Impact of Cluster Frontline Demonstration on Pigeon Pea for Increasing Production in Rain Fed Area of District Ramgarh (Jharkhand) towards Self-Sufficiency of Pulses

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ABSTRACT

According to Indian Institute of Pulses Research Vision document, India's population is expected to touch 1.68 billion by 2030 and the pulse requirement for the year 2030 is projected at 32 million tones with anticipated required annual growth rate of 4.2 per cent. Pigeon pea occupies a prominent place in as rain fed crop in Jharkhand. To fulfill the domestic demand and to boost the production and productivity 275 cluster frontline demonstration (CFLDs) on pulse in Pigeon pea were conducted at 903 farmer's field by Krishi Vigyan Kendra, Ramgarh from 2016-2020 in 110 ha areas. The district productivity (870 kg/ha) is below the average national productivity 904 kg/ha, although state average is 1002 kg/ha higher than national productivity. The study found that the yield of pigeon pea in CFLD under rain fed conditions ranged from 11.20 to 12.50q/ha whereas in FP it ranged between 7.20 to 8.90 q/ha. The per cent increase in yield with Improved Practices (IP) over FP was recorded in the range of 25.83 to 35.71 per cent. The extension gap and technological index were ranging between 3.1to 4.0 q/ha and 10.71 to 20.00 per cent, respectively. The trend of technology gap reflected the farmer's cooperation in carrying out demonstrations with encouraging results in subsequent years. The benefit cost ratio was 1.9 to 2.6 under demonstration, while it was 1.7 to 2.2 under farmer's practices. The present study resulted to convincing the farming community for higher productivity and returns. The present study resulted to convincing the farming community for higher productivity and returns.

Key words: *Extension gap; Technology transfer; Yield; Cluster; Front line demonstrations; Technology index;*

Pigeon pea occupies a prominent place in Indian rain fed agriculture. It is an integral component of in various agro ecologies of the country mainly inter cropped with cereals, pulses and oilseeds and millets. After chickpea, Pigeon pea is the second most important pulse crop in the country In Jharkhand it covered 0.23 million ha, total production 0.2358 million tones, average yield 1002kg /ha. India cultivated 5.387 million ha area, production 7.87 million tones, average yield is 904 kg/ ha. Our country covered 73 per cent area, 66.48 per cent production in global share with average yield 969kg/ ha (*Directorate of Economics & statistics 2017*). Jharkhand contribute 6 per cent in national pulse production. In Ramgarh district "t" cultivated in area 2670 ha with average yield 870 kg/ha being the largest producer we contribute 25 per cent in global production and also is the largest importer of 14 per cent of pigeon pea pulse from other country (APEEDA). More than 90 per cent of production contribution of Tur is from 8 states, namely, Maharashtra, Karnataka, Madhya Pradesh, Uttar Pradesh, Gujarat, Jharkhand, Telangana and Andhra Pradesh. The Minimum Support Price of pigeon Pea increased sharply, which were Rs 1550/q in 2007-2008 to Rs 5000q/ha in 2016-17. The average rainfall of the district is 1178mm with 41.7 rainy days. The Pigeon pea is the climate resilient pulse crop and it is suitable to grown in rain fed areas. National Food Security Mission was stated. Enhancing the productivity of the crop assumes specific significance in India mainly to combat protein malnutrition as it is the main source of protein to the predominant vegetarian population. It is mainly eaten in the form of split pulse as 'dal'. Seeds of arhar are also rich in iron, iodine, essential amino acids like lycine, threonine, cystine and arginine etc .For a quantum jump in pulses production multiple technologies need to be adopted, covering information technology, biotech, satellite tech, nanotechnology, and so on. Using Artificial Intelligence for finding end-to-end solutions is the way forward. Protein deficiency in our country is pervasive, inflicting enormous hidden cost on the country. Pulses/legumes are the most affordable vegetable protein. India is the only country in the world where a quantum jump in both production and consumption of pulses can happen simultaneously. Consumption growth will help improve crop marketability and lift domestic prices to levels that will keep pulses growers adequately motivated. It will advance growers' income security and consumers' nutrition security- a 'win-win' for all. Unless productivity increases, Indian pulses will not be globally competitive. It is possible to increase yields with policy, research and investment support. The demonstration in clusters is the initiative took by Govt of India, which help to meet the demands and increase the production and provide the opportunity to coverage the fellow land in rain fed farming system in the country. India had imported a record 5.8 million tones of pulses in FY16, followed by 5.6 million tones in FY18. The country also signed a contract with Mozambique to import pigeon pea (tur) over a period of five years. With favorable monsoon rains, India had bumper output over the past three years, preventing domestic prices from increasing. In this regard, to sustain this production and consumption system, the Department of Agriculture, Cooperation and Farmers Welfare had sanctioned the project "Cluster Frontline Demonstrations on kharif pulses 2016-20'' to ICAR-ATARI, Patna through National Food Security Mission. This project was implemented by Krishi Vigyan Kendra, Ramgarh of ATARI Patna Zone-IV with main objective to boost the production and productivity of pulses through CFLDs with latest and specific technologies.

METHODOLOGY

Cluster Front Line Demonstrations (CFLDs) is a unique approach to provide an direct interface between researcher and farmers as the scientists are directly involved in planning, execution and monitoring of the demonstrations for the technologies developed by them and get direct feedback from the farmers' field about the crops The following objective of the Cluster Frontline Demonstration viz: Improved Crop Production Technologies, popularize the newly notified and improved varieties/technologies for varietal diversification and efficient management of resources. To create better and visible impact of a technology the demonstrations may be conducted in cluster approach. The present study uses potential yield, field demonstration yield and farmers' yield. The actual average yields of the farmers' field were sourced from Department of Economics and Statistics, Ministry of Agriculture and published reports. For conducting FLDs, farmers were identified/ selected following the survey suggested by *Choudhary, 1999*. The present investigation of CFLDs was conducted during kharif season 2016-20 by the KVK Ramgarh, Jharkhand (ICAR Research Complex for Eastern Region, Patna). The demonstrations were conducted in farmer's field of 6 different villages in the year 2016-17, 6 villages in 2017-18, 7 villages in 2018-19 and 2 villages in 2019-20 of Ramgarh district in Eastern Plateau and Hills Region (VII). The area under each demonstration was 0.4 ha. Farmers were trained to follow the package and practices for pigeon pea cultivation. The treatment comprised of recommended practice (Improved variety ICPL-87119) Asha/NDA-2, integrated nutrient management-@ 20:40:20/ FYM @5.0tn/ha + *Rhizobium* + PSB @ 5 g/kg seed, integrated pest management- deep ploughing + seed treatment with *Trichoderma viridae* @ 5 g/kg seed + imidacloprid @ 125 ml/ha and Neem oil 2.5 ltr/ha with installation of pheroman trap, one spray of insecticide Flubendiamide 480SC (39.35% w/w) @100ml/ha at pod formation etc. *vs*. farmers practice. The need based inputs were provided to the beneficiaries (Table 2). In case of local check, the traditional practices were followed by using existing varieties. An area of 110 hectare was covered with plot size 0.4 ha under cluster front line demonstration with active participation of 903 farmers. In general, the soil of the experimental sites were red soil and sandy soil, sub-humid region of Chota Nagpur region, acidic in reaction (pH 4.7-5.4), Low organic carbon (0.34-0.65%) and low in available nitrogen (94.8-120.5 kg N/ha), low in available phosphorus (6.6-15.8 kg P2O5 kg/ha) and medium in available potassium (132.2-197.1 kg K_2O/ha). Crop was sown between 15 June to 15 July with a spacing of 30 cm and seed rate was 20 kg/ha. Apply full dose of N and P through Di Ammonium phosphate, K through Murate of Potash was applied as basal before sowing. The seeds were treated with *Trichoderma viridae* @5 g/kg seeds then inoculated by *Rhizobium* and phospho-solubilizing bacteria biofertilizers each 5g/kg of seeds. Application of Imazethapyr @100g a.i./ha at 25-30 DAS. The crop was shown on ridge and furrow method. Spray of Neem oil @2.5/ltr at flower initiation and install the pheromone trap for monitoring of pod borer. Before conducting the demonstration farmers group meeting and training were also organized. The farmers field and crop growth were frequently monitored and gosthi and field day were organized with extension functionaries and block level development officer at demonstration plots to visualize the technology difference and disseminate the technology at large scale. The production data on different parameters was collected from farmers practice and demonstration plots and calculated the grass returns, cost of cultivation, net returns and benefit cost ratio (B:C ratio) by using prevailing prices of inputs and outputs. We also analysis of both CFLD plots as well as Farers Practice control plots for extension gap, technology gap, technology index along with the benefit cost ratio (*Samui et al., 2000*) as given below :

Technology gap = Potential Yield - Demonstration yield

Extension gap = Demonstration Yield - Farmer's yield

$$\text{Technology index} = \frac{\text{Potential yield} - \text{Demo. yield}}{\text{Potential yield}} \times 100$$

RESULTS AND DISCUSSION

Cluster frontline demonstration on chickpea were conducted by using variety Asha (ICPL-87119) & NDA-2 in an area of 110.0 ha at 903 farmers field with diversity of 21 villages in Ramgarh district indicated that the cultivation practices comprised under CFLD *viz* use of improved variety, line sowing, balanced application of fertilizers and control of pest through insecticide at economic threshold level (Table 1).

Yield : The results revealed that due to CFLDs on chickpea an average yield were recorded as 11.85 q/ha

Table 1. Improved production technology and farmers practices of pigeon pea (Ramgarh)

Particulars farming situation	Demonstration rainfed upland	Farmers practice rainfed up land	Technology Gap (100%)
Variety	Asha (ICPL-87119), NDA-2	Un identified variety(Local)	100
Method of sowing	Line sowing	Broadcasting	50
Time of sowing	June to Mid Jully	Mid July to Mid August	50
Seed rate	20 Kg/ha	30kg/ha	High seed rate
Fertilizer / vermin compos	20:40:20/ FYM @5.0tn/ha or Vermicompost@2..5t/ha	10:10:0/ FYM@1tn/ha (FYM lower NPK dose)	50
Use of bio fertilizer	*Rhizobium* culture	Nil	100
Seed treatment	Carbendazim/ Trichoderma	Nil	100
Plant protection	IPM	Nil	100
Intercultural	One weeding at 20-25 day crop and earthling, Nibeling of bud at the 40-50 days crop	No weeding/(mix with maize crop by few farmers	100

Table 2. Details of need based input given on CFLD of pigeon pea (Ramgarh)

Year	Demo.	Technology demonstrated	Need based input
2016-17	75	(ICPL-87119) Asha, IPM	Asha + Seed 20kg/ha, treatment with Trichoderma viridi & Rhizobium culture + Line sowing + Need based Chemical spray
2017-18	75	(ICPL-87119) Asha, IPM	Asha+ Seed 20kg/ha, treatment with Trichoderma viridi & Rhizobium culture + Line sowing+Need based Chemical spray
2018-19	100	NDA-2, IPM	Asha+ Seed 20kg/ha, treatment with Trichoderma viridi & Rhizobium culture + Line sowing+ Need based Chemical spray
2019-20	25	NDA-2, IPM	Asha+Seed 20kg/ha, treatment with Trichoderma viridi & Rhizobium culture + Line sowing+ Need based Chemical spray

Table 3. Productivity, technology gap, extension gap, technology index and benefit-cost ratio of pigeon pea grown under FLDs and existing package of practices

Year	Area (ha)	No. farmers	Seed yield (Q/ha) Potential	CFLD	FP	% increase over control	Tech. gap (Q/ha)	Ext. gap (Q/ha	Tech. index (%) CFLD	B:C ratio F.P.
2016-17	30	273	14.0	11.2	7.2	35.71	2.8	4.0	20.00	2.60
2017-18	30	273	14.0	12.5	8.5	32.00	1.5	4.0	10.71	2.02
2018-19	40	307	14.0	11.8	7.8	33.89	2.2	4.0	15.71	2.08
2019-20	10	50	14.0	12.0	8.9	25.83	2.0	3.1	14.28	1.98
Total	110	903	14.0	11.87	8.1	31.85	2.12	3.77	15.17	2.17

Tale 4. Effect of frontline demonstrations on yield and economics of pigeon pea under cluster front line demonstrations

year	Farmer's Existing plot				Demonstration plot				% increase yield
	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	
2016-17	19360.00	43200.00	23840.00	2.23	25430.00	67200.00	41770.0	2.6	35.71
2017-18	18350.00	35000.00	16650.00	1.90	20130.00	40500.00	20370.0	2.02	32.00
2018-19	18990.00	35250.00	16260.00	1.85	20980.00	41800.00	20820.0	2.08	33.89
2019-20	20146.00	35600.00	15454.00	1.76	24650.00	48000.00	23350.0	1.94	25.83
Average	19211.5	37262.5	18051.0	1.93	22797.50	49375.00	26577.5	2.16	31.85

under demonstration plots as compared farmers practice 8.1 q/ha. The results is clearly indicated that yield increase up to e 31.85 per cent in demonstration field, it shown the adoption of technology packages as provided to farmers (Table 3). Similarly, yield enhancement in different crops in cluster front line demonstrations were documented by *Hiremath et al., (2007); Mishra et al., (2009); Kumar e. al., (2010); Surywanshi and Prakash (1993); Dhaka et al., (2010 and Dhaka et al., (2015)*. The decreasing trend in per cent increasing over control is indicating the suitability and adoptability of improved variety and technology.

Technology gap : The technology gap means the difference between potential yield and yield of demonstration plot. The differences between potential yield and yield of demonstration plots was 2.8, 1.5, 2.2 & 2.0 q/ha. The average demonstration plot yield (Table-3) is 11.87 q/ha with average technology gap 2.12 q/ha. The technology gap reflects farmer's cooperation in carrying out such demonstration with encouraging results from 2016-20 and location specific recommendations are necessary to bridge this gap. Similar finding was recorded by *Katare et al. (2011) and Sharma* and *Sharma (2004)* in oil seeds. It may be attributed to dissimilarity in the soil fertility status, crop production practices and local climatic situation etc.

Extension gap : It indicates the difference between demonstration plot yield and farmers practices plot yield. As average extension gap is 3.77 q/ha range 3.1-4.0 q/ha from 2016- 20 (Table 3). It show the positive trends as impact of adoption of technology by farmers with the need to educate the farmers through various extension means i.e. front line demonstration for adoption of improve production and protection technology to reverse this trend of wide extension gap.

Technology Index : It shows the feasibility of the demonstrated technology at the farmer's field. Lower the value of technology index, higher is the feasibility of the improved technology varied range from 14.28 and 20 per cent (Table 3) which shows the effectiveness of technical interventions given to farmers by KVK. So far it helps to accelerate the adoption of d technical interventions to increase the crop yield of Pigeon pea. It observed an average of 15.17 per cent technology index, which shown the positive impact of technology. It also helpful to increase the production at widely accepted by farmers

Economic Returns : Data in Table 4. Showed the cost involved for the adoption of improved technology by farmers for pigeon pea crop were profitable. An average net return and B: C of demonstration field was Rs 26577.5/ha and 2.16, respectively as compared to farmers practice Rs 19211.5/ha and 1.93. The above findings were in agreement with the findings of *Singh et al. (2014)* and *Tomar (2010)*.

Limitations of pulses cultivation and production

Table. 5 Nutritive value of pigeon pea

Minerals/	%
Protein	22.3 %
Fat	1.7 %
Minerals	3.5 %
Fiber	1.5 %
Carbohydrate	57.6 %
Calcium	73 mg/100 g
Phosphorus	304 mg/100 g
Iron	5.8 mg/100 g
Moisture	13.4%
Calorific value	335 Kcal/100 g

Table 6. Comparative productivity (kg/ha) performance in major crops cultivated in Jharkhand and India

Year	Pulses		Oilseed	
	Jharkhand	India	Jharkhand	India
2001-2	783	607	661	913
2002-3	613	543	634	691
2003-4	556	635	352	1064
2004-5	653	577	564	885
2005-6	427	598	548	1004
2006-7	727	612	497	916
2007-8	749	625	554	1115
2008-9	764	659	561	1006
2009-10	733	630	475	958
2010-11	656	691	487	1193
2011-12	817	699	679	1135
2012-13	1169	786	783	1169
2014-15	993	770	706	1149

Source: Kharif workshop-2014, Department of Agriculture and Cane Development, Govt.of Jharkhand (2012, 2013 and 2014)

Table 7. Yield of cereals, pulses and oilseeds (q/ha) in Jharkhand

	Jharkhand (q/ha)				India (q/ha)			
Year	C	P	O	GN	P	RM	PP	Ch
2013-14	21.81	10.21	663	17.64	7.64	11.85	8.139	9.60
2014-15	21.35	10.04	664	15.52	7.28	10.83	7.2	8.89
2015-16	17.38	88.6	681	14.65	6.55	11.83	6.46	8.40
2016-17	21.61	10.02	732	13.98	7.86	13.04	9.13	9.74
2017-18	22.68	10.65	729	18.68	8.41	13.97	9.60	10.63

Source: Directorate of Economics & Statistics, 2018

Note: C=Cereals; P=Pulses; O=Oilseed; GN=Ground Nut; P=Pulses; RM=Rapeseed mustard; PP=Pigeon pea; Ch=Chickpea

observed during CFLDs: Major constraints for the cultivation of pulses include the availability of desired quality and quantity of high-yielding seed varieties of pulses. Many new high-yielding varieties were developed in the past two decades, but their performance is limited to providing 10-20 per cent high yield vs local varieties. Due to inherited weaknesses, performance of these varieties is poor at the field level, and the moderate increase in yield does not attract farmers or make any significant change in the national level of production. The need is to develop varieties with better yield advantage and desirable characteristics that are best suited to a semi-arid climate. The ever decreasing pattern of shrinking land holdings dependence on monsoon, lack of irrigation, low input usage and, importantly, no breakthrough in seed technology discourages farmers from growing medium to long-duration varieties, which occupy land for 240-270 days. Traditionally, fertilizer use in pulses is very low. The average use of chemical fertilizer to pulses results in low yields. The perception and the high incidences of diseases and pests cause high losses that result in low production and high protection costs. Another thing is that resistant/tolerant varieties have limited availability to farmers. The main reason could be the weak seed production program. The incorporation of insect-resistant genes, without compromising the yield in field verification trials, is yet to be commercially daily viable. Chemical pest control is the only option left for farmers at present for effective control of pest and diseases. In general, farmers apply chemical spray at the stage where losses cross the economic threshold level. This clearly shows that technological stagnation is primarily responsible for the backwardness of pulses in the country as a whole.

CONCLUSION

Cluster frontline demonstration on pulses (pigeon pea) conducted in 21 village in Ramgarh district and result concluded that average yield 11.87q/ha found in demonstration plot as compared to 8.1q/ha in control plot. There was 31.85 per cent increase in yield observed in demonstration plot over farmers practice. It was observed that potential yield can be achieved by imparting scientific knowledge to the farmers, providing the quality need based inputs and proper application of inputs. Horizontal spread of improved technologies may be achieved by the successful implementation of frontline demonstration and various extensions activities like training program, field day, exposure visit organized in CFLDs program in the farmer's fields. For wide dissemination of technologies recommended by SAUs and other research institute, more number of FLDs should be conducted.

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