63	8.20	26.13	71
	Surguja	RVG-202	23	10	6.50	10.85	67%	16650	33835	2.01	2.57	9.40	13.36	65
Tot./Avg.			525	210	6.47	10.78	68%	17024	33297	2.06	2.54	9.15	15.39	860
G.Tot./Avg.			3287	1594	6.19	10.79	76%	14767	30138	1.98	2.39	7.98	25.94	3206

Table 2: Year Wise Summary of Chickpea During Rabi

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	819	427	5.70	11.13	98%	12490	27829	1.98	2.31	7.11	36.19	399
2018_19	975	547	6.31	10.91	73%	14170	28690	1.97	2.36	7.59	30.07	542
2019_20	418	195	6.35	10.81	70%	14621	30107	1.89	2.33	7.88	27.05	563
2020_21	550	215	6.10	10.32	70%	15533	30764	1.99	2.40	8.19	20.99	842
2021_22	525	210	6.47	10.78	68%	17024	33297	2.06	2.54	9.15	15.39	860

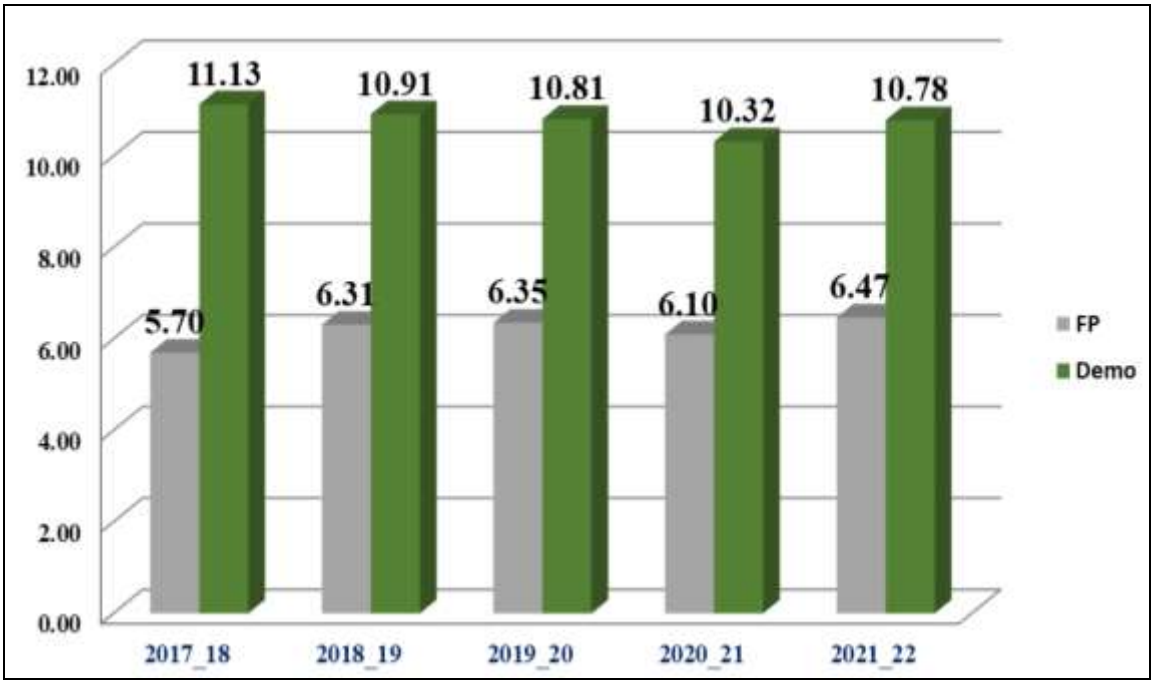

Fig 1: Year wise Yield (q/ha) of Chickpea during Rabi

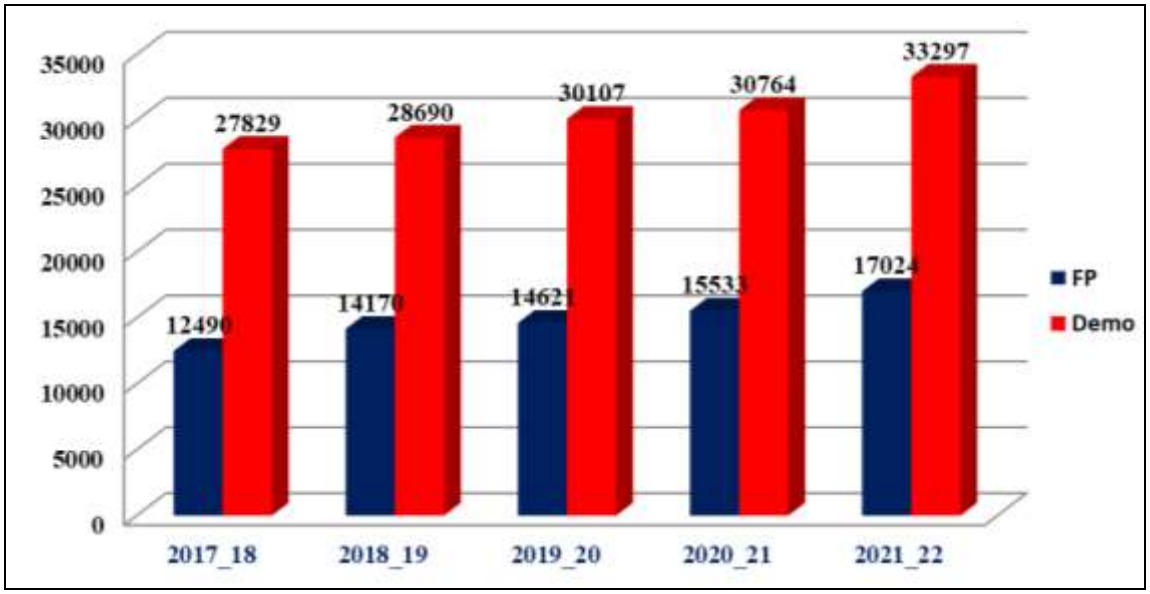

Fig 2: Year wise Net Returns (Rs/ha) of Chickpea during Rabi

Fig 3: Year wise B:C ratio of Chickpea during Rabi

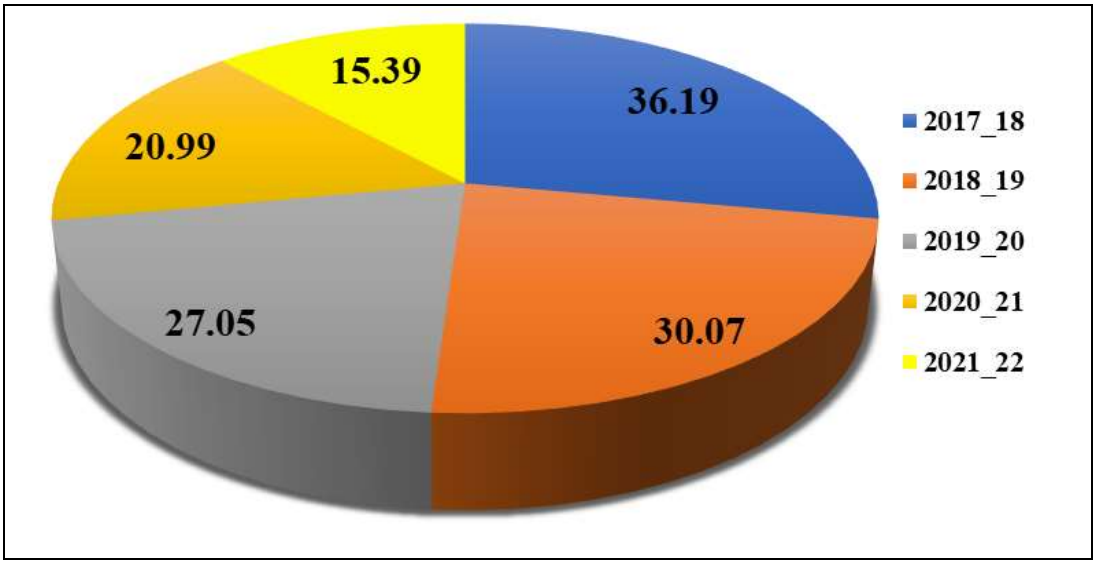

Fig 4: Year wise average Yield gap (%) of Chickpea during Rabi

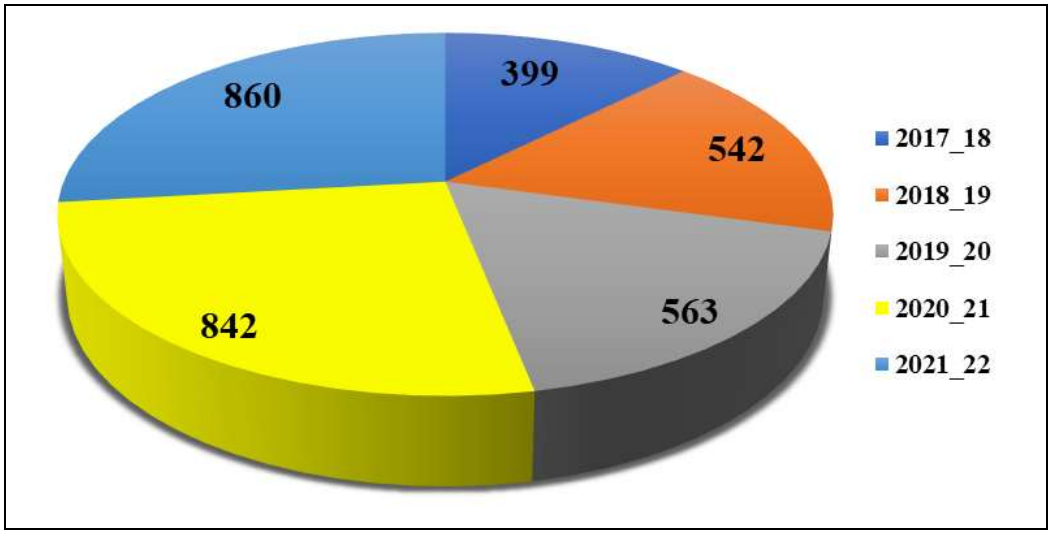

Fig 5: Year wise Horizontal Spread of Technology of Chickpea during Rabi

Table 3: Performance of CFLD on Field Pea during Rabi 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	Aman	25	10	3.40	8.40	147%	5420	19920	1.72	2.66	6.50	22.62	12
	Koriya	Paras	75	30	4.80	6.55	36%	9240	16141	2.03	2.84	4.90	25.19	18
	Narayanpur	Paras	75	30	4.50	8.43	87%	8100	20034	1.90	2.67	4.50	46.62	7
	Surguja	PARAS	84	20	4.30	6.67	55%	8840	16597	2.18	2.90	4.15	37.78	24
Tot./Avg.			259	90	4.25	7.5125	81%	7900	18173	1.96	2.77	5.01	33.05	61
2018_19	Bastar	IPFD-10-12	24	10	3.90	7.50	92%	6600	17000	1.73	2.31	6.20	17.33	15
	Koriya	Paras/Vikas	65	27	4.80	6.76	41%	11700	18291	2.56	3.09	4.90	27.51	23
	Mungeli	Paras	25	10	5.23	8.86	69%	11420	21940	2.20	2.63	4.30	51.47	25
	Narayanpur	Paras	75	30	4.18	7.99	91%	7720	18460	1.86	2.37	4.50	43.68	9
	Surguja	ADARSH	37	10	4.83	8.80	82%	9820	21700	2.03	2.61	5.50	37.50	29
Tot./Avg.			226	87	4.59	7.98	75%	9452	19478	2.08	2.60	5.08	35.50	101
2019_20	Bemetara	Paras	15	10	4.15	6.53	57%	11175	20636	2.49	3.36	4.00	38.74	19
	Koriya	Aman	35	15	4.94	6.65	35%	14730	21176	2.96	3.42	4.90	26.32	27
	Mainpat	Aman	25	10	5.25	7.25	38%	14625	23876	2.63	3.73	4.85	33.10	30
	Narayanpur	Paras	50	20	5.14	7.70	50%	14130	25901	2.57	3.96	4.50	41.56	11
	Surguja	Aman	44	20	4.96	7.30	47%	13320	24101	2.48	3.75	5.50	24.66	34
Tot./Avg.			169	75	4.89	7.09	45%	13596	23138	2.63	3.64	4.75	32.88	121
2020_21	Balod	Indira matar	22	10	4.78	7.80	63%	11444	23940	2.00	2.77	5.65	27.56	42
	Bastar	Aman	20	10	3.65	8.10	122%	8520	25380	1.95	2.88	6.80	16.05	18
	Bemetara	Paras	15	10	5.25	9.65	84%	16200	32820	2.80	3.43	5.00	48.19	24
	Bhatapara	paras	8.5	8.5	3.96	7.28	84%	10008	21444	2.11	2.59	5.62	22.80	22
	Jashpur	Aman	25	10	4.02	8.08	101%	9296	23784	1.93	2.59	6.23	22.90	38
	Koriya	Paras	60	25	3.80	7.87	107%	8240	24276	1.82	2.80	5.85	25.67	32
	Mainpat	Aman	25	10	4.18	8.92	113%	11064	27816	2.23	2.85	6.00	32.74	36
	Narayanpur	Indira matar-1	50	20	4.02	7.40	84%	10296	22020	2.14	2.63	4.50	39.19	10
	Surguja	Aman	42	20	4.27	7.97	87%	9496	22756	1.86	2.47	6.05	24.09	35
Tot./Avg.			268	124	4.21	8.12	94%	10507	24915	2.09	2.78	5.74	28.80	257
2021_22	Bastar	Aman	25	10	3.58	7.20	101%	8900	19500	1.99	2.18	6.50	9.72	21
	Bemetara	IPFD-12-04	21	10	4.67	8.18	75%	12350	24400	2.12	2.48	5.15	37.04	28
	Bhatapara	IPF-4-9	10	10	4.90	8.20	67%	13500	24500	2.23	2.48	9.00	-9.76	32
	Dantewada	IPFD 1202	25	10	3.82	7.50	96%	10100	21500	2.12	2.34	2.00	73.33	15
	Mainpat	IPFD 1202	25	10	4.15	7.59	83%	9750	21450	1.89	2.30	5.75	24.24	55
	Narayanpur	Indira Matar-1	50	20	3.25	6.40	97%	8750	18500	2.17	2.37	4.50	29.69	12
	Surguja	IPFD-10-12	24	10	5.42	8.95	65%	14600	28250	2.17	2.71	7.30	18.44	42
Tot./Avg.			180	80	4.26	7.72	84%	11136	22586	2.10	2.41	5.74	26.10	205
G.Tot./Avg.			1102	456	3.70	6.40	63%	8765	18048	1.81	2.37	4.39	26.05	745

Table 4: Year Wise Summary of Field Pea During Rabi

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	259	90	4.25	7.51	81%	7900	18173	1.96	2.77	5.01	33.05	61
2018_19	226	87	4.59	7.98	75%	9452	19478	2.08	2.60	5.08	35.50	101
2019_20	169	75	4.89	7.09	45%	13596	23138	2.63	3.64	4.75	32.88	121
2020_21	268	124	4.21	8.12	94%	10507	24915	2.09	2.78	5.74	28.80	257
2021_22	180	80	4.26	7.72	84%	11136	22586	2.10	2.41	5.74	26.10	205

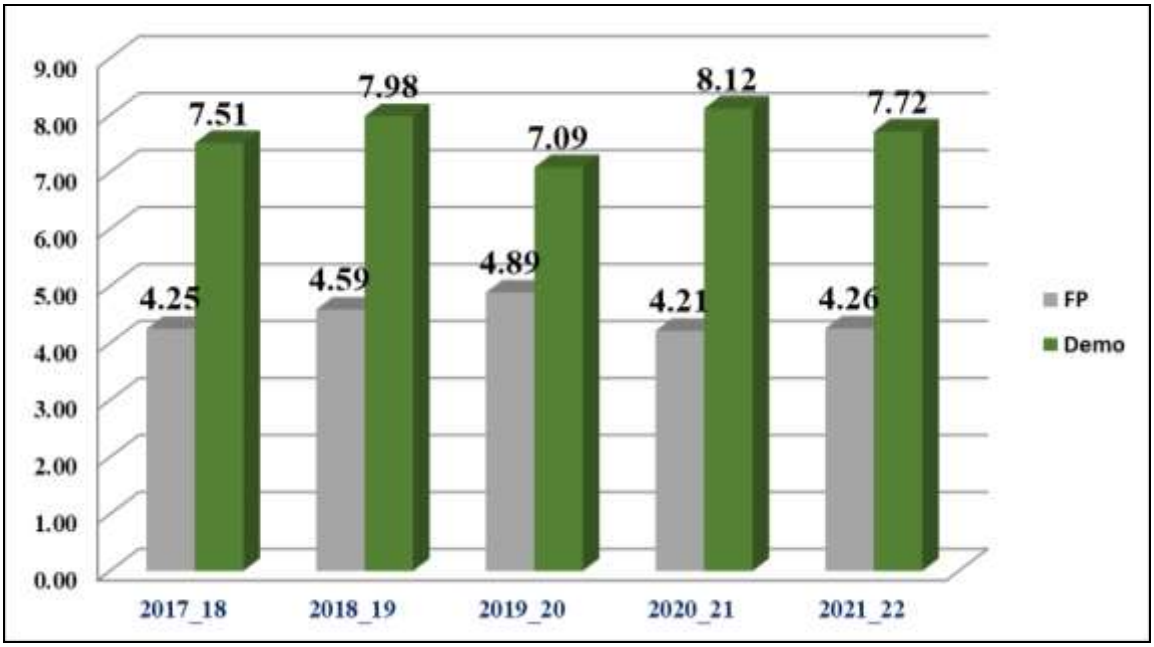

Fig 6: Year wise Yield (q/ha) of Field Pea during Rabi

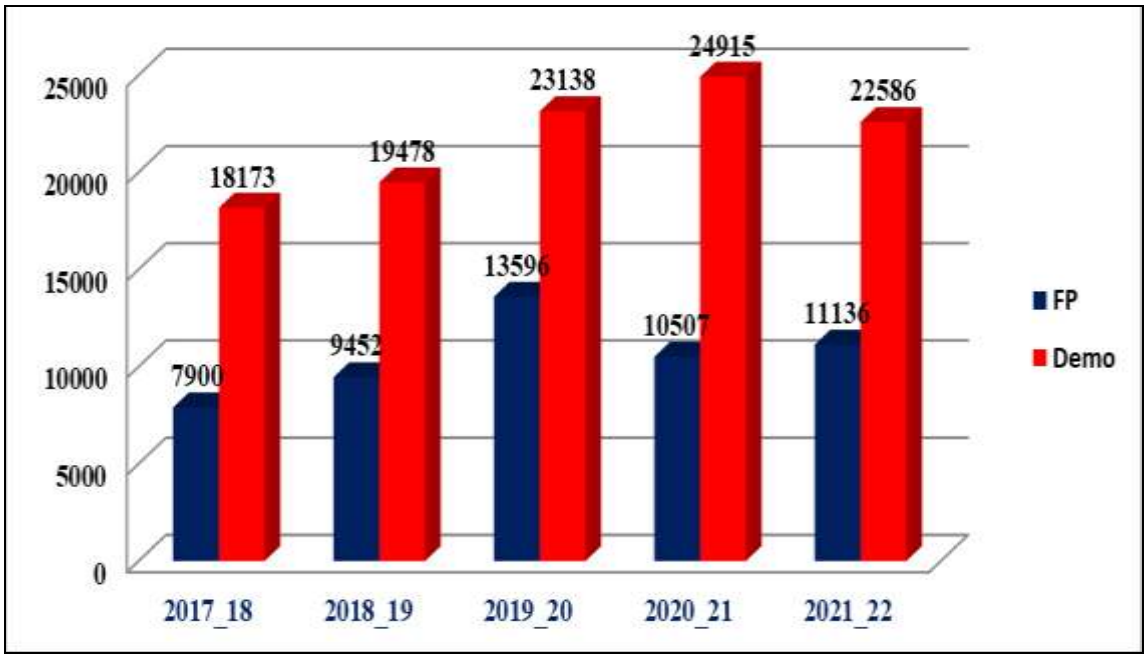

Fig 7: Year wise Net Returns (Rs/ha) of Field Pea during Rabi

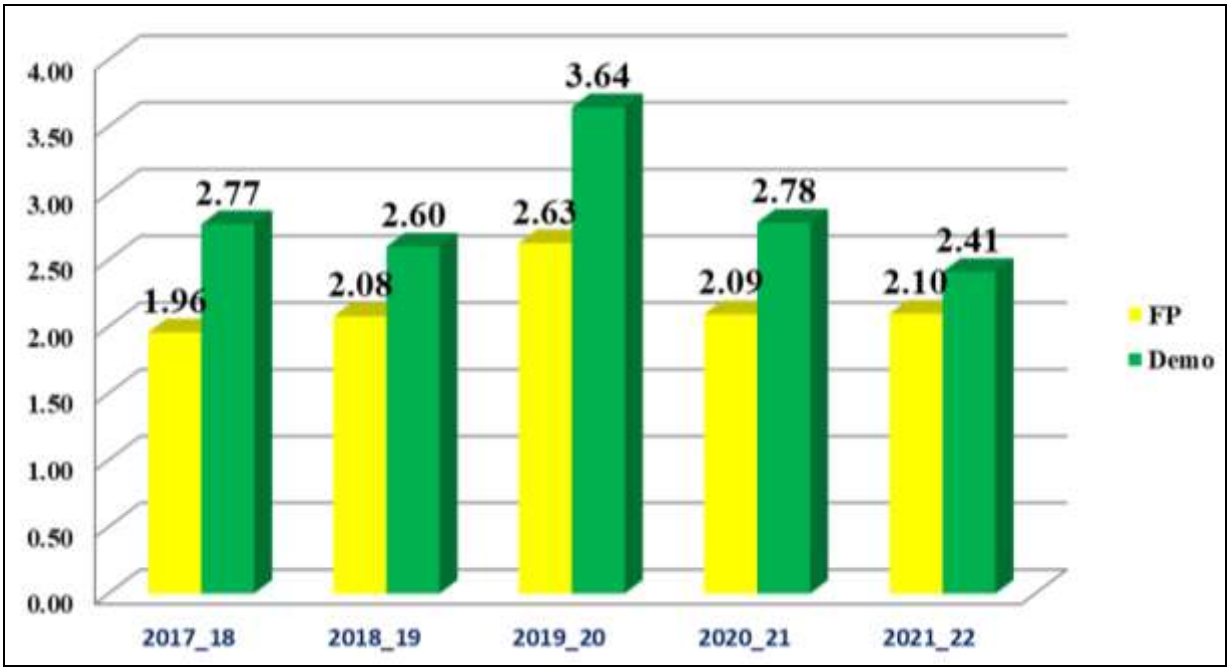

Fig 8: Year wise B:C ratio of Field Pea during Rabi

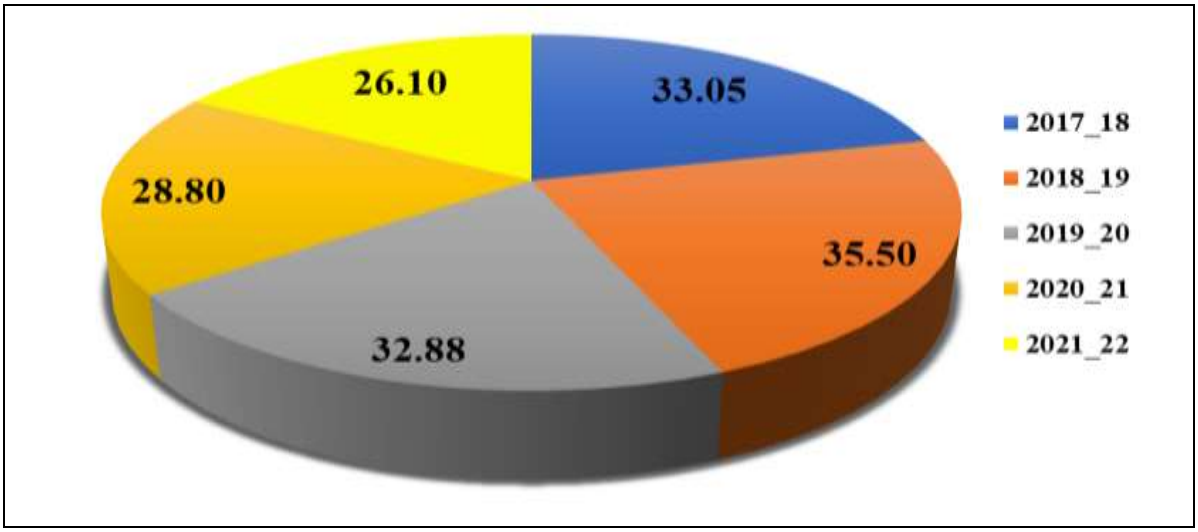

Fig 9: Year wise average Yield gap (%) of Field Pea during Rabi

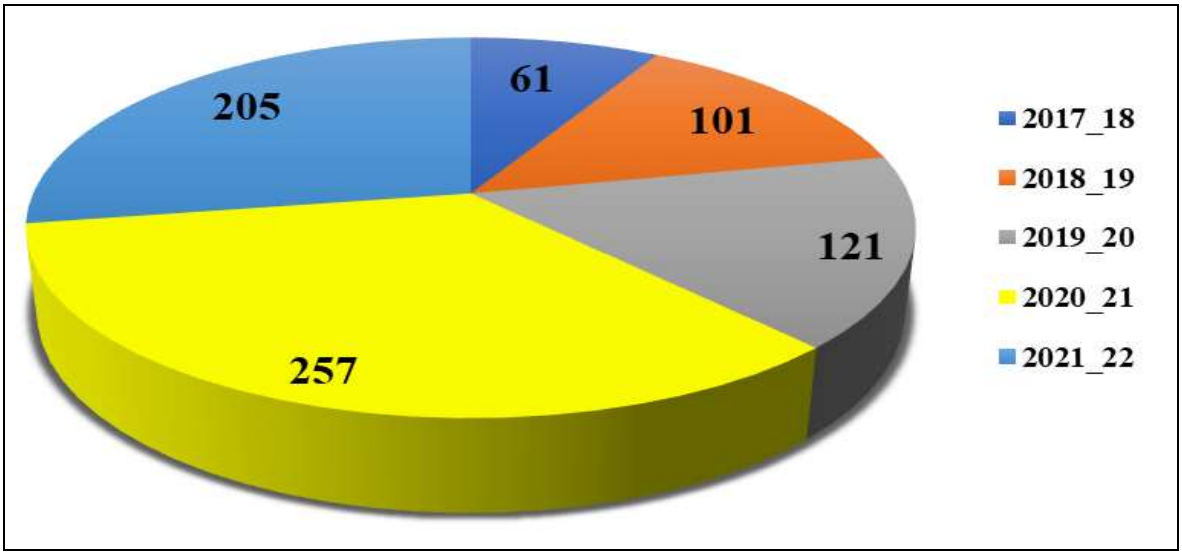

Fig 10: Year wise Horizontal Spread of Technology of Field Pea during Rabi

Table 5: Performance of CFLD on Lathyrus during Rabi 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	Bilaspur	Mahatiwada	41	20	5.00	7.19	44%	5000	7855	1.67	2.29	4.50	37.41	16
	Durg-II	Prateek	41	20	3.95	6.13	55%	2375	5205	1.32	2.94	3.50	42.90	18
Tot./Avg.			82	40	4.475	6.66	49%	3688	6530	1.49	2.62	4.00	40.16	34
2018_19	Bilaspur	Mahatiwada	75	30	4.20	6.90	64%	3840	8510	1.51	2.19	4.50	34.78	34
	Durg-II	Prateek	32	20	4.19	9.52	127%	2813	13204	1.33	1.95	5.65	40.65	42
	Mungeli	Prateek	50	20	5.45	8.20	50%	6215	9640	1.73	2.30	5.60	31.71	25
	Raipur	Prateek	50	20	5.58	10.34	85%	6066	13918	1.67	2.01	6.30	39.07	51
Tot./Avg.			207	90	4.855	8.74	82%	4734	11318	1.56	2.11	5.51	36.55	152
2019_20	Bemetara	Mahatiwada	15	10	5.00	7.50	50%	6500	8000	1.87	2.63	4.65	38.00	26
	Bilaspur	Mahatiwada	30	10	5.00	6.90	38%	6000	9200	1.75	2.10	5.00	27.54	65
	Durg-II	Mahatiwada	40	20	4.53	10.52	132%	4684	14456	1.59	2.04	6.35	39.64	71
	Jashpur	Mahatiwada	25	10	5.14	6.34	23%	5892	7632	1.69	2.33	5.42	14.51	25
	Kabirdham	Prateek	25	10	4.60	7.57	65%	4380	8696	1.52	2.44	4.50	40.55	20
	Raipur	Prateek	25	10	6.23	7.50	20%	8444	8000	1.94	2.63	6.30	16.00	87
Tot./Avg.			160	70	5.08	7.72	55%	5983	9331	1.72	2.36	5.37	29.37	294
2020_21	Balod	Mahatiwada	20	10	3.80	5.12	35%	3900	5240	1.52	2.93	4.65	9.18	17
	Bemetara	Mahatiwada	15	10	4.40	9.50	116%	4200	13500	1.47	2.11	5.90	37.89	38
	Bhatapara	Prateek	10	10	3.65	5.36	47%	2450	7080	1.29	2.27	4.50	16.04	29
	Durg-II	Mahatiwada	32	20	4.47	7.14	60%	5410	8420	1.68	2.54	6.00	15.97	85
	Jashpur	Prateek	25	10	4.69	6.20	32%	6070	8480	1.76	2.19	5.30	14.52	38
	Kabirdham	Prateek	25	10	5.12	8.69	70%	6860	12070	1.81	2.16	5.50	36.71	25
	Mungeli	Prateek	25	10	4.89	9.95	103%	5670	14850	1.63	2.01	4.30	56.78	32
	Raipur	Mahatiwada	25	10	5.32	7.83	47%	6960	10490	1.77	2.24	6.65	15.07	110
Tot./Avg.			177	90	4.54	7.47	64%	5190	10016	1.62	2.31	5.35	25.27	374
2021_22	Bemetara	Mahatiwada	20	10	4.20	5.60	33%	5520	7240	1.74	2.40	4.80	14.29	53
	Jashpur	Prateek	25	10	5.03	7.45	48%	7593	10095	1.95	2.29	6.45	13.42	58
Tot./Avg.			45	20	4.62	6.53	41%	6557	8668	1.84	2.34	5.63	13.85	111
G.Tot./Avg.			671	310	4.71	7.42	58%	5230	9172	1.65	2.35	5.17	29.04	965

Table 6: Year Wise Summary of Lathyrus During Rabi

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 (%)	Horizontal spread (ha)
			FP	Demo		FP	Demo	FP	Demo			
2017_18	82	40	4.48	6.66	49%	3688	6530	1.49	2.62	4.00	40.16	34
2018_19	207	90	4.86	8.74	82%	4734	11318	1.56	2.11	5.51	36.55	152
2019_20	160	70	5.08	7.72	55%	5983	9331	1.72	2.36	5.37	29.37	294
2020_21	177	90	4.54	7.47	64%	5190	10016	1.62	2.31	5.35	25.27	374
2021_22	45	20	4.62	6.53	41%	6557	8668	1.84	2.34	5.63	13.85	111

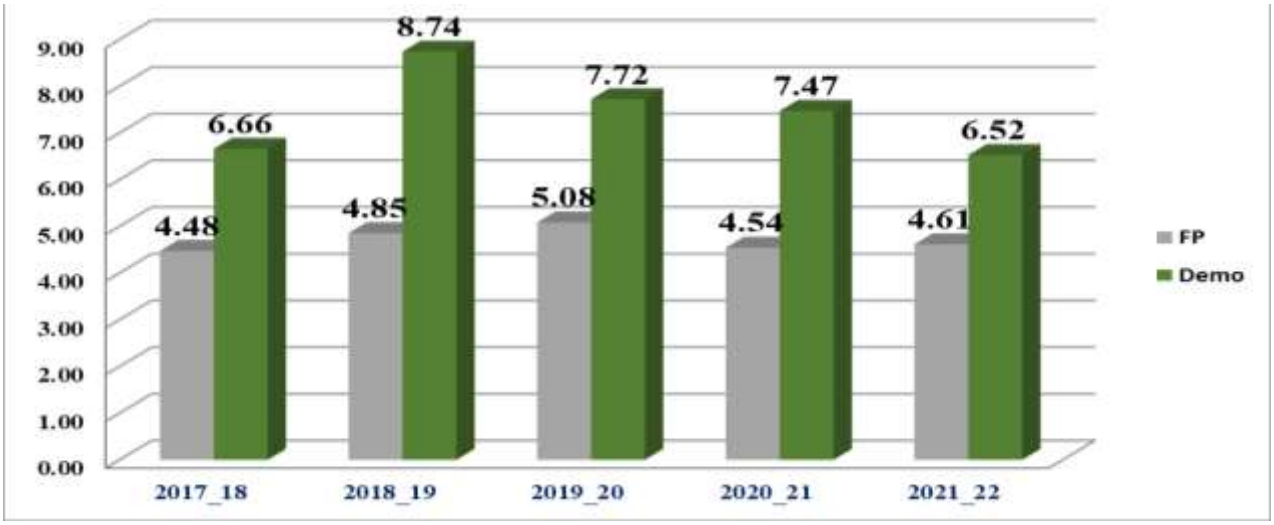

Fig 11: Year wise Yield (q/ha) of Lathyrus during Rabi

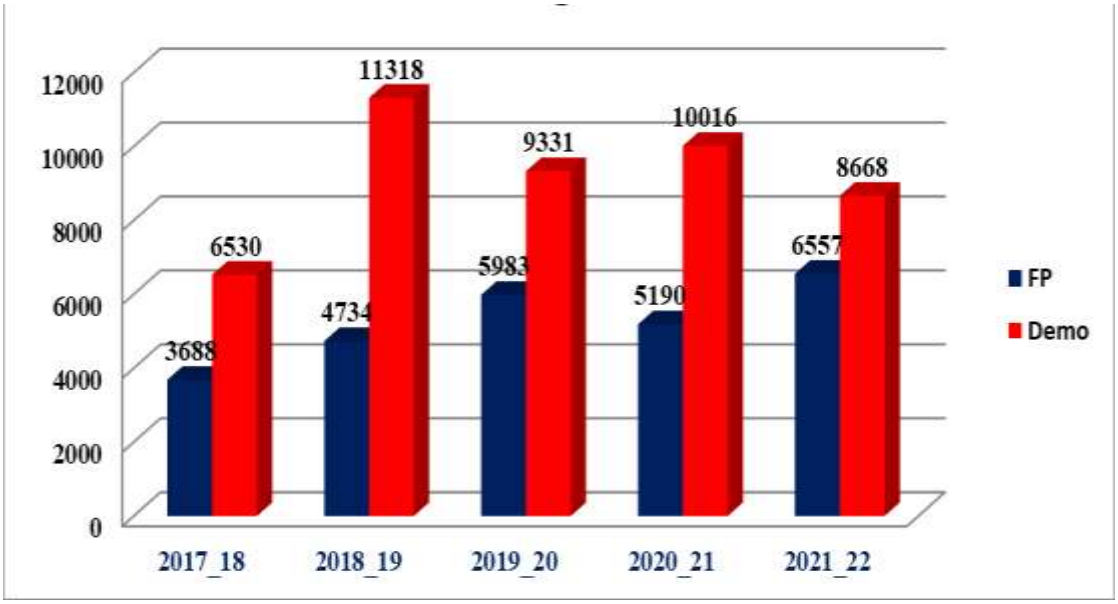

Fig 12: Year wise Net Returns (Rs/ha) of Lathyrus during Rabi

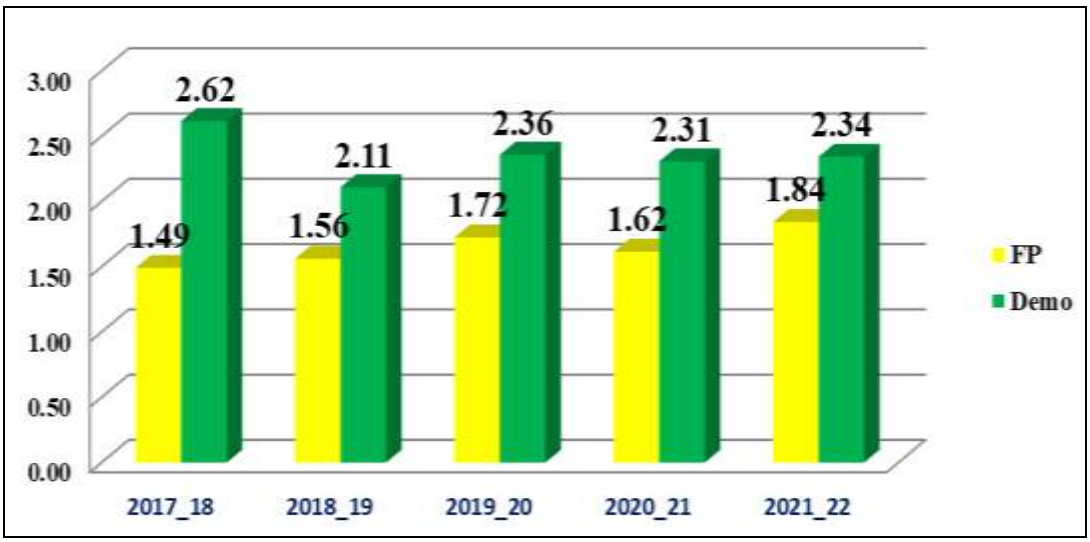

Fig 13: Year wise B:C ratio of Lathyrus during Rabi

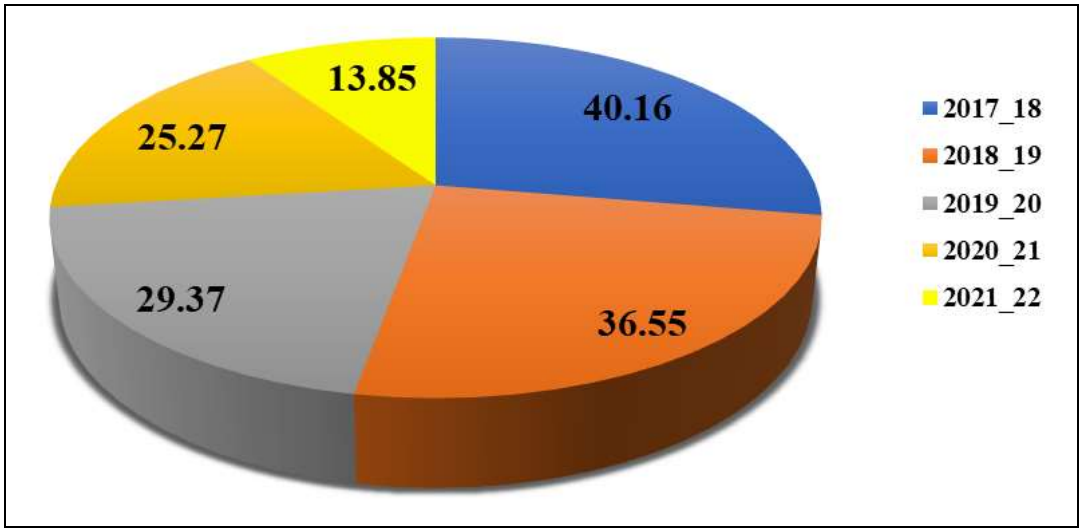

Fig 14: Year wise average Yield gap (%) of Lathyrus during Rabi

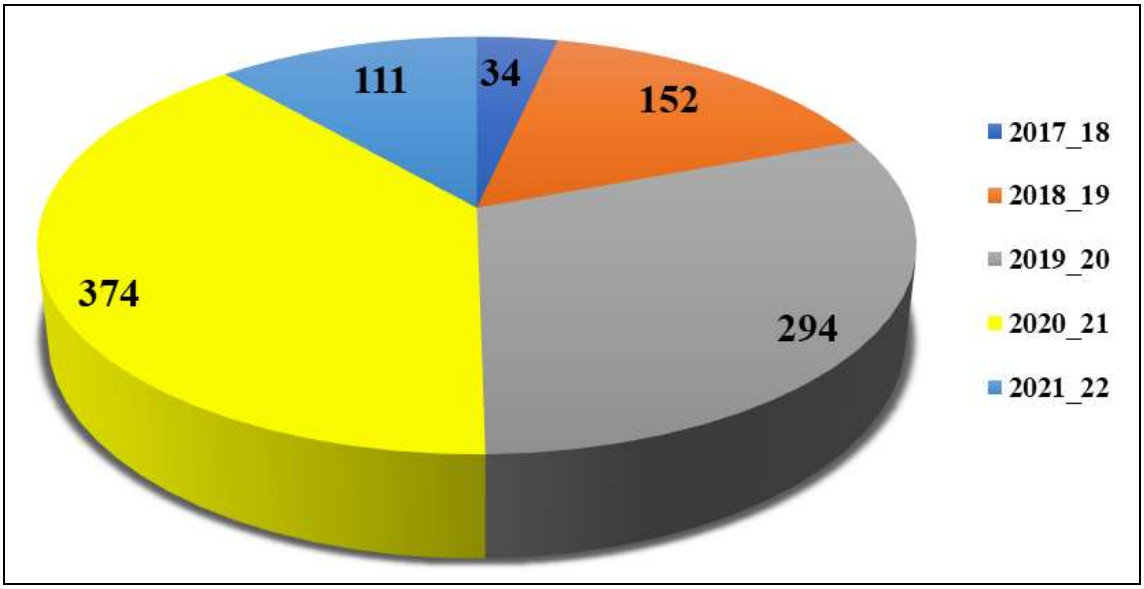

Fig 15: Year wise Horizontal Spread of Technology of Lathyrus during Rabi

Table 7: Performance of CFLD on Lentil during Rabi 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	Jashpur	HUL-57	50	20	6.50	8.49	31%	7438	20259	1.73	2.28	5.00	41.11	18
	Surguja	HUL-57	17	20	3.40	5.86	72%	4250	14655	1.42	2.01	4.00	31.74	21
Tot./Avg.			67	40	4.95	7.175	51%	5844	17457	1.57	2.15	4.5	36.42	39
2018_19	Kanker	IPL-318	47	30	5.20	7.46	43%	7969	17560	1.78	2.11	5.20	30.29	23
	Raipur	JL-3	25	10	5.20	8.21	58%	10036	22240	1.82	2.53	5.80	29.35	31
	Surguja	RVL-31	25	10	4.20	6.41	53%	6795	16172	1.57	2.02	4.50	29.80	38
Tot./Avg.			97	50	4.87	7.36	51%	8266	18657	1.72	2.22	5.17	29.82	92
2019_20	Raipur	IPL-316	25	10	5.31	6.93	31%	9484	19004	1.76	2.31	5.20	24.96	46
Tot./Avg.			25	10	5.31	6.93	31%	9484	19004	1.76	2.31	5.2	24.96	46
2020_21	Mainpat	IPL-316	25	10	3.40	5.60	65%	4840	12736	1.39	1.80	3.60	35.71	30
	Mungeli	IPL-316	25	10	5.50	8.60	56%	9950	28036	1.77	2.77	7.50	12.79	20
	Raipur	IPL-316	25	10	5.50	7.62	39%	9746	23038	1.75	2.46	5.80	23.88	71
Tot./Avg.			75	30	4.80	7.27	53%	8179	21270	1.63	2.34	5.63	24.13	121
2021_22	Bemetara	IPL-316	25	10	6.20	8.75	41%	8767	28801	1.70	2.82	7.60	13.14	41
	Mainpat	RKL-6071	25	10	4.10	6.20	51%	8410	18548	1.67	2.28	4.20	32.26	38
Tot./Avg.			50	20	5.15	7.475	46%	8589	23675	1.69	2.55	5.9	22.70	79
G.Tot./Avg.			314	150	5.02	7.24	47%	8072	20012	1.68	2.31	5.28	27.61	377

Table 8: Year Wise Summary of Lentil during Rabi

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 (%)	Horizontal spread (ha)
			FP	Demo		FP	Demo	FP	Demo			
2017_18	67	40	4.95	7.18	51%	5844	17457	1.57	2.15	4.50	36.42	39
2018_19	78	50	4.87	7.36	51%	8266	18657	1.72	2.22	5.17	29.82	92
2019_20	25	10	5.31	6.93	31%	9484	19004	1.76	2.31	5.20	24.96	46
2020_21	75	30	4.80	7.27	53%	8179	21270	1.63	2.34	5.63	24.13	121
2021_22	50	20	5.15	7.48	46%	8589	23675	1.69	2.55	5.90	22.70	79

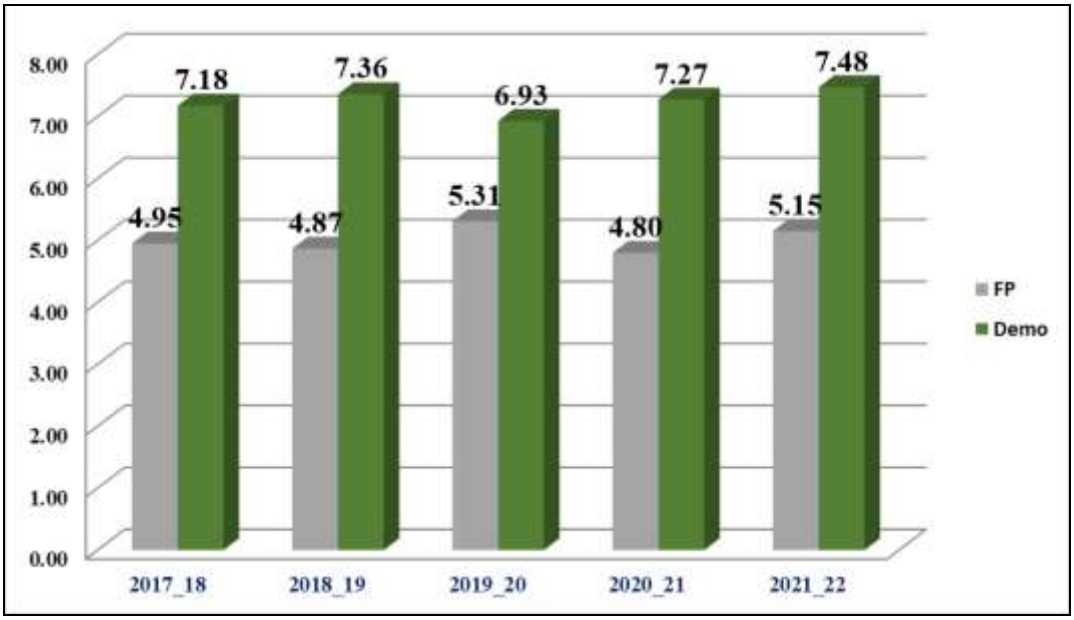

Fig 16: Year wise Yield (q/ha) of Lentil during Rabi

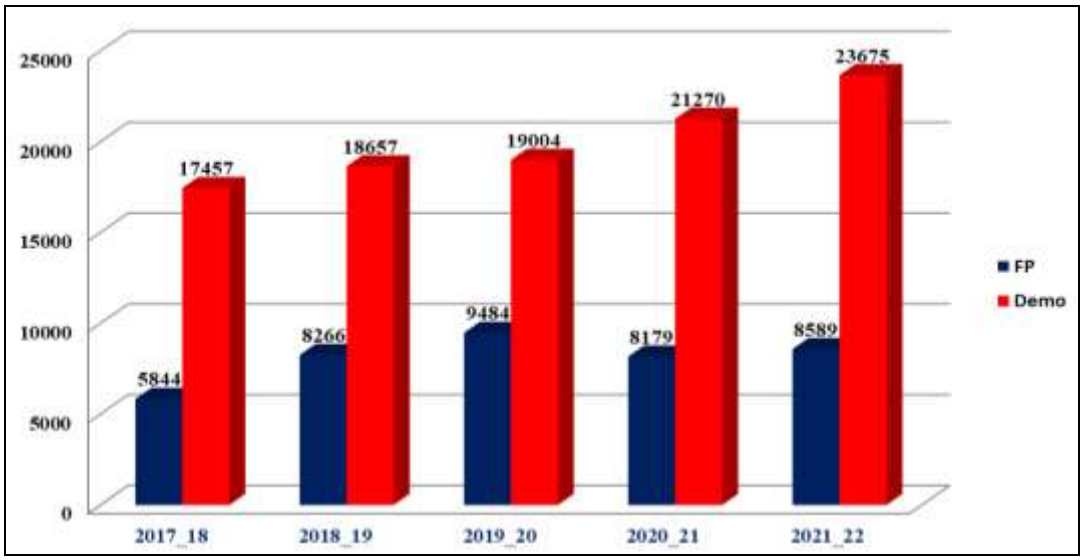

Fig 17: Year wise Net Returns (Rs/ha) of Lentil during Rabi

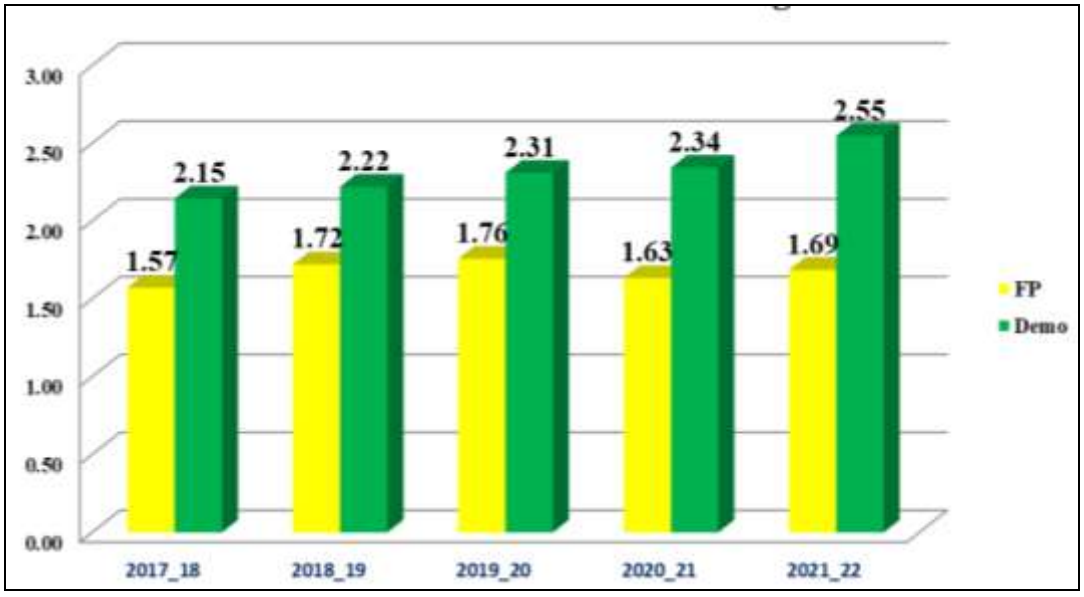

Fig 18: Year wise B:C ratio of Lentil during Rabi

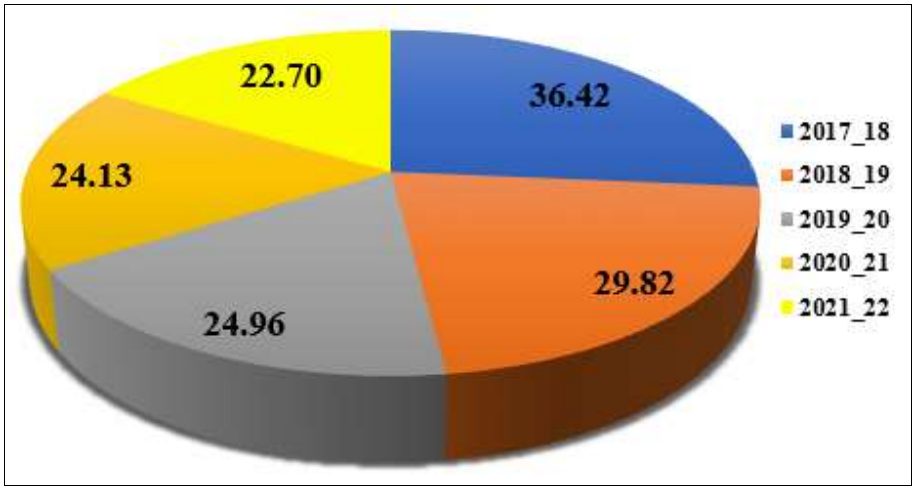

Fig 19: Year wise average Yield gap (%) of Lentil during Rabi

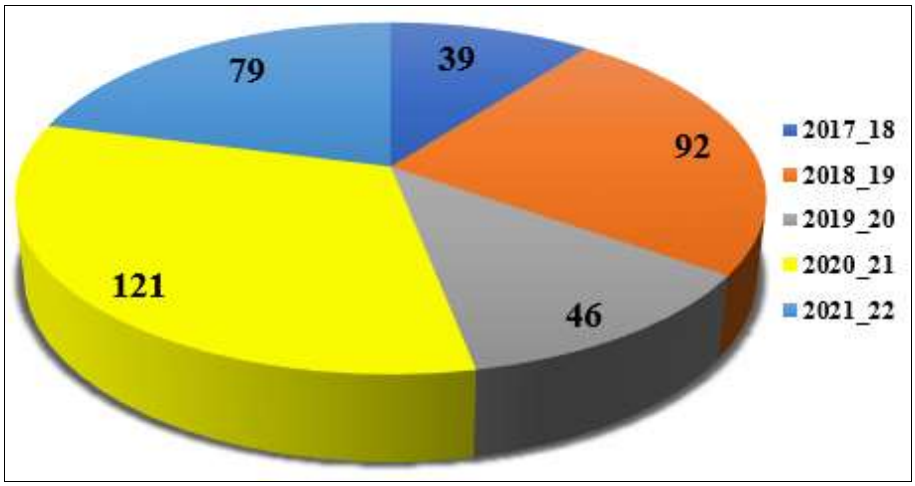

Fig 20: Year wise Horizontal Spread of Technology of Lentil during Rabi

Conclusion

Thus it is clear that productivity of Rabi crops *viz*. Chick pea, Field pea, Lathyrus and Lentil under Cluster Frontline Demonstrations is significantly higher as compared to farmers practices in all 27 districts of Chhattisgarh during Rabi season from the year 2017-18 to 2021-22. Over a span of five years significant improvement was observed both in terms of yield and economic returns with the adoption of improved varieties and recommended practices. The result revealed the potential for bridging the productivity gap in Rabi pulse crops through targeted interventions, such as the dissemination of high yielding varieties and suitable recommended agronomic practices.

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