DEMONSTRATIONAL PERFORMANCE OF PULSES IN INDIA:

Experiences of KVKs Under NFSM -2015-16

Division of Agricultural Extension
Indian Council of Agriculture Research
New Delhi-110012

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Department of Agriculture, Cooperation & Farmers Welfare

MESSAGE

India is the largest producer and consumer of pulses accounting for 25 per cent of global pulses production. Pulses are also a major source of protein and is known as "poor man's meat." Pulses occupy a unique place in the world of agriculture by virtue of its high protein content, which is almost double than that of cereals.

At a time when the Government is striving to increase the pulses production, ICAR has taken the initiative to augment pulse production and productivity in the country by conducting nationwide Cluster Frontline Demonstrations through 474 Krishi Vigyan Kendras across 26 States of the country. This initiative lays emphasis on major crops, namely, pigeon pea, green gram, black gram, rajma, chickpea and lentil. The results so far have been encouraging with yield advantage registering about 40 per cent compared to existing practices giving us the hope to break the yield plateau resulting in production of sufficient quantity of pulses for the domestic market.

I compliment the efforts of ICAR-Agricultural Technology Application Research Institute for coordinating with different stakeholders involved in pulses production and for releasing the publication "Demonstrational performance of Pulses in India: Experiences of KVKs under NFSM (2015-16)" at the closing ceremony to commemorate the celebration of International Year of Pulses on 22nd December, 2016 in Agra.

(S.K. Pattanayak)

Date: December 6, 2016

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एफ एन ए, एफ एन ए एस सी, एफ एन ए ए एस
सचिव एवं महानिदेशक

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FOREWORD

India is the largest producer and consumer of pulses in the world. Nutritionally, the pulses contain lysine, tryptophan, ascorbic acid and riboflavin that are known to regulate cholesterol in the human beings. There are reports that indicate presence of phytochemicals and antioxidants with anti-cancer properties in pulses. In order to achieve nutritional security, the Government of India has taken progressive steps in bringing self-sufficiency in pulses, whereby we expect an increase in pulses growing area by 2 m ha by 2017-18. The Council has activated frontline demonstration in this direction, wherein the Krishi Vigyan Kendras are handholding our farmers with quality seeds and agronomic techniques to enhance pulses production in the country. I am glad that the ATARIs have spearheaded these activities of the Council in letter and spirit, and have documented their experiences in the form of a book. I appreciate the efforts of Agricultural Extension Division in this direction. I am sure, much more will be done in the future to achieve self-sufficiency in pulses in the country.

(T. MOHAPATRA)

Dated the 2nd December, 2016
New Delhi

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Deputy Director General (Agricultural Extension)

MESSAGE

Pulses are very important for Indian agriculture both in terms of enriching soil health and nutritional security of country's ever growing population. Pulses being predominantly rainfed crop with multiple limiting factors in its growing environment, the increase in the productivity had remained a major challenge for several decades. Globally, pulse crops are grown in area more than 76 mha yielding more than 68 m tonnes. In India, the total pulse area is about 25 mha which produces about 18 m tonnes. The present production of Pulses in India is not meeting the annual domestic demand of 22.42 million tonnes. Hence, there is a need to increase the production and productivity through an annual growth rate of 4.2% to reach the target of 32 million tonnes by the year 2030. Cluster Frontline demonstrations of pulses on farmers fields have been devised as a powerful tool for augmenting the productivity as well as total production in the country. Currently this project is being implemented across 474 districts of the county with the active participation of Krishi Vigyan Kendras. All the major pulses of three cropping seasons are being covered under the programme. For the year 2015-16, 36112 demonstration covering 14407 ha area were conducted across 26 states. The results and the experiences gained from these demonstrations have been encouraging.

I express my sincere gratitude to Hon'ble Union Minister of Agriculture and Farmers Welfare; Secretary, DARE & DG, ICAR and Secretary, Department of Agriculture & Cooperation for their kind support and guidance for execution of this programme. I appreciate the efforts of Asstt. Director General (AE) at head quarter and all the participating Directors of ATARIs and their scientists; KVKs of the country, and officials of Ministry of Agriculture & Farmers Welfare, GOI for effective implementation and monitoring of Cluster Frontline Demonstration on Pulses under NFSM programme. I hope this publication will be helpful for the scientists, policy makers, extension workers, students and farmers.

(A.K. Singh)

PREFACE

India is the largest producer, consumer and importer of pulses having 25.2 m ha under pulse with 19.2 MT productions. The area and production has stagnated last two decades. However, the production stagnated around 12-15 million tones in last few decades with average annual pulse production of about 13.5 million tones. The pulse production touched its peak in the year 2014 which was 19.54 million tones. However, India is now facing severe shortage in pulse production in spite of taking up various measures. Per capita availability of pulses in India is highest during 1951-1961 (60.7-69.0 gram/ day) after that it constantly decreased upto the year 2001 (30.0 gram/day). Per capita availability of pulses has seen upward moment during the last two decades as against the recommendations of ICMR of 52g/capita/day. The current per capita availability however is estimated at 41.7 g/capita/day which is still low as compared to the recommendation of ICMR. Other than their suitability for human health, pulses are also good for environment. Pulses crop are considered as the wonderful gift of nature as they have an ability to fix the atmospheric nitrogen (N2), thereby helps in N cycling within the ecosystem.

In this context, we are indebted to hona'ble Union Minister of Agriculture and farmers welfare, Secretary (DARE) & Director General (ICAR), Secretary Agril. GOI, New Delhi and DDGs of (Agril. Extn. & Crop Sciences), ICAR New Delhi for their kind support and guidance for execution of this programme. ICAR-ATARI, Kanpur is coordinating centre of this activity for 474 districts & 26 states by Krishi Vigyan Kendras of the country laid out the packages of practices base technological interventions through CFLDs. The programme was implemented as per the national standards and requirement. The results have indicated encouraging trend with this publication as the major documented evidence. I do hope that the book stall as the major documented for all the stakeholders such as scientists, extension workers, Krishi Vigyan Kendras, policy makers, students and farmers.

(Author)

EXECUTIVE SUMMARY

This programme is initiated by Ministry of Agriculture and Farmers Welfares GOI, New Delhi to implement the cluster frontline demonstrations of pulses during 2015-16 During 2014, there was disaster due to *Hud-Hud* which damaged the kharif crops and pulses in general. Similarly, during *Rabi* Season it was unseasonal rainfall in the month of February and 1st week of March 2014-15. All the *Rabi* crops were at the maturity stage especially pulses were at ripening stage and these crops were damaged to a great extent up to 50-60% therefore the production on pulses reduced by 16%. There is need to meet the demand of pulses because it is an important source of protein for vegetarian is depend on pulses. India is large producer and consumer of the pulses. The availability of pulses is 37 g/capita/day as per the recommendation of ICMR against the requirement of 52g/capita/day. Keeping this in view, the present demand will be 28 million tonnes but to seeing the production during 2013-14 it was 19.2 million tonnes and further it declined to 17.2 million tonnes in 2014-15. Hence, during the year 2015-16 it is estimated that 18.2 millions tonnes pulses are needed. As we also know that pulses promote long term sustainability to the Indian Agriculture. It need less water, grown on degraded and rainfed lands.

Division of Agricultural Extension, ICAR, New Delhi have given the responsibility to laid out the cluster frontline demonstrations on important pulses crops such as chickpea, field pea, lentil, Rajmash, Green gram, Black gram, and entire country was given to organize demonstrations through Krishi Vigyan Kendra's of all eight zones. The National program has coordinated by ICAR-ATARI, Kanpur Zone IV, for the purpose the human resource development created with the help of ICAR-IIPR, Kanpur at different places for sensitization the Head/Scientist of the KVKs to conduct the demonstrations in packages of practices mode in latest technologies. First of all availability of the seed find out from the NSC/SAUs/ICAR institutes and other organizations. There was 14434.96 ha area allotted to laid out the demonstrations across all the zones. In total there was a budget allocation for cluster frontline demonstration is Rs. 11.98 crore. Some of the places different team visited to demonstration on lentil, chickpea and field pea, the performance are highly satisfied.

Indian Council of Agriculture Research New Delhi initiated National Level Cluster Frontline Demonstration on Pulses & Oilseed with main Objective to demonstrate the production potential of new pulses varieties and the related technologies. The project also aimed for enhancing the Pulses production level of the country during 2015-16. These demonstrations were laid out in 474 districts in 26 states of the country in varied agro-ecological situations. Total demonstrations were conducted on 14407.96 ha area in the country involving the major *Rabi* pulses i.e. chickpea 5553.70 ha, lentil 3156.09 ha, field pea 2019.60 ha, green gram 2792.37 ha, blackgram 856.20 ha

& rajmash 30.00 ha area. Zone wise, this area were 1597.15 ha in Zone I, 4466 ha in Zone II, 1161 ha in Zone III, 2569 ha in zone IV, 1059.2 ha in Zone V, 708 ha in zone VI, 2202.6 in Zone VII, and 672 ha in Zone VIII. On National Basis the yield advantage in lentil was recorded highest (50.49%) followed by field pea (41.09%) and chickpea (38.73%). Other pulses like blackgram (36.23%) greengram (35.45%) and rajmash (26.22%) also recorded significant yield advantage. The average demonstration yield for chickpea, lentil, field pea, green gram and blackgram & rajmash were 13.54, 9.15, 13.46, 8.57, 9.62 and 13.67 q/ha.

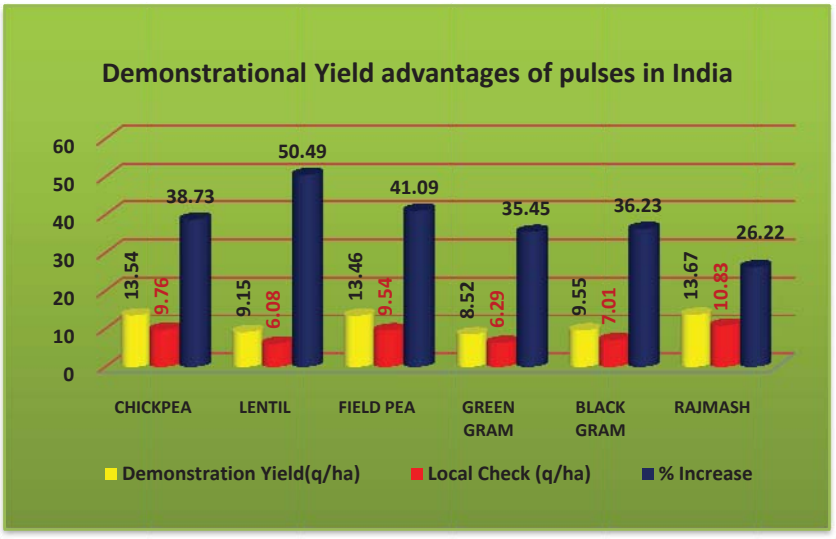


Table i. Cluster Frontline Demonstrations on Pulses during Rabi season 2015-16 in India

Sl. No.	Crop	Area (ha)	Yield (q/ha)		% Increased	Yield gap (q/ha)
			Demonstration	Local Check		
1.	Chick pea	5553.70	13.54	09.76	38.73	3.78
2.	Lentil	3156.09	09.15	06.08	50.49	3.07
3.	Field pea	2019.60	13.46	09.54	41.09	3.92
4.	Green gram	2792.37	08.52	06.29	35.45	2.23
5.	Black gram	856.20	09.55	07.01	36.23	2.51
6.	Rajmash	30.00	13.67	10.83	26.22	2.84
Total		**14407.96**				

All the zones conducted demonstration with location specific variety i.e.in lentil HUL 57, DPL 62, L 4594. Field pea-Prakash, Rachna, Anupam, Shalimar pea; Chickpea- JG 16, HC1, GNG 1581, HC 1, HC 5, Jaki 9218, Vijay, Vishal, Digvijay, NBEG-3, BDNG-797,GG-2, GJG-3 & GG-5, JGG-1, GG-5; Blackgram-LBG 752, LBG-787, GBG-1, PU-31; Greengram-LGG460, WGG-42, TM96-2, MGG-295,GG- 2, G. Co-4,CO-4, IPM-99-125with package of practices such as

integrated nutrient management, integrated pest management, resource conservation technologies such as ridge & furrow method, broad bed furrow method; etc. intercropping on basis of technology demonstrations. It has been observed that the yield gap of 2.10 q/ha to 6.66q/ha can be bridged by demonstrating the improved technologies over the conventional technologies across the different Rabi pulses demonstrated such chickpea, lentil, field pea, green gram, black gram and Rajmash.

The highest Average demonstration yield of Chickpea was found in Zone V (20.28q/ha) followed by zone IV (14.75q/ha), zone VI (14.30q/ha), zone II (13.70q/ha), zone VII (13.01q/ha), zone III (12.83 q/ha), zone-VIII (11.08 q/ha), and lowest yield in zone I (8.35 q/ha)). Similarly in Lentil crop highest Demo. Average yield was recorded in zone II (11.95 q/ha) followed by zone IV (10.51q/ha), zone VII (10.31 q/ha), zone I (8.42 q/ha), zone VI (6.92q/ha) & zone III (6.78q/ha).

Table ii. Zone wise Cluster Frontline Demonstrations on Pulses (Chick pea & Lentil) during Rabi season 2015-16

Zone	Chick pea			Lentil		
	Area (ha)	Demonstration	Local Check	Area (ha)	Demonstration	Local Check
I	586.74	08.35	07.57	172.26	08.42	5.20
II	1200.	13.70	09.97	1314	11.95	8.80
III	35	12.83	09.00	388	06.78	3.87
IV	543	14.75	09.84	939	10.51	7.60
V	872	20.28	13.82	-	-	-
VI	656.95	14.30	10.74	20.23	06.92	5.00
VII	1430	13.01	08.96	322.6	10.31	6.01
VIII	230	11.08	08.16	-	-	-
Total	**5553.69**	**13.54**	**9.76**	**3156.09**	**9.15**	**6.08**

In case of Fieldpea crop highest demonstration average yield was found in zone IV (16.52q/ha) followed by zone I (12.47q/ha), zone III (12.43q/ha) zone II (12.41q/ha), and zone VII (12.38q/ha). Demonstration of Rajma is conducted only in zone III & demonstration yield is 13.67q/ha.

Table iii. Zone wise Cluster Frontline Demonstrations on Pulses (Fieldpea & Rajmash) during Rabi season 2015-16

Zone	Fieldpea			Rajmash		
	Area (ha)	Demonstration	Local Check	Area (ha)	Demonstration	Local Check
I	20	12.47	8.87	-	-	-
II	859.6	12.41	8.87	-	-	-
III	454	12.43	9.14	30	13.67	10.83
IV	566	16.52	11.29	-	-	-
V	120	12.38	8.04	-	-	-
Total	**2019.6**	13.24	9.24	**30**	13.67	10.83

The highest Average demonstration yield of Greengram was found in zone VI (9.80q/ha), followed by zone V (9.36q/ha), zone II (9.23q/ha), zone IV (9.13q/ha), zone VIII (8.44q/ha), zone I (8.13q/ha), zone VII (7.08q/ha) & zone III (6.98q/ha). Black gram is conducted in five zones and highest yield was noted in zone IV (9.80q/ha) followed by zone V (9.36 q/ha) zone II (9.20q/ha) zone III (7.01q/ha) & zone VIII (6.97q/ha).

Table iv. Zone wise Cluster Frontline Demonstrations on Pulses (Greengram & Blackgram) during 2015-16

Zone	Greengram			Blackgram		
	Area (ha)	Demonstration	Local Check	Area (ha)	Demonstration	Local Check
I	818.15	8.13	7.05	-	-	-
II	938.4	9.23	7.30	154	9.20	7.00
III	92	6.98	4.98	162	7.01	5.68
IV	308	9.13	6.45	186	9.80	7.43
V	75	9.36	7.06	112.2	9.36	7.09
VI	30.82	9.80	6.90	-	-	-
VII	330	7.08	4.77	0	-	-
VIII	200	8.44	5.84	242	6.97	5.50
Total	**2792.37**	**8.52**	**6.29**	**856.2**	**9.55**	**7.01**

Content

1. INTRODUCTION

Globally, India is the major pulses producer followed by Canada, China, Myanmar and Brazil. The world's major pulses producing countries, which together account for half of the global production are India¸ Canada, China, Myanmar and Brazil. India is the largest producer of pulses, accounting for 25 per cent of global pulses production. In a country like India, pulses are the cheapest and concentrated source of dietary amino acids, where protein demand of vegetarian population is fulfilled through pulses, so it is also considered as "A poor man's meat". Pulses occupy a unique position in the world of agriculture by virtue of its high protein content, which is almost double than that of cereals. They have a special role in meeting the protein requirement of predominantly vegetarian population. In addition to protein, pulses also contain good quality lysine, tryptophan, ascorbic acid and riboflavin. Pulses are suitable for people with diabetes, also for coronary heart disease and anemia, as they regulate the cholesterol. The presence of bioactive compounds i.e. phytochemicals and antioxidants, build up an anti-cancer properties in pulses. Other than their suitability for human health, pulses are also good for environment. Pulses crop are considered as the wonderful gift of nature as they have an ability to fix the atmospheric nitrogen (N_2), thereby helps in N cycling within the ecosystem. Besides N_2 fixation, incorporation of crop residue increases the microbial activity, restores soil properties in soil and carbon sequestration, and thus provides sustainability in crop production system.

With the above objective in view the Government of India has initiated Cluster Front Line Demonstrations (CFLD) on Pulses during Rabi 2015-16 under National Food Security Mission (NFSM). Accordingly the ICAR-Division of Agricultural Extension planned to organize Cluster FLDs on Pulses during rabi 2015-16 through Krishi Vigyan Kendras in the country.

Production trends

Globally, pulse crops are grown in area of more than 76 m ha with a production of about 68 m tonnes. In India, the total pulse area is about 25 mha which produces about 18 m tonnes.

Table 1.1 : Trends in production and productivity of pulses in India

Year	Production (m. ton)	Yield (kg/ha)
1950-51	8.41	441
1960-61	12.70	539
1970-71	11.82	524
1980-81	10.63	437
1990-91	14.26	578
2000-01	11.08	544
2005-06	13.39	598
2008-09	14.57	659
2009-10	14.66	630
2010-11	18.24	691
2011-12	17.09	699
2012-13	18.34	789
2013-14	19.24	764
2014-15	17.15	735

Source: - http://www.iasri.res.in, http://www.dacnet.nic.in/eands

The average productivity at the global level is about 800 kg/ha and of India is 750 kg/ha. In 2014-15 the total area, production and average productivity of all pulse crops was 23.37 m ha, 17.15 m tonnes and 735 kg/ha respectively. The present production of 17.15 million tones of Pulses in India is not meeting the annual domestic demand of 22.42 million tones. Hence there is a need to increase the production and productivity through an annual growth rate of 4.2% to reach the target of 32 million tonnes by the year 2030. The progressive trends in production and productivity of pulses in indicated from the given (tables 1.2):

Table 1.2 : State wise trends in area and production of pulses in India

State	Area (000,ha.)		Production (000,Tonnes)	
	2014-15	2013-14	**2014-15**	2013-14
Andhra Pradesh+ Telangana	1450	1672.00	1156	1551.00
Assam	174	150.06	112	104.31
Bihar	506	499.96	420	522.04
Chhattisgarh	785	839.30	655	482.10
Gujarat	637	813.00	581	729.00
Haryana	86	152.60	60	125.05
Himachal Pradesh	34	28.94	42	51.04
Jammu & Kashmir	27	25.88	8	13.85
Jharkhand	595	566.84	597	578.62
Karnataka	2309	2498.00	1488	1600.51
Kerala	1	1.02	1	4.00
Madhya Pradesh	5364	5395.80	4705	4644.32
Maharashtra	3139	3953.00	1738	3169.00
Orissa	835	780.83	440	419.26
Punjab	82	45.40	73	39.60
Rajasthan	3362	4197.74	1950	2490.89
Tamilnadu	940	815.75	647	613.79
Uttar Pradesh	2341	2305.00	1447	1697.45
Uttarakhand	66	65.04	53	56.52
West Bengal	246	286.75	176	241.73
Others	120	118.43	843	120.01
All-India	**23098**	**25211.34**	**17191**	**19254.09**

Sources: Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare, Ministry of Statics and Programme implementation.

Availability of Pulses in India

Per capita net availability of pulses in India is highest during 1951-1961 (60.7-69.0 gram/day) after that constantly decreases upto year 2001 (30.0 gram/day). Per capita availability of pulses has seen upward moment during the last two decades. As per the recommendations of ICMR of 52g/capita/day. The current per capita availability is estimated at 41.7 g/capita/day which is still low as compared to the recommendation of ICMR. The progressive trends in availability of pulses in indicated from the following (tables 1.3):

Table 1.3 : Per capita Net availability of total pulses in India

S. No	Year	Availability	
		Per day (Gram)	Per Annum (Kg)
1.	1951	60.7	22.16
2.	1961	69.0	25.19
3.	1971	51.2	18.69
4.	1981	37.5	13.69
5.	1991	41.6	15.18
6.	2001	30.0	10.95
7.	2005	31.5	11.50
8.	2007	35.5	12.96
9.	2009	37.0	13.51
10.	2010	35.4	12.92
11.	2011	43.0	15.70
12.	2012	41.7	15.22

Source:- http:// www.iasri.res.in, http://www.dacnet.nic.in/eands

Nutritional value of pulses

The nutritional importance of pulses are numerous they can be a valuable source of energy.

Table 1.4 : Nutritional value of pulses

	Energy (Kcals)	Moisture (g)	Protein (g)	Fat (g)	Mineral (g)	Carbohydrates (g)	Fibre (g)	Calcium (mg)	Phosphorus (mg)	Iron (mg)
Bengal gram, whole	360	10	17	5	3	61	4	202	312	5
Bengal gram, dhal	372	10	21	6	3	60	1	56	331	5
Black gram, Dhal	347	11	24	1	3	60	1	154	385	4
Cow pea	323	13	24	1	3	54	3	77	414	9
Field bean, dry	347	10	25	1	3	60	1	60	433	3
Green gram dhal	348	10	24	1	3	60	1	75	405	4
Horsegram	321	12	22	0	3	57	5	287	311	7
Khesari, dhal	345	10	28	1	2	57	2	90	317	6
Lentil	343	12	25	1	2	59	1	69	293	7
Moth beans	330	11	24	1	3	56	4	202	230	9
Peas green	93	73	7	0	1	16	4	20	139	1
Peas dry	315	16	20	1	2	56	4	75	298	7
Rajmah	346	12	23	1	3	61	5	260	410	5
Redgram, dhal	335	13	22	2	3	58	1	73	304	2
Soyabean	432	8	43	20	5	21	4	240	690	10

Source:- Gopalan, C. et.al (2004)

The energy content of most pulses has been found to be between 315 and 432 Kcal / 100g. Energy is required for all metabolic processes. The energy of Pulses comes from the

nutrient supply of protein, fat and carbohydrate. Pulses have a high protein content, the value is about twice that in cereal and several times that in root tuber (FAO, 1968), so they can help to improve the protein intake of meals in which cereals and root tubers in combination with pulses are eaten (Kushwah *et al.*, 2002). Pulse when eaten with cereals, can also help to increase the protein quality of the meal. In man, protein helps in the repair of body tissue, synthesis of enzymes and hormones and also in the supply of energy. The details nutritional value of pulses are shown in (table 1.4).

Mission Objectives

- Increasing production of pulses through area expansion and productivity enhancement in a sustainable manner in the identified districts of the country; Ensure food security-area expansion and productivity enhancement of food crops including dual purpose coarse cereals.
- Restoring soil fertility and productivity at the individual farm level; and
- Enhancing farm level economy (*i.e.* farm profits) to restore confidence amongst the farmers with increasing the Seed Replacement Rate (SRR) under pulses crop.

Constraints of pulse Production

There are several constraints in pulse production. These include:

- Growing of lathyrus, lentil, green gram under intercropping which leads to poor plant population.
- Redgram, green gram and black gram are mostly grown as rainfed crop.
- Since rice is grown in most of the areas in kharif season, the sowing of pulses in these areas delays due to cultivation of long duration varieties.
- In most of the states pulses are grown in unproductive and up land without adequate fertilizers.
- Availability of good quality seed is still a problem in the majority of the areas, new varieties are not available in adequate quantity.
- Compared to pulses, other crops like potato, wheat, vegetable, oilseeds get more attention of the farmers as these crops are more profitable.
- Irrigation is not available in adequate quantity.
- Seed treatment and use of bio-fertilizers are still very low which affect the productivity of crops.
- Use of micronutrients is very much important in pulses in many places which farmers cannot afford leading to low productivity.

2. ICAR-ATARI, ZONE I
(Punjab, Haryana, Delhi, Himachal Pradesh, Jammu & Kashmir)

To improve the production of pulses, Division of Agriculture Cooperation and Farmers' Welfare (DAC&FW) sanctioned a project "Cluster Frontline Demonstrations of Rabi Pulses 2015-16". Under this project, National Food Security Mission (NFSM) had sponsored 129.13 lakh rupees to ICAR-ATARI, zone-I, Ludhiana during month of September 2015. Under zone-I, Ludhiana, Frontline Demonstrations (FLDs) were implemented by 33 Krishi Vigyan Kendras (KVKs) in four states namely Punjab, Haryana, Himachal Pradesh (H.P.) and Jammu & Kashmir (J&K) in during Rabi and summer season 2015-16. For conducting each FLD, Rs. 3000 per acre were allotted for pulses i.e. chickpea, lentil and summer moong. FLDs were conducted in total area of 1651ha in four states on pulses like lentil, chickpea, field pea and green gram. The list of FLDs allotted and conducted state wise and crop wise during rabi and summer 2015-16 by the KVKs of zone-I is given in Table 2.1. The KVKs were not able to conduct allotted FLDs in chickpea and lentil due to shortage of quality seed. The allotted FLDs to KVKs were converted to FLDs in summer moong in KVKs of Punjab and Haryana and KVK Una of Himachal Pradesh.

In Zone-I, out of total allotted 1651 ha area (4115 number of FLDs) only 3786 FLDs were demonstrated in chickpea, field pea and lentil, under 1318.98 ha area however, 332.50 ha area was converted to summer moong. In pulses (chickpea) was demonstrated in an area of 586.78 ha while lentil on 172.24 ha and field pea in 20 ha.

Table 2.1:- State wise and crop wise allotted and conducted FLDs in Zone-I, Ludhiana

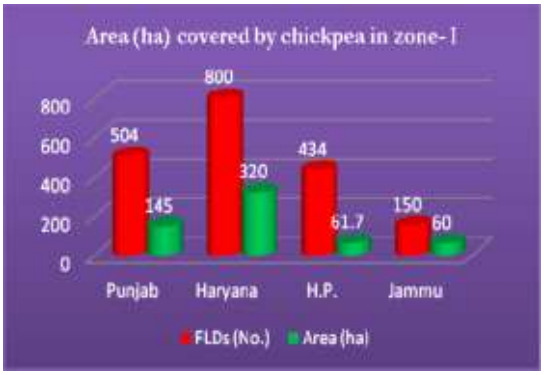
State/Crop	Allotted		Conducted during Rabi/summer		Deficient area converted to summer moong in lieu of deficient lentil and chickpea	
	Demo. (No.)	Area (ha)	Demo. (No.)	Area (ha)	Demo. (No.)	Area (ha)
Punjab						
Chickpea	900	360.00	504	145.04	400	214.96
Lentil	300	120.00	252	84.00	48	36.00
Summer moong	500	200.00	500	200	--	--
Total	**1700**	**680**	**1256**	**429.04**	**448**	**250.96**
Haryana						
Chickpea	800	320.00	800	320.00	--	--
Lentil	300	120.00	213	85.20	87	34.80
Summer moong	800	320.00	800	320	--	--
Total	**1900**	**760**	**1813**	**725.20**	**87**	**34.80**
Himachal Pradesh						
Chickpea	215	91.00	434	61.70	--	29.30
Lentil	50	20.00	33	3.04	17	16.96
Summer moong	50	20.00	50	20.00	--	--
Total	**315**	**131.00**	**517**	**84.74**	**17**	**46.26**
Jammu & Kashmir						
Chickpea	150	60.00	150	60.00	--	--
Fieldpea	50	20.00	50	20.00	--	--
Total	**200**	**80.00**	**200**	**80.00**	**--**	**--**
Grand total	**4115**	**1651.00**	**3786**	**1318.98**	**552**	**332.50**

Performance of Chickpea

Among pulse crops, chickpea is an important crop that could be grown to boost the production of pulses in India. There is perceptible need to demonstrate the farmers that chickpea/Bengal gram could be one of the alternative to wheat in *Rabi* season in the pursuit of diversification and sustainability of rice-wheat cropping system.

Punjab

In Punjab, chickpea varieties i.e. PBG-7, GPF-2 and GNG-1581 were demonstrated at 9 KVKs. Out of total allotted area 360 ha, 145.04 ha FLDs was conducted by the KVKs while rest of the area 214.96 ha was converted into summer moong. As compared to the local check, 25.49 per cent higher yield was recorded from overall FLDs of chickpea (Table 2.2). The maximum average yield was recorded at district Nawashahar while lowest was recorded at Mohali. Major technologies demonstrated at the farmer's field were Improved Variety, Seed inoculation *Rhizobium* culture, seed treatment with Bavistin, Full package and Weed Control.

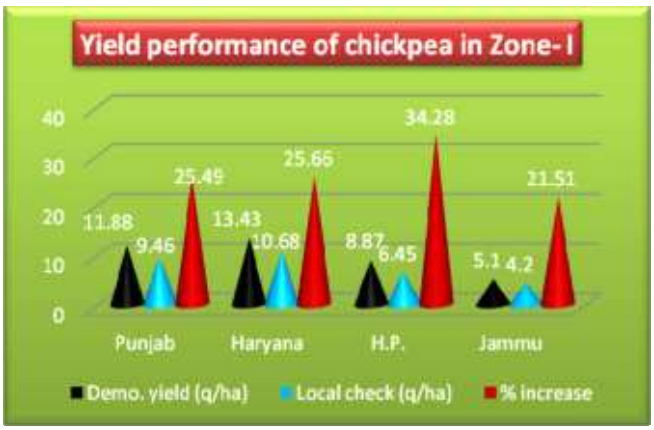


Haryana

In Haryana, all the allotted 360 ha area on chickpea varieties i.e. HC-1 were demonstrated in Bhiwani, Hisar, Fatahabad, Gurgaon, Mahendergarh, Jhajjar, Rewari and Karnal districts. The data indicated that the 25.66 per cent higher yield was obtained over the local check (Table 2.2). The integrated crop management, seed treatment with Chloropyriphos and *Rhizobium* culture in chickpeawere the technologies demonstrated at the farmer's field. In Haryana, maximum yield was recorded at Karnal district while lowest was recorded at Hisar district.

Himanchal Pradesh

In Himachal Pradesh chickpea varieties were demonstrated at 5 districts i.e Una, Hamirpur, Bilaspur, Shimla and Mandi districts. Out of total allotted 91 ha area, crop was demonstrated on an area of 61.7 ha due to unavailability of seeds and further 6.8 ha was converted to summer moong of KVK Una. Except Shimla, as compared to local check 34.28 per cent higher yield was recorded from demonstrations of chickpea, as crop is not harvested there (Table 2.2).



Jammu & Kashmir

In J&K, chickpea variety GNG-1581 was used for 150 demonstrations on 60 ha area of Kathua, Rajouri and Jammu districts under rainfed conditions. Over the local check, 21.51 per cent higher yield was recorded (Table 2.2). Full package of practices were followed to raise the crop under rainfed conditions. In Jammu intercropping of mustard was taken with chickpea for covering the risk of crop failure.

Table 2.2: Cluster Frontline demonstration conducted in Chickpea by KVKs of Zone-I during Rabi 2015-16

KVK	Variety	FLDs (No.)	Area (ha)	Average yield (q/ha)		% increase
				Demo	Local check	
Nawanshahar	PBG-7	24	11.20	16.30	10.00	63.00
Ropar	PBG-7	52	10.25	5.35	4.80	11.15
Mohali	GNG 1581	65	29.6	7.25	6.50	11.54
Amritsar	PBG-7	38	8.00	15.30	12.50	22.40
Tarn Taran	PBG-7	35	8.00	15.27	12.50	22.20
Kapurthala	PBG-7	66	8.00	12.00	10.50	14.30
Patiala	PBG-7	31	8.40	15.50	11.80	31.40
Faridkot	PBG-7	100	33.34	11.70	9.75	20.00
Bathinda	PBG-7	93	28.25	14.50	11.00	31.8
Total Punjab		**504**	**145.0**	**11.88**	**9.46**	**25.49**
Karnal	HC-1	100	40	18.00	17.50	2.90
Bhiwani	HC-1	100	40	16.94	6.32	168.0
Jhajjar	HC-1	100	40	12.10	8.70	39.10
Mahendergarh	GNG 663	100	40	15.30	12.90	18.60
Hisar	HC-1	100	40	9.90	9.10	8.80
Gurgaon	HC-1	100	40	14.60	13.75	6.18
Rewari	HC-1	100	40	10.60	8.00	32.50
Fatehabad	HC-1	100	40	9.98	9.20	8.47
Total Haryana		**800**	**320.0**	**13.43**	**10.68**	**25.66**
Una	HC1, GNG 1581	70	13.20	9.57	6.00	59.50
Hamirpur	DKG 986, HC2, GPF2,	149	8.22	8.84	5.70	55.1
Bilaspur	HPG 17, HC1, HC2 GPF2,	114	10.00	8.38	5.00	67.60
Mandi	HC2, GNG 1581, GPF2	101	5.28	7.28	4.20	73.30
Shimla	GNG 1581	100	25.00	8.54	8.00	6.75
Total H.P.		**534**	**61.7**	**8.87**	**6.45**	**34.28**
Jammu	GNG-1581	50	20	5.19	4.90	5.9
Kathua	GNG-1581	50	20	6.42	4.50	42.7
Rajouri	GNG-1581	50	20	3.70	3.20	15.62
Total Jammu		**150**	**60.0**	**5.10**	**4.20**	**20.51**
Grand Total		**1988**	**586.72**			

Varietal performance of chickpea

A number of varieties GNG-1581, PBG-7, GPF-2, HC-1, HC-2, HPG 17 and DKG-986 were demonstrated in four states. In Punjab PBG-7and GNG-1581 varieties were demonstrated. PBG-7 variety was demonstrated at 115.40 ha area through 439 FLDs as a result 27.77 per cent higher yield was recorded over the local check (Table 2.3). The variety HC-1 was demonstrated in Haryana in an area of 280.00 ha through 700 Front line demonstrationsand recorded yield was 26.94 per cent higher than the local check (Table 2.3). Similarly, in J&K 150 FLDS were conducted on area of 60 ha on GNG 1581 variety, as a result 21.51% higher yield was obtained than the existing yield (Table 2.3).

Table 2.3: Varietal performance of chickpea

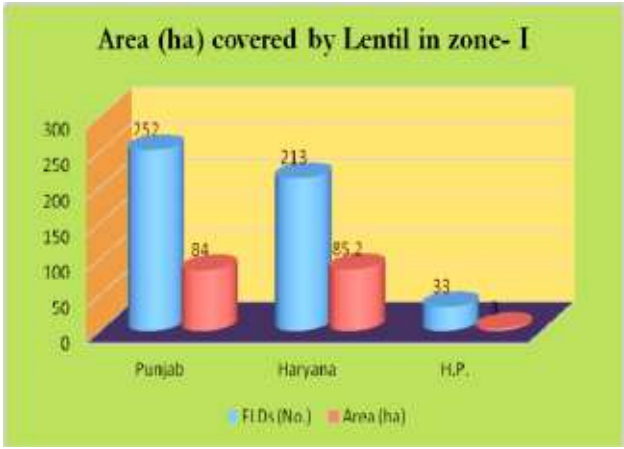
Variety	FLDs (No.)	Area (ha)	Demonstration yield (q/ha)	Existing yield (q/ha)	Percentage increase in yield	State yield (2014-15)
Punjab						
PBG-7	439	115.40	13.06	10.22	27.77	13.50
Haryana						
HC-1	700.00	280.00	13.16	10.37	26.94	10.00
J&K						
GNG-1581	150.00	60.00	4.92	5.10	21.51	NA

NA: not available

Performance of Lentil

Lentil is second major *Rabi* sown legume after chickpea which is grown in winter season. In India, rice-lentil cropping system is dominant, although lentil is sown after maize, pearlmillet, sorghum and cotton. More than 90 per cent of lentil is grown on conserved soil moisture in rainfed and dryland areas after monsoon rains. Lentil is also sown as mono cropping, mixed cropping, intercropping or relay cropping in various parts of India.

In Punjab, lentil variety LL-699 was demonstrated in 252 FLDs in KVKs of Hoshiarpur, Gurdaspur and Jalandhar. Out of total 252.00 ha area 84 ha were conducted, however, rest of the area converted into summer moong. Average 72.61 per cent higher yield was recorded from the all FLDs of the Punjab (Table 2.4). However, in Jalandhar it was introduced for the first time. Major technologies used were seed treatment with captan, inoculation with consortium [(Rhizobium)+(Rhizobacteria)].



In Haryana, lentil varieties like DPL-62 and L-4594 were demonstrated in 213 FLDs on 85.20 ha of area in Yamunanagar, Ambala and Kurukshetra districts, while deficient FLDs were converted into summer moong. The technologies demonstrated in the farmer's field were integrated crop management, seed inoculation with Rhizobium culture, as a result 34.55 per cent higher yield was recorded (Table 2.4).

At Bilaspur district of HP, Vipasha variety of lentil was demonstrated. Crop was sown by Kera method and full dose of N&P was applied at the time of sowing. Stomp 30 EC@4.5 l/ha was sprayed within 48 hours of sowing to control the weeds. As a result of such practices 51.20 per cent higher yield was recorded over the local check (Table 2.4).

Table 2.4: Cluster Frontline demonstrations conducted on Lentil during Rabi 2015-16

KVK	Variety	FLDs (No.)	Area (ha)	Average yield (q/ha)		% increase
				Demo.	Local check	
Hoshiarpur	LL-668	100	30	3.69	2.88	28.12
Gurdaspur	LL-668	80	30.00	8.31	5.30	56.79
Jalandhar	LL-668	72	24.00	9.70	-	0.00
Total Punjab		**252.00**	**84.00**	**7.06**	**4.09**	**72.61**
Ambala	DPL-62	33	13.20	7.43	7.00	6.14
Kurukshetra	L-4594	80	32.00	9.00	7.50	20.00
Yamunanagar	L-4594	100	40.00	11.62	7.50	54.93
Total Haryana		**213.00**	**85.20**	**9.99**	**7.42**	**34.55**
Bilaspur	Vipasa	33	3.00	8.2	4.00	51.20
Total H.P.		**33**	**3.00**	**8.2**	**4.00**	**51.20**
Total Zone-I		**503.0**	**172.2**			

Varietal performance of lentil

In Punjab, LL-699 variety was demonstrated on area of 84 ha through 252 FLDs. From these areas 72.61 per cent higher yield was recorded over the existing yield (Table 2.5), however, in Jalandhar it was introduced first time so there was 100 per cent improvement. In, Haryana, varieties like DPL-62 and L-4594 were demonstrated which gave 6.14 and 39.41 per cent

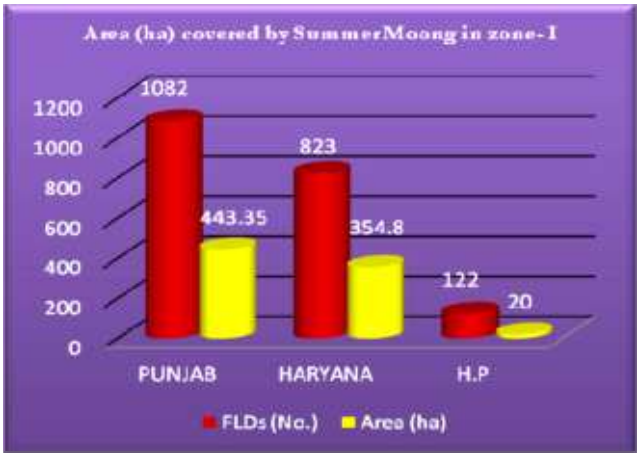
respectively higher yield than the existing yields. In H.P., over the existing yield, 51.2 per cent higher yield was obtained from Vipasa variety of lentil.

Table 2.5: Cluster Frontline demonstration conducted in Lentil during Rabi 2015-16

Variety	FLDs (No.)	Area (ha)	Average yield (q/ha)		% increase
			FLD	Local check	
Punjab					
LL-668	252	84.00	07.06	4.09	72.61
Haryana					
DPL-62	33	13.20	07.43	7.00	06.14
L-4594	180	72.00	10.46	7.50	39.41
H.P.					
Vipasa	33	03.00	08.2	4.00	51.20

Demonstrations on summer moong

In Punjab, 200.00 ha area was planned for conducting FLDs on summer moong while additional 250.95 ha was reallocated for FLDs on summer moong as a compensation to meet deficit from *Rabi* season; thus summer moong was demonstrated in an area of 443.35 ha (Table 2.6). In Haryana, FLDs on summer moong were conducted on an area of 354.80 ha, which includes 320.00 ha planned area as well as 34.80 ha additional area to compensate deficit FLDs from *Rabi* season. KVK Una of Himachal Pradesh demonstrated FLDs on summer moong on 20.00 ha of planned area, while 6.80 ha area was reallocated to be demonstrated during *Kharif* 2016-17 to compensate the Rabi season.



Details of FLDs of summer moong by KVKs of Punjab

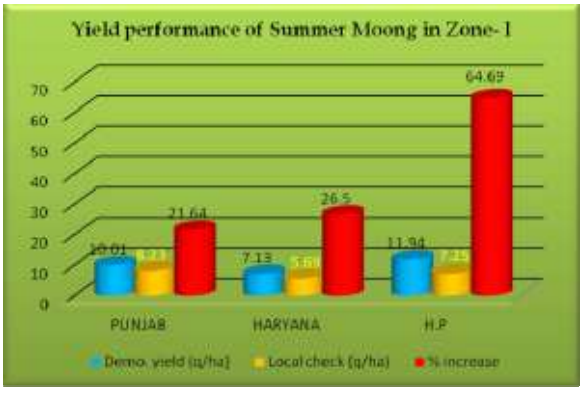
In Punjab, summer moong variety namely SML 668 demonstrated by the 17 KVKs on an area of 443.35 ha through 1082 FLDs, as a result 21.64 per cent higher yield was recorded over the local check. Summer moong was planned for five KVKs i.e. Barnala, Ludhiana, Ferozepur, Moga, Muktsar and Barnala while rest of the twelve KVKs conducted the Rabi season deficit area. Major technologies demonstrated at the farmer's field were improved variety, seed treatment with *Rhizobium* culture, Chloropyriphos and Bavistin and weed control in chickpea; while, microbial inoculants [*Rhizobium* & Rhizobactrium], integrated crop management and improved variety, weed control and plant protection were demonstrated in lentil (Table 2.6).

Table 2.6: Performance of FLDs of summer moong in Punjab

KVK	Variety	FLDs (No.)	Area (ha)	Average yield (q/ha)		% increased
				Demo	Local check	
Hoshiarpur	SML 668	26	10.00	7.58	7.00	8.43
Gurdaspur	SML 668	25	10.00	11.60	10.55	9.95
Nawanshahar	SML 668	72	28.80	10.47	8.50	23.18
Ropar	SML 668	59	29.75	6.88	5.5	25.09
Mohali	SML 668	42	10.40	10.22	8.25	23.88
Amritsar	SML 668	80	32.00	10.24	8.80	16.36
Ludhiana	SML 668	81	40.00	12.37	11.75	5.28
Tarn Taran	SML 668	80	32.00	9.36	7.15	30.91
Kapurthala	SML 668	50	32.00	10.65	6.50	63.85
Jalandhar	SML 668	38	16.00	7.79	6.25	24.64
Patiala	SML 668	72	24.00	12.6	11.8	6.78
Faridkot	SML 668	17	6.65	10.30	9.60	7.29
Ferozepur	SML 668	100	40.00	10.26	8.75	17.26
Bathinda	SML 668	42	11.75	10.10	8.90	13.48
Moga	SML 668	100	40.00	12.30	10.00	23.00
Barnala	SML 668	98	40.00	7.92	4.99	58.72
Muktsar	SML 668	100	40.00	8.40	7.20	16.67
		1082	443.35	10.01	8.23	21.64

Performance of FLDs of summer moong in Haryana

A total of 823 FLDs on summer moong varieties SML-668 and MH-421 were demonstrated by 11 KVKs of Haryana on an area of 354.80 ha (Table 2.7). Three KVKs i.e. Ambala, Yamunanagar and Kurukshetra demonstrated the Rabi season deficit as well as allotted FLDs, while summer moong was allotted to rest of the KVKs. The technologies demonstrated in the farmer's field were integrated crop management, seed treatment with Chloropyriphos and *Rhizobium*, improved



cultivation practices, seed variety and full package of practices. As a result 26.50 per cent higher yield was recorded over the local check.

Table 2.7: Performance of FLDs of summer moong in Haryana during 2015-16

Zone	KVK	Variety	FLDs (No.)	Area (ha)	Average yield (q/ha)		% increase
					Demo	Local check	
HR-I	Ambala	MH-421	118	46.80	8.97	7.00	28.14
	Kaithal	MH-421	53	20.00	9.66	7.50	28.80
	Karnal	SML-668	100	40.00	3.69	2.50	47.60
	Kurukshetra	SML-668	95	38.00	12.88	8.50	51.53
	Rohtak	MH-421	50	20.00	4.18	3.00	39.33
	Yamunanagar	MH-421	34	20.00	8.00	6.30	26.98
HR-II	Hisar	MH-421	75	30.00	2.61	2.5	4.40
	Gurgaon	SML-668	84	40.00	7.02	6.85	2.48
	Fatehabad	MH-421	50	20.00	7.80	7.80	0.00
	Jind	MH-421	100	40.00	4.12	3.20	28.75
	Sirsa	MH-421	64	40.00	9.53	7.50	27.07
Total (Haryana)			823	354.80	7.13	5.69	26.50

Performance of FLDs of summer moong in Himachal Pradesh

Amb, Una, Gagret and Haroli blocks of Una district were selected to demonstrate SML-668 variety of summer moong (Table 2.8). Line sowing method was followed to raise the crop after treating with phosphorus solubilizing bacteria (PSB). Over the local check, 64.69 per cent higher yield was recorded from the demonstrations conducted at farmers' field.

Table 2.8: Performance of FLDs of summer moong in Himachal Pradesh during 2015-16

KVK	Variety	FLDs (No.)	Area (ha)	Average yield (q/ha)		% increase/ decrease
				Demo	Local check	
Una	SML-668	122	20.00	11.94	7.25	64.69
		122	**20.00**	**11.94**	**7.25**	**64.69**

Demonstrations of Field Pea

In Pulwama district of J&K, field pea varieties Rachna and Shalimar pea-1 were demonstrated in 50 FLDs on 20 ha area and technology demonstrated such as seed with package and practices of SKUAST Srinagar. The results that the average demonstration yield 12.47q/ha which was 40.59 percentage higher over district average yield 8.87q/ha.

TECHNOLOGIES DEMONSTRATION

Use of BNF consortium in lentil at Gurdaspur district of Punjab

Biofertilizers play an important role to improve the yield of lentil as it increases the biological nitrogen fixation (BNF) in legumes. However, these days dual inoculations of *Rhizobium* and plant growth promoting rhizobacteria (PGPR) are used to boost the production and productivity. At Gurdaspur district of Punjab consortium [*Rhizobium* (LLR-12)+PGPR (RB-2)] biofertilizer was distributed among farmers (Fig.1.1). Use of biofertilizers improved the yield by 36.2 per cent (Table 2.9).

Fig 1.1:- Demonstration on inoculation of Biofertilizers in lentil

Table 2.9: Use of Biofertilizers at Gurdaspur district of Punjab

Crop demonstrated	Existing farmer variety name	Existing yield (kg/ha)	Variety +Technology demonstrated	FLDs	Area (ha)	Yield obtained (q/ha)			% increase
						Max.	Min.	Avg.	
Lentil	Desi massar	5.3	(LL-699) + Consortium [*Rhizobium* (LLR-12) + Rhizobactrium (RB2)]	100	30	17.2	2.78	8.31	56.79

Broad Bed Furrows (BBF) Mohali in Punjab

Sowing of chickpea on Broad Bed Furrows (BBF) help to save and conserve the water as well as left the space to grow other crops like maize, sugarcane etc. This technique is suitable under rainfed areas. Such practice was followed at Mohali in Punjab (Fig 1.2) by treating the seeds with seed treatment with Bavistin, *Rhizobium* (Table 2.10).

Fig. 1.2. Sowing of chickpea on BBF

Table 2.10: Sowing of chickpea on broad bed furrows (BBF) Mohali in Punjab

Name of variety	Technology demon-strated	Area (ha)	Existing (Farmer's) variety name	Yield obtained (q/ha) Max	Min	Av.	Existing yield (q/ha)
GNG1581	Seed treatment with Bavistin, *Rhizobium* and Met-*Rhizobium*	29.6	Local desi	12.5	3.75	7.25	11

Seed treatment in chickpea at Karnal, Haryana

Wilt is an important disease of the chickpea which heavily damage the crop. This disease is seed borne so seed treatment is very necessary which reduce the incidence of diseases. Seed treatment with Bavistin fungicides along with protecting the seeds or seedlings from early season diseases and also protects from insect pests attack. Treatment also ensures uniform seedling emergence, productivity, improved plant population and thus gave higher productivity. By treating the seed with Baviston, 2.9 per cent yield was increased at Karnal (Table 2.11).

Fig 1.3. Distribution of seed treatment inputs

Table 2.11: Seed treatment in chickpea at Karnal, Haryana

Name of variety	Technology demon-Strated	Area (ha)	Existing (Farmer's) variety name	Yield obtained (q/ha) Max	Min	Av.	Existing yield (q/ha)	Increases in yield
HC1	Seed treatment + Integrated crop management	40	Local	25	16 .0	18	17.5	2.9

Intercropping of lentil in agro forestry at Yamunanagr, Haryana

Now-a-days Agro forestry systems are followed to meet the requirement of food as well as timber. In Yamunanagar lentil was grown in poplar based Agro forestry systems (Fig.1.4). Agro forestry system Increased crop production, economic gain, soil conservation and improved soil quality and increased biodiversity. The yield obtained was 35 per cent higher than the existing yield (Table 2.12)

Table 2.12: Intercropping of lentil in agro forestry at Yamunanagar

Name of variety	Technology demon-strated	Area (ha)	Existing (Farmer's) variety name	Yield obtained (q/ha)			Existing yield (q/ha)	Increases in yield
				Max	Min	Av.		
L-4594	Full Package of Practices	40	L9-12	15	10	11.6	7.5	54.93

Intercropping of mustard in chickpea at Kathua

Intercropping of mustard in chickpea provides and additional income, when no rainfall is received. At Kathua district of Jammu & Kashmir (Fig.1.5). The crop was demonstrated on 20 ha area, where recorded yield was 29.9 per cent higher than the existing yield of chickpea (Table 2.13). Except maintain the soil fertility, intercropping gives higher income per unit area than sole cropping and provides an insurance against failure of crop in abnormal year.

Table 2.13:- Intercropping of mustard in chickpea at Kathua, Jammu & Kashmir

Name of variety	No. of farmers	Area (ha)	Existing (Farmer's) variety name	Yield obtained (q/ha)			Existing yield (q/ha)	Increases in yield
				Max	Min	Av.		
GNG1581	50	20	PBG1	9.5	3	6.42	4.5	42.7

Fig 1.5. Intercropping of chickpea with Mustard at Kathua and Jammu

Use of pheromone traps at Rajouri, Jammu & Kashmir

At Rajouri, pheromone traps were used to control the insect pests, as a result 1.6 per cent higher yield was recorded from the demonstration of 20 ha area (Table 2.14) (Fig 1.6). Pheromones are odorous chemicals produced by insects that affect the behavior of insects. Pheromones can be used to attract them for elimination and mating disruption.

Fig 1.6. Use of pheromone traps at Rajouri

Table 2.14: Use of pheromone traps at Rajouri

Name of variety	Technology demon-strated	No. of farmers	Area (ha)	Existing (Farmer's) variety name	Yield obtained (q/ha)			Existing yield (q/ha)
					Max	Min	Av.	
GNG1581	HYV	50	20	Local	5.12	2.35	3.74	3.2

3. ICAR-ATARI, ZONE II
(Bihar, Jharkhand and West Bengal)

In the Eastern states of Bihar, Jharkhand, and West Bengal, pulse is grown in kharif, rabi and summer season. Major rabi pulses grown in Bihar is lentil (154087 ha) followed by summer moong (145905 ha) and chickpea (61325 ha). In the state of Jharkhand, lentil (43980 ha) occupies major position in rabi pulse followed by field pea (31708 ha). In West Bengal, lentil (65462 ha) occupies largest area, followed by summer moong (21446 ha) and field pea (12661 ha). The average productivity of the major pulses in these states is indicated in below (Table 3.1, 3.2 & 3.3).

Table 3.1: Area, Production & Productivity of Pulses in Bihar.

Crops	Productivity (q/ha)	Production (mt)	Area (ha)
Lentil	1272	196055	154087
Chickpea	1147	70339	61325
Green gram (rabi summer)	672	98013	145905
Black gram	912	14142	15503

Table 3.2: Area, Production & Productivity of Pulses in Jharkhand.

Crops	Productivity (q/ha)	Production (mt)	Area (ha)
Lentil	831	36535	43980
Chickpea	1166	181731	155840
Field pea	1186	37600	31708

Table 3.3: Area, Production & Productivity of Pulses in West Bengal.

Crops	Productivity (q/ha)	Production (mt)	Area (ha)
Lentil	959	62747	65462
Chickpea	1175	29268	24903
Green gram (Rabi Summer)	802	3063	25452
Black gram	888	8543	9625
Field pea	1186	15014	12661

The total area under rabi pulse in Bihar is 376820 ha with average productivity of 1000 kg/ha and production of 378549 mt. In Jharkhand area under pulses is about 232158 ha with productivity of 1061 kg/ha with production of 255866 mt. West Bengal is having 170553 ha under rabi pulse with average productivity of 1015 kg/ha and production of 173130 mt.

Lentil: It is mainly cultivated in Uttar Pradesh, Madhya Pradesh, Chattishgarh, Bihar and West Bengal. These states together account for 80-90% of the total area under lentil. Lentil is grown in wider range of soil types and soil pH compared to other legumes, however, it is more sensitive to

water logging. In Bihar, lentil production mainly comes from the districts of Patna (28297 ha), Aurangabad (15502 ha), Nalanda (12551 ha), West Champaran (10493 ha) where diara and tal area exists. Productivity of lentil is also highest in Patna district (1605 kg/ha). Major varieties which are under cultivation in Bihar are L-406, DPL-62, Arun, HUL-57 etc. In Jharkhand lentil production comes mainly from the districts of Chatra (43980 ha), Pakur (3841 ha), Palamu (3711 ha) Garhwa (3158 ha) and Khunti (3050 ha). In Jharkhand productivity is highest in the district of Chatra (1000 kg/ha). In Jharkhand major lentil variety under cultivation is HUL-57. Lentil is grown mainly in Malda (3745 ha), Murshidabad (15676 ha), Nadia (25602 ha), Birbhum (5864 ha) and North 24 Parganas (7855 ha) in West Bengal. Maximum productivity of 1033 kg/ha comes from Murshidabad district. Major varieties under cultivation are WBL-58, B-77 etc.

Chickpea: It is grown in 61325 ha in rabi season in Bihar and production is 70339 mt with average productivity of 1147 kg/ha. The leading districts in chickpea production in Bihar are Aurangabad (7063 ha), Bhojpur (6580 ha) , Patna (6448 ha), Bhagalpur (4489 ha) and Lakhisarai (4482 ha). Productivity is highest in Lakhisarai district (1768 kg/ha). In Jharkhand crop is grown in 155840 ha with production of 181731 mt and productivity of 1166 kg/ha. Leading chickpea producing districts are Garwaha (11554 ha) and Latehar (11960 ha), Koderma (10215 ha) and Saraikela (10046 ha). Highest productivity (1880 kg/ha) comes from Saraikela district. In west Bengal chickpea is grown in 24903 ha and total production is 29268 mt. Birbhum is leading district in chickpea production with 7155 ha coverage. It is followed by Nadia (6788 ha), Murshidabad (5852 ha) . Productivity is also highest in Birbhum district (1326 kg/ha).

Greengram: It is grown in 145905 ha in rabi season in Bihar and production is 98013 mt with average productivity of 672 kg/ha. It is grown mainly in summer season. The leading districts in greengram production in Bihar are Muzaffarpur (24943 ha), Madhepura (16456 ha) ,Supual (15077 ha), Saharsa (14404 ha) and Samastipur (12923 ha). Productivity is highest in Gaya district (1212 kg/ha). In Jharkhand crop is grown in 16137 ha with production of 10283 mt . In west Bengal greengram is grown in 21446 ha and total production is 14571 mt in summer. South 24 Parganas is leading district in greengram production with 14736 ha coverage. It is followed by Uttar Dinajpur, howrah and Birbhum . Productivity is also highest in West Midnapore district (854 kg/ha).

Fieldpea: This is grown in 31708 ha in rabi season in Jharkhand and production is 37600 mt with average productivity of 1186 kg/ha. The leading districts in fieldpea production in Jharkhand are Gumla (3273 ha), Deoghar (2344 ha) , Garwah (2410 ha) and Palamau (2105 ha). Productivity is highest in Lohardaga district (3052 kg/ha).

Black gram: It is grown in 9625 ha in rabi season in West Bengal and production is 8543 mt with average productivity of 888 kg/ha. The leading districts in rabi blackgram production in West Bengal are Murshidabad (5315 ha), Coochbehar (1950 ha) and North 24 Parganas (515 ha). Productivity is highest in Murshidabad district (1038 kg /ha)

Summary of Pulse Demonstrations

Chickpea, lentil, greengram, field pea and blackgram are the major rabi pulses in the states of Bihar, Jharkhand and West Bengal. Among these three states, West Bengal produced glackgram in large areas. Clustered demonstration was organized in 4446 ha covering these three states. The details of state-wise breakup are provided in the following table.

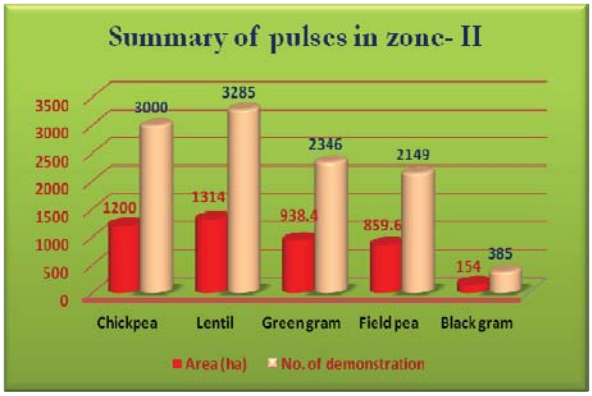


Table 3.4: State-wise demonstration conducted in rabi 2015-16

Crop/State	Area (ha)	No. of demonstration
Chickpea		
Bihar	498	1245
Jharkhand	502	1255
West Bengal	200	500
Total	**1200**	**3000**
Lentil		
Bihar	1008	2520
West Bengal	306	765
Total	**1314**	**3285**
Green gram		
Bihar	448.4	1121
Jharkhand	282.0	705
West Bengal	208.0	520
Total	**938.4**	**2346**
Field pea		
Bihar	693.6	1734
Jharkhand	86	215
West Bengal	80	200
Total	**859.6**	**2149**
Black gram		
West Bengal	154	385
Total	**4446**	**11165**
Allotment	**4486**	**11215**

Out of 4486 ha allotted demonstrations, coverage was made in 4446 ha through 11215 demonstrations. Area under chickpea was 1200 ha, lentil 1314 ha, greengram 938.4 ha, field pea 859.6 ha and blackgram 154 ha. Out of these area coverage of area in Bihar was 2802 ha, Jharkhand 1102 ha and West Bengal 948 ha (Table 3.4)

Performance of Chickpea

In Bihar, chickpea was demonstrated in 498 ha through 1245 demonstrations. Highest yield was recorded as 16.8 q/ha, lowest was 11.7 q/ha and average yield was 14.2 q/ha. Average increase due to demonstrations of various technologies was 33.4%. The average net return was Rs.47174/ha and BC ratio was 3.1. Several technologies like INM, IPM, micronutrients, line sowing, pheromone trap and seed treatment were introduced in these demonstrations.

In Jharkhand, chickpea was demonstrated is 502 ha through 1305 demonstrations. Average yield in these demonstrations was recorded as 14.6 q/ha compared to local check average of 9.5 q/ha. There by increase was 59.5%. The average net return was Rs.32168 with BC ratio of 3.9 (Table 3.5).

In West Bengal chickpea is grown in some pockets. However, initiative was taken to cover a large area of 200 ha in order to popularize the crop in West Bengal. The average yield was recorded as12.3 q/ha in these 500 demonstrations. Increase in yield was 29.6%. The average net return was Rs.27353/ha with BC ratio of 2.2 (Table 3.5).

Performance of Lentil

Lentil is the most important pulse crop in eastern states. The coverage area in Bihar was 1008 ha involving 2520 demonstrations. Highest yield was recorded as 14.9 q/ha in lentil and average yield was 14.4 q/ha. Increase in yield was 37.5%. The average net return was Rs.28220/ha due to good price of the lentil crop in last few years. The BC ratio was 3.2 (Table 3.5).

In West Bengal lentil crop was demonstrated in 306 ha and 765 demonstrations were organized. The average yield in these demonstrations was 9.5 q/ha and increase in yield about 33.4%. The average net return was attractive and as high as Rs.36341/ha with BC ratio of 2.9.

Performance of Green gram

Green gram is grown in all the three states especially in rabi and spring-season. The coverage of the crop in the state of Bihar was 448.4 ha and 1121 demonstrations were organized. The average yield was 9.1q/ha against local check of 6.7 q/ha and increase by 35.82%. Net return was Rs.43848/ha with BC ratio of 3.0 (Table 3.5).

In the state of Jharkhand, green gram demonstrations were organized in 282 ha and 705 demonstrations were conducted. The average yield was 9.7q/ha against local check of 8.8q/ha and increase by 10.2%. Net return was Rs.38681/ha with BC ratio of 2.3.

In West Bengal coverage of area under green gram was 208 ha and 520 demonstrations were organized. The average yield was 8.9q/ha increases by 26.9%. Net return was Rs.25197/ha with BC ratio of 1.8.

Performance of Field Pea

In field pea large area was covered under demonstration in Bihar which was about 693.6 ha. The number of demonstrations was 1734. Average yield recorded was 14.3 q/ha compared to existing yield of 10.4 q/ha. The average increase was 40.2%. Average net return was Rs.18289/ha with BC ratio of 1.9 (Table 3.5).

In Jharkhand coverage of area was 96 ha and number of demonstrations was 215. The highest yield was 16.6q/ha compared to local check yield of 8.9 q/ha - an increase by 62.3%. The average net return was Rs.13311/ha with BC ratio of 1.7.

In West Bengal, crop was demonstrated in 80 ha through 200 no. of demonstrations. The highest yield was 9.9 q/ha, average yield was 8.9 q/ha, an increase by 30.3%. Net return was Rs.1212976/ha with BC ratio of 1.7.

Performance of Black gram

Blackgram was demonstrated in the state of West Bengal. The coverage of area was 154 ha. The number of demonstrations was 385. The average yield recorded was 9.2/ha as compared to7.0 q/ha in local check. Increase in yield was 31.2%. Net return was Rs 23650/ha (Table 3.5).

Table 3.5: Performance of pulse demonstration in rabi 2015-16

State	Area (ha)	No of demo	Yield (q/ha)					Farmer's Existing Plot				Demonstrated Plot			
			Highest	Lowest	Average	Local Check	%	Gross Cost	Gross Return	Net Return	B:C ratio	Gross Cost	Gross Return	Net Return	BC ratio
Chickpea															
Bihar	498	1245	16.8	11.7	14.2	10.8	33.4	21505	53061	31645	2.5	23038	70285	47174	3.1
Jharkhand	502	1305	16.8	11.4	14.6	9.5	59.5	17889	39213	21481	2.3	20677	77842	41341	3.9
West Bengal	200	500	13.5	10.2	12.3	9.6	29.6	20744	48096	27353	2.3	23321	51769	32168	2.2
Lentil															
Bihar	1008	2520	14.96	10.7	14.4	10.4	37.5	19243	47196	28220	2.6	21258	65474	43588	3.2
West Bengal	306	765	11.1	7.7	9.5	7.2	33.4	17978	40967	22989	2.4	21192	57533	36341	2.9
Green gram															
Bihar	448.4	1121	10.9	7.7	9.1	6.7	36.1	18892	46233	27184	2.4	21112	66015	43848	3.0
Jharkhand	282.0	705	11.9	7.7	9.7	8.8	10.2	17445	44050	26605	2.4	20926	67625	46695	3.1
West Bengal	208.0	520	10.0	6.9	8.9	6.4	26.9	17563	42760	25197	1.8	19706	58387	38681	2.3
Field Pea															
Bihar	693.6	1734	16.8	11.5	14.3	10.4	40.2	21069	39374	18289	1.9	23103	54940	31838	2.5
Jharkhand	86	215	16.6	10.6	14.04	8.9	62.3	20394	33708	13311	1.7	23007	50782	27642	2.3
West Bengal	80	200	9.9	7.6	8.9	7.3	30.3	18841	31817	12976	1.7	19800	39645	19845	2.
Black gram															
West Bengal	154	385	9.7	8.6	9.2	7.0	31.2	10670	19800	9130	3.6	11940	23650	11710	4.2
Total	**4446**	**11215**													

Varietal performance of chickpea

Number of varieties was introduced in pulse demonstrations which have good potential to excel in the situations. In Bihar, most coverage of chickpea was through variety GNG 1581. The coverage of area was 373.3 ha. Number of demonstration under the cultivars was 1220. Demonstrated yield was highest with this variety which was 17.3 q/ha, about 28.1% more over the existing yield of 13.5 q/ha (Table 3.6). The variety was able to overcome the yield gap and excel over the state average of 11.4 q/ha (51.8% increase over state average). Other varieties like JG-11, JG-16, P-547, DGM-547, JAKI 9218, Pusa 362 were demonstrated in relatively less

areas. All these varieties minimized the yield gap and excelled over the state average (11.4 q/ha). Demonstrated yield was in the range of 12.6 to 15.2 q/ha.

Table 3.6: Performance of major varieties of chickpea.

Variety	Area in (ha)	No. of demonstrated	Demonstrated yield (q/ha)	Existing yield (q/ha)	% of yield increase	State yield (q/ha)	Yield gap (%)
Bihar							
GNG-1581	373.25	1220	17.3	13.5	28.1	11.4	51.8
JG-11	20	55	12.6	7.8	61.5	11.4	10.5
JG-16	13.4	38	13.5	12.2	10.7	11.4	18.4
P-547	50	125	15.2	8.0	90.0	11.4	33.3
DGM-547	6	15	13.7	12.5	9.6	11.4	20.2
JAKI-9218	6	28	14.5	10.3	40.8	11.4	27.2
PUSA-362	20	51	14.2	11.5	23.5	11.4	24.6
Jharkhand							
JAKI-9218	367.15	1292	16.5	12.5	32.0	11.6	42.2
GNG-1581	35	317	15.5	11.7	32.5	11.6	33.6
PUSA-372	1.25	17	16.4	7.9	107.6	11.6	41.4
Vijay	20	72	12.6	6.8	85.3	11.6	8.6
KAK-2	3.6	16	13.6	10.3	32.0	11.6	17.2
JG-14	16	25	16	8.0	100.0	11.6	37.9
West Bengal							
JAKI-9218	131.61	557	12.8	10.3	24.3	11.8	8.5
Anuradha	45	299	10.7	8.5	25.9	11.8	-9.3
Anurag	15	37	23.25	15.3	52.5	11.8	97.0
JG-14	10	25	17.53	14.5	20.9	11.8	48.6

Varietal performance of lentil

Variety PM 5 (L-4594) was demonstrated in 508.99 ha which covered maximum area under lentil in Bihar. Numbers of demonstrations were 1351. It gave demonstrated yield of 16.0 q/ha. Variety HUL-57 was demonstrated in 233 ha through 610 demonstrations. Average yield in the demonstrations was 15.2 q/ha compared to local check average of 12.4%. It has yield advantage of about 19.7%. Variety DPL-62 was demonstrated in 130 ha through 339 demonstrations to obtain average yield of 13.8 q/ha which has yield advantage of 8.7% over the state average (Table 3.7).

In West Bengal, WBL-77 was demonstrated in 80.4 ha through 326 demonstrations to harvest demonstrated yield of 12.0 q/ha over the existing average of 7.2 q/ha. Yield was about 25.1% higher over the state average. Moitree variety was demonstrated in 216 ha through 1017 demonstrations that produced average yield of 13.2 q/ha, 62.2% higher than the existing yield. The yield was 38.7% higher than the state average yield (Table 3.7).

Table 3.7 : Performance of major varieties of Lentil

Variety	Area in (ha)	No. of demonstrated	Demonstrated yield (q/ha)	Existing yield (q/ha)	% of yield increase	State yield (q/ha)	Yield gap (%)
Bihar							
PM-5 (L-4594)	508.99	1351	16.2	10.1	60.4	12.7	27.6
HUL-57	233	610	15.2	12.4	22.6	12.7	19.7
DPL-62	130	339	13.8	9.4	46.8	12.7	8.7
Arun	66	186	15.7	11.3	38.9	12.7	23.6
West Bengal							
Moitree (WBL77)	296.4	1333	13.3	8.2	62.2	9.59	38.7

Varietal performance of blackgram

Blackgram variety WBU-108 was demonstrated in 62 ha through 264 demonstrations to get average yield of 9.2 q/ha, 27% higher than the existing yield. The yield of the variety was 23.2% higher than the state average (Table 3.8).

Table 3.8 : Performance of major varieties of black gram

Variety	Area in (ha)	No. of demonstrated	Demonstrated yield (q/ha)	Existing yield (q/ha)	% of yield increase	State yield (q/ha)	Yield gap (%)
West Bengal							
WBU-108	62	264	9.2	7.2	27.7	8.88	23.3

Varietal performance of green gram

Green gram crop was demonstrated in Rabi summer. In west Bengal variety Samarat (PDM-84-139) gave demonstrated yield of 5.7 q/ha compared to existing yield of 5.7 q/ha while SML 668 gave demonstrated yield of 12.4 q/ha compared to existing yield of 9.2 q/ha (Table 3.9).

Table 3.9 : Performance of major varieties of green gram

Variety	Area in (ha)	No. of demonstrated	Demonstrated yield (q/ha)	Existing yield (q/ha)	% of yield increase	State yield (q/ha)
West Bengal						8.02
SML-668	35	75	12.4	9.15	34.7	8.02
PDM-84-139	82	139	6.2	5.7	87.7	8.02

Varietal performance of field pea

Field pea cv Prakash was demonstrated in 649.2 ha through 2181 demonstrations (Table 3.10). Average yield was 18.5 q/ha compared to existing yield of 14.9 q/ha. Increase in yield was 24.2 % , There was 103% yield increase with the variety over state average . In Jharkhnad

HUDP- 15 was mostly demonstrated variety in 46.0 ha, It recorded average yield of 16.7 q/ha which was 40.3% higher than state average.

Table 3.10 : Performance of major varieties of field pea

Variety	Area in (ha)	No. of demonstrated	Demonstrated yield (q/ha)	Existing yield (q/ha)	% of yield increase	State yield (q/ha)	Yield gap (%)
Bihar							
Prakash	649.21	2181	18.5	14.9	24.2	9.1	103.3
Vikash	20	52	16.3	10.2	59.8	9.1	79.1
Jharkhand							
HUDP-15	46	223	16.7	12	39.2	11.9	40.3
Prakash	17.32	139	12.6	10.2	23.5	11.9	5.9
Malviya	20	78	14.1	8.6	64.0	11.9	18.5
West Bengal							
Rachana	35	120	13.1	8.1	61.7	11.9	10.1
Pravat	20	107	14.8	8.3	78.3	11.9	24.4
Prakash	15.2	99	13.9	8.8	58.0	11.9	16.8

Technology Demonstrations

1. Seed treatment in chickpea (Bihar)

KVK Aurangabad, Bihar conducted cluster demonstration in chickpea. Seed treatment is one of the important agronomic practices usually neglected by the farmer and suffer loss in yield due to infestation of several diseases particularly of wilt. About 30-40% area in Aurangabad district suffers from the wilt disease in chickpea and other pulses. Due to scarcity of water, farmers do not have the choice except to grow pulse in rice fallows. The demonstration laid out in 34 ha area by involving 94 farmers on seed treatment with carbendazim @2.5 g/kg of seed and choloropyriphos @ 6ml/kg was done to control fusarium wilt disease. The average demonstration yield 9.72q/ha as compared to local check (8.4q/ha) which was 15% higher yield due to seed treatment. The farmers are enthusiastic about use of seed treatment chemicals in all pulse crops in Aurangabad district.

2. Zero tillage technology in Lentil (Bihar)

Lentil is the second most important rabi crop after wheat in Aurangabad district. It occupies first rank in pulses, farmers grow lentil in residual moisture condition as paira cropping. Conventional sowing method and line sowing are also used by the farmers. Yield of paira cropping was low due to non-scientific cultivation. However, in conventional sowing the use of higher seed rate coupled with poor land preparation results into poor yield. Therefore, zero tillage technology was introduced in lentil cultivation. Out of 6 villages in cluster demonstration, 4 villages were put under zero tillage, 1 under conventional sowing and 1 in line sowing to assess the performance of zero tillage against other methods of cultivation. Among three demonstrated technologies, maximum yield was recorded in zero tillage technology followed by conventional. Farmers having zero tillage machines should go for zero till sown lentil in next year. In zero tillage Lentil, increase in yield was 21.33%

Crop demonstrated	Existing (Farmer's) variety name	Existing yield (q/ha)	Name of Variety + Technology demonstrated	No. of farmers	Area (in ha)	Yield obtained (q/ha)			% increase
						Max.	Min.	Av.	
Lentil	Titki	11.2	HUL-57, Zero tillage	115	37.6	16.54	10.89	13.59	21.33

3. Micronutrient management in lentil (West Bengal)

Micronutrient deficiency is prevalent in many of the districts in North Bengal including Uttar Dinajpur. It affects growth of plant as well as grain formation in wheat and pulses. Lentil is also affected by the micronutrient deficiency like boron. Thus, boron management was made one of the components in clustered demonstration in lentil. Spraying of Boron 3 times (25 DAS, 50 DAS and 70 DAS) @.1.5 g/lit of water was effective in meeting the nutrition of the crop. Micronutrient application resulted in increase in yield by 10.5% and assured good crop by protecting the filling of grains.

Variety	Area (ha)	No. of farmers	Yield			LC	% increase
			Max	Min	Av		
WBL 77	20	126	8.9	7.9	8.4	7.6	10.5

4. Short duration chickpea – management in non-traditional area (West Bengal)

Chickpea is a new crop in the district of Purulia. There is small area in chickpea in the district. However, the crop fits well in the cropping system after rice. JAKI 9218 variety of chickpea which is common in some pockets of Jharkhand showed good prospect in the district of Purulia. Seed treatment with Trichoderma viridae @ 200 g/ha and Pseudomonaus @ 200 g/ha, 30 kg N & 100 kg P_20_5/ha, rhizobium and PSB @ 2 kg/ha each and Zn @25 kg/ha in 30.11ha area by involving 95 farmers resulted into harvesting of good yield (13.9 q/ha) in non-traditional area.

5. Management of root rot and wilt disease in summer greengram (West Bangal)

South 24 Parganas district falls under saline tract in West Bengal, where greengram has a good prospect in summer season, popularly known as chaiti moong. Root rot disease is prevalent in the pulse crop which requires attention by the growers. Demonstrations were organized in 20ha by involving 110 farmers which resulted yield of 8.28a/ha along with application of Trichoderma viridae and Pseudomonaus fluorescens 1.2 kg/ha resulted in 24.9% increase in yield and made greengram cultivation most successful. The bio-agents used with organic manure helped in controlling root rot disease and powdery mildew. Farmers were interested in the management of the disease making green gram cultivation successful in the district.

6. L-4595 (PM-5) – a promising cultivar in Kaimur plateau

Kaimur plateau is an area dominated by tribal people and the crop is grown in dry conditions. Lentil is an important pulse crop in rabi season which could augment the livelihood security of the farmers. Blight is a serious problem in the Kaimur plateau in lentil. New variety L-4594 (PM-5) is found to show resistance to blight and suits well in the system due to its medium duration (125-130 days). It recorded yield as high as 15-16 q/ha.

7. Line sowing in chickpea (West Bengal)

In spite of scientific advancement, the farmers are still practicing broadcasting method in most of the pulse crops including chick pea. However, this technique is not appropriate to give significant yield advantage. The profitability can be increased with the adoption of line showing technology. Chick pea when shown as line sown crop in 20ha area at 126 farmers

field gave a yield advantage of 10.5% over broadcasting system. The demonstration average yield 8.4q/ha was obtained.

8. Weed management in chickpea (Bihar)

Weed is a severe problem in chickpea in the state of Bihar. Farmers of Arwal District do not use chemicals as a means of weed management strategy. Use of Pendimethaline @ 1.5 kg ai/ha as pre-emergence weedicide helps to get rid of common weeds. Seasonal weeds get reduced up to 90% with the use of this herbicide. It also helps to check the germination of cascuta and suppress the growth of the weed. The average demonstration yield is 14.0 q/ha and district average (previous year) 9.4 q/ha

9. Surface seeding and surface mulching in lentil (West Bengal)

In terai region of West Bengal lentil is grown in rice follows. Sowing of lentil is delayed due to late harvest of rice in Coochbehar District. Surface seeding and surface mulching are the new techniques introduced by the KVK to augment the productivity of lentil. The crop is grown in 20ha area at 100 farmers field with no tillage condition and seeds are sown through putting a stick so that seed could be sown within 1 cm on the surface. Mulching is done with paddy straw to cover the crop. This technique helps to get additional yield of 2.9 q/ha. The average demonstration yield is 7.5q/ha which was 49.2 percent higher over local check 5.9q/ha.

4. ICAR-ATARI, ZONE III
(Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura)

Pulse is the most important crop in majority of the states in India. It is a predominately rain fed crop grown in different land situation like rice-fallows, uplands, char and *diara* lands. Pulse being a leguminous crop, enriches soil fertility. Being a short duration crop, it enhances the profitability of the cropping system.

In the North Eastern states of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura, pulses are grown in kharif, rabi and rabi-summer season. Major pulses grown in Assam are black gram (54000 ha) followed by field pea (31300 ha) and lentil (30000 ha). In the state of Manipur, field pea (26000 ha) occupies major position in rabi pulse followed by black gram (1300 ha). In Nagaland, rajma (9200 ha) occupies largest area, followed by field pea (7100 ha) and lentil (2000 ha). The average productivity of the major pulses in these states is indicated below.

Table 4.1 (a) : Area, Production and Productivity of Pulses under zone III

Arunachal Pradesh

Crops	Productivity (q/ha)	Production ('000 tones)	Area ('000 ha)
Total Pulses	11.0	10.0	9.0

Assam

Crops	Productivity (q/ha)	Production ('000 tones)	Area ('000 ha)
Lentil	7.47	22.4	30.0
Field pea	8.48	26.5	31.3
Blackgram	5.80	31.32	54.0
Greengram	6.41	7.81	12.18
Other pulses	9.20	5.64	6.13

Manipur

Crops	Productivity (q/ha)	Production ('000 tones)	Area ('000 ha)
Black gram	8.25	1.07	1.30
Field pea	8.37	21.8	26.0
Other Pulses	7.65	1.41	1.84

Meghalaya

Crops	Productivity (q/ha)	Production ('000 tones)	Area ('000 ha)
Total Pulses	14.33	11.49	8.02

Table 4.1 (b) : Area, Production and Productivity of Pulses under zone III

Mizoram

Crops	Productivity (q/ha)	Production ('000 tones)	Area ('000 ha)
Total Pulses	11.15	4.46	4.0

Nagaland

Crops	Productivity (q/ha)	Production ('000 tones)	Area ('000 ha)
Lentil	8.40	1.68	2.0
Field pea	10.77	7.65	7.1
Rajma	12.49	11.49	9.2
Chickpea	8.0	0.60	0.75

Sikkim

Crops	Productivity (q/ha)	Production ('000 tones)	Area ('000 ha)
Total Pulses	9.26	5.83	6.30

Tripura

Crops	Productivity (q/ha)	Production ('000 tones)	Area ('000 ha)
Total Pulses	8.05	5.96	8.58

The total area under pulses in Arunachal Pradesh is 9000 ha with average productivity of 1100 kg/ha and production of 10000MT. In Assam, area under pulses is about 1.50 lakh ha with productivity of 700 kg/ha with production of 1.04 lakh MT. Manipur is having 29140 ha under rabi pulse with average productivity of 809 kg/ha and production of 1240MT.Meghalaya covers about 8018 ha with productivity of 1433kg/ha and production of 11493 MT. The area under pulses in Mizoram is about 2900ha with production of 2640 MT. In Nagaland pulses are grown in an area of about 19050 ha with productivity of 992 kg/ha and production of 5355MT. Sikkim state covers an area of 6.30 thousand ha under pulses with productivity of 926 kg/ha and production of 5.83 thousand MT. Tripura covers about 8.58 thousand ha under pulses with productivity of 805 kg/ha and production of 5960 MT.

Lentil: Lentil is mainly cultivated in Uttar Pradesh, Madhya Pradesh, Chhattisgarh, Bihar and West Bengal. These states together account for 80-90% of the total area under lentil. Lentil is grown in wider range of soil types and soil pH compared to other legumes, however, it is more sensitive to water logging.In Northeastern states, lentil production mainly comes from the state of Assam(30000 ha), followed by Nagaland (2000 ha) and is covered in small area in the other states of North east region. The cultivation of this crop in the North eastern states is comparatively new and many of the states have not taken up this crop in the previous years. With the conductance of cluster frontline demonstrations, popularization of this crop is being undertaken so that many of the districts in the different states may start to grow it on a larger scale. Major varieties which are under cultivation include HUL-57, PL-406, Moitree, L-9, KLS-218 etc.

Chickpea: India is the major producing country for chickpea, contributing for over 75% of total production in the world. Chickpea is grown in 750 ha in rabi season in Nagaland and production is 600 MT with average productivity of 800 kg/ha. Major varieties cultivated in the North East include JG-16, AP-1, etc. Different technology interventions are being demonstrated on this crop to popularize its cultivation and to achieve better yield results.

Greengram: Green gram is grown in 12180 ha in rabi season in Assam and production is 7810MT with average productivity of 641 kg/ha. It is grown mainly in summer season. Pratap is a major variety of green gram cultivated in the North east.

Field pea: Field pea is a popular pulse crop of India. India is the second largest producer of pea in the world after Russia. Field pea is grown in 31300 ha in rabi season in Assam and production is 26500MT with average productivity of 848 kg/ha. Major varieties of field pea grown in the North East are Prakash, Arkel, Azad Pea-1, PB-89, HUDP-15, Rachna, etc.

Black gram: Important states producing black gram are Maharashtra, Uttar Pradesh, Andhra Pradesh, Orissa, Tamil Nadu, Rajasthan, Chhattisgarh and Madhya Pradesh. Black gram is grown in 54000ha in Assam and production is 31320MT with average productivity of 580kg/ha. Varieties of black gram cultivated in North East include IPU-94-1, PU-31, Shekhar 1, Kalindi, KU-301, etc.

Rajma: In India, rajma is grown mainly in the states of Maharashtra, Jammu and Kashmir, Himachal Pradesh and Uttar Pradesh Hills, Nilgiri (Tamil Nadu) and Palni (Kerala) hills, Chickmangalur (Karnataka) and Darjeeling hills (West Bengal).In Nagaland, rajma is cultivated in an area of about 9200 ha with a production of 11490 MT and productivity of 1249 kg/ha. The crop is mainly grown in states of Nagaland and Sikkim. Cluster frontline demonstration on this crop is being conducted to popularize its cultivation in other states and to obtain higher yield through various technology interventions. Major Rajma varieties viz. Anupam K-5, Jwala, etc. are being cultivated.

SUMMARY

Lentil, field pea, chickpea, green gram and black gram, rajma and french bean are the major rabi pulses in the states of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura. Clustered demonstration was organized in 1161 ha covering these eight states. The details of state-wise breakup are provided in table 4.2. Out of 1254 ha allotted demonstrations, coverage was made in 1161ha through 3563 demonstrations. Area under lentil was 388 ha, field pea 454 ha, black gram 162 ha, green gram 92 ha, chickpea 35 ha, rajma 20 ha and French bean 10ha. Out of these, area coverage in Arunachal Pradesh was 70 ha, Assam723 ha, Manipur100 ha, Meghalaya 78 ha, Mizoram 60 ha, Nagaland 46 ha, Sikkim 14 ha and Tripura 70 ha. (Table 4.2)

Table 4.2: State-wise demonstration conducted in *Rabi* 2015-16

Crop/State	Area (ha)	No. of demonstrations
LENTIL		
Arunachal Pradesh	10	27
Assam	256	663
Manipur	40	64
Meghalaya	16	177
Mizoram	20	50
Nagaland	6	6
Tripura	40	142
Total	**388**	**1129**
FIELD PEA		
Arunachal Pradesh	40	105
Assam	277	765
Manipur	30	54
Meghalaya	23	206
Mizoram	30	75
Nagaland	30	60
Sikkim	4	18
Tripura	20	74
Total	**454**	**1357**
BLACKGRAM		
Assam	120	252
Manipur	10	25
Meghalaya	22	173
Tripura	10	29
Total	**162**	**479**
GREENGRAM		
Assam	70	185
Manipur	10	25
Meghalaya	12	146
Total	**92**	**356**
CHICKPEA		
Arunachal Pradesh	10	25
Manipur	10	20
Meghalaya	5	112
Mizoram	10	25
Total	**35**	**182**
RAJMA		
Nagaland	10	4
Sikkim	10	25
Total	**20**	**29**
FRENCH BEAN		
Arunachal Pradesh	10	31
Total	**10**	**31**
Grand total	**1161**	**3563**
Allotment	**1254**	**3135**

Performance of Lentil

Lentil is an important pulse crop in north eastern states. In Arunachal Pradesh where lentil was demonstrated in 10 ha area at 27 farmers field. Highest yield was recorded as 8.9 q/ha, lowest was 5.8 q/ha and average yield was 7.44 q/ha. The average net return was Rs.21795/ha and BC ratio was 2.44. Several technologies like INM, IPM, micronutrients, line sowing and seed treatment were introduced in these demonstrations.

In Assam, lentil was demonstrated in 256 ha through 663 demonstrations. Average yield in these demonstrations was recorded as 7.65 q/ha compared to local check average of 5.38 q/ha. There by increase was 50.88%. The average net return was Rs. 28703 with BC ratio of 2.46.

In Manipur, lentil covered an area of 40 ha. The average yield was recorded as 6.0 q/ha in64 demonstrations. The average net return was Rs. 26546/ha with BC ratio of 2.0.

In Meghalaya, lentil is a new crop. It was demonstrated in an area of 16 ha through 177 demonstrations. The average yield was recorded as 7.0q/ha. The average net return was 23200/ha with BC ratio of 1.90.

In Mizoram, lentil was demonstrated in 20 ha through 50 demonstrations. Highest yield was recorded as 8.75 q/ha, lowest was 4.75 q/ha and average yield was 7.0 q/ha. The average net return was Rs.76250/ha and BC ratio was 3.80. In Nagaland, the demonstrations were conducted on lentil in 6 ha through 6 demonstrations. Highest yield was recorded as 6.57 q/ha in lentil and average yield was 5.57 q/ha. The average net return was Rs.44920/ha with BC ratio of 2.31.

The coverage area in Tripura was 40 ha through 142 demonstrations. The average yield was 6.80 q/ha against local check of 3.55 q/ha and increase by 91.54%.The average net return was Rs. 19452/ha and BC ratio was 1.82.

Performance of Field pea

In Arunachal Pradesh, field pea was demonstrated in an area of 40 ha at 105 farmers field. Highest yield was recorded as 16.44 q/ha, lowest was 8.25 q/ha and average yield was 10.31 q/ha. Average increase due to demonstrations of various technologies was 54.11%. The average net return was Rs.33778/ha and BC ratio was 2.14.

In Assam, field pea was demonstrated in282 ha through 765 demonstrations. Average yield in these demonstrations was recorded as 10.0 q/ha compared to local check average of 6.61 q/ha. There by increase was 80.19%. The average net return was Rs.23739/ha with BC ratio of 2.20.

In Manipur, field pea covered an area of 30 ha. The average yield was recorded as 12.92 q/ha in54 demonstrations. Increase in yield was 8.29%. The average net return was Rs.27474/ha with BC ratio of 2.03.

In Meghalaya, field pea was demonstrated in an area of 23 ha through 206 demonstrations. The average yield was recorded as 15.45q/ha with increase of 56.85%. The average net return was 35410/ha with BC ratio of 2.06.

In Mizoram, field pea was demonstrated in 30 ha through 75 demonstrations. Highest yield was recorded as 15.47 q/ha, lowest was 10.59 q/ha and average yield was 13.32 q/ha. Average increase due to demonstrations of various technologies was 166.4%. The average net return was Rs.44940/ha and BC ratio was 4.40.

In Nagaland, the demonstrations were conducted on field pea in 30 ha through 60 demonstrations. Highest yield was recorded as 17.62 q/ha in field pea and average yield was 12.29 q/ha. Increase in yield was 62.85%.The average net return was Rs.42300/ha with BC ratio of 3.72.

In Sikkim, area under field pea was 4 ha through 18 demonstrations. Average yield was 17.3 q/ha with increase of 54.46%. The average net return was 28660/ha with BC ratio of 1.89. The coverage area in Tripura under field pea was 20 ha through 74 demonstrations. The average yield was 13.0 q/ha against local check of 9.5 q/ha and increase by 36.84%.The average net return was Rs.13591/ha and BC ratio was 1.41.

Performance of Chickpea

In Arunachal Pradesh, area under chickpea was 10 ha through 25 demonstrations. Average yield in these demonstrations was recorded as 11.0q/ha with percent increase of 22.22%. The average net return was Rs. 55500 with BC ratio of 3.46.

In Manipur, area under chickpea was 10 ha through 20 demonstrations. Average yield was 10.50 q/ha. The average net return was Rs. 41784/ha with BC ratio of 2.97.

In Meghalaya, area under chickpea was 1ha through 112 demonstrations. In Mizoram, area under chickpea 10 ha through 25 demonstrations. Average yield was 17 q/ha with average net return of Rs. 67855/ha and BC ratio of 4.06.

Performance of Rajma

In Nagaland, area under rajma was 2 ha with an average yield of 13.5 q/ha with increase of 14.50%. The average net return was Rs. 81820/ha with BC ratio of 7.54.

In Sikkim, area under this crop was 3 ha with an average yield of 10.26 q/ha. This is a new crop introduced for the first time in the KVK. The average net return was Rs. 91120/ha with BC ratio of 3.80.

In Arunachal Pradesh, area under French bean was 10 ha through 31 demonstrations. Average yield was 17.65 q/ha with increase of 78.82%. The average net return was Rs. 72475/ha with BC ratio of 3.94.

Performance of Blackgram

In Assam, area under black gram was 120 ha through 252 demonstrations. In Manipur, area under black gram was 10 ha through 25 demonstrations, while, in Meghalaya black gram covered 22 ha through 173 demonstrations. In Tripura, area under black gram was 10 ha through 29 demonstrations (Table 4.3).

Performance of Greengram

In Assam, area under green gram was 70 ha through 185 demonstrations. In Manipur, area under green gram was 10 ha through 25 demonstrations, while, in Meghalaya area under green gram was 12 ha through 146 demonstrations (Table 4.3).

Table 4.3 : Performance of pulse demonstration during Rabi 2015-16

Crop	State	Area	Demo	Average Yield		% increase	Farmer's Existing Plot				Demonstration plot			
				Demo	Check		Gross Cost (Rs/ha)	Gross Return (Rs/ha	Net Return (Rs/ha)	B:C ratio	Gross Cost (Rs/ha)	Gross Return (Rs/ha)	Net Return (Rs/ha)	B:C ratio
Lentil	Arunachal Pradesh	10	27	7.44	0.00	N/A	NA	NA	NA	NA	15225.00	37200.00	21795.00	2.44
	Assam	256	663	7.65	5.38	42.17	19835.59	39342.30	19856.71	2.10	24014.79	52586.96	28702.55	2.46
	Manipur	40	64	6.00	NA	NA	NA	NA	NA	NA	22020.67	48566.67	26546.00	2.21
	Meghalaya	16	177	7.00	0.00	N/A	NA	NA	NA	NA	28600.00	51800.00	23200.00	1.90
	Mizoram	20	50	7.00	1.50	33.33	7500.00	20000.00	12500.00	2.7	13610.00	64000.00	50375.00	4.70
	Nagaland	6	6	5.57	0.00	N/A	NA	NA	NA	NA	34200.00	79120.00	44920.00	2.31
	Tripura	40	142	6.80	4.73	43.56	19415	27333.33	8418.33	1.41	24947.5	44400	19452.5	1.78
Field Pea	Arunachal Pradesh	40	105	10.31	9.56	35.09	24780	47410	22630	2.02	29183.33	37184.44	40341.11	2.87
	Assam	277	765	10.02	6.61	51.58	21516.75	39213.55	17246.85	1.82	23181.22	47340.08	24178.66	2.04
	Manipur	30	54	12.92	11.93	8.29	27864.00	47250.00	19386.00	1.70	26672.67	54146.67	27474.00	2.03
	Meghalaya	23	206	15.45	8.43	19.07	58775.00	213000.00	154225.00	2.80	32593.33	57866.67	25273.33	1.77
	Mizoram	30	75	13.32	7.13	72.35	15750	31020	15270	1.96	18840	63780	44940	3.38
	Nagaland	30	60	12.30	11.73	22.14	15270.75	45925.00	31404.25	3.01	44975.00	87275.00	42300.00	3.72
	Sikkim	4	18	17.30	11.20	54.46	28230.00	50400.00	22170.00	1.79	31890.00	60550.00	28660.00	1.89
	Tripura	20	74	7.80	6.50	20.00	29433.00	43700.00	14267.00	1.48	26509.50	40100.00	13590.50	1.51
Rajmah	Nagaland	10	4	13.5	11.79	14.50	15500.00	94320.00	81820.00	6.08	12500.00	94320.00	81820.00	7.54
	Sikkim	10	25	10.26	0	N/A	0	0	0	0	32000.00	123120.00	91120.00	3.80
Chick Pea	Arunachal Pradesh	10	25	11	9.00	22.22	21500.00	45500.00	24000.00	2:47	22500.00	78000.00	55500.00	3.46
	Manipur	10	20	10.50	N/A	N/A	N/A	N/A	N/A	N/A	21216.00	63000.00	41784.00	2.97
	Meghalaya*	5	112											
	Mizoram	10	25	17	NA	N/A	NA	NA	NA	NA	22145.00	90000.00	67855.00	4.06
French bean	Arunachal Pradesh	10	31	17.65	9.87	78.82	21,250.00	49,350.00	28,100.00	2.32	24600.00	97075.00	72475.00	3.94
Black gram*	Assam	120	252	7.26	5.68	27.81	24462.6667	51212.5	26083.17	2.00	31958.25	67678.75	35720.5	2.20
	Manipur	10	25	**Crop failed due to occurance of flood during seedling stage**										
	Meghalaya	22	173	Report yet to receive from KVK										
	Tripura	10	29	6.75	N/A	N/A	0	0	0	0	18665	54000	35335	2.89
Green gram*	Assam	70	185	6.98	4.99	39.83	18046.3	37100	19170.3	2.06	19787.5	47016.7	27229.2	2.38
	Manipur	10	25	**Crop failed due to occurance of flood during seedling stage**										
	Meghalaya	12	146	Report yet to receive from KVK										
	Total	**1161**	**3563**											

Varietal performance of Lentil

Number of varieties was introduced in pulse demonstrations which have good potential to excel in the situations. In Arunachal Pradesh, coverage of lentil was through variety HUL-57. The coverage of area was 10 ha. Number of demonstration under the cultivars was 27. Demonstrated yield was high with this variety which was 7.44 q/ha (Table 4.4).

Table 4.4: Performance of major varieties of lentil

Variety	Area in (ha)	No. of demonstrated	Demonstrated yield (q/ha)	Existing yield (q/ha)	% of yield increase
Arunachal Pradesh					
HUL-57	10	27	7.44	N/A	N/A
Assam					
HUL-57	176	467	7.46	5.9	26.44
Moitree	30	76	7.79	5.35	45.63
PL-406	20	44	11	6	83.33
L-9	10	25	4.5	3.80	18.42
KLS-218	20	51	8.75	5.85	49.57
Manipur					
HUL-57	40	64	6.00	5.8	3.5
Meghalaya					
HUL-57	16	177	7	N/A	N/A
Mizoram					
HUL-57	16	177	7	2	250
Nagaland					
HUL-57	6	6	5.57	4.5	23.77
Tripura					
HUL-57	30	103	7.46	4.73	57.61
Lentil selection-1	10	39	4.8	N/A	N/A

Varietal performance of Field pea

Variety Prakash was demonstrated in 117 ha which covered maximum area under field pea in Assam. Number of demonstrations was 607. It gave demonstrated yield of 8.89 q/ha. In Arunachal Pradesh the variety Prakash was demonstrated in 30 ha through 85 demonstrations. Average yield in the demonstrations was 9.91 q/ha compared to local check average of 7.31 q/ha. Moreover, variety VRP-22 was demonstrated in 9 ha through 20 demonstrations producing an average yield of 20.5 q/ha with percent increase of 180.43%In Manipur, variety Prakash was demonstrated in 30 ha through 54 demonstrations to obtain average yield of 12.92 q/ha with percent increase in yield of 19.11% (Table 4.5). In Nagaland, variety HUDP-15 was demonstrated in 10 ha through 15 demonstrations to harvest demonstrated yield of 19.0 q/ha over the existing average of 14.0 q/ha. Yield increased to about 35.71%. Further, Arkel variety was demonstrated in 10 ha through 5 demonstrations that produced average yield of 15.23 q/ha, 65.54% higher than the existing yield. In Tripura, variety HUDP-15 was demonstrated in 10 ha through 38 demonstrations yielding 13.0 q/ha over the existing yield.

Table 4.5 : Performance of major varieties of Field pea

Variety	Area in (ha)	No. of demonstrated	Demonstrated yield (q/ha)	Existing yield (q/ha)	% of yield increase
Arunachal Pradesh					
Prakash	30	85	9.91	7.31	35.55
VRP-22	9	20	20.5	7.31	180.43
Assam					
Prakash	117	607	8.89	7.68	15.77
HUP-2	10	24	12.5	8	56.25
MS-55	10	44	11.25	5.5	104.55
V-10	10	39	11.1	7.0	58.57
Rachna	30	107	11.62	6.8	70.83
HUDP-15	50	171	9.24	7.67	20.51
Manipur					
Prakash	30	54	12.92	10.85	19.11
Meghalaya					
Prakash	20	90	11.1	9.85	12.69
Anupam	3	112	24.15	0	-
Mizoram					
Prakash	20	50	10.48	5	109.6
Rachna	10	25	19	N/A	N/A
Nagaland					
HUDP-15	10	15	19	14	35.71
Arkel	10	5	15.23	9.2	65.54
Prakash	5	28	9.15	7	30.71
Rachna	5	12	5.8	N/A	N/A
Sikkim					
Prakash	4	18	17.3	11.2	54.46
Tripura					
HUDP-15	10	38	13	9.5	36.84
TRCP-8	10	36	2.6	Nil	N/A

Varietal performance of chickpea

In Arunachal Pradesh, chickpea variety JG-16 was demonstrated in 10 ha through 25 demonstrations to get average yield of 11q/ha, 22.22% higher than the existing yield. In Manipur the same variety was demonstrated in 10 ha through 20 demonstrations to get an average yield of 10.5q/ha, 16.67% higher than the existing yield. In Mizoram, chickpea variety AP-1 was demonstrated in 10 ha through 25 demonstrations to get an average yield of 17q/ha (Table 4.6).

Table 4.6: Performance of major varieties of chickpea

Variety	Area in (ha)	No. of demonstrated	Demonstrated yield (q/ha)	Existing yield (q/ha)	% of yield increase
Arunachal Pradesh					
JG-16	10	25	11.0	9.0	22.22
Manipur					
JG-16	10	20	10.5	9.0	16.67
Mizoram					
AP-1	10	25	17.0	9.0	88.89

Varietal performance of Rajma

Rajma crop was demonstrated in rabi season. In Nagaland variety Anupam K-5 gave demonstrated yield of 13.5q/ha compared to existing yield of 11.79q/ha with percent increase of 14.50% (Table 4.7)

Table 4.7: Performance of major varieties of Rajma

Variety	Area in (ha)	No. of demonstrated	Demonstrated yield (q/ha)	Existing yield (q/ha)	% of yield increase
Nagaland					
Anupam K-5	2	1	13.5	11.79	14.50
Sikkim					
Jwala	3	5	10.26	N/A	N/A

Varietal performance of French bean

French bean cv. S-9 was demonstrated in 10 ha through 31 demonstrations (Table 4.8). Average yield was 17.65 q/ha compared to existing yield of 9.87 q/ha. Increase in yield was 78.82 %.

Table 4.8: Performance of major varieties of French bean

Variety	Area in (ha)	No. of demonstrated	Demonstrated yield (q/ha)	Existing yield (q/ha)	% of yield increase
Arunachal Pradesh					
S-9	10	31	17.65	9.87	78.82

Varietal performance of Blackgram

In Assam, Blackgram cv. IPU-94-1 was demonstrated in 40 ha through 80 demonstrations (Table 4.9). Average yield was 8.69 q/ha compared to existing yield of 5.8 q/ha with increase of 49.82%. The cv. IPU 2-43 was demonstrated in 30 ha through 58 demonstrations with an average yield of 6.35 and percent increase of 19.58%. Moreover, the cv.

PU-31 was demonstrated in 30 ha through 72 demonstrations with an average yield of 7.8 q/ha and percent increase of 30%. In Tripura, the cv. Tripura Maskolai was demonstrated in 10 ha through 29 demonstrations. Average yield was 6.75 q/ha with percent increase of 12.5%.

Tabel 4.9: Performance of major varieties of Blackgram

Variety	Area in (ha)	No. of demonstrated	Demonstrated yield (q/ha)	Existing yield (q/ha)	% of yield increase
Assam					
IPU-94-1	40	80	8.69	5.8	49.82
IPU 2-43	30	58	6.35	5.31	19.58
PU-31	30	72	7.8	6	30.00
Tripura					
Tripura Maskolai	10	29	6.75	6	12.5

Varietal performance of Greengram

Greengram cv. Pratap was demonstrated in 70 ha through 177 demonstrations (Table 4.10). Average yield was 6.98 q/ha compared to existing yield of 5.57 q/ha. Increase in yield was 25.31 %.

Table 4.10 : Performance of Blackgram var. Pratap

Variety	Area in (ha)	No. of demonstrated	Demonstrated yield (q/ha)	Existing yield (q/ha)	% of yield increase
Assam					
Pratap	70	177	6.98	5.57	25.31

Technology demonstrations

1. Management of macronutrient in Lentil (Assam)

Macronutrient deficiency is prevalent in many of the districts in Assam including Baksa. It affects growth of plant as well as grain formationin pulses. Lentil is also affected by the macronutrient deficiency like Nitrogen, phosphorus and also requires certain soil amendment techniques. Thus, NPK management and application of lime were included as components in clustered demonstration in lentil. Application of N: P (15:35 kg/ha) was effective in meeting the nutrition of the crop. Micronutrient application resulted in increase in yield by 83.33% and assured good crop by protecting the filling of grains.

Name of the technology	Crop	Variety	Area (ha)	No. of farmers	Demo Yield (q/ha)	Control Yield (q/ha)	% increase
• N:P:K@ 15:35:0 kg/ha • FYM + Vermicompost= 5ton • Lime: 65.5 kg	Lentil	PL- 406	10	25	11.0	6.0	83.33

2. Integrated Nutrient Management of Lentil (Tripura)

Increasing productivity of crops ensure the food and nutritional security of the farmers which depends upon the soil fertility and productivity. Pulses can play a vital role in nutritional requirement and also increases the fertility status of the soil. In Tripura state, pulses are grown in very small area in marginal land using mostly local varieties. Lentil is an important pulse crop and highly consumed by the people of Tripura. But except some few places, people do not like to grow lentil. This is may be due to the some of the reasons like i) Seeds of high yielding varieties are not available ii) Lack of processing unit at village level iii) Marketing problem. Since the climatic and edaphic factors of the South Tripura are favorable for lentil cultivation, hence there is an immense scope of cultivation for this crop in the unutilized rice fallow of the district.

The trial conducted by ICAR clearly indicated that in Tripura as high as upto 9.0 q/ha lentil seed yield can be obtained using different high yielding varieties. With a view to popularize lentil cultivation in the South Tripura District, Krishi Vigyan Kendra South Tripura introduced lentil cultivation in the farmers' field through awareness programme, trainings, Front Line Demonstration (FLD), and field day activities.

In FLD programme, KVK has demonstrated scientific practices of cultivation with correct time of sowing, line sowing of seeds, liming, maintenance of proper distance (30 x 10 cm), recommended doses of fertilizer, it's time and method of application, intercultural operation including pest and disease management etc. Critical inputs like seed, fertilizers, lime etc. has been provided to the farmers by KVK, South Tripura.

Name of the technology	Crop	Variety	Area (ha)	No. of farmers	Demo Yield (q/ha)	Control Yield (q/ha)	% Increase
Urea-43 kg SSP-250 kg MOP-33 kg	Lentil	HUL-57	10	37	8.7	6.0	45.0

Demonstration of Lentil Var.HUL-57 in the farmers' field

3. Organic cultivation of field pea (Assam)

Cluster Front Line Demonstration of rabi pulse under NFSM for 2015-16 with the variety Prakash in 10 ha areas for the first time was conducted on field pea. Field pea was sown during 2nd fortnight of Oct'2015 and harvested in Feb'2016. The cluster FLD was demonstrated at 32 locations in 5 villages viz. Otongkhoua, Natun Basti, Dadam, Deomali and Bera Basti. The crop was cultivated organically as per recommended package and practices under line sowing without application of fertilizers, insecticides and fungicides under rainfed condition. Only dry cowdung was applied @ 1 t/ha. Total 180 mm rainfall was recorded to have received during the growing period of the crop.

Training, field visit, group discussion and method demonstration on scientific cultivation of field pea was carried out for successful completion of the programme. During the programme "Field day" on 4th Jan'2016 at Otongkhowa, the better performance of field pea, variety Prakash over their local varieties of pea was shown practically to the local farmers.

The economic and social impact of the intervention, cultivation of field pea, variety: Prakash is very positive. On an average 12,210 kg seeds/house hold was produced where 300 kg was sold in nearby market and the income gained was utilized for day to day home expenditure and especially for education ofchildren and created 80 man daysemployment generation/household. 30 kg seeds were utilized for home consumption and 30 kg kept for seed purpose for next year.

Name of the technology	Crop	Variety	Area (ha)	No. of farmers	Demo Yield (q/ha)	Control Yield (q/ha)	% increase
FYM @ 1015 Kg/ ha	Field pea	Prakash	10	32	12.21	8.4	45.35

Cluster FLD on Field pea

TV Programme on Cluster FLD of Rabi pulse, Field pea

4. Organic production technology of field pea in rice-fallow (Sikkim)

Sikkim is first organic state in India, hence, pulse crop play an important role sustaining the soil health under existing cereal based system. The pulse crop is important due to its multiple uses in the form of vegetable, dal, chhola. Pulses are grown merely only 6.3 (000) ha area in Sikkim. Sikkim is not

Field inspection of demo plot at Amba village

producing sufficient amount of food grains in fulfilling the demand of the populace. Keeping in view diversifying of pulse crops is necessary to cover maximum area under leguminous crops and to provide the improved varieties along with organic package of practices for productivity enhancement in a sustainable manner in the state. The program also stressed for enhancing farm level economy to restore confidence amongst the farmers in the region.

Field inspection of demo plot at Timpyem village

Field pea var. Prakash seed was distributed among the farmer of Amba, Lossing, Beyong, Burung Nandok and Timpyem villages of East Sikkim to popularize the field pea as a *rabi* pulse crop in rice - fallow. Organic package of practices for cultivation of field pea were demonstrated to the farmer's field of the aforesaid villages.

Name of the technology	Crop	Variety	Area (ha)	No. of farmers	Demo Yield (q/ha)	Control Yield (q/ha)	Net income (Rs/ha)	B:C ratio
• FYM (2.5 t/ha) + Neem cake (200 kg/ha), Biofertilizer-Nalpak (5 kg/ha). • Phytoneem @ 4 ml/l, Sulfex @ 2g/l, COC @ 2g/l	Field pea	Prakash	3.0	15	17.3	In Sikkim Farmers are not cultivating field pea, preferring vegetable pea	28660	1.89

5. Integrated and Pest Nutrient Management in Field pea (Tripura)

KVK, West Tripura in collaboration with Department of Agriculture, Government of Tripura implemented Cluster Demonstration on field pea for augmenting field pea production of tribal farmers of Sepaihaur, Kamal Nagar, Narayanpur and Kalyanpur villages of Khowai district of Tripura under National Food Security Mission (NFSM) during *rabi*, 2015. Initially some capacity building programmes were organized on field pea cultivation technology in which skill based knowledge on the technology was imparted to the farmers. The crop was sown in the second and third week of November with the adaptation of minimum tillage. All the scientific management practices were adopted in the demonstration plot starting from application of lime, seed treatment with Trichoderma followed by Integrated Nutrient Management (INM) and Integrated Pest Management (IPM) practices. With the lentil cultivation; the group of farmers got an average yield of 13q/ha which enhanced their income by getting an average net profit of Rs. 26400.00/ha.

Name of the technology	Crop	Variety	Area (ha)	No. of farmers	Demo Yield (q/ha)	Control Yield (q/ha)	% increase
• Soil Amelioration with Lime • Seed treatment with Trichoderma • Organic Manure:60 kg, Plantaid (Zn 5%, B 5%): 3.5lit, Rhizobium 2 kg • Nimbicidine: 3.5 lit, Trichodermaviridae: 3.5 kg	Field pea	HUDP-15	10	38	13.00	6.2	109.67

6. Plant protection and stacking in Rajma (Nagaland)

In Mon district of Nagaland, Rajma is an important pulse crop in rabi season which could supplement and add towards the livelihood security of the farmers in addition to other major pulses. The crops susceptibility to pests was reduced by application of carbofuron and bavistin which led it to producing a recorded yield as high as 13.5 q/ha. Seed treatment was also adopted.

Name of the technology	Crop	Variety	Area (ha)	No. of farmers	Demo Yield (q/ha)	Control Yield (q/ha)	% increase
• Seed treatment with Thiram- 4 kg • Plant protection: Carbofuron- 5 kg/ha &Bavistin- 5 kg	Rajma	Anupam K-5	2	1	13.5	11.79	14.5

7. Organic cultivation of French bean (Arunachal Pradesh)

Cluster Front Line Demonstration of rabi pulse under NFSM for 2015-16 with the variety S-9 in 10 ha areas for the first time for pulse purpose was conducted on French bean. French bean was sown in mid Oct'2015 and harvested in last week Jan'2016. The cluster FLD was demonstrated at 31 locations in 4 villages viz. Noitong, Khonsa, Natun Kheti, Berabasti.The crop was cultivated organically as per recommended package and practices under line sowing without application of fertilizers under rainfed condition. Only dry cow dung was applied @ 1 t/ha. Total 139.8 mm rainfall was recorded to have received during the growing period of the crop.

Training, field visit, group discussion and method demonstration on scientific cultivation of French bean was carried out for successful completion of the programme. During the programme **"**Field day**"** on 5th Jan'2016 at Noitong, the better performance of French bean, variety: S-9 over their local varieties of French bean was showed practically to local farmers.

Name of the technology	Crop	Variety	Area (ha)	No. of farmers	Demo Yield (q/ha)	Control Yield (q/ha)	% increase
FYM/Cow dung @1000 Kg/ha from farmers side	French bean	S-9	10	31	17.65	9.87	78.82

8. INM techniques in Chickpea (Arunachal Pradesh)

KrishiVigyan Kendra, Lower Subansiri made interventions with the different activities under Cluster frontline demonstrations programme on pulses crop to enhance the production of pulses thereby increase cropping area during winter season 2015-16.In order to enhance the cropping intensity of the village by exploring the best possible resource conserving technologies (RCTs) and using the methods were demonstrated during *Rabi* season on chickpea crop. Organic manure was applied @750 kg, timely sowing and sowing method like line spacing and organic inputs were adopted. In addition, seed treatment and IPM techniques were also adopted. This provided a yield advantage of 22.22%.

Name of the technology	Crop	Variety	Area (ha)	No. of farmers	Demo Yield (q/ha)	Control Yield (q/ha)	% increase
• Rhizobium culture and Captan @2g/kg • 750kg organic manure and 30 Kg N and 40 Kg P • Weed control-Pendimethalin2.5 litre/ha	Chickpea	JG-16	10	25	11.0	9.0	22.22

9. Cultivation of Summer Blackgram with the use of Vermicompost

Field day on Cluster FLD of Summer pulse, Blackgram

In the district of Karimganj there are pockets in which farmers grow Blackgram as *Kharif* crop, but there are areas where Blackgram can be included in the cropping sequence during summer season also. But to get the farmers convinced for the cultivation of Blackgram during summer season was a challenging task.

Weeding of Summer Blackgram

The KVK, Karimganj did adequate field survey and met lots of farmers and selected suitable areas and interested farmers for the Cluster Frontline Demonstration of Blackgram in the summer season with the application vermicompost. Two locations (village Alekhargool and Chamtila) for the crop were selected covering an area of 10 ha with 17 nos. of farmer. Farmers were given adequate training and all necessary guidelines regarding improved production technology of Blackgram including use of vermicompost in the crop. All the farmers cooperated with the effort of KVK, Karimganj and sincerely executed the technical programmes of the Cluster FLD. The farmers mostly grow blackgram during Kharif season without application of chemical fertilizer or vermicompost. It was a new experience for the farmers. Vermicompost @ 5 ton/ ha was applied in the field. The early vegetative growth of the crop was satisfactory. But coincidence of pre monsoon flood caused substantive damage to the crop. Nevertheless, the demonstration was a successful one and on an average yield achieved was @ 5.5 qt per ha. Indeed, the KVK, Karimganj successfully implemented the Cluster Frontline Demonstration of pulse crop involving Blackgram in an area where the selected crop was not so popular among the farmers during summer season.

Name of the technology	Crop	Variety	Area (ha)	No. of farmers	Yield (q/ha)	Control Yield (q/ha)	% Increase
• Cultivation of summer Blackgram with the use of vermicompost	Black gram	Shekhar- 1	10	17	5.5	3.6	52.78

Farmers learned a lot regarding cultivation of Blackgram in the fallow land after the harvest of Sali paddy. This will ensure increased in area and production of pulse crop in the district. Farmers understood the feasibility, prospect and constrains of the growing the crop in the summer season in the district. Other farmers in large number in addition to the selected ones for the FLD participated in Field Days and showed interest in cultivation of Blackgram in the coming season.

Training on improved production technology of Blackgram

From the feedback received from the Farmers it was learned that short duration area specific variety of Blackgram are needed so that harvesting of the crop can be completed before the onset of pre-monsoon flood. Besides, early vegetative growth of the variety should be aggressive so that performance of the crop does not hamper due to moisture stress condition.

10. Integrated Nutrient Management in Summer Greengram (Assam)

KVK, Jorhat under the Cluster FLD on Summer Pulse programme, 2015-16 has conducted a cluster demonstration on green gram with HYV (Pratap), Integrated Nutrient Management (INM) Practices (Bio-fertilizer: : Seed inoculation with Rhizobium @ 50g/kg seed) & FYM (1 t/ha) under Rice-Toria-Fallow situation, Lime @ 65.5 kg/ha as soil amendment with a zeal to create a “PULSE HUB” to minimize the time gap of availability of Summer Green Gram HYV seeds as well as to popularize the technology with proper utilization of rice-toria fallows to increase the cropping intensity.

Excellent crop growth of Summer Green Gram at Adi elengi Under Cluster FLD Rabi Pulse (Summer Green gram)- 2015-16

A very good crop was harvested from his area and around 6.7 quintals of seed was produced and 4 quintals was distributed among the nearby farmers with an exchange of local varieties and around 2 quintals is being kept for their sowing in next season. Visualizing the yield performance of Pratap 7.85q / ha of the new variety and technology as compared to 6.07 q per ha of local variety, farmers were very much happy & interested to adopt the new variety & the technology. This year also farmers are planning to cultivate more than 150 ha area under these HYV of summer green gram.

Name of the technology	Crop	Variety	Area (ha)	No. of farmers	Yield (q/ha)	Control Yield (q/ha)	% Increase
HYV- Pratap + Integrated Nutrient Management Practices (Bio-fertilizer: : Seed inoculation with Rhizobium@50g/kg seed) & FYM (1 t/ha) under Rice- Toria-Fallow situation, Lime@ 65.5 kg/ha as soil amendment	Green gram	Pratap	10	33	7.85	6.07	29.32

6. ICAR-ATARI, ZONE V
(Andhra Pradesh, Telangana and Maharashtra)

Andhra Pradesh, Telangana and Maharashtra states are important in terms of area, production and productivity of pulses in the country. According to 2013-14 statistics, in Maharashtra pulses are grown in an area of 36.53 lakh hectares with a production of 29.41 lakh tonnes. The overall productivity of the pulses in the state is 805 kg/ha.

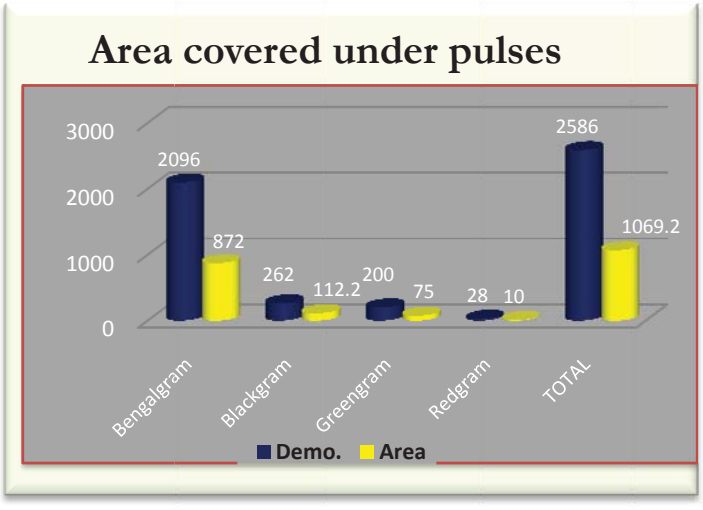
In Maharashtra, Chickpea is grown in 18.20 lakh hectares area with a production of 16.22 lakh tonnes. The productivity of the crop is 891 kg/ha. The Maharashtra stands 3rd position in area and production and 8th in productivity of the gram crop. The Andhra Pradesh state stands 5th in area, 4th in production and 1st in productivity of the gram crop in the country.

In Andhra Pradesh, the Bengalgram is grown in 5.86 lakh hectares area with a production of 8.43 lakh tonnes. The productivity of the crops is 1439 kg/ha. In rabi season, blackgram is grown in 2.63 lakh ha area with a production of 2.10 lakh tonnes. The productivity of the crop is 798 kg/ha. and in rabi greengram is grown in 1.32 lakh ha area with a production of 0.87 lakh tonnes. The productivity of the crop is 659 kg/ha.

Table 6.1: Cluster FLD programme on Rabi Pulses during 2015-16 under NFSM implemented in Zone-V (Maharasthra, Andhra Pradesh & Telangana)

Crop	MS		AP		TS		Zone	
	Demo (No)	Area (ha)	Demo (No)	Area (ha)	Demo (No)	Area (ha)	Demo (No)	Area (ha)
Bengalgram	1683	685	175	82	238	105	**2096**	**872**
Blackgram	0	0	249	105	13	7.2	**262**	**112.2**
Greengram	0	0	127	45	73	30	**200**	**75**
Redgram	0	0	0	0	28	10	**28**	**10**
TOTAL	**1683**	**685**	**551**	**232**	**352**	**152.2**	**2586**	**1069.2**

A total of 2586 cluster front line demonstrations on chickpea, pigeon pea, black gram and green gram were organized by KVKs covering an area of 1069ha in Telangana, Andhra Pradesh and Maharashtra states. In Maharashtra, demonstrations were conducted only on chickpea and in A.P. demonstrations on chickpea, black gram and green gram and in Telangana demonstrations on all the four pulse crops were organized by KVKs.



Training:- A two day Zonal workshop cum Training program was organized on Cluster Frontline Demonstrations on Pulses, 2015-16 for KVK scientists by ICAR-ATARI, Zone-V, Hyderabad during 22-23 December, 2015. The scientists from ICAR –Indian Institute of Pulses Research, Kanpur, from Universities i.e. ANGRAU, MPKV Rahuri, VNMKV Parbhani imparted the training. Director, ICAR-CRIDA, inaugurated the workshop in the presence of Director-ATARI Zone-V, Hyderabad and Bangalore and Dr. D. P. Malik, Additional Commissioner Crops, Dr. S. M. Kolhatkar, Director, Directorate of Oilseed Development, Ministry of Agriculture, Govt. of India, Hyderabad. During the training covered all the relevant and latest technologies on pulses which includes improved varieties INM, IPM, IWM practices etc.

Programme Implementation on Rabi Cluster Front Line Demonstrations:

Table 6.2 : Details of Technology implemented under FLD Pulses 2015-16 in Zone V

Crop	Sowing week	Soil type	Rainfed / Irrigated	Variety	Inputs used
Bengalgram (chickpea)	October & November	Medium to heavy black soils	Rainfed & Irrigated	Digvijay, JAKI 9218, Vijay, BDNG-797(Akash), Vishal, NBeG-3 (Nandyala Sanaga-1), JG-11	Imp. Seed, bio-fertilizer rhizobium, PSB, bio pesticides (T.viridae), Sulphur, micronutrients (Zn, Fe),weedicides, pheromon traps, neem oil, HaNPV, insecticides etc. RDF
Black gram	November, December & January	Medium black, Sandy loams	Rainfed & Irrigated	LBG 752, PU-31	Imp.seed, Bio-fertilizer rhizobium,Pseudomonas, PSB, weedicide,Sticky traps, KNo3 spray, RDF,insecticides
Green gram	November-December&February	Medium black soils, sandy loams, red soils	Irrigated	LGG460, TM96-2, MGG-295	Seed, Biofertilizer, Imp.seed, Bio-fertilizer rhizobium,Pseudomonas, PSB, weedicide,Sticky traps, KNo3 spray Neem oil, RDF,insecticidess
Redgram (pigeonpea)	October	Red soils, sandy soils	Irrigated	LRG41	Seed, Quinolphos, Chloropyriphos, Neem oil ,RDF,insecticides

Extension activities:-

The demonstrator farmers were imparted training before organizing the demonstrations by KVKs. The regular field visits were taken up by the Subject Matter Specialists of KVKs and given on the spot guidance to the farmers. Field days were organized during flowering and pod formation stage of the crops.

Performance of Pulses

Pigeon pea:

To promote rabi pigeon pea cultivation in Telangana, cluster frontline demonstration were organized in red soils under irrigated situation in Nalgonda district. A total of 28 demonstrations were taken up in 10 hectares area. Improved and high yielding seed of LRG-41 variety along with rhizobium, plant protection measures were demonstrated in the villages

Rabi pigeon pea was introduced in Nalgonda district through conducting cluster FLDs in place of rabi maize, paddy and vegetables which require more irrigation. Improved and high yielding and helicoverpa tolerant variety LRG-41 was demonstrated along with recommended package i.e. 20:50:0 NPK and plant protection measures. Chloropyriphos, neem oil for control of helicoverpa etc. The crop was sown in October II week in red soils. The results showed that an average yield of 12.75 q/ha was obtained in the demonstration with an highest yield of 17.5 q/ha. The improved technology gave and additional net returns of Rs.10,125/ha (Table 6.3 a&b).

Performance of Cluster FLD in Redgram (LRG-41) at Nalgonda dist.

Due to low rainfall in kharif season and less requirement of irrigation, the farmers satisfied with the performance of the rabi red gram demonstrations and expressed their interest to cultivate the crop in next rabi season.

Table 6.3 : (a). Performance of Cluster FLDs on Red gram, Telangana Rabi (Irrigated) 2015-16

DISTRICT (KVK)	Technology demonstrated	Variety	Area(ha)/ Demo No	Av. Yield (q/ha)			% increase over check
				Demo Highest	Demo	Check	
Nalgonda (Kampasagar)	Var.+ Plant protection	LRG-41	10(27)	17.5	12.75	8.75	45.71

Table 6.3 (b). Economic of Cluster FLDs on Red gram, Telangana Rabi (Irrigated) 2015-16

KVK	Demonstration plot				Farmer's Existing plot			
	Gross Cost (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C ratio	Gross cost (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C Ratio
Kamp asagar	21250	70125	48875	2.3	21250	60000	38750	1.8

Green gram :

In Telangana, on greegram, the demonstrations were conducted in Khammam district in November month in red sandy loams and medium black soils after paddy and sugarcane crops. Variety MGG-295 along with recommended dose of fertilizer, weedicide and need based plant protection measures were demonstrated. In Chittor (Tirupathi), Srikakulam and Vizianagaram also the green gram demonstrations were organized during November and December months in rice fallows with variety LGG-460, application of micronutrients, weed management and plant protection against YMV and leaf spot. In case of Karimnagar and Chittoor (Kalikiri) area the demonstrations were sown during February II nd fortnight with variety WGG-42 and TM 96-2, seed treatment with azospirrulum, PSB and chemical weed management. In Khammam the early withdrawal of rainfall, in September III rd week and sudden increase in temperatures during crop growth period, insect pest and disease incidence was more. In demonstrations, at different locations, the average seed yield recorded ranged from 8.14 to 12.0 q/ha with an average of 9.04 q/ha against 6.55q/ha in the check plots. The highest yield recorded in the demonstration is15.0q/ha in Karimnagar district followed by13.25q/ha in Srikakulam obtained in the demonstration in Khammam district against the existing yield of 5.4 q/ha. In Vishakapatnam, district the demonstrations were failed due to moisture stress.

Performance Greengram demonstrations at Chittoor, KVK

Over the locations, the improved package of practices gave an additional net returns of Rs.9,113/ha over existing practice.

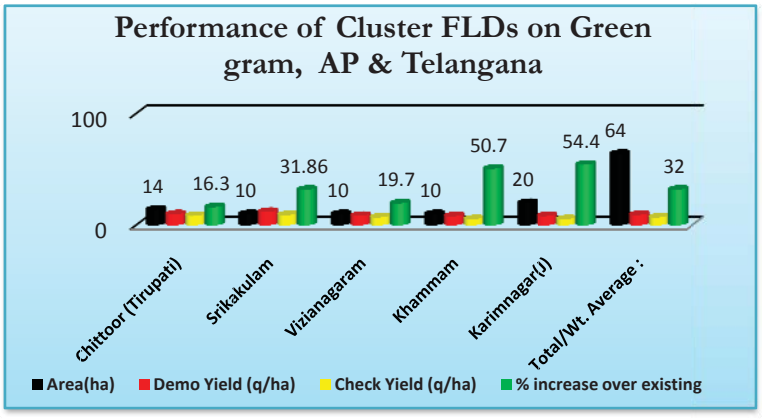


Table 6.4 : (a) Performance of Cluster FLDs on Green gram, AP & Telangana Rabi (Irr.) 2015-16

DISTRICT (KVK)	Technology demonstrated	Variety	Area(ha) / Demo No	Av. Yield (q/ha)			% increase over existing
				Demo highest	Demo	Check	
Chittoor (Tirupati)	Weed mgt.+ plant protection	LGG-460	14(35)	10.5	9.83	8.45	16.3
Srikakulam	Var+ICM	LGG-460	10(25)	13.25	12.0	9.1	31.86
Vizianagaram	Var+ICM	LGG-460	10(25)	10.0	8.5	7.1	19.7
Khammam	Var+ICM	MGG-295	10(23)	15	8.14	5.4	50.7
Karimnagar(J)	Var+weed mgt.& PP	WGG-42	20(50)	9.5	8.34	5.4	54.4
Total/Wt. Average :			**64(158)**		**9.36**	**7.09**	**32.0**

Table 6.4 : (b) Economic of Cluster FLDs on Green gram, AP & Telangana Rabi (Irrigated)2015-16

KVK	Demonstration plot				Farmer's Existing plot			
	Gross Cost (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C ratio	Gross cost (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C Ratio
Chittoor (RAAS)	31280	59963	28683	1.92	31380	51545	20615	1.64
Srikakulam	17600	51750	34150	2.94	14620	38800	24180	2.65
Vizianagaram (R.K.Bai)	8100	44200	36100	4.46	7200	36920	29720	4.13
Khammam (Wyra)	27150	53375	26225	1.96	27950	41907	13957	1.49
Karimnagar (J)	26700	53825	27125	2.01	28750	42405	13655	1.40
Average :	22166	52623	30457	2.66	21980	42315	20425	2.26

Blackgram :

Cluster demonstrations on blackgram during rabi 2015-16 were conducted at 11 locations by KVKs in Telangana and Andhra Pradesh states with improved varieties and package of practices. Latest high yielding & YMV tolerant varieties viz., LBG-752 and PU-31 and other package of practices viz., rhizobium, PSB, Tricoderma viridae, weed control through pre & post emergence weedicides, foliar application of micro nutrients Zn, Kno3 and application of need based plant protection measures against YMV, sucking pests etc. were demonstrated. The demonstrations were sown under residual moisture conditions in rice fallows and other kharif crops. The soil type varied from medium black, sandy loams & red soils. A perusal of yield data recorded showed that (Table 6.5 a&b) revealed that, the average yields of the demonstration ranged from 8.8 to 12.3 q/ha under rain fed residual moisture situation. Under irrigated condition, the average yield of 17.12q/ha was obtained in Guntur district with variety PU-31 which is tolerant to yellow mosaic virus. In Krishna (Ghantasala) area, an average yield of 12.3 q/ha was recorded with a highest yield of 15.0 q/ha. At other locations the average yields are low, due to demonstrations conducted under rainfed situation and rains were not received during crop season.

Performance of Black gram variety PU-31 at Guntur district

Table6.5:(a) Performance of Cluster FLDs on Black gram, Andhra Pradesh Rabi (Rainfed) 2015-16

DISTRICT (KVK)	Technology demonstrated	Variety	Area(ha) /Demo No	Yield (q/ha)			% increase over existing
				Demo highest	Demo	Check	
Krishna (Ghantasala)	Var,bio-fertz,pl.protection ,sticky traps	LBG-752	10(25)	15	12.3	10.3	19.4
W.Godavari (V.R.Gudem)	Variety+biopesticides	LBG-752	16(40)	14	8.8	8.18	7.6
Vizianagaram	Var+micronutrient+PP	LBG-752	10(25)	12.75	10.8	9.1	18.7
Total/Wt. Average :			**36(66)**		**11.15**	**9.19**	**21.3**

Table 6.5: (b) Economic of Cluster FLDs on Black gram, Andhra Pradesh Rabi (Rainfed) 2015-16

KVK	Demonstration plot				Farmer's Existing plot			
	Gross Cost (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C ratio	Gross cost (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C Ratio
Ghantasala	24068	121240	97172	4.03	30550	105820	75270	2.4
Venkatraman nagudem	37525	83505	45980	2.2	37525	77668	40143	2.06
Vizianagaram	10200	77760	67560	6.62	9200	65520	56320	6.12
Average:	23931	94168	70237	4.3	25758	83003	57244	3.5

The demonstration on black gram organized under rainfed situation in Andhra Pradesh state gave an average additional net returns of Rs.12,993/ha. In case of irrigated blackgram the additional net returns obtained was Rs.33, 739/ha.

Table 6.6: (a) Performance of Cluster FLDs on Black gram, Andhra Pradesh Rabi (Irrigated) 2015-16

DISTRICT (KVK)	Technology demonstrated	Variety	Area/ Demo No	Yield (q/ha)			% increase over existing
				Demo Highest	Demo	Check	
Guntur (Lam)	Var+bio.fertz.+PP	PU-31/LBG-752	10(25)	17.7	17.12	12.3	32.1

Table 6.6: (b) Economic of Cluster FLDs on Black gram, Andhra Pradesh Rabi (Irrigated) 2015-16

KVK	Demonstration plot				Farmer's Existing plot			
	Gross Cost (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C ratio	Gross cost (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C Ratio
Lam	47678	148964	101294	2.1	43353	110284	67555	1.5

Bengalgram:

Cluster demonstrations on Chickpea crop were conducted during rabi 2015-16 by KVKs covering three states i.e. Andhra Pradesh, Telangana and Maharashtra states. A total of 2096 demonstrations were organized in 872.0 hectares area. In Telangana the demonstration were conducted by 9 KVKs in eight districts under rain fed and irrigated situation. Improved varieties viz., NBeG-3, JAKI-9218 and JG-11 were demonstrated along with bio-fertilizers and pesticides viz., Rhizobium, *Trichoderma Viridae*, pheromone traps. Farmers applied recommended doses of fertilizer on their own. The average yields obtained in the demonstrations under rain fed situation in different districts ranged from 13.63-15.0 q/ha. The highest average yield recorded was of 15q/hain Adilabad and Mahaboobnagar. Under rainfed condition with the use of improved technology the average yields were increased up to 44.3 percent over farmers practice.

In Adilabad, demonstration organized in black soils with sprinkler irrigation gave an average yield of 23.75 q/ha with an highest yield of 3.0 t/ha. In Kurnool district of Andhra Pradesh the average yields recorded under irrigated condition is18.17q/ha.

In Telanaga the improved technology demonstrated in chickpea crop gave an average additional net returns of Rs.17225/ha over farmers existing practice.

During rabi 2015-16, in Andhra Pradesh State, chickpea demonstrations were conducted by five KVKs in Ananthapur, Kurnool, Kadapa and Prakasam districts under both rainfed and irrigated conditions in medium to heavy black soils. Latest improved and high yielding cultivars viz., NBeG-3 and Nandyal Sanaga-1, bio-fertilizers, bio-pesticides, weedicide, micro-nutrients were demonstrated. The average gram yields recorded in different districts are ranged from 12.5 -19.35 q/ha. The demonstrations organized by KVK Reddipalli in Atmakur, Tadimarri and Yellanur blocks of Ananthapur area received good rainfall during November month and recorded an average yield of 19.35 q/ha with an highest yield of 22.5 q/ha.

In Andhra Pradesh state the demonstrations on chick pea conducted under rainfed gave an average additional net returns of Rs.2, 935/ha.

Table 6.7 : (a) Performance of Cluster FLDs on Chick pea, Telangana Rabi (Rainfed) 2015-16

DISTRICT (KVK)	Technology demonstrated	Variety	Area(ha)/ Demo No	Yield (q/ha)			% increase over existing
				Demo highest	Demo	Check	
Adilabad	Weed mgt.+PP	JG-11	8.8(22)	17.5	15	12.5	20.0
Karimnagar (Ramgirikilla)	Bio.fertz+weed mgt.	JG-11	20(50)	16.6	14.4	5.0	188.0
Mahaboobnagar (Palem)	Bio.fertz+weed mgt.	JG-11	10(25)	16.9	15	9.0	66.7
Ranga Reddy	Var.+bio fertz+pesticides,Zn	Jaki-9218	10(25)	16	13.63	13.0	4.8
		Average :	**58.8(141)**		**14.28**	**9.9**	**44.3**

Table 6.7 : (b) Economic of Cluster FLDs on Chick pea, Telangana Rabi (Rainfed) 2015-16

KVK	Demonstration plot				Farmer's Existing plot			
	Gross Cost (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C ratio	Gross cost (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C Ratio
Adilabad	27945	95000	67055	3.39	31258	80000	48742	2.55
Ramgirikilla	15800	59040	43240	3.7	14500	43460	28960	3.0
Palem	28750	55125	26375	1.91	32500	41000	8500	1.26
Rangareddy	20370	57246	36876	2.81	19000	35700	16700	1.88
Average :	22773	65878	43105	2.8	23552	49432	25880	2.0

Table 6.8 : (a) Performance of Cluster FLDs on Chickpea in Telangana &A.P. Rabi (Irrigated) 2015-16

DISTRICT (KVK)	Technology demonstrated	Variety	Area(ha)/ Demo No	Yield (q/ha)			% Increase over check
				Demo highest	Demo	Check	
Adilabad	Weed mgt.+PP	JG-11	6.2(18)	30	23.75	20	18.8
Kurnool (Yagantipally)	Var.+bio .fertz.+Bio.pesticides,Sulphur	NS-1	2.5(5)	19.38	18.17	11.75	54.63
Total/Wt.Average			**8.7(23**		**22.15**	**17.63**	**25.62**

Table 6.8 : (b) Economic of Cluster FLDs on Chickpea in Telangana &A.P. Rabi (Irrigated) 2015-16

KVK	Demonstration plot				Farmer's Existing plot			
	Gross Cost (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C ratio	Gross cost (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C Ratio
Adilabad	31500	152000	120500	4.80	31200	128000	96800	4.10
Yagantipally	25450	85435	59985	3.35	23587	54779	23587	2.32
Average :	28475	118718	90243	4.08	27394	91390	60194	3.21

Economics:

In Maharashtra, during rabi 2015-16 chickpea demonstrations were conducted in 30 districts by 39 KVKs. A total of 1683 demonstrations were laid out covering an area of 685.0 hectares. Improved varieties Digvijay, BDNG-797, JAKI-9218 along with rhizobium, PSB, Tricoderma Viridae, micro nutrients, ZnSo4, IPM practices were demonstrated. The demonstrations were taken up in medium to heavy black soils under protective irrigation condition. In some locations irrigation was applied through drip. In most of the districts, the rainfall was received up to III rd week of September 2015 and sudden raise in temperature during crop growth period resulted low yields.

The demonstrations on chickpea conducted in Central Vidarbha zone in medium to heavy black soil with variety JAKI-9218 & improved practices under irrigated situation gave an

average yield of 17.18 q/ha against the existing farmers yield of 12.16 q/ha showing a increase of 41.56% (Table 6.10).

The demonstrations conducted under rain fed situation and in Central Maharashtra Plateau zone, in the districts of Aurangabad, Beed, Jalna, Nanded and Parbhani with variety Akash, Digvijay and JAKI-9218 along with recommended practices gave an average yield of 11.70 q/ha against the productivity of 8.67 q/ha under existing practice (Table.13). Under farmers practice the varieties used are Vijay and Annegiri. This region is receiving low rainfall during past three years.

In Central Maharashtra Plateau zone covering eight districts in Marathwada region, the improved technology gave an additional net returns of Rs.12,786/ha. The average net returns obtained under irrigated situation the average net returns of Rs.15, 821/ha.

The demonstrations conducted under irrigated situation in three districts viz., Nanded, Beed and Hingoli, an average of 19.28q/ha was realized and in farmers practice the average yield recorded was 11.7q/ha.

In Western Mahararashtra Dry zone the demonstrations on gram were taken up with Digvijay and JAKI-9218 variety by 16 KVKs in 10 districts. In irrigated condition, across the locations, the average yields obtained under demonstrations was 22.49 q/ha and in check plots the average yields recorded are 14q/ha. The highest average yield of 27. 43 q/ha was achieved in Solapur (Khed) with Variety Digvijay , and drip irrigation.

The cluster Front Line Demonstration organized under irrigated situation in Western Maharashtra Dry Zone gave an average additional net returns of Rs.17,426/ha. Under rainfed situation the average additional net returns obtained are Rs.5,948/ha.

Under rainfed situation, the average yields recorded in demonstration is 11.19 q/ha against local checks average of 7.0 q/ha where very low rainfall was received in kharif and lack of rains in cropping season.

Monitoring

Monitoring of the cluster Frontline Demonstrations of Pulses programme was carried out by the scientists of ATARI along with Officers/ Scientists of the Directorate of Extension of SAUs, Directorate of Oilseed Development, GOI, Hyderabad and Directorate of Cotton Development, Nagpur (Ministry of Agriculture) and Officers from the State Department of Agriculture from Andhra Pradesh, Telangana and Maharastra states were participated during the visit and suggested necessary measurers to the farmers.

Table 6.9 : (a) Performance of Cluster FLDs on Chickpea, Andhra Pradesh Rabi (Rainfed) 2015-16

DISTRICT (KVK)	Technology demonstrated	Variety	Area(ha)/ Demo No	Yield (q/ha)			% increase over existing
				Demo highest	Demo	Check	
Ananthapuram (Reddipalli)	Var.+bio fertz.+Zn,Fe	NBeG	11.2(28)	22.5	19.35	17	13.8
Kurnool (Yagantipally)	Var.+bio fertz.+Zn,Fe	NS-1	20(50)	15	13.77	11.75	17.2
Prakasam (Darsi)	Var.+bio fertz.+weed mgt.	JG-11	10(25)	18.75	12.5	9.37	33.4
Kadapa	Var.+bio fertz.+weed mgt. Sulphur, Zn	JG-11	15(31)	18.1	13.55	10.1	34.15
W3			**56.2(121)**		**14.79**	**12.06**	**22.7**

Table 6.9 : (b) Economic of Cluster FLDs on Chickpea , Andhra Pradesh Rabi (Rainfed) 2015-16

KVK	Demonstration plot				Farmer's Existing plot			
	Gross Cost (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C ratio	Gross cost (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C Ratio
Reddipalli	31917	91325	59408	2.79	31917	79143	47227	2.42
Yagantipally	25450	64742	39292	2.5	23587	54778	32691	2.50
Darsi	31250	42210	10960	0.35	23750	56250	32500	1.36
Kadapa	34000	63685	29685	1.87	37500	52687	15187	1.41
Average :	30654	65491	34836	1.88	29188	60715	31901	1.92

Table 6.10 : (a) Performance of Cluster FLDs on Chickpea in Central Vidarbha Zone in Maharashtra Rabi (Irrigated) 2015-16

DISTRICT (KVK)	Technology demonstrated	Variety	Area(ha)/ Demo No	Yield (q/ha)			% increase over existing
				Demo highest	Demo	Check	
Akola	Var+ICM	JAKI-9218	20(50)	21.25	17.42	12.5	39.4
Amaravati (Durgapur)	Var+bio fertz.+PP	JAKI-9218	15(37)	23.75	20.92	9	132.4
Amaravati (Ghatkhed)	Var=bio fertz.	JAKI-9218	20(50)	26.1	20.1	16	25.6
Buldhana (ARS)	Var=bio fertz.	JAKI-9218	15(37)	20.25	18.72	5.8	222.8
Buldhana (Jalgaon Jamod)	Var+ICM	JAKI-9218	15.6(39)	14.04	13.45	10.34	30.1
Nagpur	Var=bio fertz.+Zn	JAKI-9218	20(50)	22.5	17.17	14.25	20.5
Wardha	Var+IPM	JAKI-9218	10(25)	22.5	16.58	14.84	11.7
Washim	Var+IPM+Zn	JAKI-9218	20(50)	14.1	10.9	9.6	13.5
Yavatmal	Var+bio fertz.+PP	JAKI-9218	15(37)	24.55	20.7	16.85	22.8
Total/Wt. Average :			**150.6(386)**		**17.18**	**12.16**	**41.56**

Table 6.10 : (b) Economic of Cluster FLDs on Chickpea in Central Vidarbha Zone in Maharashtra Rabi (Irrigated) 2015-16

KVK	Demonstration plot				Farmer's Existing plot			
	Gross Cost (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C ratio	Gross cost (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C Ratio
Akola	30460	73156	42695	2.40	32520	66688	34167	2.05
Durgapur	28285	75600	47315	1.67	25460	59375	33915	1.33
Ghatkhed	23220	99408	76187	4.28	21810	85425	63615	3.91
ARS	23994	72559	48566	3.02	21661	61788	40127	2.89
Jalgoan Jamod	24210	53800	29590	2.22	22650	44400	21750	1.96
CICR Nagpur	29275	94435	65160	3.2	26300	78375	52075	2.98
Selsure	25518	69105	43587	2.7	23632	61853	38221	2.6
Karda	26897	45043	18146	1.67	24947	40209	15262	1.61
Yavatmal	27900	77625	49725	1.78	25400	63187	37787	1.49
Average :	26640	73415	46775	2.55	24931	62367	37435	2.31

Table 6.11 : (a) Performance of Cluster FLDs on Chickpea, in Central Maharashtra Plateau Zone during Rabi (Rainfed) 2015-16

DISTRICT (KVK)	Technology demonstrated	Variety	Area(ha) Demo No	Yield (q/ha)			% increase over existing
				Demo highest	Demo	Check	
Aurangabad (VNMKV)	Var+bio-fertz+PP	Digvijay	20(50)	22.5	12.3	8.37	47.0
Aurangabad(MGM)	Var=bio-fertz+sulphur	JAKI-9218	20(50)	14.38	10.55	9	17.2
Beed (Ambajogai)	Var+Sulphur	Akash	20(50)	24.0	11.86	9	31.8
Beed (Khamogaon)	Var=bio-fertz+sulphur+PP	Akash	9.6(24)	18.0	14.7	8.0	83.75
Jalna	Var+bio-fertz&pesticideses	JAKI-9218	15(37)	14.87	9.93	8.5	16.8
Nanded (Pokharni)	Var+bio-fertz.& pesticideses,Zn	Digvijay	11(27)	12.5	10	5.76	73.6
Parbhani	Var=bio-fertz+sulphur+PP	Digvijay	20(50)	17.5	12.9	10.35	24.6
Total/Wt.Average :			**115.6/(288)**		**11.70**	**8.67**	**34.95**

Table 6.11 : (b) Economic of Cluster FLDs on Chickpea, in Central Maharashtra Plateau Zone during Rabi (Rainfed) 2015-16

KVK	Demonstration plot				Farmer's Existing plot			
	Gross Cost (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C ratio	Gross cost (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C Ratio
VNMKV (A'bad)	39500	75250	35750	1.9	35250	60375	25125	1.7
MGM (A'bad)	22200	43255	21055	1.94	19620	26076	6456	1.32
Ambajogai (Beed)	20000	53392	33392	2.66	17500	37100	19600	2.12
Khamgaon (Beed)	30000	60270	30270	2	30000	47150	17150	1.6
Jalna	20375	50240	29865	2.47	21750	39720	17970	1.83
Pokharni (Nanded)	16190	40000	23810	2.47	13500	23040	9540	1.7
Parbhani	26000	51600	25600	1.98	27000	41400	14400	1.53
Average :	24895	53430	28535	2.20	23517	39266	15749	1.69

Visit of monitoring team ICAR, GOI to Cluster FLD on Bengalgram at Jalna district

View of Bengal Gram plot At Salwadgaon Village, Aurangabad (VNMKV)

Table 6.12 : (a) Performance of Cluster FLDs on Chickpea, in Central Maharashtra Platae Zone in Maharastra Rabi (Irrigated) 2015-16

DISTRICT (KVK)	Technology demonstrated	Variety	Area(ha) Demo No	Yield (q/ha)			% increase over existing
				Demo highest	Demo	Check	
Nanded (Pokharni)	Var+bio-fertz.& pesticideses,Zn	JAKI-9218	4(10)	17.5	13.12	7.63	72.0
Nanded (Sagroli)	Var=bio-fertz+sulphur+PP	JAKI-9218	20(50)	26.5	20.69	12.5	65.5
Beed (Khamogaon)	Var=bio-fertz+sulphur+PP	Akash	5.4(13)	18.0	16.74	8.0	109.25
Hingoli	Var=bio-fertz+sulphur+PP	Akash	20(50)	27.5	19.8	12.72	55.7
Total/Wt. Average			**49.4(123)**		**19.28**	**11.70**	**64.78**

Table 6.12 : (b) Economic of Cluster FLDs on Chickpea, in Central Maharashtra Platae Zone in Maharastra Rabi (Irrigated) 2015-16

KVK	Demonstration plot				Farmer's Existing plot			
	Gross Cost (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C ratio	Gross cost (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C Ratio
Pokharni (Nanded)	16378	52480	36103	3.2	13500	30520	17020	2.26
Sagroli (Nanded)	40285	84837	44552	2.1	38740	68683	29943	1.77
Khamgaon	30000	60270	30270	2	30000	47150	17150	1.6
Hingoli	24933	83160	58228	3.33	21750	63504	41754	2.92
Average :	27899	70187	42288	2.66	25998	52464	26467	2.14

Table 6.13 : (a) Performance of Cluster FLDs on Chickpea, in Western Maharashtra Dry Zone during Rabi (Irrigated) 2015-16

DISTRICT (KVK)	Technology demonstrated	Variety	Area(ha) Demo No	Yield (q/ha)			% increase over existing
				Demo highest	Demo	Check	
Ahmednagar (Bableshwar)	Var+bio-fertz,bio-pesticides,Zn	Digvijay	15(37)	20.62	17.87	15.05	18.7
Ahmednagar (Dahigaon)	Var+bio-fertz,bio-pesticides,Zn	JAKI-9218	15(25)	21.3	19.18	9.6	99.8
Dhule	Var+bio-fertz,bio-pesticides, Zn,weed mgt.	Digvijay	20(50)	25	17.9	10.5	70.5
Jalgaon (Pal)	Var+bio-fertz,pesticides, Zn,	Digvijay	20(50)	23.5	20.74	16	29.6
Kolhapur	Var+bio-fertz,IPM	Digvijay	20(50)	31.43	25.17	13	93.61
Nandurbar	Var+bio-fertz,bio-pesticides	Digvijay	20(50)	14.35	13.02	9.73	33.8
Nasik (Malegaon)	Var+bio-fertz,IPM	Digvijay	10(25)	27.93	21.16	12.17	73.9
Nasik (YCMOU)	Var+bio-fertz,pesticides	Digvijay	15(37)	18.5	15.95	9.5	67.9
Satara (Borgaon)	Var+bio-fertz,IPM	Digvijay	15(24)	32.5	24.23	10.38	133.4
Pune (Baramati)	Var+bio-fertz,bio-pesticides, Zn,weed mgt.	Digvijay	20(50)	25.5	19.87	16.12	23.3
Pune (Narayanagaon)	Var+bio-fertz,IPM	Digvijay	20(50)	27.2	24.31	16.5	47.3
Sangli	Var+bio-fertz,IPM	Digvijay	10(25)	30	27.07	20.82	30.0
Solapur (Khed)	Var+bio-fertz,bio-pesticides, Zn,weed mgt.	Digvijay	20(50)	38.75	27.43	12.5	119.4
Total/Wt. Average :			**205(499)**		**22.49**	**14.07**	**59.78**

Table 6.13 : (b) Economic of Cluster FLDs on Chickpea, in Western Maharashtra Dry Zone during Rabi (Irrigated) 2015-16

KVK	Demonstration plot				Farmer's Existing plot			
	Gross Cost (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C ratio	Gross cost (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C Ratio
Babhaleshwar	34783	76863	42073	2.21	33171	64810	31639	2.04
Dahigoan	26619	78621	52002	1.95	24698	56875	32177	1.3
Dhule	22500	53685	31185	2.39	21000	38940	17940	1.85
Pal (Jalgaon)	14600	89225	74625	5.1	15800	67650	51850	3.3
Kolhapur	36931	74940	38009	1.98	37437	65446	28009	1.71
Nandurbar	15700	62496	46796	3.98	14050	45244	31194	3.22
Malegaon	36600	64993	28393	1.77	33091	84636	51545	2.55
YCMOU	21450	54230	32780	2.53	17800	32300	14500	1.81
Boargaon	28250	102500	74250	2.60	30250	71750	41500	1.40
Baramati	35970	86145	50176	2.44	34122	65699	31577	1.99
Narayangaon	48452	88150	39697	1.81	48452	88150	39697	1.81
Sangli	42300	108280	65980	2.55	48150	93690	45540	1.94
Solapur	32764	123435	90672	3.77	15781	38720	22940	2.45
Average :	30532	81813	51280	2.70	28754	62608	33854	2.11

Bengalgram demonstrations, Ahmednagar, Babhaleshwar KVK

Field visits to FLDs on Bengalgram at Ahemdnagar, Dahigaon

Table 6.14 : (a) Performance of Cluster FLDs on Chickpea, in Western Maharashtra Dry Zone during Rabi (Rainfed) 2015-16

DISTRICT (KVK)	Technology demonstrated	Variety	Area(ha) Demo No	Yield (q/ha)			% increase over existing
				Demo highest	Demo	Check	
Jalgaon (Mumrabad)	Var+bio-fertz,bio-pesticides,	Digvijay	20(50)	16.25	13.0.5	8.3	38.6
Satara (Karad)	Var+bio-fertz,bio-pesticides	Digvijay	10(24)	16.58	13.54	10.38	30.4
Solapur (Mohal)	Var+bio-fertz,pheromone traps	Digvijay	20(50)	12.5	8.15	4	103.8
Total/Wt.Average			**65(161)**		**11.19**	**7**	**59.92**

Table 6.14 : (b) Economic of Cluster FLDs on Chickpea, in Western Maharashtra Dry Zone during Rabi (Rainfed) 2015-16

KVK	Demonstration plot				Farmer's Existing plot			
	Gross Cost (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C ratio	Gross cost (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C Ratio
Mumrabad	38036	47682	9646	1.21	35516	42500	6984	1.2
Karad	31265	40776	9511	1.3	32357	34665	2308	1.1
Mohal	23000	34230	11230	1.49	20750	24000	3250	1.15
Average :	30767	40896	10129	1.33	29541	33722	4181	1.15

Yield comparison of Cluster FLDs over District and State wise

An attempt was made to see the performance of Cluster FLDs through comparison of average yields obtained in the demonstrations with that of district and state average of different crops.

Red gram : In case of rabi redgram the average yields obtained under cluster FLDs are higher 167.3 and 157.6 % over district and state average (Table 6.15).

Table: 6.15. Yield comparison of Cluster FLDs over district and State wise in Telangana

Sl. No	STATE	District (KVK)	Variety	Avg. yield (q/ha)						
				Demo	Check	% increase	District	% increase	State	% increase
1	TS	Nalgonda (Kampasagar)	LRG-41	12.75	8.75	45.7	4.77	167.3	4.95	157.6

Green gram : The cluster FLDs organized on green gram crop with improved technology gave higher average yields 19.9 to to 126.4 % over district and 20.9 to 62.6% over State.

Table 6.16 : Yield comparison of Cluster FLDs over district and State wise in Telangana & Andhra Pradesh

Sl. No	STATE	District (KVK)	Variety	Avg. yield (q/ha)						
				Demo	Check	% increase	District	% increase	State	% increase
1	AP	Chittoor (RAAS)	LGG-460	9.83	8.45	16.3	8.2	19.9	8.13	20.9
2	AP	Srikakulam	LGG-460	12.0	9.1	31.8	5.3	126.4	8.13	47.6
3	AP	Vizianagaram (R.K.Bai)	LGG-460	8.5	7.1	19.7	4.8	77.1	8.13	4.6
4	TS	Khammam (Wyra)	MGG-295	8.14	5.4	50.7	5.67	43.6	5.13	58.7
5	TS	Karimnagar (J)	WGG-42	8.34	5.4	54.4	5.8	43.8	5.13	62.6

Black gram : Where the average yields attained in cluster FLDs compared with district average, the yields are higher in four districts except Krishna. In Krishna district, the blackgram is grown traditional and farmers are well versed with the cultivation of blackgram. The yields are higher by 92 % over district and 85% over state average yields.

Table 6.17 : Yield comparison of Cluster FLDs over district and State wise in Andhra Pradesh

Sl. No	STATE	District (KVK)	Variety	Avg. yield (q/ha)						
				Demo	Check	% increase	District	% increase	State	% increase
1	AP	Guntur (Lam)	PU-31	17.12	12.3	39.2	10.0	71.2	9.25	85.1
2	AP	Krishna (Ghantasala)	LBG-752	12.3	10.3	19.4	11.7	5.1	9.25	33.0
3	AP	Vizianagaram (R.K.Bai)	LBG-752	10.8	9.1	18.7	5.6	92.9	9.25	16.8
4	AP	W.Godavari (V.R.Gudem)	LBG-752	10.36	8.18	26.6	8.9	16.4	9.25	12.0

Bengal gram : In chickpea, the demonstration average yields in Telangana, under rainfed was higher than the district in majority of the locations. The demonstration yields when compare with the state average increase is 16-98 and 5-73 % over district and state average yields.

Table 6.18 : Yield comparison of Cluster FLDs over district and State wise in Telangana

Sl. No	STATE	District (KVK)	Variety	Avg. yield (q/ha)						
				Demo	Check	% increase	District	% increase	State	% increase
1	TS	Adilabad	JG-11	15	12.5	20.0	11.95	25.5	13.7	9.5
2	TS	Karimnagar (Ramgirikilla)	JG-11	14.4	5	188.0	12.34	16.7	13.7	5.1
3	TS	Mahabubnagar (Palem)	JG11	15	9	66.7	12.00	25.0	13.7	9.5
4	TS	Rangareddy	Jaki 9218	13.63	13	4.8	10.00	36.3	13.7	-0.5
5	TS	Adilabad (I)	JG-11	23.75	20	18.7	11.95	98.7	13.7	73.4

In Andhra Pradesh also, the cluster FLDs organized under rainfed situation has not given higher than the demonstration. But Ananthapur, Kurnool the satisfactory yields were obtained due to cyclonic rains received during November month. Under irrigated conditions the demonstrations yields are higher in Kurnool than the district and state averages.

Table 6.19 : Yield comparison of Cluster FLDs over district and State wise in Andhra Pradesh

Sl. No	STATE	District (KVK)	Variety	Avg. yield (q/ha)						
				Demo	Check	% increase	District	% increase	State	% increase
1	AP	Ananthapur (Reddipalli)	NBeG-3	19.35	8.5	127.6	9.26	109.0	14.79	30.8
2	AP	Kurnool (Yagantipally) (I)	JG-11	18.17	11.75	54.6	5.68	219.9	14.79	22.9

In Maharashtra, the average yields harvested in chickpea under cluster FLDs are higher than the district and state average yields.

Table 6.20 : Yield comparison of Cluster FLDs over district and State wise in Maharashtra

Sl. No	STATE	District (KVK)	Variety	Avg. yield (q/ha)						
				Demo	Check	% increase	District	% increase	State	% increase
1	MS	Ahmednagar (Babhaleshwar)	Digvijay	17.87	15.05	18.7	7.73	131.2	9.22	93.8
2	MS	Ahmednagar (Babhaleshwar)	Vishal	16.47	13.75	19.8	7.73	113.1	9.22	78.6
3	MS	Ahmednagar (Dahigoan)	JAKI- 9218	19.18	9.6	99.8	7.73	148.1	9.22	108.0
4	MS	Akola	JAKI- 9218	17.42	12.5	39.4	12.75	36.6	9.22	88.9
5	MS	Amravati (Durgapur)	JAKI- 9218	15.75	7.5	25.6	11.49	37.1	9.22	70.8
6	MS	Amravati (Ghatkhed)	JAKI- 9218	20.1	16	25.6	11.49	74.9	9.22	118.0
7	MS	Aurangabad (VNMKV)	Digvijay	15.2	8.37	47.0	7.6	100.0	9.22	64.9
8	MS	Aurangabad (MGM)	JAKI- 9218	10.9	9	21.1	7.6	43.4	9.22	18.2
9	MS	Beed (Ambajogai)	Akash	14.45	9	60.5	7.45	94.0	9.22	56.7
10	MS	Beed (Khamgaon)	Akash	14.7	8	83.7	7.45	97.3	9.22	59.4
11	MS	Bhandara (Sakoli)	JAKI-9218	9.34	5.52	69.2	6	55.7	9.22	1.3
12	MS	Buldhana (ARS)	JAKI- 9218	18.72	5.8	222.8	7.99	134.3	9.22	103.0
13	MS	Buldhana (Jalgoan Jamod) (I)	JAKI- 9218	12.44	10.34	20.3	7.99	55.7	9.22	34.9
14	MS	Buldhana (Jalgoan Jamod)(I)	Digvijay	13.45	10.34	30.1	7.99	68.3	9.22	45.9
15	MS	Chandrapur (Sindewahi)	JAKI- 9218	10.8	4.5	140	5.23	106.5	9.22	17.1
16	MS	Dhule	Digvijay	17.9	10.5	70.5	12.59	42.2	9.22	94.1
17	MS	Gadchiroli	JAKI- 9218	9	3.5	157.1	4.8	87.5	9.22	-2.4
18	MS	Gondia	JAKI- 9218	8.4	7.3	15.1	4.96	69.4	9.22	-8.9
19	MS	Hingoli	Akash	19.8	12.72	55.7	10.62	86.4	9.22	114.8
20	MS	Jalgaon (Mumrabad)	Digvijay	13	8.3	56.6	11.56	12.5	9.22	41.0
21	MS	Jalgaon (Pal)	Vijay	20.74	16	29.6	11.56	79.4	9.22	124.9
22	MS	Jalna	Digvijay	9.93	8.5	16.8	8.76	13.4	9.22	7.7
23	MS	Kolhapur	Digvijay	25.1	13	93.0	11.91	110.7	9.22	172.2

24	MS	Nagpur	JAKI- 9218	17.17	14.25	20.5	6.87	149.9	9.22	86.2
25	MS	Nanded (Pokharni)	Digvijay	10	5.76	73.6	9.13	9.5	9.22	8.5
26	MS	Nanded (Pokharni)	JAKI- 9218	13.12	7.63	72.0	9.13	43.7	9.22	42.3
27	MS	Nanded (Sagroli)	JAKI- 9218	20.69	12.5	65.5	9.13	126.6	9.22	124.4
28	MS	Nandurbar	Digvijay	13.02	9.73	33.8	8.55	52.3	9.22	41.2
29	MS	Nasik (Malegaon)	Digvijay	21.16	12.17	73.9	6.56	222.6	9.22	129.5
30	MS	Nasik (YCMOU)	Digvijay	15.95	9.5	67.9	6.56	143.1	9.22	73.0
31	MS	Parbhani	Digvijay	12.9	10.35	24.6	7.13	80.9	9.22	39.9
32	MS	Pune (Baramati)	Digvijay	19.87	16.12	23.3	8.15	143.8	9.22	115.5
33	MS	Pune (Narayangaon)	Digvijay	24.31	16.5	47.3	8.15	198.3	9.22	163.7
34	MS	Sangli	Digvijay	27.07	20.82	30.0	7.43	264.3	9.22	193.6
35	MS	Satara (Boargaon)	Digvijay	24.23	8	202.1	6.72	260.6	9.22	162.8
36	MS	Satara (Karad)	Digvijay	13.54	10.38	30.4	7.99	69.5	9.22	46.9
37	MS	Satara (Karad)	Jaki 9218	11.33	10.38	9.2	7.99	41.8	9.22	22.9
38	MS	Solapur (Mohal)	Digvijay	8.15	4	103.8	5.56	46.6	9.22	-11.6
39	MS	Solapur (Mohal)	Digvijay (BBF + ICM)	11.5	7.56	52.1	5.56	106.8	9.22	24.7
40	MS	Solapur (Mohal)	Digvijay (Ridge & Furrow+ICM)	18.75	12.5	50.0	5.56	237.2	9.22	103.4
41	MS	Solapur (Mohal)	Digvijay Drip + ICM)	27.43	12.5	119.4	5.56	393.3	9.22	197.5
42	MS	Thane(Palghar)	Digvijay	9.1	5	82.0	11.88	-23.4	9.22	-1.3
43	MS	Wardha (Selsura)	JAKI- 9218	16.58	14.84	11.7	7.56	119.3	9.22	79.8
44	MS	Washim (Karda)	Digvijay	10.9	9.6	13.5	10.71	1.8	9.22	18.2
45	MS	Yavatmal	JAKI- 9218	20.7	16.85	22.8	8.14	154.3	9.22	124.5

Comparative performance of different improved varieties of Pulses under Cluster FLDs during Rabi 2015-16

In greengram four varieties viz., LGG-460, TM-96-2, MGG-295 & WGG-42 were demonstrated during rabi / summer seasons in Andhra Pradesh and Telangana States iunder irrigated condition. The average yields of the varieties over the locations is ranged from 8.17 to 8.41 q/ha. The low yields are due to low moisture, high temperatures and incidence of insect pest and diseases despite adopting the plant protection measures.

Table 6.21 : Comparative performance of different varieties of Green gram under Cluster FLDs in Telangana and Andhra Pradesh

Sl. No	Variety demonstrated	No. of Demo	Yield (q/ha)		
			Demo	Check	% increase
1	LGG-460	85	8.41	6.98	20.5
2	TM-96-2	40	8.2	5.0	64.0
3	MGG-295	23	8.14	5.4	50.7
4	WGG-42	50	8.34	5.4	54.4

In blackgram two varieties viz., LBG-752 and PU-31 were taken up in the demonstrations under rabi residual moisture condition over the locations LBG-752 gave an average yield of 8.61 q/ha with a highest average yield of 12.3 q/ha in Krishna district. Variety PU-31, under irrigated situation in upland areas of Guntur gave an average yield of 17.12 q/ha and found resistant to yellow mosaic virus disease compared to LBG-752.

Table 6.22 : Comparative performance of different varieties of Black gram under Cluster FLDs in Andhra Pradesh

Sl.No	Variety demonstrated	No.of Demo	Yield (q/ha)		
			Demo	Check	% increase
1	LBG-752 (Rainfed)	242	8.61	6.72	28.1
2	PU-31 (Irrigated)	13	17.12	12.03	39.2

In Chickpea, in Telangana and Andhra Pradesh States, under protective irrigation three varieties viz., NBeG-3, JG-11 and JAKI-9218 were demonstrated. Over the locations variety JG-11 got highest average yield of 14.6 q/ha fallowed by JAKI-9218, 13.63 q/ha and NBeG-3, 12.4 q/ha.

Table 6.23 : Comparative performance of different varieties of Bengal gram under Cluster FLDs in Telangana and Andhra Pradesh

Sl.No	Variety demonstrated	No.of Demo	Yield (q/ha)		
			Demo	Check	% increase
1	NBeG-3	125	12.4	7.9	56.1
2	JG-11	245	14.6	10.1	44.2
3	JAKI-9218	25	13.63	13.0	4.8

In Maharashtra, among the demonstrated varieties, Digvijay & Akash gave almost similar yields 16.5 & 16.3 q/ha where as JAKI-9218 gave an average yield of 14.8 q/ha.

Table 6.24 : Comparative performance of different varieties of Bengal gram under Cluster FLDs in Maharashtra

Sl. No	Variety demonstrated	No.of Demo	Yield (q/ha)		
			Demo	Check	% increase
1	Akash	137	16.3	9.9	64.7
2	Digvijay	839	16.5	10.8	53.6
3	JAKI-9218	557	14.8	9.9	49.8

5. ICAR-ATARI, ZONE IV
(Uttar Pradesh and Uttarakhand)

The ICAR project entitled Cluster Frontline Demonstrations (FLDs) of Rabi Pulses under NFSM 2015-16 was sanctioned by Government of India, Ministry of Agriculture & Farmers Welfare, Department of Agriculture, Co-operation & Farmers Welfare with an aim to enhance the production of pulses in the country and it was implemented by the Division of Agricultural Extension, ICAR, New Delhi through eight ICAR-ATARIs located in different Zones of the country. Under this project, National Food Security Mission (NFSM) had sponsored 210.65 lakh rupees to ICAR-ATARI, Zone-IV, Kanpur during month of September 2015. Under Zone-IV, Kanpur, Frontline Demonstrations (FLDs) were implemented by Krishi Vigyan Kendras (KVKs) in two states namely Uttar Pradesh & Uttarakhand in during *Rabi* and *summer season* 2015-16. For conducting each FLD, Rs. 3000 per acre were allotted for pulses i.e. chickpea, lentil and summer moong.

Area Production and Productivity of Pulses in Uttar Pradesh:

Chickpea: The average area of chickpea is 0.58 million hectare and production of 0.60 million tonnes were as average yield of chickpea in Uttar Pradesh is 1031 kg/ha. The details are as follows.

Table 5.1 : Area, Production and Productivity of Chickpea

Year	Area	Production	Yield
2008-09	0.55	0.56	1018
2009-10	0.62	0.51	823
2010-11	0.57	0.53	930
2011-12	0.58	0.68	1172
2012-13	0.60	0.73	1217
Average (2008-13)	0.58	0.60	1031

Area -million Hectares, Production - Million Tonnes, Yield- Kg/Hectare
Source:- National Food Security Mission(NFSM)

Lentil: The average area of lentil is 513.48 thousand hectare and production of 458.56 thousand tonnes were as average yield of lentil in Uttar Pradesh is 832 kg/ha. The details are as follows:

Table 5.2 : Area, Production and Productivity of Lentil

Year	Area	Production	Yield
2008-09	321.0	460.0	883
2009-10	592.4	475.8	803
2010-11	586.0	411.0	701
2011-12	573.0	505.0	881
2012-13	495.0	441.0	891
Average (2008-13)	513.48	458.56	832

Area -(000' ha), Production - -(000' tons), Yield- Kg/Hectare
Source:- IIPR, Kanpur

Field pea: The average area of Field pea is 318.0 thousand hectare and production of 419.88 thousand tonnes were as average yield of Field pea in Uttar Pradesh is 1316 kg/ha. The details are as follows:

Table 5.3 : Area, Production and Productivity of Field pea

Year	Area	Production	Yield
2008-09	351.0	424.0	1208
2009-10	312.0	400.4	1283
2010-11	304.0	353.0	1161
2011-12	323.0	463.0	1433
2012-13	304.0	459.0	1495
Average (2008-13)	**318.8**	**419.88**	**1316**

Area -(000' ha), Production - -(000' tons), Yield - Kg/Hectare
Source:- IIPR, Kanpur

Summary

FLDs were conducted in total area of 2542ha by Zone IV on pulses like lentil, chickpea, field pea, black gram and green gram. The list of FLDs allotted and conducted state wise and crop wise during rabi and summer 2015-16 by the KVKs of Zone-IV is given in Table 5.4. The KVKs were not able to conduct allotted FLDs in chickpea, lentil and Rajmash due to shortage of quality seed and climatic factor. The allotted FLDs to KVKs were converted to FLDs in summer Moong & Urd.

In Zone-IV, 2704 ha were allotted in different pulses crop like chickpea (644), lentil (1096), field pea (522), rajmash (250) and greengram (192) out of total allotted 2542 ha area were conducted in chickpea (543), field pea (566) and lentil (939), black gram (186) and greengram (308), however, 257 ha deficient area from chickpea, rajmash & lentil are converted to field pea, summer moong & urd.

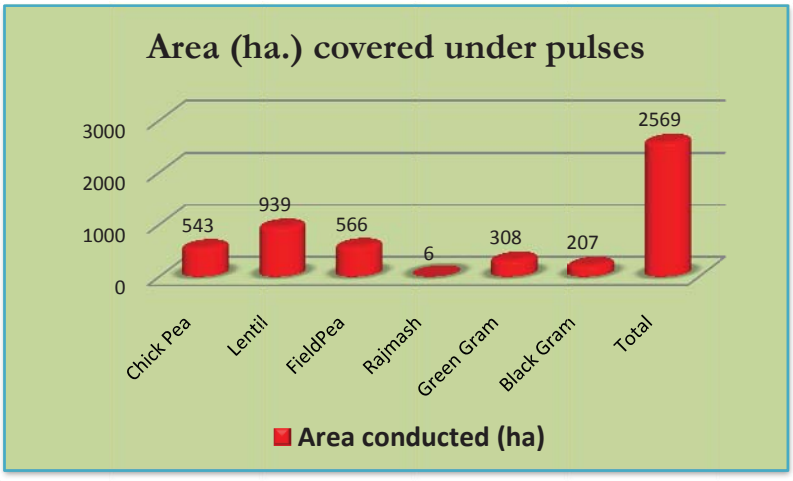


Table 5.4: Summary of Pulses in Zone IV

Crop	Area Allotted (ha)	Area conducted (ha)	Area Converted (ha.)	Remaining Area (ha)
Chick Pea	644	543	346 ha deficient area from C.P., Rajmash & Lentil converted to Fieldpea, summer Moong & Urd	0
Lentil	1096	939		0
Field Pea	522	566		0
Rajmash	250	0		162
Green Gram	192	308		0
Black Gram	0	186		0
Total	**2704**	**2542**		**162**

(i) Chickpea: Cluster FLDs on Chickpea were conducted in an area of 1358 acre (543 ha) by 23 KVKs in Uttar Pradesh. Results indicate that the average demo yield of 14.75 q/ha with yield increase of 49.89 per cent in Uttar Pradesh was more as compared to Existing farmers Yield (9.84q/ha) followed by 43.62 percent yield increases over district level (10.27q/ha). Among Chickpea varieties demonstrated, Jaki-9218 was demonstrated in more area (570 acre) with 640 farmers by 11 KVKs viz., Allahabad, Auriya, Lalitpur, Varanasi, Banda, Jhansi, Kaushambi, Mirzapur, Jalaun, Etawah, and Unnao followed by RSG-945, 963, 895, 973, Awrodhi, Uday, JG 16, KGD 1168, KPG-59, PG-186, and DCP 92-3 in 701 acre with 704 farmers by fourteen KVKs .

Varietal Performance of Chickpea (JAKI-9218) in Uttar Pradesh

In Uttar Pradesh cluster FLD on chickpea var, JAKI-9218 was conducted in an area of 569.65 acre through Krishi Vigyan Kendras in 11 districts of Uttar Pradesh. All the KVKs conducted FLDs with full packages of practices. Results shows that the average demonstration yield of JAKI-9218 is 16.19q/ha and maximum average demonstration yield is 17.83q/ha followed by minimum average demonstration yield is 14.42q/ha. The average farmer existing yield is 10.17q/ha. were as demonstration yield is 59.19 percent (6.02q/ha) higher than farmer existing yield (Table 5.5).

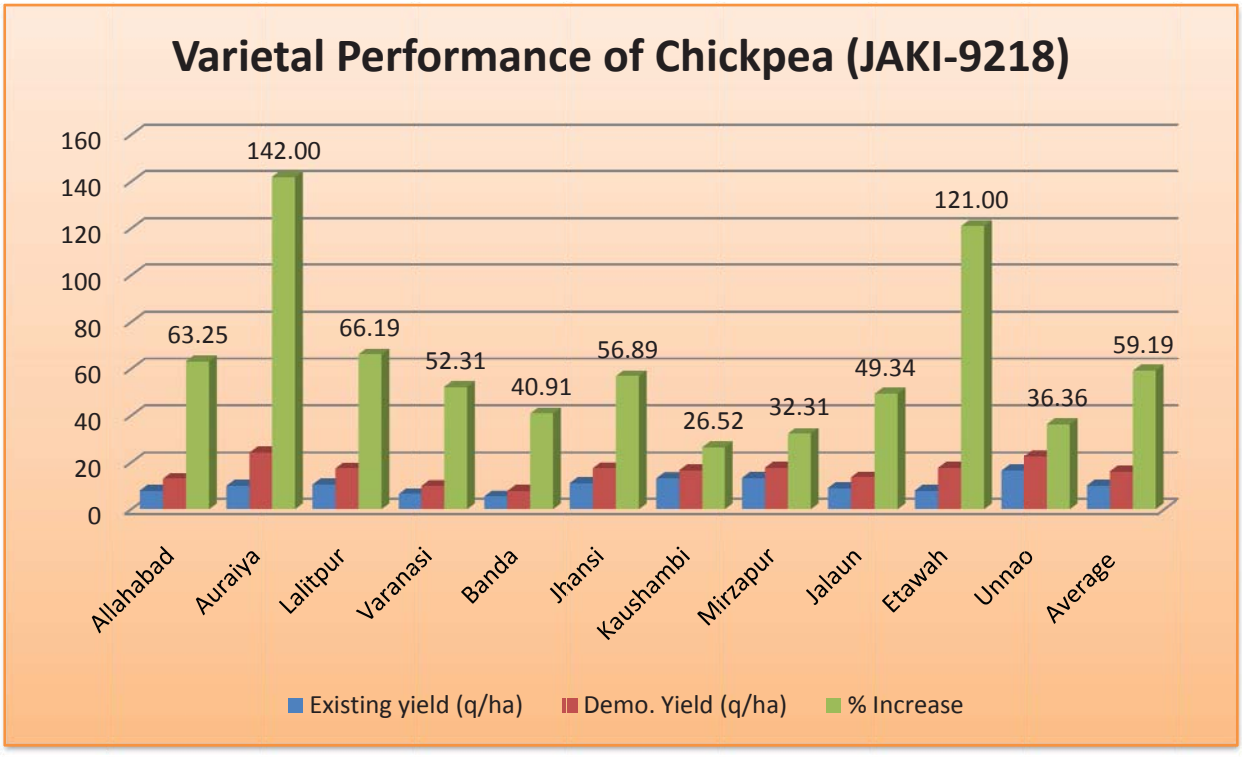


Table 5.5 : Varietal Performance of JAKI - 9218 (UP)

Sl. No	KVK	Existing yield (q/ha)	Variety demonstrated	Area (Acre)	Yield obtained (q/ha)		
					Max.	Min.	Av.
1	Allahabad	08.00	JAKI-9218	25	14.00	12.50	13.06
2	Auraiya	10.00	JAKI-9218	40	26.70	20.80	24.2
3	Lalitpur	10.50	JAKI-9218	124	18.50	16.40	17.45
4	Varanasi	06.50	JAKI-9218	40	11.80	08.50	9.9
5	Banda	05.50	JAKI-9218	125	08.50	06.00	7.75
6	Jhansi	11.18	JAKI -9218	15	21.20	13.32	17.54
7	Kaushambi	13.20	JAKI-9218	15	16.86	16.63	16.7
8	Mirzapur	13.40	JAKI-9218	60	20.00	15.46	17.73
9	Jalaun	09.12	JAKI- 9218	106	14.75	12.50	13.62
10	Etawah	08.00	JAKI-9218	6.65	19.35	16.05	17.68
11	Unnao	16.50	JAKI-9218	13	24.50	20.50	22.5
	Total/mean	**10.17**		**569.65**	**17.83**	**14.42**	**16.19**

In Auriya district chickpea (Jaki-9218) crop demonstrated in 40 acre with full package of practices. The Promising technology demonstrated are variety JAKI (9218) with application, seed treatment with Carbendazime @2 gm/kg of seed, along with soil test based recommended fertilizer NPK @(20:60:40 kg/ha). Result shows that the average demonstration yield is 24.2 q/ha. The District average yield is 10.0q/ha. There was yield advantage of 14.2q/ha (142%) over district yield. Farmers are satisfied with technology and variety.

(ii) Lentil: Cluster demonstrations on lentil were conducted in an area of 2348 acre (939) ha by 49 KVKs. In Uttar Pradesh 52 KVKs conducted 2148 demonstration (863) with 2333 farmers and 6 KVKs in Uttarakhand conducted 190 demonstration in 75 ha area. In Uttar Pradesh results shows that the average demo yield of 12.50q/ha with yield increase of 38.89 per cent over local check (8.99 q/ha). Among lentil varieties demonstrated in Uttar Pradesh are IPL-81, NDL-1PL-08, IPL-406, L-4594, DPL-62, HUL-57, K-75, Shekhar-3, KLB-320 etc. In Uttarkhand results shows that the average demo yield of 8.53q/ha with yield increase of 37.13 per cent over local check (6.22 q/ha). Among lentil varieties demonstrated are PL-08.

Performance of Lentil var. L-4594

In Uttar Pradesh cluster FLD on lentil var, L-4594 were conducted in an area of 317.00 acre through Krishi Vigyan Kendras in 9 districts of Uttar Pradesh. All the KVKs conducted FLDs with full packages of practices. Results shows that the average demonstration yield of L-

4594 is 13.34 q/ha and maximum average demonstration yield is 16.41/ha followed by minimum average demonstration yield is 10.97/ha. The average farmer existing yield is 10.27q/ha. were as demonstration yield is 29.90 percent (3.07q/ha) higher than farmer existing yield (Table 5.6).

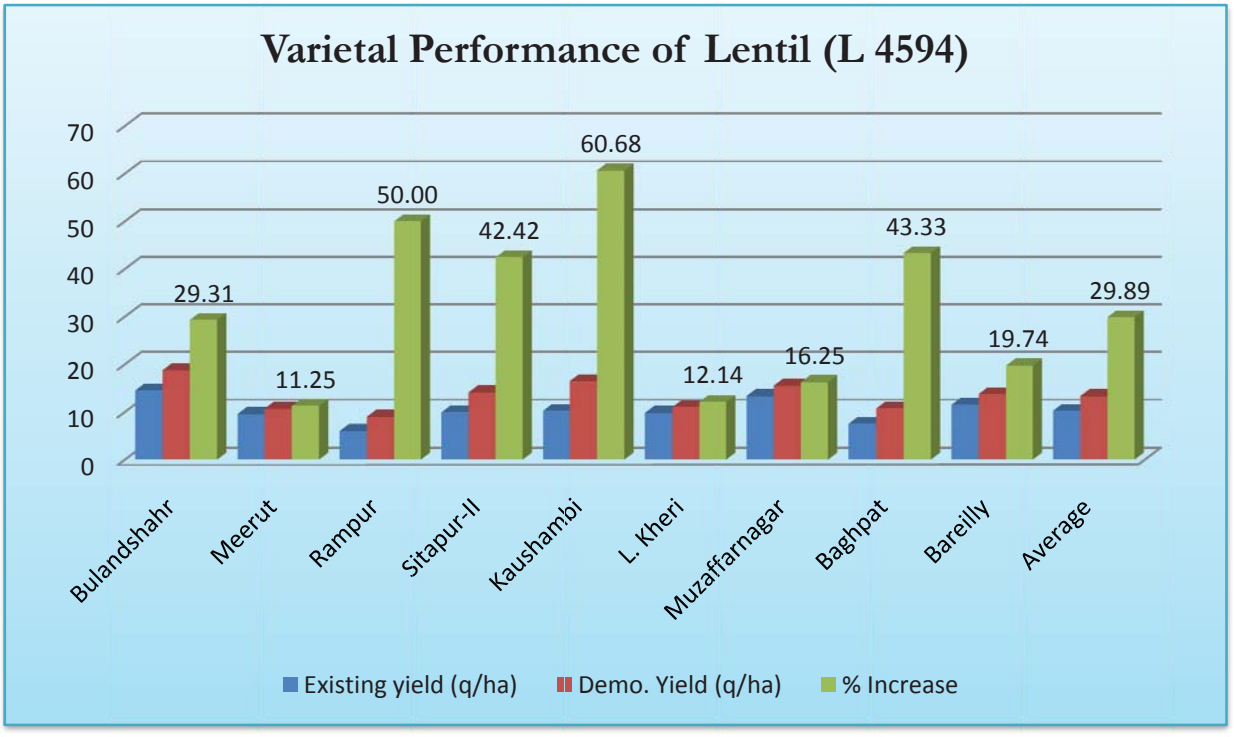
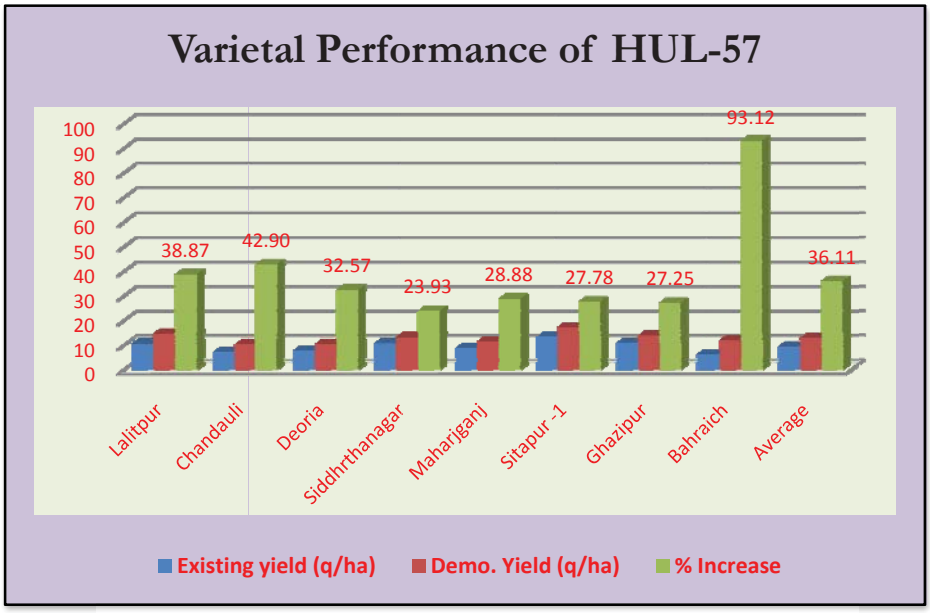


Table 5.6 : Varietal Performance of Lentil (L-4594)

SI. No	KVK	Existing Farmer yield (q/ha)	Variety demonstrated	Area (acre)	Yield obtained (q/ha)		
					Max.	Min.	Av.
1	Bulandshaher	14.50	L-4594	5	21.00	16.50	18.75
2	Meerut	09.60	L 4594	40	15.62	08.00	10.68
3	Rampur	06.00	L-4594	40	12.50	05.50	09.00
4	Sitapur-II	09.90	L-4594	13	15.20	12.20	14.10
5	Kaushambi	10.25	L-4594	50	17.20	15.75	16.47
6	Lakhimpur Kheri	09.80	L-4594	40	15.00	08.00	10.99
7	Muzaffarnagar	13.35	L-4594	40	18.90	12.50	15.52
8	Baghpat	07.50	L-4594	39	15.80	08.00	10.75
9	Bareilly	11.50	L-4594	50	16.50	12.25	13.77
	Average/Total	10.27		317.00	16.41	10.97	13.34

Performance of HUL-57:



The variety (HUL-57) was conducted in an area of 439.00 acre through Krishi Vigyan Kendras in 8 districts of Uttar Pradesh. All the KVKs conducted FLDs with full packages of practices. Results shows in table 5.7. That the average demonstration yield of HUL-57 is 12.93 q/ha and maximum average demonstration yield is 15.38q/ha followed by minimum average demonstration yield is 10.10/ha. The average farmer existing yield is 9.50q/ha. were as demonstration yield is 36.13 percent (3.43q/ha) higher than farmer existing yield. The maximum average yield was obtained in the district of Sitapur (17.25q/ha) followed by Lalitpur (14.72q/ha), Gazipur (13.87q/ha) and Siddarthnagar (1331q/ha). The average yield of other districts ranges between 10.26q/ha to 12.07q/ha.

Table 5.7 :Varietal Performance of HUL-57

SI. No	KVK	Existing Farmer yield (q/ha)	Variety demonstrated	Area (acre)	Yield obtained (q/ha)		
					Max.	Min.	Av.
1	Lalitpur	10.60	HUL-57	124	15.98	13.45	14.72
2	Chandauli	07.18	HUL-57	47	12.25	08.26	10.26
3	Deoria	07.89	HUL 57	46	16.20	07.80	10.46
4	Siddharthnagar	10.74	HUL 57	40	14.70	11.80	13.31
5	Maharjganj	08.90	HUL-57	27	12.70	10.25	11.47
6	Sitapur -1	13.50	HUL-57	65	19.25	15.50	17.25
7	Ghazipur	10.90	HUL-57	40	16.50	11.00	13.87
8	Bahraich	06.25	HUL-57	50	15.43	02.71	12.07
	Average/Total	**9.50**		**439.00**	**15.38**	**10.10**	**12.93**

Varietal performance of DPL-62:

The variety (DPL62) was conducted in an area of 397.00 acre through Krishi Vigyan Kendras in 6 districts of Uttar Pradesh. The varietal performance results shows in given table that the average demonstration yield of DPL-62 is 11.87 q/ha and maximum average demonstration yield is 14.82q/ha followed by minimum average demonstration yield is 10.10/ha. The average farmer existing yield is 8.53q/ha. were as demonstration yield is 61.23 percent (4.51q/ha) higher than farmer existing yield.

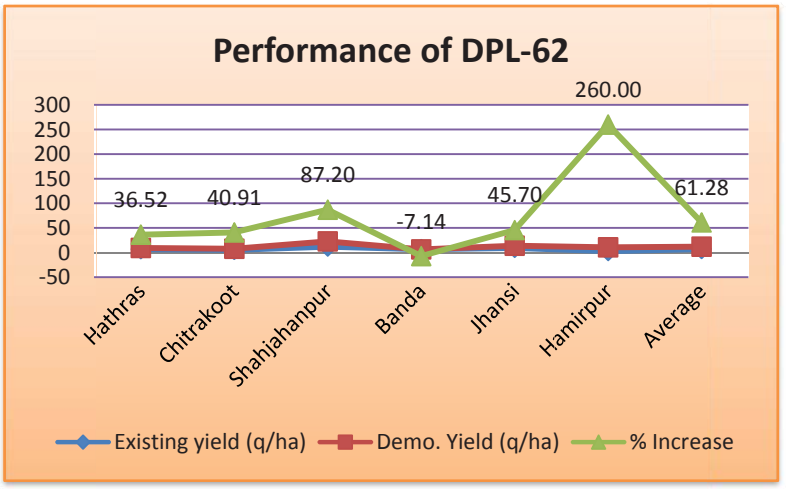


Table 5.8 :Varietal Performance of DPL-62

SI. No	KVK	Existing Farmer yield (q/ha)	Variety demonstrated	Area (area)	Yield obtained (q/ha)		
					Max.	Min.	Av.
1	Hathras	06.90	DPL-62	40	12.75	06.87	09.42
2	Chitrakoot	05.50	DPL-62	125	08.60	03.10	07.75
3	Shahjahanpur	12.11	DPL-62	50	26.75	18.50	22.67
4	Banda	07.00	DPL-62	5	08.50	06.50	06.50
5	Jhansi	09.65	DPL-62	104	18.28	08.89	14.06
6	Hamirpur	03.00	DPL-62	73	14.02	07.30	10.80
	Average/Total	**7.36**		**397.00**	**14.82**	**8.53**	**11.87**

Varietal Performance of IPL-81:

The variety (IPL-81) was conducted in an area of 131.00 acre through Krishi Vigyan Kendras in 4 districts of Uttar Pradesh. The varietal performance results shows that the average demonstration yield of IPL-81 is 11.96 q/ha and maximum average demonstration yield is 13.75 q/ha followed by minimum average demonstration yield is 10.10/ha. The average farmer existing yield is 10.63 q/ha. were as demonstration yield is 44.64 percent (3.69 q/ha) higher than farmer existing yield (Table 5.9).

Table 5.9 : Varietal Performance of IPL-81

SI. No	KVK	Existing Farmer yield (q/ha)	Variety Demonstrated	Area (area)	Yield obtained (q/ha)		
					Max.	Min.	Av.
1	Allahabad	06.40	IPL-81	25	12.50	10.00	11.37
2	Barabanki	11.97	IPL-81	51	16.80	11.8	14.29
3	Mau	09.40	IPL-81	5	14.25	11.60	12.92
4	Fatehpur	05.31	IPL-81	50	11.45	09.10	09.27
	Average/Total	**8.27**		**131.00**	**13.75**	**10.63**	**11.96**

In Saharanpur district lentil (IPL-406) were demonstrated in 40 acre with the active participation of farmers field. The Promising technology demonstrated in Lentil is IPL-406 with application of sulphur 90% (Bentonight) @30kg/ha , seed treatment with fungicide sprint (Carbendazim 2gm+ Mencozeb 1gm) @3gm/kg of seed, seed inoculation with Rhizobium culture @200gm/10kg seed along with soil test based recommended fertilizer NPK @(25:60:40 kg/ha). Result shows that the average demonstration yield is 22.6 q/ha. The District average yield is 14.40 q/ha. There was yield advantage of 8.2q/ha (56.94%) over district yield. The potential yield of variety is 20-25 q/ha

Sahjahanpur KVK conducted demonstration in 20ha acre with lentil variety PL-08. The Promising technology demonstrated are Lentil variety (PL-08) with application of Bentonite Sulphur @25 kg/ha, seed treatment with Carbendazim @ 3gm/kg of seed, with soil test based recommended fertilizer NPK @ (20:40:40 kg/ha). The result shows that average demonstration yield is 22.67 q/ha with yield advantage of 10.56q/ha (87.20%) as compared to their local check (12.11q/ha). Demonstrated yield is 140.65 percent higher than district yield (9.42q/ha)

Performance of Lentil (Pant lentil 08) in Uttarkhand

The Krishi Vigyan Kendras were conducted demonstration of Lentil var. Pant lentil 08 in an area of 75.00 acre in 3 districts of Uttarakhand. The varietal performance results shows that the average demonstration yield of Pant lentil 08 variety is 8.53 q/ha and maximum average demonstration yield is 10.90 q/ha followed by minimum average demonstration yield is 14.15 q/ha. The average farmer existing yield is 6.30 q/ha. were as demonstration yield is 37.04 percent (2.31q/ha) higher than farmer existing yield.

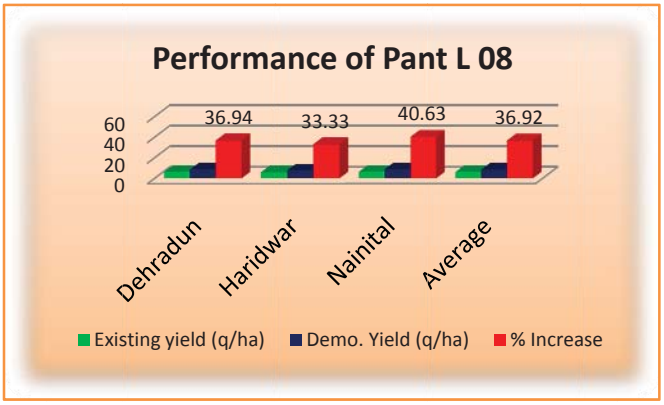


Table 5.10 : Performance of Lentil cv. Pant lentil 08

Sl. No	KVK	Existing yield (q/ha)	Name of Variety demonstrated	Area (acre)	Yield obtained (q/ha)		
					Max.	Min.	Av.
1.	Dehradun	6.28	Pant lentil -08	40	11.20	5.40	8.60
2.	Haridwar	6.00	Pant lentil -08	10	9.50	7.00	8.00
3.	Nainital	6.40	Pant lentil -08	25	12.00	6.50	9.00
	Average	**6.23**		**75.00**	**10.90**	**6.30**	**8.53**

In Uttarakhand, Dehradun KVK conducted lentil demonstration in 10 ha area with variety Pant Lentil-08 in full Packages of practices. The Promising technology demonstrated: Lentil, HYV Pant Lentil 08, seed treatment with thiram 2g+carbendazim 1g per kg of seed, 2% urea as foliar spray at flowering stage. Result shows that average demonstration yield is 8.6q/ha which is 43.33 percent higher than district yield (6.0q/ha) and 48.27 percent higher as compared with state yield (5.8q/ha). The potential yield of variety is 12-18 q/ha.

(iii) Field pea: Cluster demonstrations on Field pea were conducted in an area of 1415 acre (566) ha with active participation 1827 farmers by 27 KVKs of Uttar Pradesh. Results shows that the average demo yield of 16.52q/ha with yield increase of 46.32 per cent over local check (11.29 q/ha). Among field Pea varieties demonstrated in Uttar Pradesh are Vikas, Prakash, Aman, KPMR-400, KPMR-522, HUDP-15, JPF-9925, Jai, Indra, Sapna, Sikha etc.

Varietal performance of Pea cv. Vikas:-

The variety of pea vikas was conducted in an area of 381.00 acre through Krishi Vigyan Kendras in 8 districts of Uttar Pradesh. The varietal performance results shows that the average demonstration yield of pea vikas is 15.01 q/ha and maximum average demonstration yield is 17.50q/ha followed by minimum average demonstration yield is 12.52q/ha. The average farmer existing yield is 10.29 q/ha. were as demonstration yield is 45.92 percent (4.72q/ha) higher than farmer existing yield (Table 5.11).

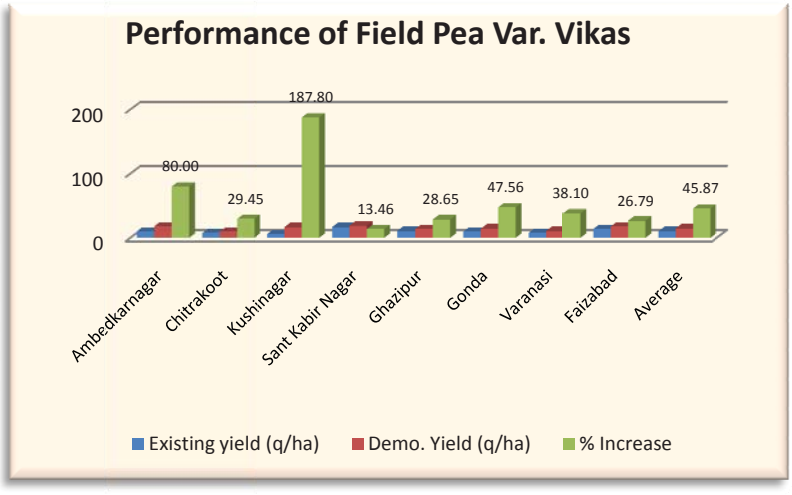
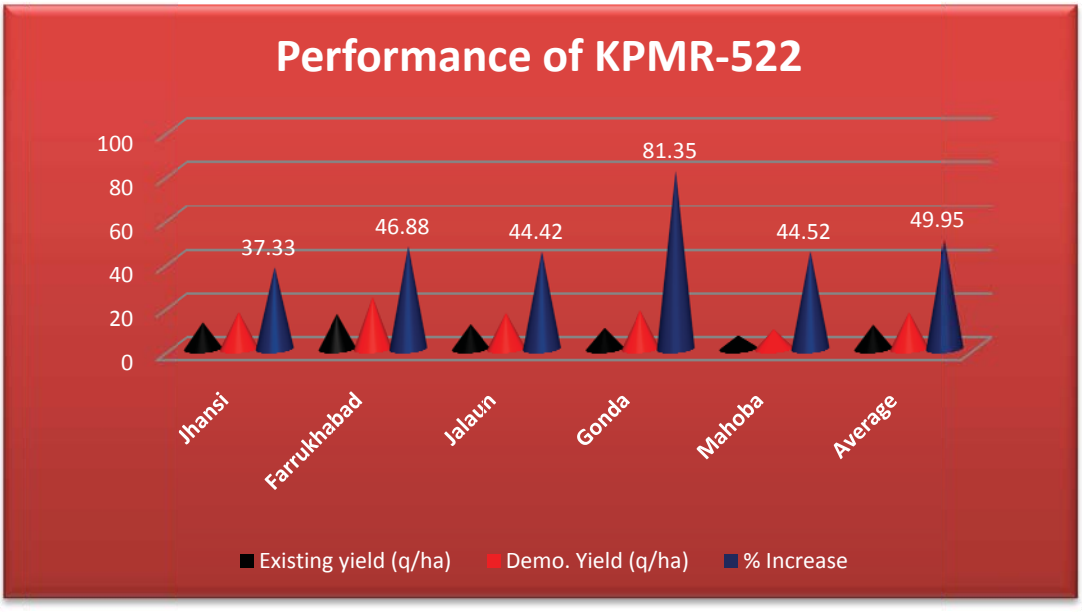


Table 5.11 : Varietal performance of Pea cv. Vikas

Sl. No	KVK	Existing yield (q/ha)	Variety demonstrated	Area (Acre)	Yield obtained (q/ha)		
					Max.	Min.	Av.
1	Ambedkarnagar	10.00	Vikas	40	22.10	14.20	18.00
2	Chitrakoot	07.30	Vikas	113	11.30	08.45	09.45
3	Kushinagar	05.82	Vikas	40	19.25	14.65	16.75
4	Sant Kabir Nagar	16.79	Vikas	40	21.00	16.90	19.05
5	Ghazipur	10.82	Vikas	40	15.00	13.00	13.92
6	Gonda	09.65	Vikas	33	19.50	10.00	14.24
7	Varanasi	07.90	Vikas	35	12.35	09.32	10.91
8	Faizabad	14.00	Vikas	40	19.50	16.00	17.75
		10.29		**381.00**	**17.50**	**12.82**	**15.01**

Varietal Performance of KPMR-522:-



The Krishi Vigyan Kendras were conducted demonstration of field pea var. KPMR-522 in an area of 258.00 acre in 6 districts of Uttar Pradesh. The varietal performance results shows that the average demonstration yield of KPMR-522 is 16.60 q/ha and maximum average demonstration yield is 19.37 q/ha followed by minimum average demonstration yield is 14.15 q/ha. The average farmer existing yield is 11.07 q/ha. were as demonstration yield is 50.01 percent (5.54q/ha) higher than farmer existing yield .

Table 5.12 : Varietal Performance of KPMR-522

Sl. No	KVK	Existing yield (q/ha)	Variety demonstrated	Area (Acre)	Yield obtained (q/ha)		
					Max.	Min.	Av.
1	Jhansi	12.19	KPMR-522	50	22.6	10.6	16.74
2	Farrukhabad	16.00	KPMR-522	40	25.00	22.00	23.50
3	Jalaun	11.30	KPMR-522	138	17.40	15.25	16.32
4	Gonda	9.65	KPMR -522	2	18.50	16.50	17.50
5	Mahoba	6.20	KPMR -522	28	13.33	06.42	08.96
	Average/ Total	**11.07**		**258.00**	**19.37**	**14.15**	**16.60**

KVK Pratapgarh conducted field pea demonstration in 20 ha area with cultivar Aman having soil pH 9.5. The Promising technology demonstrated are New cultivar variety Seed Aman (80 kg/ha), Line sowing (Seed Drill), Weed Management (Pendimethalene@3.3litr/ha) with soil test based recommended fertilizer NPK @(20:60:40 kg/ha). Result shows that the average demonstrated yield is 17.9 q/ha. Which is 32.27 percent higher than district yield (13.54q/ha) and 18.85 percent higher as compared with state yield (15.06 q/ha). The potential yield of the variety is 22.0 q/ha.

KVK sahjahnpur conducted demonstration in 16 ha area with field pea cultivar Aman in full packages of practices. The Promising technology demonstrated are Field Pea variety. Aman with application of Bentonite Sulphur @25 kg/ha , seed treatment with Carbendazim @ 3gm/kg of seed, with soil test based recommended fertilizer NPK @ (20:40:40 kg/ha) sowing will be done in Furrow irrigation raised bed (FIRB) system. Results shows that the average demonstration yield is 22.85 q/ha with yield advantage of 10.06 q/ha (78.65%) as compared with local check yield (12.79 q/ha). The demonstrated yield is 133.16 percent higher than district yield (9.80q/ha) and 202.64 percent higher than state yield (7.55q/ha). The potential yield of variety is 25.00 q/ha.

Demonstrations on summer pulses in Uttar Pradesh and Uttarakhand

Blackgram: Cluster FLDs on urd were conducted in an area of 465 acre (189 ha) by 11 KVKs in Uttar Pradesh. Results indicate that the average demo yield of 9.20 q/ha with yield increase of 37.46 per cent in Uttar Pradesh was more as compared to Existing farmers Yield (6.70q/ha). The technologies demonstrated in the farmer's field were integrated crop management, seed treatment with Chloropyriphos and *Rhizobium*, improved cultivation practices, seed variety and full package of practices.

Table 5.13 : Varietal performance of Blackgram (PU-31)

Sr. No	KVK	Area (ha)	Average Yield (q/ha)		% Increased
			Demo.	Local check	
1.	Bijnour	48	10.90	8.50	28.24
2.	Saharanpur	16	12.84	10.33	24.30
3.	Meerut	16	5.88	4.89	20.25
4.	Muzaffarnagar	16	11.07	8.50	30.24
5.	Baghpat	16	8.25	6.75	22.22
6.	Pilibhit	08	13.65	8.27	65.05
7.	Moradabad	16	9.95	6.83	45.68
8.	Haridwar	20	7.56	5.57	35.73
9.	Pithauragarh	10	8.13	7.26	11.98
10.	Chitrakoot	04	7.50	3.25	130.77
11.	Rampur	16	5.51	3.50	57.43
	Total/Average	**186**	**9.20**	**6.70**	**37.46**

Greengram : Cluster FLDs on moong were conducted in an area of 772 acre (309 ha) by 19 KVKs in Uttar Pradesh. Results indicate that the average demo yield of 9.18 q/ha with yield increase of 38.08 per cent in Uttar Pradesh was more as compared to Existing farmers Yield (6.43q/ha). The technologies demonstrated in the farmer's field were integrated crop management, seed treatment with Chloropyriphos and *Rhizobium*, improved cultivation practices, seed variety (IPM 2-3, PDM 139, IPM 2-174) and full package of practices.

Varietal Performance of IPM 2-3 in Uttar Pradesh

In Uttar Pradesh cluster FLD on Green gram var, IPM 2-3 was conducted in an area of 530acre (212ha) through Krishi Vigyan Kendras in 14 districts of Uttar Pradesh. All the KVKs conducted FLDs with full packages of practices. Results shows that the average demonstration yield of IPM 2-3 is 9.27 q/ha and maximum average demonstration yield is 10.49/ha followed by minimum average demonstration yield is 7.63/ha. The average farmer existing yield is 6.36q/ha. were as demonstration yield is 37.15 percent (2.51q/ha) higher than farmer existing yield.

Sr. No	KVK	Area (ha)	Average Yield (q/ha)				% Increased
			Max. Demo. Yield	Min. Demo. Yield.	Average Demo. Yield	Local check	
1.	Pilibhit	8	13.52	11.14	12.31	7.43	65.68
2.	Bulandsehar	16	7.40	1.00	6.48	4.60	40.87
3.	GB Nagar	16	9.90	6.80	8.30	7.10	16.90
4.	Firozabad	**10**	8.20	2.30	5.25	4.10	28.05
5.	Aligarh	16	10.20	8.50	9.60	7.75	23.87
6.	Mainpuri	12	12.30	9.55	10.92	9.00	21.33
7.	Pratapgarh	19	9.60	7.50	**8.55**	5.00	71.00
8.	Farrukhabad	7	12.20	12.00	12.10	7.50	61.33
9.	Saharanpur	20	11.40	9.20	10.14	8.30	22.17
10.	Bagpath	16	10.75	6.80	8.80	7.50	17.33
11.	Meerut	20	6.75	5.65	6.16	5.50	12.00
12.	Moradabad	16	10.80	7.70	9.67	6.36	52.04
13.	Shahjahanpur	16	11.30	8.90	10.29	6.66	54.50
14.	Muzaffarnagar	20	12.60	9.75	11.17	7.8	43.21
	Total/Average	**212**	**10.49**	**7.63**	**9.27**	**6.76**	**37.15**

7. ICAR-ATARI, ZONE VI
(Rajasthan and Gujarat)

The major area, production and productivity of Rajasthan and Gujarat have been depicted in table 7.1 & 7.2.

Table: 7.1 Area, production and productivity of major pulses in Rajasthan (2013-14).

Pulses	Productivity (kg/ha)	Production (000 tonnes)	Area (000 ha)
Chickpea	853	1640.4	1923.5
Green gram (rabi/summer)	384	391.0	1020.0
Lentil	853	625.00	498.36
Total	**595**	**2490.9**	**4197.7**

Source: http://agriculture.rajasthan.gov.in/images/media/pdf/AgriculturalStatistics/updated_crop-wise_2014-15.pdf

Table: 7.2 Area, production and productivity of major pulses in Gujarat (2013-14).

Pulses	Productivity (kg/ha)	Production (000 tonnes)	Area (000 ha)
Chickpea	1251	309.0	247.0
Green gram (rabi/summer)	579	106.0	183.0
Total	**897**	**729.0**	**813.0**

Source: http://agri.gujarat.gov.in

Constraints in Pulse Production in Rajasthan and Gujarat

1. Availability of quality seed of farmer's preferred varieties in desired quantity.
2. There is wide fluctuation (area increasing and decreasing) in Rajasthan as most of pulses are grown under rain fed farming system
3. In almost all districts, salinity is the serious issues and under such condition pulses are not be grown.
4. Mostly soils are sandy loam with slight slope. Nematode is the severe cause for low productivity of pulses especially chickpea during winter season.
5. Incidence of wilt is major cause for low productivity of Chickpea.
6. There is less scope to popularize short duration green gram during spring/summer season as majority of farmers are not having assured irrigation.
7. Pigeon pea suffers a heavy loss due to water inundation in Gujarat state which needs pigeon pea varieties suitable for post-rainy season (Pre-rabi season).
8. Lack of well-developed processing unit, markets and policy support for pulses
9. High risk in production, and its unpredictability, due to vulnerability to weather and biotic stress, and consequent price fluctuations.
10. Limited availability of key inputs, such as quality seed and effective insecticides.
11. Limited knowledge of farmers on the latest production technologies for the crop.

Rajasthan

Rajasthan is the second largest chickpea producing state in the country after Madhya Pradesh with contribution of 16 per cent in the acreage and 12 per cent in total production of the country. Chickpea is cultivated during rabi season almost in all the 33 districts of state. However, Jaipur, Ajmer, Tonk, Sikar, Jhunjhunu, Bikaner, Churu, Jaisalrner, Sri Ganganagar, Hanumangarh and Bhilwara are the major districts of the state. During 2013-14, it was cultivated on 1923.5 ha in the state with a production of 1640.4 tonnes of grains. The average productivity of the crop in the state was 853 kg/ha which was lower than the national average (960 kg/ ha). The leading districts in chickpea production in Rajasthan are Bikaner (220951 ha), Churu (219686 ha), Jaipur (118627 ha) and Jaiselmer (107829 ha). Production is highest in Bikaner district (170868 tonnes), Jaipur (86174 tonnes), Jhunjhunu (76643 tonnes) and Churu (68547 tonnes). Productivity is highest in Sawai Madhopur district (1438 kg/ha), Dungarpur (1315 kg/ha), Dausa (1284 kg/ha) and Bharatpur (1265 kg/ha), respectively during 2014-15.

Sensitization-cum-Workshop on Pulse Production Technology at ICAR-ATARI, Jodhpur

Gujarat

In Gujarat, crop is grown in 1361 ha with production of 1331 mt and productivity of 978 kg/ha. Leading chickpea producing districts are Dahod (487 ha), Ahamadabad (157 ha), Surendernagar (123 ha) and Patan (99 ha). Production is highest in Dahod district (472 mt), Junagarh (140 mt), Panchmahal (136 mt) and Ahamadabad (113 mt). Highest productivity (1435 kg/ha) comes from Rajkot District of Gujarat state.

Performance of Chickpea:

A total of 1798 demonstrations of chickpea were organised in 656.95 ha area in zone-VI. Out of total demonstrations, 1243 demonstrations conducted in 444.33 ha area of Rajasthan state while 212.62 ha area covered under 555 demonstrations in Gujarat. The highest average yield was observed in sub-humid southern plain and aravali hill zone (IVa) i.e.,17.46q/ha which involved Rajsamand, Chittorgarh and Udaipur districts. GJG3 variety of chickpea demonstrated highest yield i.e., 25.29q/ha in Sabarkantha (North Gujarat). In Rajasthan, maximum yield of 18.85q/ha was recorded by KVK, Rajsamand under demo of GNG 1581 variety. The performance of Chickpea demonstration is depicted in table 7.3 & 7.4 and Fig.1& 2.

Fig. 1: Performance of Chickpea demonstrations during Rabi 2015-16 in Rajasthan.

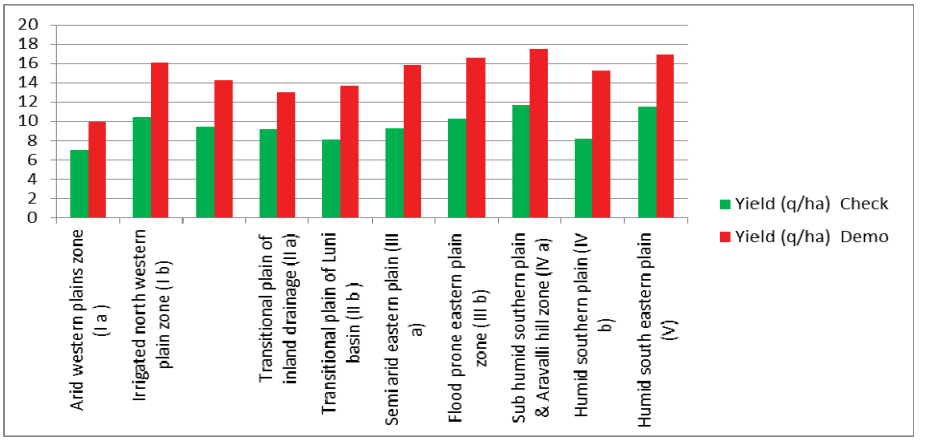


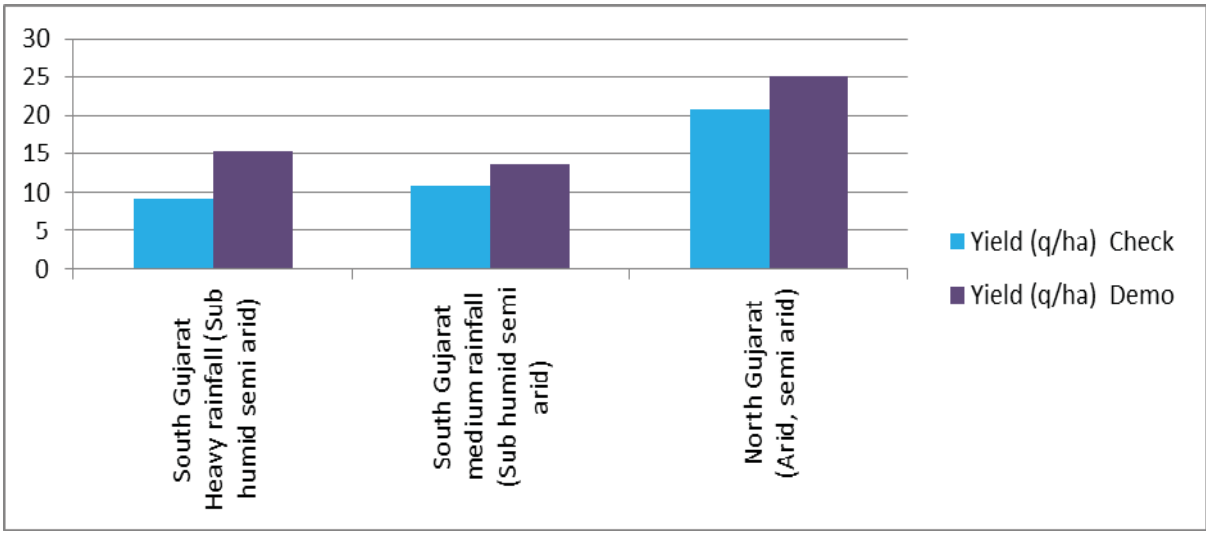
Table 7.3 : Performance of Chickpea demonstration during Rabi 2015-16 in Rajasthan.

Agro-climatic zone	KVKs/ Dist. Avg. (q/ha)	Area (ha)	No. of Demo	Yield (q/ha)		% increase	Net Return Check (Rs./ha)	Net Return Demo (Rs./ha)
				Check	Demo			
Rajasthan								
Arid western plains zone (Ia)	Barmer- I (7.28)	16.19	25	7.00	9.90	41.36	17793	26538
Irrigated north western plain zone (I b)	Hanumangarh-I (10.33) Sriganganagar (8.32)	30.36	75	10.36	16.08	54.85	31866	85701
Hyper arid and partially irrigated western plain (I c)	Bikaner- I (7.73) Jaisalmer- I (4.50) Churu- I (3.12)	34.32	87	9.38	14.32	52.62	28825	49609
Transitional plain of inland drainage (II a)	Jhunjhunu (11.74) Sikar (10.75) Nagaur- I (6.53) Jaipur- I (7.26) Tonk (7.61)	59.77	187	9.24	12.99	40.60	28459	43490
Transitional plain of Luni basin (II b)	Sirohi (6.35) Karauli (10.99) Pali (9.90)	43.06	119	8.11	13.70	69.00	21943	46275
Semi-arid eastern plain (IIIa)	Dausa (12.84), Tonk (7.61), Ajmer (4.65) Jaipur-I (7.26)	36.86	125	9.26	15.88	71.42	27323	51104
Flood prone eastern plain zone (III b)	Alwar-I (9.53) Dholpur (9.69)	23.06	69	10.30	16.60	61.17	32618	58582
Sub humid southern plain & aravalli hill zone (IV a)	Rajsamand (11.91) Chittorgarh (10.24) Udaipur (9.96)	63.12	156	11.70	17.46	49.27	39863	62604
Humid southern plain (IV b)	Banswara (9.85), Bhilwara (7.26) & Dungarpur (13.15)	56.65	200	8.20	15.25	85.97	24351	53009
Humid south eastern plain (V)	Kota (13.04), Jhalawar (10.49), S.Madhopur (14.38) & Bundi (3.44)	80.94	200	11.52	16.92	46.95	38805	60568

Table 7.4 : Performance of Chickpea demonstrations in Gujarat during Rabi 2015-16.

Agro-climatic zone	KVKs/ Dist. Avg. (q/ha)	Area (ha)	No. Of Demo.	Yield (q/ha)		% increase	Net Return Check (Rs./ha)	Net Return Demo (Rs./ha)
				Check	Demo			
South Gujarat heavy rainfall	Narmada (9.78) Navsari (9.78)	35.00	108	9.10	15.40	215.36	27233	55381
South Gujarat medium rainfall	Bharuch (9.78)	20.23	58	10.78	13.58	25.97	29137	42262
North Gujarat	Sabarkantha(14.98)	20.23	50	20.71	25.29	22.11	79050	98670
North west	Kuch (9.78)	20.23	50	8.60	10.35	20.35	22200	30250
North saurastra	Rajkot-I (14.35) Jamnagar (9.33) Amreli (8.84) Surendranagar (7.39)	80.92	200	13.81	17.11	23.87	49993	67185
South saurasthara	Porbandar (10.35)	20.23	50	12.80	16.62	29.84	48400	69600
Bhal and coastal	Ahmedabad (7.22)	15.78	39	9.20	13.90	51.09	17400	40300

Fig. 2 Performance of Chickpea demonstrations during Rabi 2015-16 in Gujarat.



A. Cluster Front Line Demonstrations (CFLDs) on Lentil

Lentil is mainly cultivated in Uttar Pradesh, Madhya Pradesh, Chhattisgarh, Bihar West Bengal and Rajasthan states. These states together account for 80-90 per cent of the total area under lentil crop. Lentil is grown in wider range of soil types and soil P^H compared to other legumes, however, it is more sensitive to water logging. In Rajasthan, lentil production mainly comes from the Districts of Jhalawar (10416 ha), Bhilwara (9815 ha) Pratapgarah (8743 ha), Chittorgarh (1108 ha) and Bharatpur (1000 ha). Productivity of lentil is also highest in Jhalawar District (10855 kg/ha). Major varieties which are under cultivation in state are K-75, IPL-8 and IPL-406 *etc.*

Performance of Cluster Frontline Demonstration on Lentil

Lentil demonstrations were laid out in 20.23 ha area in 50 farmers' fields in Bharatpur district of Rajasthan. The average yield under demonstration was 6.92q/ha with the net return of Rs.27000/ha compared to local variety (5q/ha). Under demo, a yield advantage of 38.48% was observed (Table 7.5).

Table 7.5 : Performance of Lentil demonstrations during Rabi 2015-16 in Rajasthan.

Agro-climatic zone	KVKs/ Dist. Avg. (q/ha)	Area (ha)	No. of Demo.	Yield (q/ha)		% Increase	Net Return Check (Rs./ha)	Net Return Demo (Rs./ha)
				Check	Demo			
Flood prone eastern plain zone (III b)	Bharatpur	20.23	50	5.00	6.92	38.40	20000.00	27000.00

B. Cluster Front Line Demonstrations (CFLDs) on Green gram:

Greengram is mainly grown in kharif with area (893947 ha), production is (337446 tonnes) with average productivity of (515 kg/ha). But it is mostly grown in Baran, Pratapgarh and Banswara District of Rajasthan which are having assured irrigation facility. In Gujarat green gram is grown mainly in spring/summer season grown with area (234 ha), production is (116 mt) with average productivity of (497 kg/ha).

Performance of Cluster Frontline Demonstration on Green gram (Rabi)

Total 100 demonstrations were conducted in 30.84 ha area in rabi season in Navsari and Tapi districts of Gujarat. The average yield of demonstrations in Tapi district was 10.5q/ha with 50% yield increase compared to local variety. The demo yield was recorded 8.35q/ha in Navsari district (Table 7.6).

Table 7.6 : Performance of green gram demonstrations in Gujarat during Rabi 2015-16.

Agro-climatic zone	KVKs/ Dist. Avg. (q/ha)	Area (ha)	Yield (q/ha)		% increase	Net Return Check (Rs./ha)	Net Return Demo (Rs./ha)
			Check	Demo			
South Gujarat heavy rainfall	Navsari (5.79)	6.56	5.9	8.35	41.53	12950	25350
South Gujarat medium rainfall	Tapi (4.36)	24.28	7.0	10.5	50.00	18255	33515

8. ICAR-ATARI, ZONE VII
(Madhya Pradesh, Chhattisgarh and Odisha)

Madhya Pradesh has been the major pulses producing state in the country. It ranked first both in terms of area (19.8%) and production (20.9%) of pulses in India.(ref-net) Over 20% of gross cropped area (GCA) of mp in under pulses though ranked first in terms of area and production, it ranked sixth after UP, Bihar, Haryana, West Bengal, and Gujarat in terms of average yield. And analysis of production stability for the different states reveals the MP ensures long- run production stability without losing its comparative advantage, associated with production stability provides the most desirable criterion for long term investment for the growth of a crop. The state of Madhya Pradesh is one of the most important regions where pulses development programme are likely to succeed in the long-run. Other states that command attention in this context are Bihar and U.P. Where in, like MP, the production in large and any small increase in production adds substantially to output. A more rigorous analysis may be needed at the disaggregated level to indentify districts, where the pulses development programme may be harnessed to increase productivity with stability. (Ref-Directorate of economics and statistics, Ministry of agriculture New Delhi.) In the Central states of Madhya Pradesh, Chhattisgarh and Odisha pulse is grown in kharif, rabi and rabi-summer season. Major rabi pulses grown in Madhya Pradesh is Chickpea (2.91m'ha) followed by Lentil (0.57m'ha), Green gram (0.39m'ha) and Field pea (0.28m'ha). In the state of Chhattisgarh, Chickpea (0.26m'ha) occupies major position in rabi pulse followed by field pea (0.01m'ha), Green gram (0.01m'ha) and Lentil (0.01m'ha). In Odisha, Green gram (0.26m'ha) occupies largest area, followed by Chickpea (0.06m'ha). The average productivity of the major pulses in these states are indicated in below.

Table 8.1 : Area, Production and Productivity of major pulse crops in Madhya Pradesh, Chhattisgarh and Odisha

Crops	Area (in m'ha)			Production (in m't)			Productivity (q/ha)		
	MP	CG	OD	MP	CG	OD	MP	CG	OD
Chickpea	2.91	0.26	0.06	3.54	0.24	0.05	12.18	9.42	8.33
Lentil	0.57	0.01	-	0.33	0.004	-	5.84	3.26	-
Green gram	0.39	0.01	0.26	0.19	0.004	0.08	4.91	2.93	2.98
Field Pea	0.28	0.01	-	0.19	0.005	-	6.93	3.74	-

PEFORMANCE OF CLUSTERED PULSE DEMONSTRATION IN RABI 2015-16

Chickpea and lentil are the major rabi pulses in the states of Madhya Pradesh and Chhattisgarh and Greengram is the major pulses in the state of Odisha. Among these three states, Madhya Pradesh produced Chickpea in large areas. Clustered demonstration was organized in 2202.6 ha covering these three states. The details of state-wise breakup are provided in the following table.

Table 8.2 : State-wise area and no. of demonstration conducted in rabi 2015-16

Crop name	Madhya Pradesh		Chhattisgarh		Odisha		Zone total	
	Area (in ha.)	No. of Demo	Area (in ha.)	No. of Demo	Area (in ha.)	No. of Demo	Area (in ha.)	No. of Demo
Chickpea	760	1878	490	1034	180	460	1430	3372
Lentil	172.6	433	150	295	-	-	322.6	728
Green gram	-	-	-	-	330	839	330	839
Field Pea	40	97	80	153	-	-	120	250
Grand Total	**972.6**	**2408**	**720**	**1482**	**510**	**1299**	**2202.6**	**5189**

Out of 2392 ha allotted demonstrations, coverage was made in 2202.6ha through 5189 demonstrations. Area under chickpea was 1430ha, lentil 322.6ha, greengram 330ha and field pea 120ha. Out of these area coverage in Madhya Pradesh was 972.6ha, Chhattisgarh 720ha and Odisha 510ha (Table 8.2)

In Madhya Pradesh, chickpea was demonstrated in 760ha through 1878 demonstrations. Highest yield was recorded as 19.76q/ha, lowest was 10.11q/ha and average yield was 14.85q/ha. Average increase due to demonstrations of various technologies was 38.66%. The average net return was Rs.31624/ha and BC ratio was 2.73. Several technologies like INM, IPM, micronutrients, line sowing, pheromon trap, and seed treatment were introduced in these demonstrations. In Chhattisgarh, chickpea was demonstrated is 490 ha through 1034 demonstrations. Average yield in these demonstrations was recorded as 11.15q/ha compared to local check average of 7.28q/ha. There by increase was 72.9%. The average net return was Rs.25895.20 with BC ratio of 2.63. In Odisha chickpea was demonstrated in 180ha through 460 demonstrations. The average yield was recorded as 12.7q/ha in these 460 demonstrations. Increase in yield was 24.4%. The average net return was Rs.29263.30/ha with BC ratio of 2.41.

Lentil is the important pulse crop in central states. The coverage area in Madhya Pradesh was 172.6ha involving 433 demonstrations. Highest yield was recorded as 21.45q/ha in lentil and average yield was 12.58 q/ha. Increase in yield was 88.27%. The average net return was Rs.42273.30/ha. The BC ratio was 3.26. In Chhattisgarh lentil crop was demonstrated in 150ha and 295 demonstrations were organized. The average yield in these demonstrations was 8.02q/ha and increase in yield about 59.5%. The average net return was Rs.17815/ha with BC ratio of 2.14.

Greengram is grown specially Odisha state. The coverage of the crop in the state of Odisha was 330ha and 839 demonstrations were conducted. The average yield of green gram crop is 7.08q/ha. The highest yield was recorded 7.92q/ha in kvk, Sundergarh II. Increase in yield was 61.96% and the average net return was Rs. 14156.28/ha with BC ratio was 2.03.

In Madhya Pradesh, Field Pea was demonstrated in 40 ha through 97 demonstrations. Average yield recorded was 14.8 q/ha compared to existing yield of 9.28q/ha. The average

increase was 56.27%. Average net return was Rs.34430.50/ha with BC ratio of 3.08. In Chhattisgarh coverage of area was 80 ha and number of demonstrations was 153. The highest yield was 9.95q/ha compared to local check yield of 6.79q/ha - an increase by 46.54%. The average net return was Rs.17444.75/ha with BC ratio of 2.32.

MADHYA PRADESH

Madhya Pradesh has the major pulses producing state in the country. Its ranked first both in terms of area (19.8%) and production (20.9%) of pulses in India. (ref. agricoop) over 20% gross cropped area (GCA) of M.P in under pulses. The state of Madhya Pradesh is one of the most important regions where pulses development programme are likely to succeed in the long run. The M.P. Government needs to provide adequate policy and institutional support to production of pulses in rice fallow areas to complement efforts of scientists in raising productivity levels in these crops. Investigations to grow pulses in RRFL showed that their cultivation is not only agronomically feasible but it is economically viable as well. In Madhya Pradesh Rice Fallows Districts are Shahdol, Seoni, Balaghat, Rewa, Betul, Chhatarpur, Satna, Panna, and Jabalpur.

Tribal Areas: Alirajpur, Anuppur, Balaghat, Badwani, Betul, Chhindwara, Dhar, Dindori, Hoshangabad, Jhabua, Mandla, Khargone, Seoni, Sidhi, Shahdol, Panna, Rajgarh. More than 50% tribal population districts are Chhindwara, Khargone, Seoni, Sidhi, Shahdol and 30 to 50% tribal population districts are Mandla, Badwani, Panna, Rajgarh.

Table 8.3 : Performance of Pulses in tribal areas

S. No.	Name of Crop	Variety	Districts	Area (in ha.)	No. of Demo
1	Chickpea	JG 130, JG 11, JG 63	Betul, Dhar, Seoni, Panna, Hoshangabad,	150	375
2	Lentil	HUL 57, JL-1, L-4076 DPL-62	Panna, Shahdol	70	175

Table 8.4 : Districts classification of Odisha state based in growth rate of area

Name of crop	Non-Traditional (area<2000ha)	Negative growth	Low (0-2%)	Moderate (2-4%/annum)	High (>4%/annum)
Chickpea	-	Hoshangabad, Shahdol, Narsinghpur, Bhind, Morena, Neemuch,	Chhattarpur, Panna, Sagar, Jabalpur, Raisen, Satna, Jhabua	Balaghat, Betul, Seoni, Umaria, Burhanpur, Badwani, Sehore	Dewas, Dhar, Ujain, Indore, Ratlam
Lentil	-	Sagar, Satna	Narsinghpur	-	Panna, Rewa, Shahdol
Greengram	Harda, Seoni	-	-	-	Narsinghpur, Hoshangabad
Fieldpea	-	Chhattarpur	Jabalpur	-	-

In chickpea crop, 6 districts comes under negative growth rate areas, 7 districts comes under low growth rate where as 7 districts comes under comes under moderate growth rate as well as 5 district comes under high growth rate.

In Lentil crop, 2 districts comes under negative growth rate, 1 district comes under low growth rate where as 3 districts comes under comes under high growth rate.

In green gram crop, 2 districts comes under non traditional areas, where as 2 districts comes under high growth rate.

Performance of Chickpea

Madhya Pradesh state under the Chickpea crop 25 districts 760ha area and 1900 demonstrations are allotted in which 1878 demonstrations conducted in 760ha area. JG-14, 130, 11, 1, 8, JAKI-9218, PKV-4, KAK-2, Kripa, Digvijay varieties were assessed under different KVKs.

1. JG-14: This variety was assessed by 2 KVK (Balaghat, Shahdol) of district MP and performs very well. It is pre-emergence Bold Seeded variety and its crop duration period is 100-110 days. Farmers are used rhizobium culture (20gm culture per1kg of seed) for seed treatment and line sowing method. The no. of pods per plant were also increase by 54.56%. Similarly the net return 39616 Rs./ha. and BC ratio was also found to be 2.09. There are 98 farmers used GPS based soil sampling. Full Nitrogen, Phosphorus, Potash and Sulphur applied at the time of sowing. This variety having tolerance to major pests and diseases.

Line Sowing

Sprinkler Irrigation

2. JAKI 9218: This variety was assessed by 4 KVK (Indore, Morena, Neemuch, Ratlam) of MP and perform very well. It is pre-emergence Bold Seeded variety and its crop duration period is 110-120 days. Farmers are used Carbandazim @ 2.0gm /kg and Vitavax 2.5gm/kg. for seed treatment and method of sowing are used line sowing and raised bed. Similarly the net return 128870Rs./ha and BC ratio was also found to 2.48. There are 327 farmers used GPS based soil sampling. Basal application and Ferti cum seed drill applied at the time of sowing.

BOLD SEEDED

3. JG 130: This variety was assessed by 5 KVK (Barwani, Bhind, Hoshangabad, Jhabua, Ujjain) of MP. It is pre flowering Bold and small Seeded variety and its crop duration period for bold seeded 110-115 days and Small seeded 95-100 days. Farmers are used Fungicide (Mancozeb + Carboxin)@2.5 g/kg for seed treatment and method of sowing are used line sowing with seed drill and raised bed. Similarly the net return Rs.33519.40/ha and BC ratio was also found to be 2.97. There are 219 farmers used GPS based soil sampling. Nitrogen 20kg, Phosphorus 60kg and Potash 30kg/ha at the time of sowing.

Seed Treatment

Line Sowing with seed drill

Promising technology demonstrated:

- Full Package except subsidised fertilizers
- Line sowing, seed treatment and soil test based recommended dose of fertilizer
- Improved variety and Raised bed sowing technique

Specific characteristics of technology and performance

Specific Technology	Demo Yield (q/ha)	Local check Yield (q/ha)	Yield gap (q/ha) over local check	Net Return (Rs./ha.)	B:C
Seed Treatment	13.45	9.56	0.28	33743.00	2.57
Improved Variety	15.71	11.38	0.27	44483.52	3.46
Raised bed planting	19.02	13.50	0.29	73225.00	4.34
Biological Control	12.96	9.84	0.24	34640.00	3.01

Yield (q/ha)

- Potential yield of variety/ technology: 17.53
- Demonstration: 14.84
- District average (previous year): 11.29
- State average(Previous year): 11.14
- National average Yield: 7.89

Performance of Lentil

Madhya Pradesh state under the Lentil crop 6 districts 192ha area and 480 demonstrations are allotted in which 433 demonstrations conducted in 172.6ha area. DPL-62, JL-1, L-4076, HUL-57, JLS-3 varieties were assessed under different KVKs of M.P.

Varietal, NM and Line Sowing

1. DPL 62: This variety was assessed by 1 KVKs (Shahdol) of MP. It is Bold Seeded variety and its crop duration period is 120-122 days. Farmers are used Vita vax (Carboxin) @ 1gm/Kg of seed+ Rhizobium Culture @ 10 gm/Kg of seed for seed treatment and method of sowing are used line sowing. Spray of Acetamarid @ 125 kg/ha is used for plant protection by farmers. Similarly the net return Rs.20200/ha and BC ratio was also found to be 2.36. There are 75 farmers used GPS based soil sampling. Nitrogen 20kg, Phosphorus 50kg, Potash 20kg and Sulphur 20kg/ha at the time of sowing.

Ridge & Furrow, Drip irrigation

Pre emergence by herbicide

2. HUL 57: This variety was assessed by 2 KVKs (Rewa and Panna) of MP. It is small Seeded variety and its crop duration period is 120-125 days and seed rate 15kg/ha. Farmers are used Trichoderma for seed treatment and method of sowing are used line sowing. Similarly the net return Rs.12300R/ha and BC ratio was also found to be 1.72. There are 208 farmers used GPS based soil sampling. Nitrogen 20kg, Phosphorus 50kg, Potash 20kg/ha at the time of sowing.

HUL 57: Line sowing

Promising technology demonstrated:

- Lentil (Variety- HUL-57).
- Seed treatment with *Trichoderma viride* @ 5gm/kg seed.
- Seed inoculation with Rhizobium & PSB,Use of NPK@20:50:20 kg/ha+Insect control

Specific characteristics of technology and performance

Specific Technology	Demo Yield (q/ha)	Local check Yield (q/ha)	Yield gap (q/ha) over local check	Net Return (Rs./ha.)	B:C
Seed treatment	8.93	4.50	0.49	26116.52	2.28
Early sowing and Line sowing	21.45	13.00	0.39	81210.00	4.73
Improved Variety	10.85	6.78	0.37	41450.00	4.23
Nutrient management and Pest control	8.93	4.50	0.49	26116.52	2.28

Yield (q/ha)

- Potential yield of variety/ technology: 12.62
- Demonstration: 11.77
- District average (previous year): 7.55
- State average(Previous year): 6.35
- National average Yield : 7.97

CHHATTISGARH

Chhattisgarh is agricultural chief land & due to large production of rice Chhattisgarh is known as the "rice bowl" of Madhya Pradesh. Chhattisgarh used to produce over seventy percent of the total paddy production in the state. The main rabi crops of Chhattisgarh are jowar, gram, urad, moong and moth. In pulses, a quarter of all produce in Madhya Pradesh during the rabi season comes from Chhattisgarh. The small seeded variety of lentil, Moongbean, Urd bean, Lathyrus, Peas may find prominence under Utera cultivation in the state of Chhattisgarh. This practices can be made more effective by using short duration and high yielding verities of rice as rice crop will vacate the field in September-October. In Chhattisgarh Rice Fallows Districts are Sarguja, Jashpur, Raigarh, Durg, Bilaspur and Bastar.

Tribal Areas: Sarguja, Koria, Bastar, Dantewada, Kanker, Korba, Jashpur, Raigarh, Durg, Bilaspur, Rajnandgaon, Raipur and Dhamtari.

Table 8.5 : Performance of Pulses in tribal areas

S. No.	Name of Crop	Variety	Districts	Area (in ha.)	No. of Demo
1	Chickpea	JAKI 9218, JG 226, JG 11, JG 130, JG 6, JG 16	Bastar, Bhatapara, Bilaspur, Dantewada, Dhamtari, Durg, Kanker, Korea, Rajnandgaon	350	774
2	Lentil	KL 320, KLS 218	Bhatapara, Durg, Jashpur, Rajnandgaon, Sarguja	105	210
3.	Field pea	Paras	Korea	40	56

Table 8.6 : Classification of districts based in growth rate

Name of crop	Non-Traditional (area<2000ha)	Negative growth	Low (0-2%)	Moderate (2-4%/annum)	High (>4%/annum)
Chickpea	Bastar, Dantewara, Janjgir-champa, Kanker, Koriya, Mahasamund, Narayanpur	-	-	-	Bahtapara, Bilaspur, Dhamtari, Durg, Kawardha, Rajnandgaon
Lentil	Jashpur, Narayanpur	Durg	Bhatapara, Gariyaband, Surguja	Rajnandgaon	Kawardha
Greengram	-	Mahasamund	-	-	-
Fieldpea	Koriya	Balrampur	-	-	-

In chickpea, crop 7 districts comes under non traditional areas, where as 6 districts comes under high growth rate.

In Lentil, crop 2 districts comes under non traditional areas, 1 district comes under negative growth rate, 3 districts comes under low growth rate, 1 district comes under moderate growth rate where as 1 districts comes under comes under high growth rate.

In green gram crop, 1 district comes under negative growth rate.

In Fieldpea crop, 1 district comes under non traditional areas, 1 district comes under negative growth rate.

Performance of Chickpea

Chhattisgarh state under the Chickpea crop 13 districts 490ha area and 1225 demonstrations are allotted in which 13 KVK conducted 1034 demonstrations in 490ha area. JG-11, JG-226, JG-130, JG-6, JG-16 and JAKI-9218 varieties were assessed under different KVKs.

1. JG-6: This variety was assessed by 1 KVKs (Janjgir Champa) of Chhattisgarh. It is bold seeded variety and its crop duration period is 110-115 days. Farmers are used Carbendazim + PSB + Rhizobium for seed treatment and method of sowing are used line sowing. Similarly the net return Rs.13187.50/ha and BC ratio was also found to be 1.95. There are 28 farmers used GPS based soil sampling. Nitrogen 30kg, Phosphorus 60kg, Potash 30kg/ha at the time of sowing. The number of pods per plant was also increased. This variety gave good performance due to every tolerance to major pest and disease.

2. JG 226: This variety was assessed by 1 KVKs (Bhatapara) of Chhattisgarh. It is bold seeded variety and its crop duration period is 112-115 days. Farmers are used Trichoderma @ 5g/kg Seed / Carbendazim @ 3g/kg seed for seed treatment and method of sowing are used line sowing. Similarly the net return Rs.21430/ha and BC ratio was also found to be 2.35. There are 86 farmers are used GPS based soil sampling. DAP 150 Kg/ha, MOP 25 Kg/ha at the time of sowing and also used pendamethilene weedicide.

Weed Management

3. JG 11: This variety was assessed by 1 KVKs (Dantewada) of Chhattisgarh. It is bold seeded variety and its stage pod development. Its crop duration period is 110-115 days. Farmers are used Trichoderma harzianum for seed treatment and used the technology of FIRBS. Similarly the net return Rs.13035/ha and BC ratio was also found to be 2.37. There are 100 farmers are used GPS based soil sampling. DAP- 55 Kg/ha, Urea- 43 Kg/ha at the time of sowing.

Promising technology demonstrated:

- Line sowing of Chickpea with complete package of practices.
- Soil test based recommended dose of fertilizer.

Specific characteristics of technology and performance

Specific Technology	Demo Yield (q/ha)	Local check Yield (q/ha)	Yield gap (q/ha) over local check	Net Return (Rs./ha.)	B:C
Seed treatment	10.52	4.14	0.60	22670.75	2.74
Improved variety	11.11	7.64	0.31	26931.40	2.62
Soil test based fertilizer application	10.81	8.91	0.17	27346.00	2.72
Utera Cultivation	8.10	4.95	0.38	19400.00	2.49

Yield (q/ha)

- Potential yield of variety/ technology: 14.75
- Demonstration: 10.56
- District average (previous year): 10.37
- National average(previous year);7.89
- State average(Previous year): 11.40

Ridge & Furrow

Performance of Field Pea

Chhattisgarh state under the Field Pea crop 80ha area & 200 demonstrations were allotted to 2 KVKs out of which whole demonstrations conducted successfully. Paras variety was assessed under different KVKs.

1. Paras: This variety was assessed by 2 KVKs (Korea and Balrampur) of Chhattisgarh. It is bold seeded variety and seed rate 40kg/ha. Its crop duration period is 100 days. Farmers are used Trichoderma @ 500 gm/ha, Rhizobium @ 1 kg/ha for seed treatment and method of sowing are used line sowing and also doing INM & IPM. Similarly the net return Rs.9526/ha and BC ratio was also found to be 1.80. There are 153 farmers used GPS based soil sampling. N- 25Kg/ha, P - 25 Kg/ha and K-50kg/ha at the time of sowing.

Field Pea : PARAS

Promising technology demonstrated:

- Soil test based fertilizer application, Full package & practices

Specific characteristics of technology and performance

Specific Technology	Demo Yield (q/ha)	Local check Yield (q/ha)	Yield gap (q/ha) over local check	Net Return (Rs./ha.)	B: C
Line Sowing by seed cum Ferti dril	9.07	6.35	0.29	17444.00	2.32
Soil inoculation (Rhizobum and PSB Culture @ 5 gram/kg)	8.91	6.06	0.31	12296.00	1.59

Yield (q/ha)

- Potential yield of variety/ technology: 8.60
- Demonstration: 9.02
- District average (previous year): 7.00
- State average(Previous year): 5.53
- National average Yield: 7.81

INM

Performance of Lentil

Chhattisgarh state under the lentil crop 8 districts 150ha area and 375 demonstrations are allotted in which 295 demonstrations conducted in 150ha area.

1. KL 320: This variety was assessed by 1 KVKs (Bhatapara) of Chhattisgarh. It is bold seeded variety and seed rate 12kg/ha. Its crop duration period is 128 days. Farmers are Trichoderma @ 5g/kg Seed / Carbendazim @ 3g/kg seed for seed treatment and method of sowing are used line sowing. Similarly the net return Rs.6780/ha and BC ratio was also found to be 1.52. There are 68

farmers are used GPS based soil sampling. DAP 150 Kg/ha, MOP 25 Kg/ha at the time of sowing and used Propenophos (50 EC) @ 1 lit/ha.

Ridge maker

Raised & Furrow

Promising technology demonstrated: Improved variety HUL 57, Line sowing, INM, Seed treatment

Specific characteristics of technology and performance

Specific Technology	Demo Yield (q/ha)	Local check Yield (q/ha)	Yield gap (q/ha) over local check	Net Return (Rs./ha.)	B:C
Improved variety	8.02	5.09	0.36	17815.84	2.14
Use of IPM	9.89	5.90	0.40	14773.00	1.98
Line sowing	6.48	3.70	0.42	14515.00	2.15
Soil Treatment through Trichodarma	9.00	5.50	0.38	14500.00	2.01

Yield (q/ha)

- Potential yield of variety/ technology: 8.79
- Demonstration: 8.02
- District average (previous year): 4.53
- State average(Previous year): 6.35
- National average Yield: 7.97

Line Sowing

ODISHA

The most important pulses grown in Odisha are gram, tuar, arhar. According to the classification the pulses of Odisha can be broadly divided in to Kharif and Rabi crops. The Mahanadi delta, the Rushikulya plains and the Hirakud and Badimula regions are favourable to the cultivation of pulses. Production of pulses is basically concentrated in districts like Cuttack, Puri, Kalahandi, Dhenkanal, Bolangir and Sambalpur. In Odisha Rice Fallows Districts are Koraput, Kalahandi, Sambalpur, Sundergarh, Bhadrak, Cuttack, Puri, Dhenkanal, Mayurbhanj.

Constraints and Strategies

- The major cause of worry for the stakeholders has been the low productivity of pulses which affects the production, availability of pulses for consumption and processing. The pulses are normally grown as a secondary crop in the marginal and sub marginal land with poor fertility and low moisture availability. The high rainfall and water logging during kharif season and moisture stress and low temperature during the rabi season further aggravates the problem. The seed replacement being quite low (varying between 1 to 3 per cent), lack of proper package of practices, inter-state and inter-district variation in the soil quality combine together to make the crop all the more vulnerable.
- As revealed by the scientists engaged in pulses research, eventhough, around 70 per cent of the pulses are sown by 'Paira' method in Orissa, mainly in coastal districts, no suitable variety has been developed for the same. Further, adequate quantity of seeds are not available at the required time at the govt. sales centres for which the farmers either purchase the low quality seeds or use their own seeds which ultimately affects the productivity.

Tribal Areas: Mayurbhanj, Sundergarh, Koraput , Sambalpur, Keonjhar, Boudh, Ganjam, Kalahandi, Balasore. These districts are tribal areas of Odisha state.

Table 8.7 : Performance of Pulses in tribal areas

S. No.	Name of Crop	Variety	Districts	Area (in ha.)	No. of Demo
1	Chickpea	JAKI 9218	Boudh, Kalahandi, Keonjhar, Mayurbhanj, Sundergarh I & II	80	240
2	Green gram	TARM 1	Boudh, Kalahandi, , Sundergar I & II, Ganjam I & II, Sambalpur	125	306

Table 8.8 : Districts classification of Odisha state based in growth rate of area

Name of crop	Non-Traditional (area<2000ha)	Negative growth	Low (0-2%)	Moderate (2-4%/annum)	High (>4%/annum)
Chickpea	Bolangir, Boudh, Deogarh, Dhenkanal, Khordha	Kalahandi, Nuapada	Sundargarh-I and Sundargarh-II	Nabrangpur	Keonjhar, Mayurbhanj
Greengram	Sambalpur, Sundargarh-I & II	Gajapati, Ganjam-I & II, Nayagarh, Khordha	Angul, Sonepur,	Bhadrak, Boudh	Bolangir, Kalahandi

In chickpea, crop 5 districts comes under non traditional areas, 2 districts comes under negative growth rate where as 2 districts comes under low growth rate and 1 district comes under moderate growth rate as well as 2 district comes under high growth rate districts.

In green gram, crop 3 districts comes under non traditional areas, 5 districts comes under negative growth rate where as 2 districts comes under low growth rate and 2 district comes under moderate growth rate as well as 2 district comes under high growth rate districts.

Performance of Chickpea

Odisha state under the Chickpea crop 12 districts 190ha area and 475 demonstrations are allotted in which 460 demonstrations conducted in 190ha area. JAKI-9212, JAKI-9218 and JG-11 varieties were assessed under different KVKs.

1. JAKI 9212 - This variety was assessed by 1 KVKs (Bolangir) of Odisha. It is bold seeded variety and seed rate 20kg/ha. Its crop duration period is 110 days. Farmers are used Thiram @ 3gm/kg for seed treatment and method of sowing are used line sowing, ridge and furrow. There are 25 farmers are used GPS based soil sampling N - 20Kg/ha, P - 40 Kg/ha and K-40kg/ha at the time of sowing.

Phenomantrape

Promising technology demonstrated:

- Cultivation of HYV JAKI -9218 with NPK @ 10:25:0 kg/ha

Specific characteristics of technology and performance

Specific Technology	Demo Yield (q/ha)	Local check Yield (q/ha)	Yield gap (q/ha) over local check	Net Return (Rs./ha.)	B:C
Improved Variety	12.76	7.75	0.39	32921.25	2.41
IWM , INM & IPM	13.78	9.37	0.32	22410.00	1.93
Soil testing based fertilizer application	10.10	6.10	0.39	29650.00	2.63
Line sowing	11.50	8.10	0.29	52760.00	3.01

Yield (q/ha)

- Potential yield of variety/ technology: 15.66
- Demonstration: 12.76
- District average (previous year): 6.51
- State average(Previous year): 7.74
- National average Yield: 7.89

Performance of Green gram

Odisha state under the Green gram crop 14 districts 330ha area and 825 demonstrations were allotted which was successfully conducted. Pusa 9072, SML 668, Tarm 1 varieties were assessed under different KVKs.

1. **Pusa 9072:** This variety was assessed by 1 KVKs (Bolangir) of Odisha. It is small seeded variety and seed rate 8kg/ha. It is short duration period variety (65 days). Farmers are used Thiram@ 3gm/kg for seed treatment and method of sowing are used line sowing. There are 75 farmers are used GPS based soil sampling N- 20Kg/ha, P - 40 Kg/ha and K-40kg/ha at the time of sowing.
2. **Tarm 1:** This variety was assessed by 14 KVKs (Bhadrak, Boudh, Gajapati, Ganjam I & II, Jajpur, Kalahandi, Keonjhar, Khordha, Nayagarh, Sambalpur, Sonepur, Sundergarh I & II) of Odisha. It is small and bold seeded variety and seed rate 9kg/ha. Its crop duration period is 75 days. Farmers are used Carbendazim @ 2gm/kg of seed+Rhizobium culture @ 20gm/kg of seed and Vitavax power 1.5g/kg of seed , then Rhizobium culture20g/kg for seed treatment and method of sowing are used line sowing. Similarly the net return Rs.6428.16/ha and BC ratio was also found to be 1.31. There are 671 farmers used GPS based soil sampling N - 20Kg/ha, P - 50 Kg/ha and K-20kg/ha at the time of sowing and used Pendimethalene @ 2lt/ha. weedicide.

Promising technology demonstrated: Seed Rate - 20 kg/ha., seed treated with Bavistin, Seed to be Inoculated with Rhizobium culture, Seed should be sown at a spacing of 30x10 cm., Irrigation to be ensured at critical stages of crop growth, plant protection practice for Mosaic, Powdery Mildew, Aphids & Pod Borer to be carried out.

Specific characteristics of technology and performance

Specific Technology	Demo Yield (q/ha)	Local check Yield (q/ha)	Yield gap (q/ha) over local check	Net Return (Rs./ha.)	B:C
Seed treatment	7.09	4.23	0.40	16895.00	2.16
Improved Variety	7.08	4.91	0.30	14156.28	2.03
INM, IPM, IDM, IWM	7.44	5.08	0.31	15165.00	2.09
Full package & practices	6.27	5.58	0.11	8620.00	1.29

Yield (q/ha)

- Potential yield of variety/ technology: 8
- Demonstration: 7.08
- District average (previous year): 4.36
- State average(Previous year): 5.08
- National average Yield: 7.86

9. ICAR-ATARI, ZONE VIII
(Karnatka, Tamil Nadu and Kerela)

In Karnataka, pulses are being cultivated in an area of about 20 lakh ha (about 17% of cultivated area). Important pulse crops of the state are pigeonpea, chickpea, greengram, blackgram and cowpea. In addition, horsegram and field bean (Avare) need a special mention here, as they occupy unique position among pulse crops especially in Karnataka. The Area, Production and Productivity of chickpea, blackgram and greengram in Karnataka is presented in Table 9.1.

Table 9.1: Area, Production and Productivity of Chickpea, Blackgram and Greengram in **Karnataka (2012-13)**

Crops	Productivity (q/ha)	Production (t)	Area (ha)
Chickpea	6.42	623101	969072
Blackgram	4.84	52239	108012
Greengram	3.01	52429	174139

Source: Directorate of Economics and Statistics, New Delhi

***(a) Chickpea*:** It is a major pulse crop in Karnataka and ranks fifth in the cultivation with an area of 9.69 lakh ha, 6.23 lakh tonnes of production and 6.42 q/ha of productivity. Gulbarga district of Karnataka occupies the first position in chickpea with area (1.24 lakh ha), production (0.63 lakh tonnes) and productivity (5.08 q/ha) followed by Bijapur, Bidar, Gadag, Belgaum, Dharwad and Bellary.Thearea, production and productivity of chickpea are fluctuating year after year in Karnataka due to high incidence of pest and diseases, frequent droughts, lack of irrigation facilities i.e mostly cultivated on rainfed, fluctuating market price, high cost of cultivation, non-adoption of proper production technologies, its cultivation mainly as a mixed crop and therefore less importance given to this crop.

***(b) Blackgram*:** It ispopularly grown in all seasons in Karnataka with maximum area under kharif cultivation where it is intercropped with sorghum, pearl millet, maize, cotton, castor, pigeonpea etc. During rabi season, it is cultivated as a sole relay crop in the rice fallows of the coastal districts and black soils of Northren Karnataka. In summer, it is cultivated under protected irrigation. It occupies 1.08 lakh ha area with 0.52 lakh tonnes of production and 4.84 q/ha of productivity. The major blackgram growing districts in Karnataka are Belagavi, Bidar, Dharwad, Kalaburagi, Haveri, Koppal, Udupi, Dakshina Kannada, Hassan, Chikmagalur, Mysuru, Mandya, Tumakuru and Chamarajanagar.Several constraints for cultivation of blackgram,of which drought has become common phenomenon, during vegetative growth often leads to development of powdery mildew disease and attack of stem fly. This is a serious threat which causes loss in the yield ranging from 25 to 75 per cent.

(c) Greengram: It is one of the major pulse crops of Karnataka and is mainly cultivated in red soils during Kharif as rainfed. Further, it is cultivated during rabi/summer with supplement irrigation, besides in rice fallow under residual moisture in coastal districts of Karnataka. It occupies 1.74 lakh ha area with 0.52 lakh tonnes of production and 3.01 q/ha of productivity. The major greengram growing districts in Karnataka are Bagalkote, Belagavi, Bellary, Bidar, Vijayapura, Dharwad, Gadag, Kalaburagi, Haveri, Koppal, Raichur, Hassan,

Chicmagalur,Chitradurga, Chamrajanagar, Mysuru, Tumakuru and Shivamogga.The cultivation of greengram encounters many constraints. During its vegetative growth, droughthas become common event that often leads to development of powdery mildew disease and attack of stem fly. This is a serious threat which causes loss in the yield ranging from 25 to 75 per cent.

Tamil Nadu

In Tamil Nadu, blackgram, greengram, and chickpea are the major pulse crops grown in an area of 8.15 lakh ha with an annual production of 6.13 lakh tonnes with productivity of 7.52 q/ha.The Area, Production and Productivity of chickpea, blackgram and greengram in Tamil Nadu is presented in Table 9.2.

***(a) Chickpea* :** It is mainly cultivated in Rabiseason and it occupies 0.08 lakh ha area with 0.05 lakh tonnes of production and 6.54 q/ha of productivity. Chickpea in paired row planting with one or two rows of coriander as intercrop would give the highest return in Tamil Nadu. Wheat can also be intercropped with chickpea in deep black cotton soil in Coimbatore, Erode, Salem, Namakkal and Dharmapuri districts.

***(b) Blackgram* :** It iscultivated during three seasons viz., kharif, rabi and summer in all districts of Tamil Nadu except Nilgiris and Kanyakumari in an area of 3.65 lakh ha with an annual production of 3.10 lakh tonnes and productivity of 8.51 q/ha. The increase in significance and horizontal expansion of blackgram in Tamil Nadu is attributed to the development of suitable high yielding and YVM resistant varieties as well as location specific agronomical practices for cultivation in rabi rice fallows.

***(c) Greengram* :** It is mostlycultivated in rabi season under rainfed condition and also in rice fallows utilising residual moisture during summer season. Greengram occupies 1.95 lakh ha with an annual production of 1.51 lakh tonnes with productivity of 7.75 q/ha.

Table 9.2 : Area, Production and Productivity of Chickpea, Blackgram and Greengram in **Tamil Nadu (2013-14)**

Crops	Productivity (q/ha)	Production (t)	Area (ha)
Chickpea	6.54	5823	8908
Blackgram	8.51	310658	365128
Greengram	7.75	151400	195285

Source: Directorate of Economics and Statistics, New Delhi

Summary of Cluster FLDs on rabi pulses under NFSM 2015-16

Cluster FLDs were implemented on three pulse crops namely chickpea, blackgram and greengram under NFSM in an area of 672 ha in two states viz., Karnataka and Tamil Nadu in Zone VIII by involving 1680 farmers (Demos) and details are presented in Table 9.3.

Cluster FLDs on chickpea were conducted in 230 ha area with the involvement of 575 farmers which consist 218 ha with 545 farmers by 19 KVKs viz.,Bangalore Rural, Belagavi-I,Belagavi-II, Bellary, Bidar,Vijayapura, Chamrajnagar, Chikkamagalur, Chitradurga, Davanagere, Dharwad, Gadag, Kalaburagi-I, Kalaburagi-II, Haveri, Koppal, Mysuru, Raichur

and Tumakuru-Iin Karnataka and 12 ha with 30 farmers by one KVK namely Dindigul in Tamil Nadu.

In case of blackgram, area covered was 242 ha under cluster FLDs by involving 605 farmers, of which 30 ha with 75 farmers by two KVKs viz., Koppal and Uttara Kannada in Karnataka and 212 ha with 530 farmers by 14 KVKs viz., Cuddalore, Erode, Karur, Madurai, Nagapattinam, Namakkal, Perambalur, Pudukottai, Thiruvannamalai, Tiruvarur, Tiruvallur, Trichy, Villupuram, and Virudhunagarin Tamil Nadu.

Whereas, cluster FLDs on greengram were conducted in an area of 200 ha by involving 500 farmers that comprises 70 ha with 175 farmers by five KVKsviz., Dakshina Kannada, Dharwad,Kalaburagi-I,Shivamogga, and UttaraKanndain Karnataka and 130 ha with 325 farmers by 11 KVKs viz., Dindigul, Kancheepuram, Nagapattinam, Namakkal, Pudukottai, Salem, Tiruvarur, Tiruvallur, Vellore, Villupuram, and Virudhunagarin Tamil Nadu.

Table 9.3: State-wise cluster FLDs conducted on rabi pulses under NFSM 2015-16

Crop/State	Area (ha)	Demonstrations (Number of farmers)
Chickpea		
Karnataka	218	545
Tamil Nadu	12	30
Sub-total (A)	**230**	**575**
Blackgram		
Karnataka	30	75
Tamil Nadu	212	530
Sub-total (B)	**242**	**605**
Greengram		
Karnataka	70	175
Tamil Nadu	130	325
Sub-total (C)	**200**	**500**
Grand total (A+B+C)	**672**	**1680**

While implementing cluster FLDs, the guidelines provided under NFSM Scheme were followed. Details on varieties along with production technologies demonstrated on the farmers' fields are given below:

(a) Chickpea: Four improved varieties of chickpea viz., JG-11, JAKI-9218, GBM-2,BGD-103 in Karnataka along with check variety Annigeri -1 and variety JG-11 in Tamil Nadu along with check variety Annigeri -1 were demonstrated through cluster FLDs. Production technologies demonstrated as per recommendation

(b) Blackgram: Two improved varieties of blackgram viz., DU-1 and TAU-1 in Karnataka along with local varieties and four improved varieties VBN-5, VBN-6, MDU-1 and ADT-5 in Tamil Nadu along with check varieties namely VBN-3, VBN-4, ADT-3, T-9, and ADH-9 were demonstrated through cluster FLDs. Production technologies demonstrated as per recommendation

(c) Greengram: Four improved varieties of greengram viz., BGS-9, DDGV-2, IPM-02-14 (Shreya),and KKM-3in Karnataka along with local, Kari Hesaru, S-4 varieties and four improved varieties CO (Gg)-8, ADT-3, and PDM-139in Tamil Nadu along with check varieties namely KM-2, VBN-2, VBN-3, CO-6, VRM-1 and local were demonstrated through cluster FLDs. Seed treatment with Imidacloprid @ 5ml/kg of seeds

Performance of cluster FLDs on rabi pulses under NFSM 2015-16

A total of 1680 cluster FLDs were conducted in an area of 672 ha that comprises 545 demos in 218 ha in Karnataka and 30 demos in 12 ha in Tamil Nadu for chickpea, 75 demos in 30 ha in Karnataka and 530 demos in 212 ha in Tamil Nadu for blackgram, and 175 demos in 70 ha in Karnataka and 325 demos in 130 ha in Tamil Nadu for greengram.Performance of cluster FLDs on chickpea, blackgram and greengram under NFSM 2015-16 are presented in Annexure-I, Annexure-II and Annexure-III, respectively. Details with regard to yield and net returns are presented in Table 9.4 and Fig.1 and Fig.2.

(a) Chickpea: Data indicate that the average yield obtained with demonstrated varieties along with production technologies of chickpea was 10.35 q/ha as against check (8.06 q/ha) in Karnataka and 11.80 q/ha as against check (8.25 q/ha) in Tamil Nadu with yield increase of 21.12 and 30.03 per cent in Karnataka and Tamil Nadu, respectively. However, the BCR (2.85) was more in chickpea demos in Karnataka as compared to demos in Tamil Nadu (2.05).

(b) Blackgram: Data shows that the average yield obtained with demonstrated varieties along with production technologies of blackgram was 5.27 q/ha as against check (4.22 q/ha) in Karnataka and 8.67 q/ha as against check (6.77 q/ha) in Tamil Nadu with yield increase of 19.93 and 21.26 per cent in Karnataka and Tamil Nadu, respectively. Correspondingly, the BCR (3.11) was more in blackgram demos in Tamil Nadu as compared to demos in Karnataka (3.09).

(c) Greengram: Data shows that the average yield obtained with demonstrated varieties along with production technologies of greengram was 4.69 q/ha as against check (3.76 q/ha) in Karnataka and 8.70 q/ha as against check (6.70 q/ha) in Tamil Nadu with yield increase of 19.06 and 23.32 per cent in Karnataka and Tamil Nadu, respectively. Correspondingly, the BCR (2.84) was more in greengram demos in Tamil Nadu as compared to demos in Karnataka (2.41).

Table 9.4 : Performance of cluster FLDson rabi pulses under NFSM 2015-16

Crop/ State	Area (ha)	No of demos	Yield (q/ha)					Cost of cultivation and returns (Rs./ha)							
			Demonstration			Local Check	% yield increase	Demonstration				Check (Farmers Existing practice)			
			Highest	Lowest	Average			Gross Cost	Gross Return	Net Return	B:C ratio	Gross Cost	Gross Return	Net Return	BC ratio
Chickpea															
Karnataka	218	545	11.88	8.70	10.35	8.06	21.12	17807	46907	29100	2.85	17497	36247	18750	2.24
Tamil Nadu	12	30	13.50	9.50	11.80	8.25	30.08	28750	59000	30250	2.05	32250	57750	25500	1.79
Blackgram															
Karnataka	30	75	6.88	3.38	5.27	4.22	19.93	20928	54615	60293	3.09	15093	33442	33536	2.22
Tamil Nadu	212	530	9.92	7.80	8.67	6.77	21.26	26083	79560	53450	3.11	25420	60862	35441	2.51
Greengram															
Karnataka	70	175	5.75	3.55	4.69	3.76	19.06	15478	34959	19480	2.41	14487	28198	13710	2.08
Tamil Nadu	130	325	9.61	7.95	8.70	6.70	23.32	21938	59621	37683	2.84	20995	46146	25151	2.29
Total	672	1680													

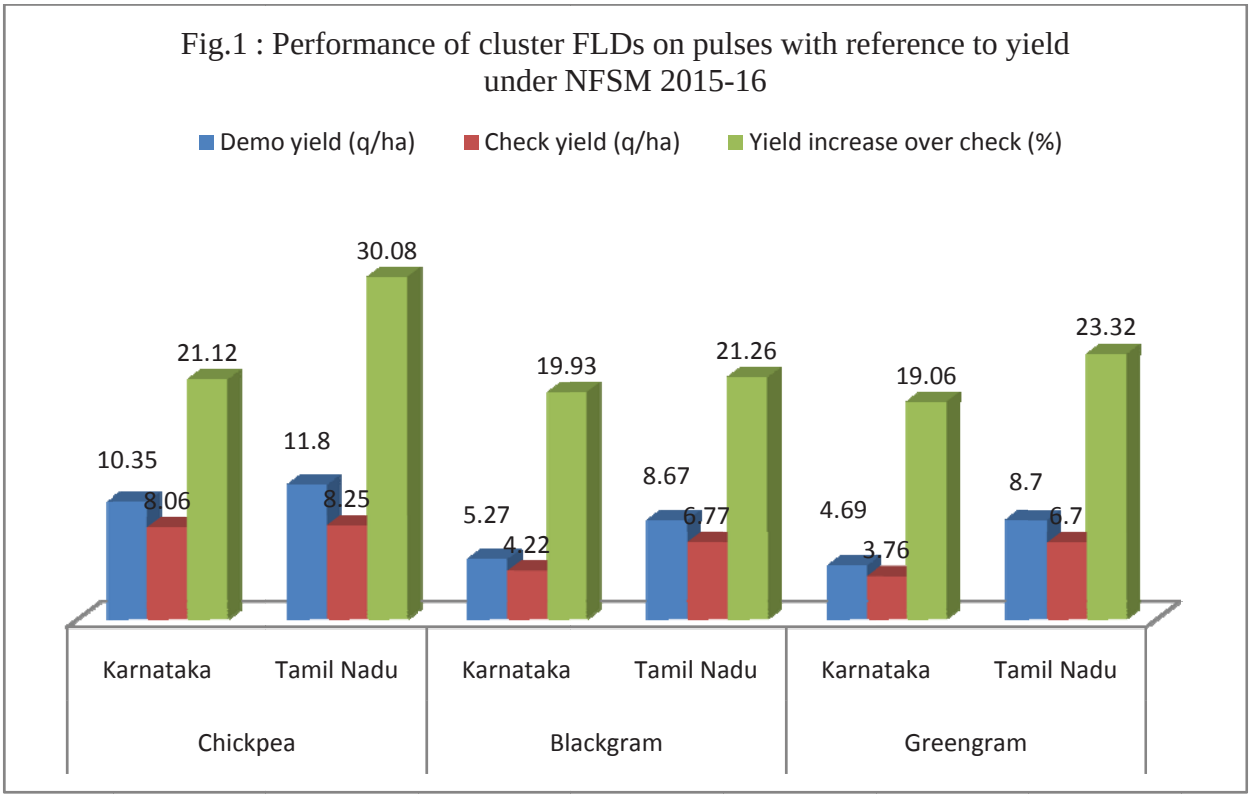


Fig.2 : Performance of cluster FLDs with reference to net returns under NFSM 2015-16

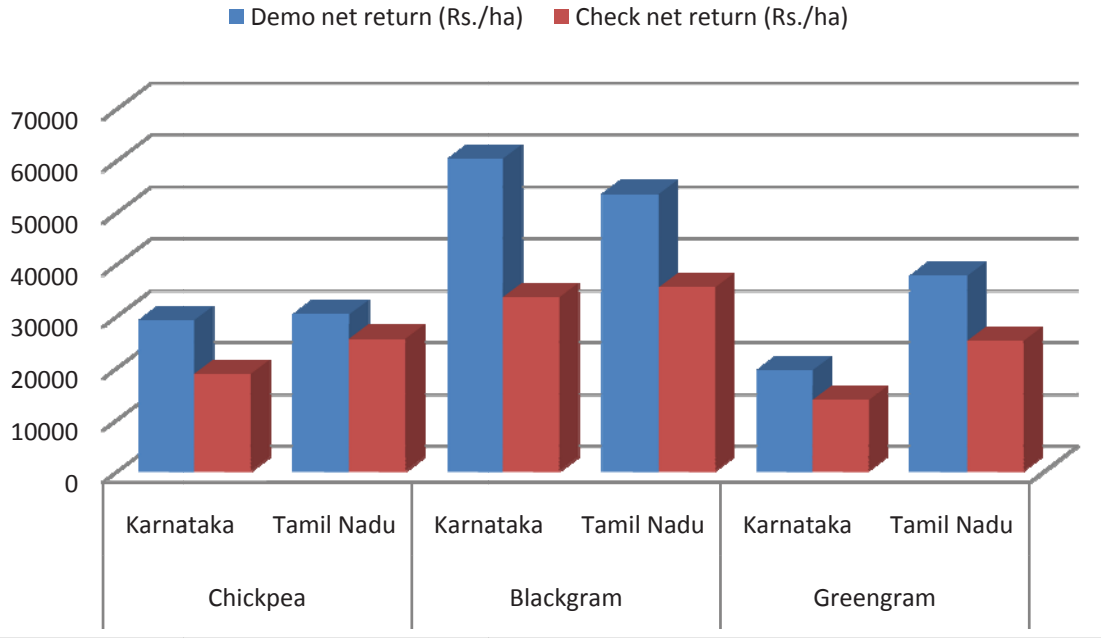
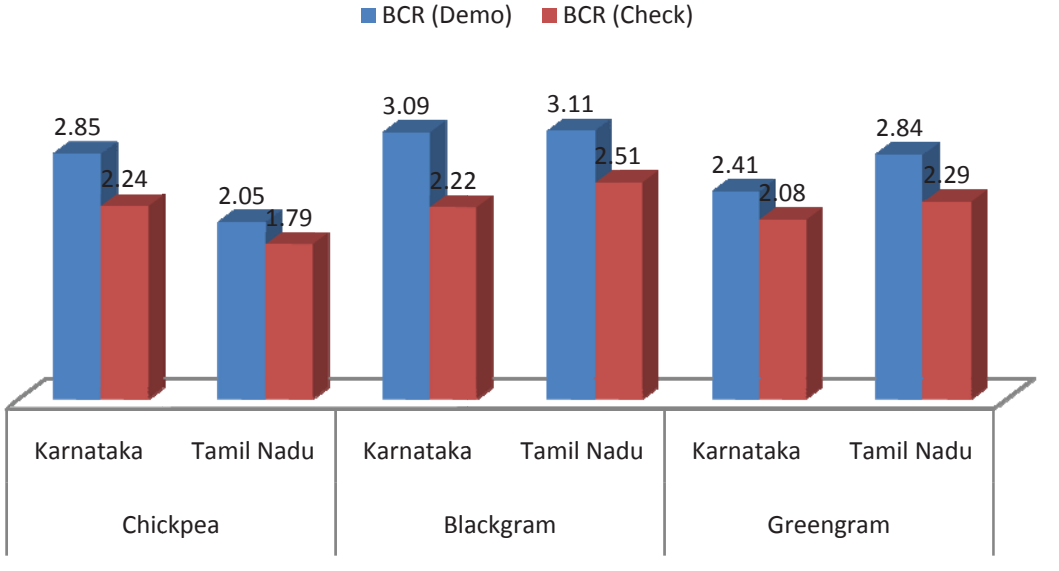


Fig.3: Performance of cluster FLDs with refwerence to BCR under NFSM 2015-16



Performance of pulse crop varieties under cluster FLDs of NFSM 2015-16

Different improved varieties of pulse crops viz., chickpea, blackgram and greengram were demonstrated through cluster FLDs under NFSM 2015-16. Details on performance of these varieties in different KVK districts of Karnataka and Tamil Nadu are described below:

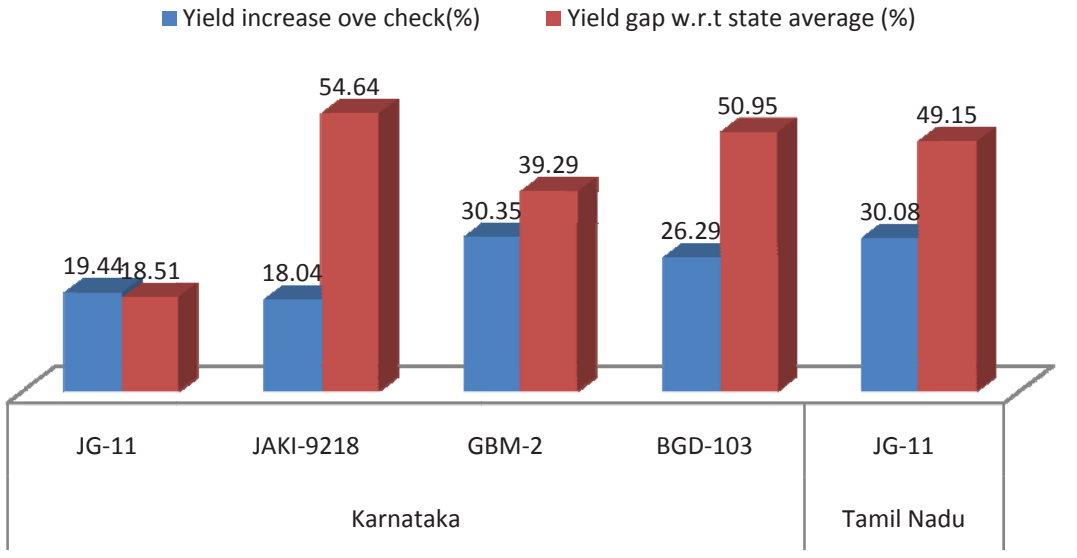
(a) Chickpea: Cluster FLDs on chickpea under NFSM were conducted in 230 ha area by involving 575 farmers in the states of Karnataka and Tamil Nadu during 2015-16 with four varieties of chickpea viz., JG-11, JAKI-9218, GBM-2,and BGD-103 in Karnataka and one variety JG-11 in Tamil Nadu along with check variety Annigeri -1.Among these varieties, JG-11 was demonstrated in more area (133 ha) with 333 farmers followed by JAKI-9218 in 36 ha with 90 farmers, GBM-2 in 32 ha with 80 farmers,and BGD-103 in 10 ha with 25 farmers in Karnataka and JG-11 in 12 ha with 30 farmers in Tamil Nadu. Details with regard to performance of these varieties are presented in Table 9.5 and Fig.4.

The variety BGD-103 performed better and gave 15.29 q/ha yield followed by GBM-2 (14.66 q/ha), JAKI-9218 (11.42 q/ha) and JG-11 (8.59 q/ha) in Karnataka as against check 11.27, 10.21, 9.36 and 6.92 q/ha, respectively and only one variety JG-11 in Tamil Nadu gave 11.80 q/ha as compared to check (8.25 q/ha). The yield increase over check was ranged from 18.04% with variety JAKI-9218 to 30.35% with variety GBM-2 in Karnataka and 30.08% yield increase was found with variety JG-11 over check in Tamil Nadu. In case of yield gap with reference to state average yield, the minimum 18.51% recorded with variety JG-11 followed by 39.29% with GBM-2, 50.95% with BGD-103 and 54.64% with JAKI-9218 in Karnataka and 49.15% yield gap with JG-11 noted in Tamil Nadu.

Table 9.5 : Performance of Chickpea varieties under cluster FLDsof NFSM 2015-16

State/Variety	Area (ha)	Demonstrations (No.)	Average				
			Demo yield (q/ha)	Check yield (q/ha)	Yield increase (%)	State yield (q/ha)	Yield gap w.r.t state yield (%)
Karnataka-(Chickpea)							
JG-11	133	333	8.59	6.92	19.44	7.00	18.51
JAKI-9218	36	90	11.42	9.36	18.04	5.18	54.64
GBM-2	32	80	14.66	10.21	30.35	8.90	39.29
BGD-103	10	25	15.29	11.27	26.29	7.50	50.95
Tamil Nadu-(Chickpea)							
JG-11	12	30	11.80	8.25	30.08	6.00	49.15

Fig.4 : Performance of Chickpea varieties with reference to yield increase and gap under cluster FLDs of NFSM 2015-16



JG-11, KVK Bangalore Rural

JG-11, KVK Vijayapura

JG-11, KVK Chamrajanagar

JG-11, KVK Chikkamagalur

JG-11, KVK Chitradurga

JG-11, KVK Davanagere

JG-11, KVK Dharwad

JG-11, KVK Mysuru

JG-11, KVK Haveri

JG-11, KVK Tumakuru

A view of demonstration on chickpea variety: JG-11


A view of demonstration on chickpea variety BGD-103, KVK, Bellary


JAKI-9218, KVK Belgavi-I JAKI-9218, KVK Gadag

A view of demonstration on chickpea variety: JAKI-9218


GBM-2, KVK Gulbarga-I GBM-2, KVK Gulbarga-II

A view of demonstration on chickpea variety: GBM-2

A view of demonstration on chickpea variety JG-11, KVK Dindigul

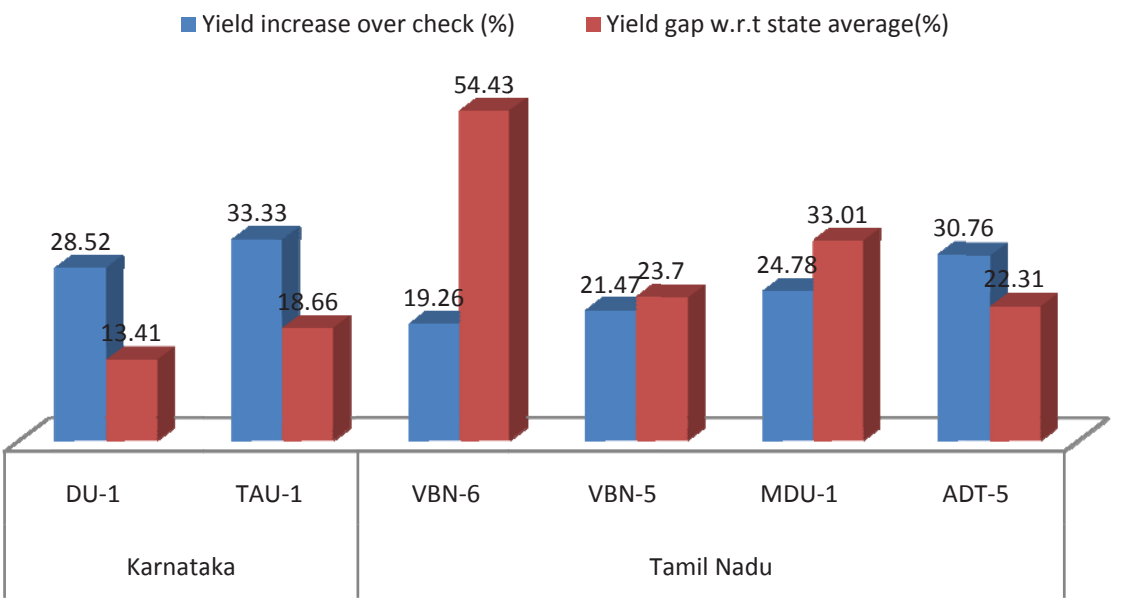
(b) Blackgram: Cluster FLDs on blackgram under NFSM were conducted in 242 ha area by involving 605 farmers in the states of Karnataka and Tamil Nadu during 2015-16 with two varieties of blackgramviz., DU-1 and TAU-1in Karnataka along with local varieties and four varieties viz., VBN5, VBN-6, MDU-1 and ADT-5 in Tamil Nadu along with check varieties namely VBN-3, VBN-4, ADT-3, T-9, and ADH-9.Among these varieties, DU-1 was demonstrated in more area (26 ha) with 65 farmers followed by TAU-1 in 4 ha with 10 farmers in Karnataka andVBN-6 in 120 ha with 300 farmers, VBN-5 in 68 ha with 170 farmers, MDU-1 in 36 ha with 90 farmers and ADT-5 in 12 ha with 30 farmers in Tamil Nadu. Details with regard to performance of these varieties are presented in Table 9.6 and Fig.5.

The variety TAU-1 performed better and gave 7.50 q/ha yield followed by DU-1 (5.89 q/ha) as compared to check 5.00 q/ha and 4.21 q/ha, respectivelyin Karnataka. The variety MDU-1 gave high yield (10.21 q/ha) followed by VBN-5 (8.52 q/ha), VBN-6 (8.36 q/ha) and ADT-5 (6.50 q/ha) as against check 7.68, 6.69, 6.75, 4.50 q/ha, respectively in Tamil Nadu. The yield increase over check was recorded 33.33% with TAU-1 and 28.52% with DU-1 in Karnataka. In Tamil Nadu, high yield increase (30.76%) was observed with variety ADT-5 over check followed by MDU-1 (24.78%), VBN-5 (21.47%) and VBN-6 (19.26%).Whereas yield gap with reference to state average yield, it was 13.41% with DU-1 and 18.66% with TAU-1 in Karnataka and the minimum yield gap of 22.31% was recorded with ADT-5 followed by 23.70% with VBN-5, 33.01% with MDU-1 and 54.43% with VBN-6 in Tamil Nadu.

Table 9.6: Performance of Blackgram varieties under cluster FLDsof NFSM 2015-16

State/Variety	Area (ha)	Demonstrations (No.)	Average				
			Demo yield (q/ha)	Check yield (q/ha)	Yield increase (%)	State yield (q/ha)	Yield gap w.r.t state yield (%)
Karnataka-(Blackgram)							
DU-1	26	65	5.89	4.21	28.52	5.10	13.41
TAU-1	4	10	7.50	5.00	33.33	6.10	18.66
Tamil Nadu-(Blackgram)							
VBN-6	120	300	8.36	6.75	19.26	3.81	54.43
VBN-5	68	170	8.52	6.69	21.47	6.50	23.70
MDU-1	36	90	10.21	7.68	24.78	6.84	33.01
ADT-5	12	30	6.50	4.50	30.76	5.05	22.31

Fig. 5: Performance of Blackgram varieties with reference to yield increase and gap under cluster FLDs of NFSM 2015-16



VBN-6, KVK Pudukottai

VBN-6, KVK Erode

VBN-6, KVK Nagapattinam

VBN-6, KVK Namakkal

VBN-5, KVK Villupuram

VBN-5, KVK Karur

MDU-1, KVK Madurai

ADT-5, KVK Thiruvarur

DU-1, KVK Uttara Kannada

TAU-1, KVK Koppal

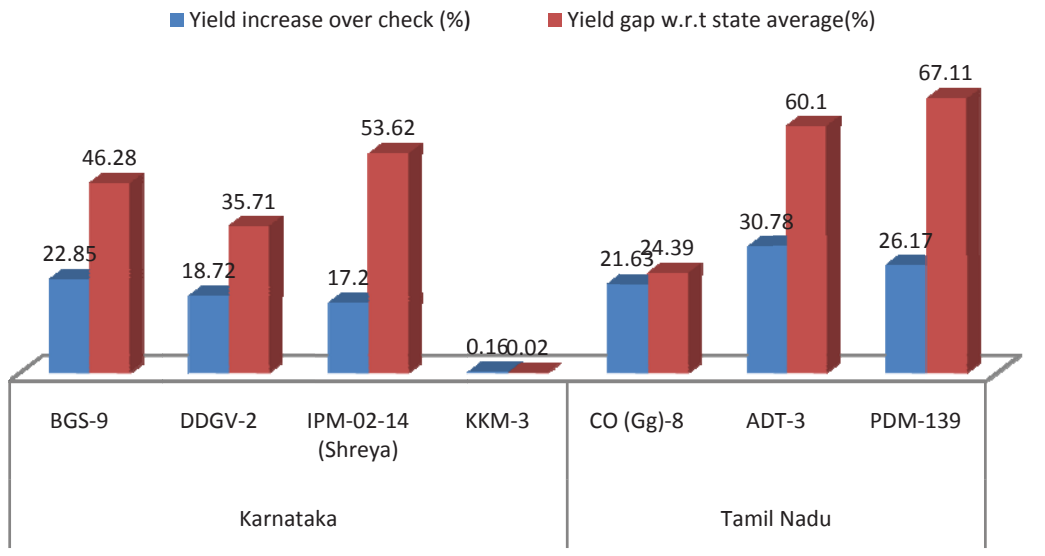
(b) Greengram: Cluster FLDs on greengram under NFSM were conducted in 200 ha area by involving 500 farmers in the states of Karnataka and Tamil Nadu during 2015-16 with four varieties viz., BGS-9, DDGV-2, IPM-02-14 (Shreya), and KKM-3 in Karnataka along with local, Kari Hesaru, S-4 varieties and three varieties viz., CO (Gg)-8, ADT-3, and PDM-139 in Tamil Nadu along with check varieties namely KM-2, VBN-2, VBN-3, CO-6, VRM-1.Among these varieties, BGS-9 was demonstrated in more area (30 ha) with 75 farmers followed by DDGV-2 in 12 ha with 30 farmers, IPM-02-14 (Shreya) and KKM-3 each in 10 ha with 25 farmers in Karnataka and CO9Gg)-8 in 76 ha with 190 farmers, ADT-3 in 10 ha with 25 farmers and PDM-139 in 6 ha with 15 farmers in Tamil Nadu. Details with regard to performance of these varieties are presented in Table 9.7 and Fig.6.

The variety IPM-02-14 (Shreya) performed better and gave 5.93 q/ha yield followed by BGS-9 (5.25 q/ha), DDGV-2 (4.06 q/ha), and KKM-3(2.98 q/ha)as against check 4.91, 4.05, 3.30 and 2.5 q/ha, respectively in Karnataka and CO(Gg)-8 gave high yield (9.06 q/ha) followed by PDM-139 (7.45 q/ha) and ADT-3 (6.14 q/ha) as compared to check 7.10, 5.50 and 4.25 q/ha, respectively in Tamil Nadu. The yield increase over check was recorded high 22.85% with BGS-9 followed by 18.72% with DDGV-2, 17.20% with IPM-02-14 (Shreya) and 0.16 % with KKM-3 in Karnataka and high yield increase (30.78%) was observed with variety ADT-3 over check followed by PDM-139 (26.17%), and CO(Gg)-8 (21.63%) in Tamil Nadu. In case of yield gap with reference to state average yield, the minimum 0.02% was recorded with KKM-3 followed by 35.71% with DDGV-2, 46.28% with BGS-9 and 53.62% with IPM-02-14 (Shreya) in Karnataka whereas in case of Tamil Nadu the minimum yield gap 24.39 was noticed with CO(Gg)-8 followed by ADT-3 (60.10%) and PDM-139 (67.11%).

Table 9.7 : Performance of Greengram varieties under cluster FLDs of NFSM 2015-16

State/Variety	Area (ha)	Demonstrations (No.)	Average				
			Demo yield (q/ha)	Check yield (q/ha)	Yield increase (%)	State yield (q/ha)	Yield gap w.r.t state yield (%)
Karnataka-(Greengram)							
BGS-9	30	75	5.25	4.05	22.85	2.82	46.28
DDGV-2	12	30	4.06	3.30	18.72	2.61	35.71
IPM-02-14 (Shreya)	10	25	5.93	4.91	17.20	2.75	53.62
KKM-3	10	25	2.98	2.5	0.16	2.92	0.02
Tamil Nadu-(Greengram)							
CO (Gg)-8	76	190	9.06	7.10	21.63	6.85	24.39
ADT-3	10	25	6.14	4.25	30.78	2.45	60.10
PDM-139	6	15	7.45	5.50	26.17	2.45	67.11

Fig. 6: Performance of Greengram varieties with reference to yield increase and gap under cluster FLDs of NFSM 2015-16



CO (Gg)-8, KVK Thiruvallur

CO (Gg)-8, KVK Salem

CO (Gg)-8, KVK Namakkal

CO (Gg)-8, KVK Vellore

CO (Gg)-8, KVK Villupuram

CO (Gg)-8, KVK Nagapattinam

CO (Gg)-8, KVK Kancheepuram

ADT-3, KVK Thiruvarur

BGS-9, KVK Gulbarga-A

BGS-9, KVK Dharwad

IPM-02-14 (Shreya), KVK Dharwad

DDGV-2, KVK Uttara Kannada

Performance of production technologies of pulse crops demonstrated through cluster FLDs under NFSM 2015-16

Location specific production technologies were demonstrated along with improved varieties of pulse crops through cluster FLDs under NFSM 2015-16. Details where highest yield was obtained are given below:

(a) Chickpea: Improved varieties along with recommended location specific production technologies of chickpea were demonstrated by KVKs in cluster FLDs under NFSM 2015-16. Out of some specific technologies where higher yield obtained are presented hereunder:

(i)*Integrated Crop Management along with wilt resistant variety JG-11:*It was demonstrated by KVK Bangalore Rural on the field of cluster FLD farmer - Shri Manjunath, S/o N.Rajanna belonging to Beedaganahalli village, Devenahalli taluk, Bengaluru Rural district, Karnataka. The demonstrated ICM practices includes JG-11 variety of chickpea, coriander as trap crop, seed treatment with *rhizobium*, installation of pheromone traps 50 days after sowing, NPV (1ml/lt) at 5 % flowering stage and spraying of need based plant protection sprays viz., Spinosad (0.15 ml/lt during pod formation stage). Farmer was trained and technically guided by KVK scientists on the production technology in different growth stages of the crop. ICM with JG-11 demonstration was performed better and gave 10.25 q/ha yield as against 7.75 q/ha with local check (Annigeri-1) that recorded 24.30% yield and 38.1 net returns increase over check. Net return obtained with demo was Rs.23500 as compared to check Rs.14568. Further, it was observed that JG-11 was tolerant to moisture stress and crop was less infected with wilt disease as well as less attack of pod borer.

Plant difference of check and JG-11 (demo)

Installation of pheromone traps

A view of demo on ICM with JG-11 visited by Officials and farmers

(ii) Chickpea variety BGD-103 in maize fallow in Bellary district of Karnataka: Improved variety of chickpea was demonstrated by KVK Bellary on the field of Shri Balanajanaiah, Babbugunte, Bellary taluq, Bellarydistrict in Karnataka through cluster FLDs under NFSM 2015-16. Variety BGD-103 performed better with tolerant to wilt pod borer and gave 15.29 q/ha as against 11.27 q/ha in check (Annigeri-1) that gave an increase of 35.58% yield. It resulted an increase of 127.33% return with net return of Rs.68787 under demoand Rs.49989 under check.

BGD-103 variety in the maize fallow

Check variety A-1 in the maize fallows

BGD-103 variety during growth stage

BGD-103 variety at harvesting stage

(iii) Nipping followed by2% DAP spray at floweringin Mysurudistrict of Karnataka: It was demonstrated by KVK Mysuruthrough cluster FLD under NFSM 2015-16 on the field of Shri Siddalingeshwara, S/o ChannabasavadevaruDevanuru, NanjangudTaluq, MysuruDistrict in Karnataka. Nipping was done at 30-40 days after sowing of variety JG-11 that increased no. of branches as well as pods per plant. DAP @ 2% was sprayed before flowing stage. Demo yielded 9.40 q/ha as against 8.50 q/ha in check that gave 9.57 % yield increase. Correspondingly 12.5 % increase on net return in demo was obtained with net returns of Rs.18850 (demo) and Rs.16500 (check).

A view of demonstration field of Chickpea

***(iv) Seed treatment with Trichoderma in Dindigul district of Tamil Nadu*:** It was demonstrated by KVK Dindigul through cluster FLDs under NFSM 2015-15 on the field of Shri R.Ganesan, S/o Ramakrishnan, Chinnappapuram, Konur(Po), Dindigul District, Tamil Nadu. Seed of chickpeavariety JG-11 was treated with Trichoderma @ 4 g/kg that resulted only 6% disease incidence in demo as against check (17%). Demo gave 13.50 q/ha as compared to check (8.25 q/ha) that increased yield (63.60%) and net return (61.12%). Net return obtained in demo was Rs.41715 and Rs.25500 (check).

Seed Treatment

Field Advisory services

(v) GBM-2 variety of Chickpea for mechanical harvesting in Kalaburagi district of Karnataka: It was demonstrated by KVK Kalaburagi-I through cluster FLDs under NFSM 2015-16. Crop was harvested through combine harvester with a cost of Rs.2500/ha that saved Rs.700, 13 hours of time, reduced yield loss of 7.7% and finally reduced labour dependency.

A view of chickpea crop with GBM-2 variety

(b) Blackgram: Improved varieties along with recommended location specific production technologies of blackgramwere demonstrated by KVKs in cluster FLDs under NFSM 2015-16. Out of some specific technologies where higher yield obtained are presented hereunder:

***(i) ICM with VBN-6 variety of Blackgram in Perambalurdistrict of Tamil Nadu*:** It was demonstrated by KVK Perambalur through cluster FLDS under NFSM 2015-16 on the field of Shri M. Rajamanickam, S/o Muthusamy, 2/351, Anna nagar, Anukkur post, Veppanthattai Taluk, Perambalurdistrict,Tamil Nadu. Technologies demonstrated were Variety VBN -6, seed treatment with bioagents, mechanical sowing, NSKE 5% application to control sucking pests, NPV application to control borers, *Verticilliumlecanii* application for controlling *Helicoverpa*, *p*heromone trap setting @ 12 nos/ha, and TNAU pulse wonder application @ 6.25 kg/ ha. Results indicated that no YMV incidence was noticed in demo which led to yield increase of 47.47% (11.48 q/ha in demo and 6.03 q/ha in check T-9). Correspondingly net return was increased to 64.02% in demo with a net returns of RS. 82569 (demo) and Rs.29707 (check).

A view of crop in Demo

A view of crop in Check

***(ii) Foliar application of pulse wonder inBlackgram in Thiruvannamalaidistrict of Tamil Nadu*:** It was demonstrated by KVK Thiruvannamalai through cluster FLDs under NFSM 2015-16 on the field of Shri M. Velayutham, S/O Munisamy, Brammadesam, VembakkamTaluq, Thiruvannamalidistrict, Tamil Nadu. Foliar application of pulse wonder @ 2.25 kg/acre was done at 30 DAS that led to increased no. of flowers, pods and pod clusters. Results indicated that crop in demo performed better with not even a single YMV plant up to harvest and gave an yield of 9.14 q/ha as against check (7.87 q/ha) with an increase of 16.14% yield. Correspondingly net return increased by 36.47% with net returns of Rs. 64751 under demo and Rs.47445 under check.

Single plant- Blackgram – T9

Single plant- Blackgram – VBN 6

Application of TNAU pulse wonder at flowering stage

A view of crop in demo

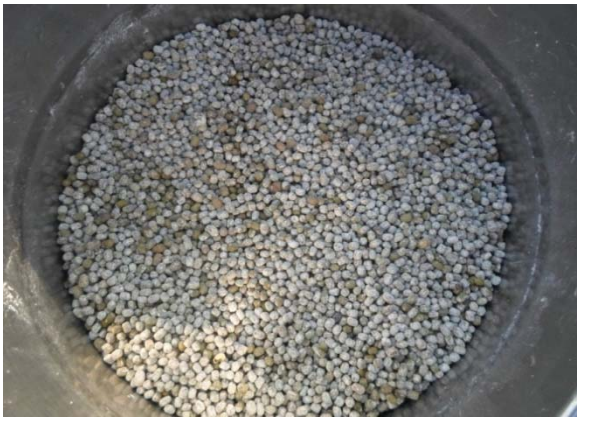
***(iii) Growing of Blackgram on rice fallow by utilizing residual soil moisture in Koppal district of Karnataka*:** It was demonstrated with TAU-1 variety of blackgram by KVK Koppal through cluster FLDs under NFSM on the field of Shri Siddana Gowda belonging to Yaradona Village, GangavatiTaluq, Koppaldistrict, Karnataka. Crop performed well and gave a yield of 7.50 q/ha as against check (5.00 q/ha) that provided increase of 50.00% yield and 70.00% net return over the check with Rs. 61875 under demo and Rs.36200 under check.

A view of Black gram crop with improved variety TAU-1

A view of crop with local variety of Blackgram

(c) Greengram: Improved varieties along with recommended location specific production technologies of greengramwere demonstrated by KVKs in cluster FLDs under NFSM 2015-16. Out of some specific technologies where higher yield obtained are presented hereunder:

***(i) ICM with CO (Gg)-8 variety of Greengram in Villupuramdistrict of Tamil Nadu*:**it was demonstrated by KVK Villupuram through cluster FLDs under NFSM 2015-16 on the field of Shri S. Arumugam, S/o Subburayan, Alanguppam village, Marakanam Block, VillupuramDistrict, Tamil Nadu. The technologies demonstrated were improved variety CO (Gg)-8 along with production technologies *viz.,* Seed treatment with *Pseudomonasfluorescens* @ 10 g/ kg seed and rhizobium @ 600 g / ha seed, installation of pheromone traps @ 12 / ha, spraying of pulse wonder @ 5 kg/ha, release of *Trichogrammachilonis* @ 5 cc/ha and need based nutrient, weed, disease and pest management practice. Results indicated that number of pods per plant were more and less incidence of diseases in demo than the check and gave an yield of 11.50 q/ha as against check (7.5 q/ha) that endowed with increase of 53.33% yield and 76.00% net return over the check with Rs. 45210 under demo and Rs.25603 under check.



Seed treatment with Biofertilizers

A view of demo field at vegetative stage

A view of demo field Maturity stage

***(ii) Foliar application of TNAU pulse wonder in Greengram in Nagapattinam District of Tamil Nadu*:**it was demonstrated by KVK Nagapattinam through cluster FLD under NFSM 2015-16 on the field of Shri Mr. P. Murugan,Ponveli village, Sikkal – (PO),Nagapattinam Taluq, Nagapattinam district, Tamil Nadu. Spraying of pulse wonder @ 5 kg/ha gave more number of pods (25 nos.) per plant and more number of seeds (12 nos.) than check pods (20 nos.) and seeds (9 nos.) and size of the seeds was larger than check. Yield recorded in demo was 4.66 q/ha as compared to check (3.12 q/ha). Yield and net return was increased in demo were 33.00% each with net returns of Rs.46600 under demo and Rs.31200 under check.

Demonstration of pulse Wonder

Green gram CO 8 field overview

Green gram pods and seeds

Demonstration of pulse Wonder

***(iii) Relay cropping of Greengram in paddy fields in Thiruvarurdistrict of Tamil Nadu*:** It was demonstrated with ADT-3 variety of greengram through cluster FLDs under NFSM 2015-16 on field of ShriK. Alagesan, Kottagachery, Mannargudi, ThiruvarurDistrict, Tamil Nadu. Production technologies demonstrated were seed rate – 25 kg/ha, seed treatment with pseudomonas and rhizobium, sowing greengram about 4 days prior to paddy harvest, integrated weed management, TNAU Pulse wonder spray,and harvested with tyre type combine harvester. Demo performed well with sowing of greengram seed at 4 days prior to harvest of paddy with enhanced seed rate maintained optimum plant population in rice fallow condition in machine harvested rice fields. Results gave 45.51% yield increase with 7.80 q/ha (demo) and 4.25 q/ha (check) and 57.25% net returns increase with Rs.44260 under demo and Rs.28100 under check.

Ideal soil condition for Rice Fallow for Greengram sowing as relay cropping

Optimum plant population of greengram

Spraying of TNAU pulse wonder

Field day

Harvesting with tyre type harvester of green gram

Training conducted on production technologies of pulse crops demonstrated through cluster FLDs under NFSM 2015-16

On and Off campus training programmes were organized by KVKs on production technologies of chickpea, blackgram and greengram for the cluster FLD farmers of rabi pulses under NFSM 2015-16 and details are presented in Table 9.8. Data indicate that a total of 151 training programmes were organized with the participation of 4662 FLD farmers (3775 male and 888 female) that consists of 36 on-campus with 1053 participants (927 male and 126 female) and 115 off-campus with 3609 participants (2848 male and 762 female). Out of which, 59 training programmes (18 on-campus and 41 off-campus) were conducted on production technologies of Chickpea with the participation of 1638 FLD farmers (1462 male and 176 female) followed by 53 training programmes (9 on-campus and 44 off-campus) on production technologies of greengram with the participation of 1823 FLD farmers (1372 male and 452 female) and 39 training programmes (9 on-campus and 30 off-campus) on production technologies of blackgram with the participation of 1201 FLD farmers (941 male and 260 female).

Table 9.8 : Training programmes organized for the cluster FLD farmers of rabi pulses under NFSM 2015-16

Crop	On-campus				Off-campus				Total			
	No. of courses	FLD farmers			No. of courses	FLD farmers			No. of courses	FLD farmers		
		Male	Female	Total		Male	Female	Total		Male	Female	Total
Chickpea	18	494	33	527	41	968	143	1111	59	1462	176	1638
Blackgram	9	235	45	280	30	706	215	921	39	941	260	1201
Greengram	9	198	48	246	44	1174	404	1577	53	1372	452	1823
Total	**36**	**927**	**126**	**1053**	**115**	**2848**	**762**	**3609**	**151**	**3775**	**888**	**4662**

Extension activities organised towards cluster FLDs on rabi pulses under NFSM 2015-16

Different extension activities were organized by KVKs for the cluster FLD farmers of rabipulses under NFSM 2015-16. Data indicate that a total of 22428 personnel (21751 FLD farmers and 677 Extension Officials) participated in different extension activities organized in relation to cluster FLDs on chickpea, blackgram and greengram. Out of which, 10526 personnel (10253 FLD farmers and 273 Extension Officials) participated in extension activities related to chickpea followed by 10005 personnel (9763 FLD farmers and 242 Extension Officials) participated in extension activities related to greengram and 1897 personnel (1735 FLD farmers and 162 Extension Officials) participated in extension activities related to blackgram.

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