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Quantifying the yield gap minimization in lentil (*Lens culinaris*) under Cluster Frontline Demonstrations (CFLD) conducted in Uttar Pradesh

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ABSTRACT

On-farm cluster front line demonstrations were conducted for lentil crop across the nine districts of Eastern Plain Zone (Faizabad, Barabanki, Sultanpur, Azamgarh, Ballia, Chandauli, Mau, Gazipur and Jaunpur) and six districts of Bundelkhand Zone (Jhansi, Lalitpur, Hamirpur, Banda, Jaloun and Chitrakoot) of Uttar Pradesh during *rabi* season of (2015- 16) in Indian sub-continent. In Eastern Plain Zone an area of 120 ha and in Bundelkhand zone 230 ha area each with plot size of 0.40 ha (1 acre) were included under these demonstrations with active participation of 930 farmers from both the zones. Data were analyzed in terms of yield gap, yield advantages and yield gap minimized for district level, state level and potential yield level of winter pulse crop lentil (*Lens culinaris* L.). The profitability analysis was also done for these demonstrations. The district level yield gap was computed highest in Bundelkhand (133-296%) followed by in the districts of eastern plain zone (128-158%). The obtained yield advantages helped to minimize the extension gap to maximum extent in districts of eastern plain zone (43-66%). Similar trend was observed in state level yield gap minimization (%) in both the zones of Uttar Pradesh. The potential yield gap minimized (%) at farmer level through demonstration of lentil was computed to be higher (31-52%) for most (3) of the districts of Bundelkhand and remaining districts (2) could witness 15 to 30 percent yield gap minimization except for Banda (7.64%) whereas in other districts of eastern plain zone, the potential yield gap could be minimized only to the extent of 5.43 to 15.43% and for the district Jaunpur, the gap was minimized to as lower extent as 1.62%. The major economic indicators like gross cost (₹/ha), gross return (₹/ha), net return (₹/ha), and B:C ratio were computed both for farmers field and demonstrated plot. The percentage increase in net return over farmers' existing plot and demonstration plot was highest in the district of Mau (219.27%), Sultanpur (115.70%), Jhansi (110.34%), Faizabad (105.57%) and other districts ranged from 18.29 to 88.12% in both the zones of Uttar Pradesh. The above study is, thus, the indicated the practical implications and usability of CFLD in minimizing the yield gap of lentil at the farmers' fields..

Key words: Cluster frontline demonstration, Lentil, Pulses and Yield gap minimization

Pulses play an important role in rainfed as well as partially irrigated agriculture by improving physical, chemical, and biological properties of soil and are considered excellent crops for natural resource management, environmental security, crop diversification and consequently for viable agriculture (Kannaiyan 1999, Ali and Kumar 2006). At the same time, the nutritional importance of pulses are numerous. The energy content of most pulses has been found to be between 315 and 432 Kcal/100g with high protein content which is about twice as compared to cereal and several times than root tuber (FAO 1986, Kushwah *et al*. 2002). Lentil predominantly is the rainfed crop grown in constrained environment. Several causes are responsible for low yield of lentil of which the use of traditional local cultivars, low plant density per unit area, weed infestation and poor crop management practices constitute the major ones. The major constraints under rainfed lentil cultivation of eastern Uttar Pradesh are non-availability of superior genotypes, reduced plant population due to reduced soil moisture and delayed sowing. The use of improved varieties alone accounts for 20-25% increase in productivity of lentil crop.

Measuring the different yield gaps in pulses has been the major methodological exercise till date. In this regard, the standard terminologies have been identified and defined. For example, yield potential (Yp), also called potential yield, is the yield of a crop cultivar when grown with water and nutrients non-limiting and biotic stress are effectively controlled (Evans 1993, Van Ittersum and Rabbinge 1997, Evans and Fischer 1999). Potential yield depends on location as it relates to weather but is

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independent of soil, which is assumed to be physically and chemically favourable for crop growth. The climate factors that influence potential yield are radiation, ambient CO_2 concentration and temperature (Evans and Fischer 1999, van Ittersum *et al.* 2013), photosynthesis, growth and potential yield are also responsive to fraction of diffuse radiation and vapour pressure deficit (Rodriguez and Sadras 2007). Similarly, attainable yield is the best yield achieved through skillful use of the best available technology. Some studies used attainable yield as an approximation to either potential yield or water-limited yield (Hall *et al.* 2013). On the other hand, actual yield (Ya) reflects the current state of soils and climate, average skills of the farmers, and their average use of technology and the average yield (Ya) is defined as the yield actually achieved in a farmer's field. To represent variation in time and space in a defined geographical region, it is defined as the average yield (in space and time) achieved by farmers in the region under the most widely used management practices (sowing date, cultivar maturity, and plant density, nutrient management and crop protection). Scientists have also worked on defining the yield gap (Yg) as the difference between Yp (irrigated crops), or Yw (rainfed crops) and actual yields (Ya). Water resources to support rainfed and irrigated agriculture also are under pressure, making water productivity (WP—the efficiency with which water is converted to food) another critical benchmark of food production and resource use efficiency (Passioura 2006, Grassini *et al.* 2011).

With respect to need for bridging the yield gap, Rao *et al*. (2010) had stated that the main challenges for research and development are to bridge the gap between actual and attainable yield by enhancing farmers' access to quality inputs, improved technologies and information. Frontline demonstration may be the important supplementary tool in this regard as the new technologies demonstrated have the greater potential to yield more. Chaudhary *et al*. (2014) reported that the front line demonstrations have given a good impact over the farming community of Narmada district as they were motivated by the new agricultural technologies applied in the FLD plots. Poonia and Pithia (2011) also reported the similar observation in past. The technological gap may be attributed to the dissimilarity in the soil fertility status and weather conditions (Mukharjee 2003) who also opined that depending on identification and use of farming situation, specific interventions may have greater implications in enhancing system productivity. Raj *et al*. (2013) emphasized the need to educate the farmers through various means for the adoption of improved agricultural production technologies to reverse this trend of wide extension gap. The new technologies will eventually lead to the farmers to discontinue the old technology and to adopt new technology (Hiremath and Nagaraju 2010). Demonstrations are one of the practical approaches to maximize the production by display of relevant technologies at farmers' field under strict supervision of agricultural experts helped to narrow down the extension and technological gaps to a considerable extent. (Katare *et al.* 2011). Kokate *et al*. (2013) reported that demonstrations conducted on lentil with improved varieties and technologies showed a yield advantage of about 33 per cent over local check and net return of ₹ 34400 per ha which was 46 per cent higher to local check in lentil in Bundelkhand zone of Uttar Pradesh.

However, most of the frontline demonstrations results have been presented in the form of yield and economic advantages and hence, quantification of yield gap minimized because of the such demonstrations becomes an important area of investigation.

MATERIALS AND METHODS

The present study was the part of cluster frontline demonstrations (CFLDs) on pulses being implemented by Indian Council of Agricultural Research (ICAR), New Delhi, India across the 555 districts of the country during *rabi* 2015-16. The analytical framework for the present investigation constituted the CFLDs conducted by nine *Krishi Vigyan Kendras* (Agricultural Science Center) of Eastern Plain Zone (Faizabad, Barabanki, Sultanpur, Azamgarh, Ballia, Chandauli, Mau, Gazipur and Jaunpur) and six Krishi Vigyan Kendras of Bundelkhand Zone (Jhansi, Lalitpur, Hamirpur, Banda, Jaloun and Chitrakoot) of Uttar Pradesh, India during *rabi* season (2015- 16) at farmer's field. In Eastern Plain Zone an area of 120 ha and, 230 ha area in Bundelkhand zone each with plot size 0.40 ha (1 acre each) under front line demonstration with active participation of 360 farmers in different villages were conducted in Eastern Plain Zone and with 570 farmers with similar specifications in Bundelkhand Zone were covered.

Before conducting CFLDs, a list of farmers was prepared from group meeting and specific skill training was imparted to the selected farmers regarding different aspects of improved lentil cultivation techniques (during first week of September 2016) in integrated crop management mode as suggested by Choudhary (1999) and Venkattakumar *et al.* (2010). In case of farmer's practice, existing practices being used by farmers were followed. In general, soils of the area under study were sandy loam and lower in fertility status. In demonstration plots, use of quality seeds of improved variety DPL-62 IPL-81, NL-1, HUL-57, K-75, line sowing, seed treatment, and timely weeding, use of balanced fertilizers (using micro nutrient sulphur) and bio-fertilizer (Rhizobium, PSB) was ensured. For the control of pod borer, Indoxacarb @ 500 ml/ha was used in demonstrated plots given in package and practices. Visit of farmers and the extension functionaries was organized at demonstration plots to disseminate the message at large scale. The demonstration farmers were facilitated by KVK scientists in performing field operations like sowing, fertilizer application, pest management, weed management, harvesting etc. The necessary steps for selection of site and farmers, layout of demonstration etc. were followed as suggested by Choudhary (1999). The traditional practices were maintained in case of local checks.

The data utilized for the analysis constituted both the

secondary data as well the primary data. The secondary data on existing district yield, state yield and potential yield of improved lentil varieties were procured from the official records (IIPR 2016, Sankhyiki Patrika 2016). These data were utilized to assess the yield gaps at different levels. Similarly, primary data were obtained both for the demonstration yield and farmer's yield of lentil in the adjoining plot. The primary data were used for computing yield advantages, profitability and B:C ratio. Both primary and secondary data were utilized for assessing the level of different types of yield gaps minimized due to the CFLDs for lentil.

As stated above both primary and secondary data were utilized for computation of several parameters. Those parameters were operationalized and measured as detailed below:

Crop Productivity Index: Crop Productivity Index (CPI) referred to the extent of crop productivity level in comparison to the normal yield of crops before and after the CFLD (Sharda 2006) and this was calculated by dividing the crop yield obtained in the control plot and demonstration plots by the yield obtained under recommended package of practices.

$$\text{Crop Productivity Index (CPI)} = \frac{1n}{ni=1} \quad \Sigma(y_1/Y_1)$$

where n is the number of crops in the consideration which was only one (1) in this case.*Y,* is the average yield of i^{th} crop cultivated in demonstration, and Yjis the yield of i^{th} crop with standard package of practices. The CPI can attain any value greater than zero in a given location. Higher value of CPI is indicative of crops' yields closer to the maximum attainable yield under standard package of practices.

Yield gap: Yield gap was the extent to which there was a difference in reported yields of lentil at different level with respect to its potential yield. It was calculated with respect to the potential yield of lentil in comparison to district yield, state yield and farmers' existing yield. The yield gap was ascertained both in terms of both absolute yield gap (q/ha) and in percent terms using following formula separately at district level, state level and farmers' level reported yield.

$$\text{Yield gap (\%)} = \sum_{I=1}^{n} (\text{Pyi - Ryi})_{D,S,F}/\text{Py}_i$$

where, Py_i is the potential yield of i^{th} farmer and $Ry_i$is the reported yield for the i^{th} farmer against the district (D), state (S) and farmer (F) yield.

Yield advantage: Yield advantage was the extent of gain in the reported yield of lentil at district level, state level and farmers' level as against the average yield obtained in the demonstrations.

$$\text{Yield advantage (\%)} = \sum_{i=1}^{n} (\text{Pyi - Ryi})_{D,S,F}/\text{Dy}_i$$

where, Dy_i is the demonstration yield of i^{th} farmer and $Ry_i$is the reported yield for the i^{th} farmer against the district (D), state (S) and farmer (F) yield.

Yield gap minimized: It is the extent to which the yield gap at different level, i.e. district, state, farmers' level and also potential yield level were compensated because of the yield advantages obtained from the demonstrations.

$$\text{Yield gap minimized} = \{[\sum_{i=1}(Dy_i\text{-}Ry_i)_{D,S,F}/Dy_i]\text{-}[\sum_{i=1}(Py_i\text{-}Ry_i)_{D,S,F}/Py_i]\}_{(D,F,P)}$$

$$= (\text{Yield advantages obtained} - \text{Yield gap estimated})_{D,F,P}$$

where, D, F, P are the district level, farmers' level and potential level yield gap and yield advantages in absolute and percent terms respectively.

The data were subjected to both descriptive and inferential statistics. The descriptive statistics utilized were average, percent and range. The inferential statistics were Coefficient of Variation (CV) to draw the meaningful implications. The analyzed data were presented in tabular as well graphical form.

RESULTS AND DISCUSSION

Cross-sectional analysis of existing lentil productivity: The existing yield analysis of lentil at district, state, potential and farmer's level as well as Crop Productivity Index was calculated. The result is shown in Table 1, for both Bundelkhand zone and eastern plain zone of Uttar Pradesh. The results indicated that the average district yield was higher in Mau district (11.11 q/ha) followed by Ballia (11.10 q/ha). Other districts ranged between 8.05 to 10.63 q/ha. The CPI was highest in Ballia (0.55) followed by Ghazipur

Table 1 Different yield level of lentil in the selected district

Zones	District	Average DY (q/ha)	Average SY (q/ha)	PY (q/ha)	Average FY (q/ha)	Crop Productivity Index (CPI)
Eastern Plain Zone of Uttar Pradesh	Faizabad	08.13	8.24	21.00	12.00	0.47
	Barabanki	08.05	8.24	21.00	11.97	0.47
	Sultanpur	09.20	8.24	21.00	04.10	0.31
	Azamgarh	11.09	8.24	21.00	09.65	0.48
	Ballia	11.10	8.24	21.00	12.52	0.55
	Chandauli	07.31	8.24	21.00	07.18	0.34
	Mau	11.11	8.24	21.00	09.40	0.48
	Gazipur	10.63	8.24	21.00	10.90	0.50
Bundelkhand Zone of Uttar Pradesh	Jaunpur	09.03	8.24	21.00	07.14	0.38
	Jhansi	08.94	8.24	21.00	09.65	0.43
	Lalitpur	09.01	8.24	21.00	10.60	0.46
	Hamirpur	06.43	8.24	21.00	06.20	0.29
	Banda	05.36	8.24	21.00	05.30	0.25
	Chitrakoot	05.30	8.24	21.00	05.50	0.25
	Jaloun	05.90	8.24	21.00	06.60	0.29

Average DY= Average District Yield; Average SY= Average State Yield; Average FY= Average farmer Yield.

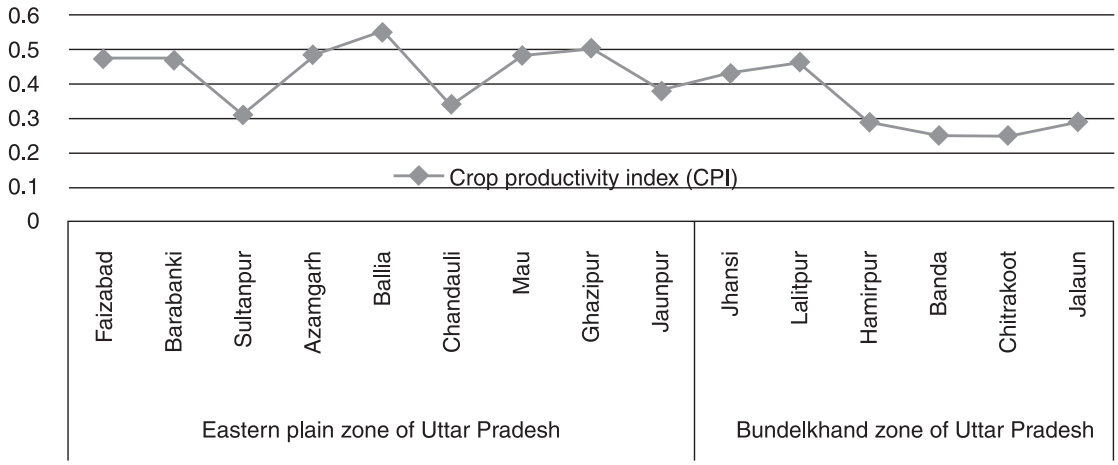


Fig 1 Crop productivity index in the selected districts

(0.50). In Bundelkhnad zone, highest average district yield was found in Lalitpur district (9.01 q/ha) followed by Jhansi (8.94 q/ha), Hamirpur (6.43 q/ha) and in the other districts, it ranged from 5.30 to 5.90 q/ha. The average yield of lentil in Uttar Pradesh was 8.24 q/ha as against the potential yield of 21.00 q/ha. Similarly, the average existing farmer yield reported was also recorded and found that maximum yield obtained by farmers was in the district of Ballia (12.52 q/ha) followed by Faizabad (12.00 q/ha) with range of 11.97-10.90 q/ha for other districts. However, the farmers' level lentil yields in other districts of eastern Uttar Pradesh ranged between 7.14 to 9.65 q/ha except in Sultanpur (4.10 q/ha) which was very low. In Bundelkhnad zone highest average farmer yield was in Lalitpur district (10.60 q/ha) followed by Jhansi (9.65 q/ha) and for other districts it ranged from 5.30 to 6.20 q/ha. It revealed that there is major gap in different levels of lentil in Uttar Pradesh.

The crop productivity index of lentil in these districts across both the zones is shown in Fig 1.

Yield gap analysis: The gap of lentil yield in comparison to potential yield was analyzed at the district, state and farmers' level and presented in Table 2.

The result as shown in Table 2 revealed that in both Bundelkhand and eastern plain zones, the district level

Table 2 Yield gap of lentil in the selected district

Zones	District	Absolute yield gap (q/ha) w.r.t. potential yield			Percentage yield gap w.r.t potential yield		
		DYG	SYG	FYG	DYG	SYG	FYG
Eastern Plain Zone of Uttar Pradesh	Faizabad	12.87	12.76	09.00	158.30	154.85	075.00
	Barabanki	12.95	12.76	09.03	160.87	154.85	075.44
	Sultanpur	11.80	12.76	16.90	128.26	154.85	412.20
	Azamgarh	09.91	12.76	11.35	089.36	154.85	117.62
	Ballia	09.90	12.76	08.48	089.19	154.85	067.73
	Chandauli	13.69	12.76	13.82	187.28	154.85	192.48
	Mau	09.89	12.76	11.60	089.02	154.85	123.40
	Gazipur	10.37	12.76	10.10	097.55	154.85	092.66
	Jaunpur	11.97	12.76	13.86	132.56	154.85	194.12
Bundelkhand Zone of Uttar Pradesh	Jhansi	12.06	12.76	11.35	134.90	154.85	117.62
	Lalitpur	11.99	12.76	10.40	133.07	154.85	098.11
	Hamirpur	14.57	12.76	14.80	226.59	154.85	238.71
	Banda	15.64	12.76	15.70	291.79	154.85	296.23
	Chitrakoot	15.70	12.76	15.50	296.23	154.85	281.82
	Jaloun	15.10	12.76	14.40	255.93	154.85	218.18

DYG= District level Yield Gap, SYG= State level Yield Gap, FYG= Farmer level Yield Gap

yield gap was higher in Chitrakoot district (296%) followed by Banda (292%).The overall yield gap for other district varied from 135-256%. Whereas in eastern plain zone, the gap was little less and ranged from 133-187%. The state level yield gap of lentil with respect to the potential yield was calculated to be the 155% which is alarmingly high at the farmer's level. The existing farmer level yield gap with respect to potential yield was observed to be highest (412.2%) in the Sultanpur district of Uttar Pradesh. The yield gaps were of higher order in Bundelkhand zone (range 117.62% to 296.2%) except for Lalitpur district (98.11%). The scenario was little bit impressive in the other district of Eastern Plain Zone where the yield gap ranged from 75% to 194%.

The analysis of yield gap at different levels indicates that against the potential yield of improved varieties of lentil, the prevailing yield at every level is disappointing. This also discloses that the lentil growers might be using old varieties without any supporting packages of practice and, even the related line departments may not be able to meet the required amount of improved lentil varieties.

*Productivity advantage***:** As indicated in Table 3, maximum demonstration yield was recorded in the district of Faizabad (16.63 q/ha) with range from 12.92–15.36 q/ha in other districts. The average demonstration yield was 12.46 q/ha with coefficient of variance of 25% in eastern plain zone of Uttar Pradesh but in Bundelkhand zone the maximum demonstration yield was recorded in Lalitpur district (14.72 q/ha) followed by another districts ranges from 6.5 to 14.0 q/ha. However, the average demonstration yield of this zone was 10.37 q/ha with coefficient of variance is 33%.The result in term of yield advantage from these demonstrations over the district yield, state yield, farmers'existing yield and potential yield are also presented in the same table. Findings indicated that the yield advantages from the demonstrated improved varieties and technologies of lentil were very impressive.

The yield advantage was highest in Faizabad district (105%), followed by Barabanki (78%) and Hamirpur (68%). Other districts also recorded the yield advantage to the extent of 15% to 63%. Data also indicated that the yield advantage over the district yield was as low as 4% in Jaunpur and -2.39 % in Sultanpur district. Similarly, against state level yield, the advantage was highest in Faizabad (102%) and Ballia (86%). Other districts in both zones followed the positive and increasing trends (14% to 68%) except for Jalon and Chitrakoot where the advantages were only 2% to -6%. Result also indicated (Table 1) that across both the zones the yield advantages in all the demonstration could not touch the potential yield as a result there was a gap of 30 % to 69%

Table 3 Yield advantage accrued due to Cluster Frontline Demonstration of lentil

Zones	District	Demo yield (q/ha)	Quantitative yield advantage (q/ha) w.r.t. Demonstration				Percent yield advantage w.r.t. demonstration yield			
			DYA	SYA	FYA	PYA	DYA	SYA	FYA	PYA
Eastern Plain Zone of Uttar Pradesh	Faizabad	16.63	8.50	8.39	4.63	-4.37	104.55	101.82	38.58	-22.05
	Barabanki	14.29	6.24	6.05	2.32	-6.71	077.52	73.42	19.38	-11.05
	Sultanpur	6.68	-2.52	-1.56	2.58	-14.32	-27.39	-18.93	62.92	-12.29
	Azamgarh	12.73	1.64	4.49	3.08	-8.27	14.79	54.49	31.91	-14.67
	Ballia	15.36	4.26	7.12	2.84	-5.64	38.38	86.41	22.68	-13.52
	Chandauli	10.26	2.95	2.02	3.08	-10.74	40.36	24.51	42.89	-14.67
	Mau	12.92	1.81	4.68	3.52	-8.08	16.29	56.80	37.44	-16.76
	Gazipur	13.87	3.24	5.63	2.97	-7.13	30.48	68.33	27.24	-14.14
	Jaunpur	9.37	0.34	1.13	2.23	-11.63	3.77	13.71	31.23	-10.62
	Average	12.46	2.94	4.22	3.03	-8.54				
	SD (CV)	3.15 (0.25)	3.22 (1.10)	3.15 (0.75)	0.72 (0.24)	-8.54 (-0.37)				
	Range	9.95	11.02	9.95	2.24	-9.95				
Bundelkhand Zone of Uttar Pradesh	Jhansi	14.06	5.12	5.82	4.41	-6.94	57.27	70.63	45.69	-21.00
	Lalitpur	14.72	5.71	6.48	4.12	-6.28	63.37	78.64	38.86	-19.62
	Hamirpur	10.8	4.37	2.56	4.6	-10.20	67.96	31.07	74.19	-21.90
	Banda	6.5	1.14	-1.74	1.2	-14.50	21.27	-21.12	22.64	-5.71
	Chitrakoot	7.75	2.45	-0.49	2.25	-13.25	46.23	-5.95	40.90	1-0.71
	Jaloun	8.39	2.49	0.15	1.79	-12.61	42.20	1.82	27.12	-8.52
	Average	10.37	3.55	2.13	3.06	-10.68				
	SD (CV)	3.42 (0.33)	1.79 (0.50)	3.42 (1.61)	1.49 (0.49)	3.42 (-0.32)				
	Range	8.22	4.57	8.22	3.4	8.22				

DYA= District Yield Advantage, SYA= State Yield Advantage, FYA= Farmer Yield Advantage, PYA= Potential Yield Advantage.

in Bundelkhand Zone and 21% to 68% gap in the districts of Eastern Plain Zone of Uttar Pradesh. Findings therefore indicate that through the new varieties of lentil and related technologies were not able to perform the average district yield, but could not realize the potential yield.

The yield advantages due to these demonstrations over farmer's existing yield in the district of both the zones are also presented in Table 3. The result as shown in the table indicate that the yield advantage was positive and considerable across the selected districts as farmers of Hamirpur registered the highest yield advantage (74%), followed by Sultanpur (63%), Jhansi (46%) and Chandauli (43%) and other districts could register the yield advantage from 30-40%. In all these demonstrations the average existing farmers' yield varied from 4.1 q/ha. In Sultanpur to 12.5 q/ha in Ballia, whereas average demonstration yield ranged from 6.5 q/ha in Banda to 16.63 q/ha in Faizabad. The yield advantages as compared with potential yield was maximum recorded in Faizabad district (22.05%) followed by Hamirpur (21.9%), Jhansi (21%) and Lalitpur (19.62%) and for other districts, it ranged from 10.62 to 16.76 % except Banda (5.71%) and Jaloun (8.52%) in both the zones.

Minimizing the yield gaps: The result of yield gap minimized (%) with respect to extension gap was computed both for district level yield gap and state level yield gap. Similarly, Yield gap minimized at farmers' level was assessed with respect to farmers level yield gap, whereas research gap minimized was analyzed with respect to potential yield gap. These results are presented in Table 4.

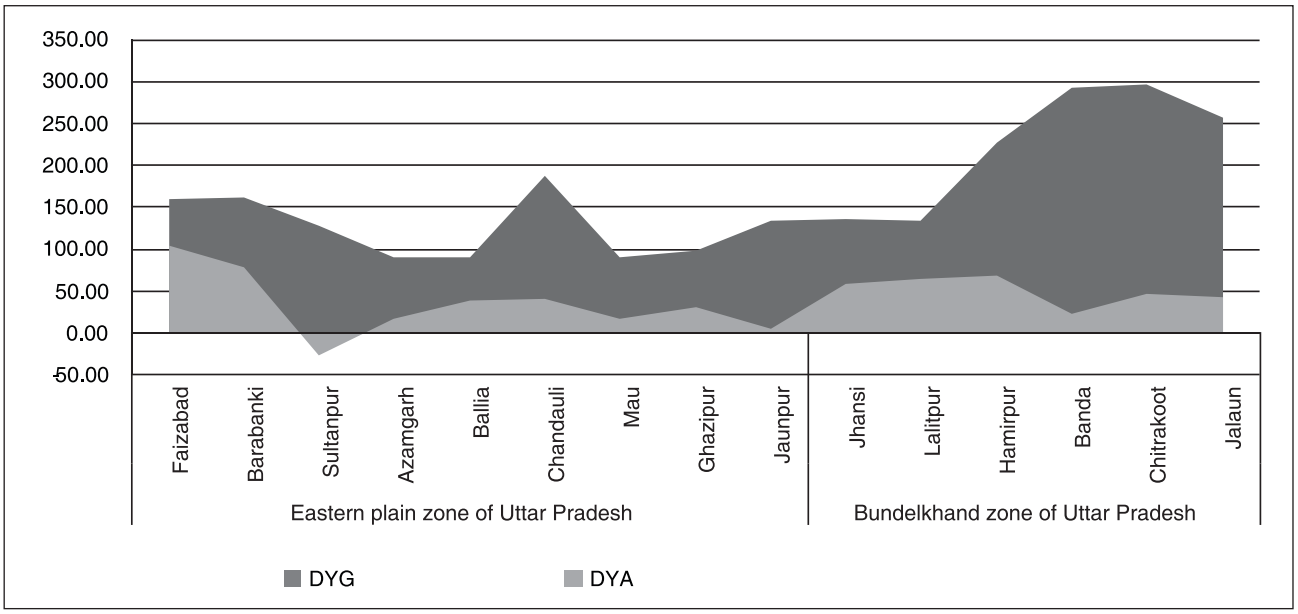
Extension gaps minimized: Demonstrations minimized extension gap (yield gap at district level) to the maximum extent. At the district level, the yield gap minimized in terms of percentage was highest at Faizabad (66.05%) followed by Barabanki (48.19%) and Lalitpur (47.62%).

Table 4 Farmers' yield gap, research gap and extension gap minimized due to cluster frontline demonstration of lentil

Zones	District	Yield gap minimized (%) with respect to			
		Extension gap (DYG)	Extension gap (SYG)	Farmer yield gap (FYG)	Research gap (PYG)
Eastern Plain Zone of Uttar Pradesh	Faizabad	66.05	65.75	51.44	40.48
	Barabanki	48.19	47.41	25.69	29.71
	Sultanpur	-21.36	-12.23	15.27	-12.00
	Azamgarh	16.55	35.19	27.14	07.81
	Ballia	43.03	55.80	33.49	20.29
	Chandauli	21.55	15.83	22.29	14.05
	Mau	18.30	36.68	30.34	08.62
	Gazipur	31.24	44.12	29.41	15.43
	Jaunpur	02.84	08.86	16.09	01.62
Bundelkhand Zone of Uttar Pradesh	Jhansi	42.45	45.61	38.85	24.38
	Lalitpur	47.62	50.78	39.62	27.19
	Hamirpur	29.99	20.06	31.08	20.81
	Banda	07.29	-13.64	07.64	05.43
	Chitrakoot	15.61	-3.84	14.52	11.67
	Jaloun	16.49	1.18	12.43	11.86

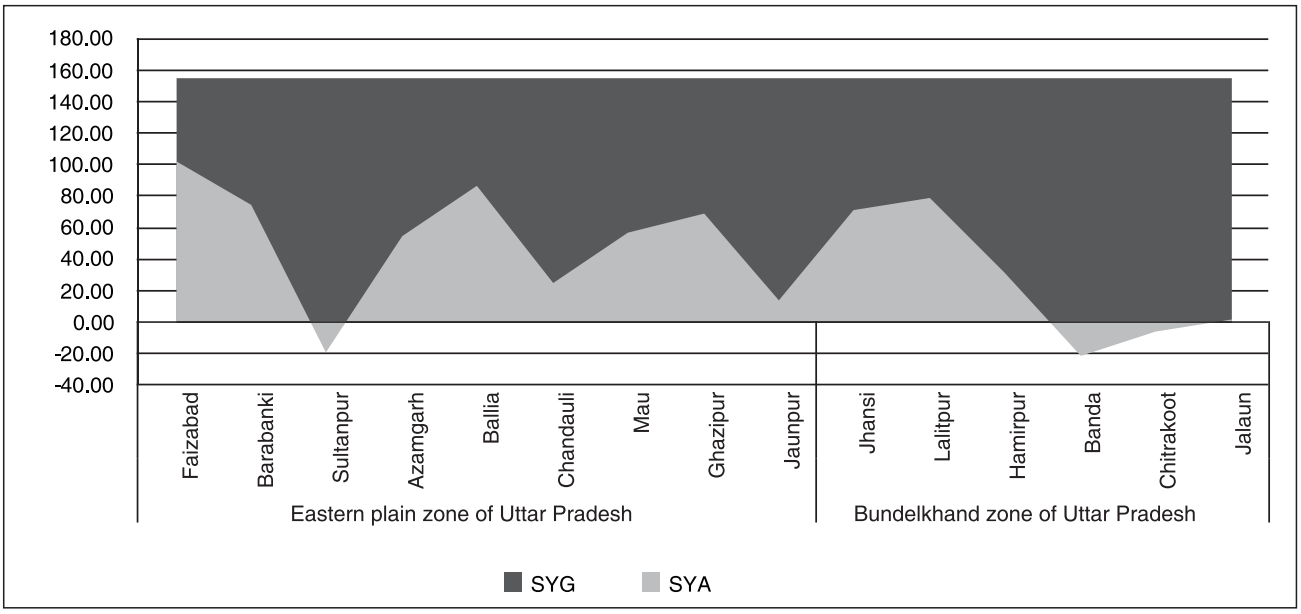
DYG= District level Yield gap, SYG= State level Yield gap, FYG= Farmer level Yield gap, PYG= potential level Yield gap.

Other districts recorded the extension gap minimization from 15.61 to 31.24% except Sultanpur (-21.36%), Jaunpur (2.84%) and Banda (7.29%) as shown in Fig 2. Similar



DYG: District Yield Gap; DYA: District Yield Advantage

Fig 2 Extent of minimization of district level yield gap due to demonstrations.



SYG: State Yield Gap; SYA: State Yield Advantage

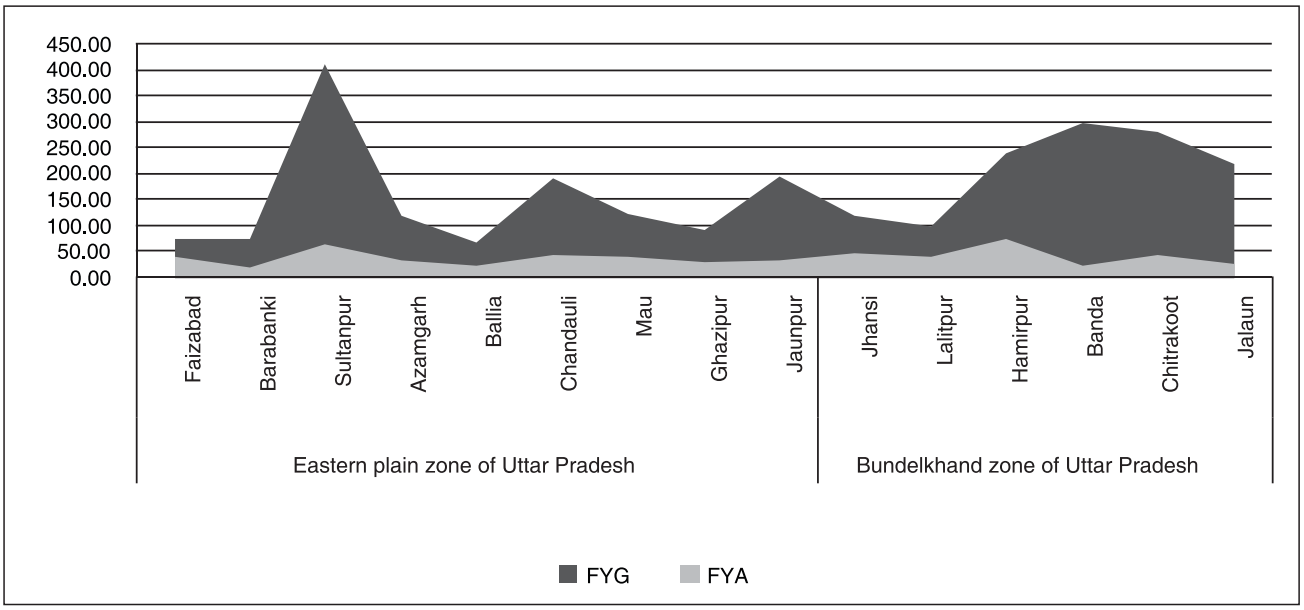
Fig 3 Extent of minimization of state level yield gap due to demonstrations.

trend was observed in minimizing the state level yield gap in both the zones of Uttar Pradesh and Uttarakhand (Fig 3). The results indicate that still lot of scope remains for minimizing the yield gap with respect to district and state level lentil yield. This can be done only when there is sufficient convergence of state and district agricultural departments by ensuring timely supply of quality seeds of improved varieties of lentil supported with need based and timely extension activities.

Bridging the research gap: At potential yield level gap analysis, maximum yield gap was found to be minimized in the districts of Faizabad (40.48%), Barabanki (29.71%), Lalitpur (27.19%), Jhansi (24.38%), Hamirpur (20.81%) and Ballia (20.29%) whereas other district ranged between 5.43 to 15.43 % except Jaunpur (1.62%) in both the zones of Uttar Pradesh and Uttarakhand. This implies that there if further scope for doing the need based and situation specific adaptive trials to be conducted and also the capacity of the farmers regarding correct use of the technologies and package also demand attention.

Table 5 Economic advantages of Cluster Frontline Demonstration of lentil

Selected zones	KVK	Farmer existing plot				Demonstration plot				% Inc. net return
		Gross cost (₹/ha)	Gross return (₹/ha)	Net return (₹/ha)	B:C ratio	Gross cost (₹/ha)	Gross return (₹/ha)	Net return (₹/ha)	B:C ratio	
Eeastern Plain Zone of Uttar Pradesh	Faizabad	24500	36000	11500	1.47	26250	49890	23640	1.9	105.57
	Barabanki	23200	65835	42635	2.84	25225	78595	53370	3.12	025.18
	Sultanpur	11900	20500	8600	0.72	14850	33400	18550	1.24	115.70
	Azamgarh	18290	52110	33820	2.85	20750	68742	47992	3.31	041.90
	Ballia	23930	72604	48674	3.03	24430	89088	63658	3.5	030.78
	Chandauli	8956	26207	17251	1.93	10424	37449	27024	2.59	056.65
	Mau	17800	31255	13455	1.75	20800	42959	22159	2.06	219.27
	Gazipur	25468	70850	45382	2.78	26819	90155	63336	3.36	039.56
	Jaunpur	17600	38556	20956	2.20	18100	50598	32498	2.8	055.08
Bundelkhand Zone of Uttar Pradesh	Jhansi	19500	32816	13316	1.68	19800	47809	28009	2.41	110.34
	Lalitpur	13120	63600	50480	4.80	14560	88320	73760	6.06	046.12
	Hamirpur	15800	24900	9100	1.57	17500	32550	15050	1.86	065.38
	Banda	14500	35000	20500	1:2.4	17000	41250	24250	1:2.4	018.29
	Jalaun	16775	38280	21505	2.28	17500	48662	31162	2.78	044.91
	Chitrakoot	16500	24750	8250	1.50	18500	34020	15520	0.83	088.12



FYG: Farmer level Yield Gap; FYA: Farmer level Yield Advantage

Fig 4 Extent of minimization of farmer level yield gap due to demonstrations.

Bridging the farmer' level yield gap: Results also show that (Table 4) in both the zones, the yield gap minimized (%) at farmer level yield gap through demonstration of lentil was higher in the district of Faizabad (51.54), Lalitpur (39.62), Jhansi (38.85), Ballia (33.49), Hamirpur (31.08) and other district below 30 to 15 percent except Banda (7.64) in both the zones (Fig 4).

Economic advantage on the demonstrated technologies: The major economic indicators like gross cost (₹/ha), gross return (₹/ha), net return (₹/ha), and BC ratio were computed both for farmers field and demonstrated plot in Table 5. The percentage increased in net return over farmer existing plot and demonstration plot was highest in the district of Mau (219.27), Sultanpur (115.70), Jhansi (110.34), Faizabad (105.57) and other districts ranged from 18.29 to 88.12 in both the zones of Uttar Pradesh and Uttarakhand.

Implications: Findings of the study helped to quantify not only the yield gap of lentil at different level, the yield advantages due to on-farm demonstrations of lentil production technologies were also ascertained. Study also quantified the level of yield gap minimized due to cluster frontline demonstrations of lentil. The findings showed that there are massive grey areas remained for minimizing the yield gap in lentil at various levels like, district, state, farmers and also with respect to the potential of improved varieties of lentil which could be possible only through making the state agricultural extension systems more sensitive and responsive.

REFERENCES

Ali Masood and Shiv Kumar. 2006. Paradigm shift in planning needed. The Hindu Survey of Indian Agriculture, 63–65.

Evans L T. 1993. *Crop Evolution, Adaptation and Yield.* Cambridge University Press.

Evans L T and Fischer R A. 1999. Yield potential: its definition, measurement and significance. *Crop Science* **39**: 1544–51.

Grassini P, Thorburn J, Burr C and Cassman K G. 2011. High-yield irrigated maize systems in Western U.S. Corn-Belt. II. Irrigation management and crop water productivity. *Field Crops Research* **120**: 133–41.

Hiremath S M and Nagaraju M V. 2010. Evaluation of on-farm front line demonstrations on the yield of chilli. *Karnataka Journal of Agricultural Science* **23**(2): 341–2.

Hall A J, Feoli C, Ingaramo J and Balzarini M. 2013. Gaps between farmer and attainable yields across rainfed sunflower growing regions of Argentina. *Field Crops Research* 143: 119–29.

IIPR 2016.http://www.iipr.res.in.

Kokate K D, Singh A K and Singh Lakhan. 2013. Harnessing Pulses Productivity. Division of Agricultural Extension, ICAR, New Delhi.

Katare S, Pandey S K and Mustafa M. 2011. Yield gap analysis of rapeseed- mustard through front line demonstrations. *Agric. Update* **6**(2): 5–7.

Kannaiyan S. 1999. *Bioresources Technology for Sustainable Agriculture,* pp 4–22. Associated Publishing Company, New Delhi.

Kushwah A, Rajawat P, Kushwaha H S. 2002. Nutritional evaluation of extruded faba bean (*Vicia faba* L.) as a protein supplement in cereals based diet in rats. *J. Exp Biol* **40**(1) 49–52.

Mukharjee N. 2003. *Participatory, Learning and Action*, pp 63–5. Concept, Publishing Company, New Delhi.

Poonia T C and Pithia M S. 2011. Impact of front line demonstrations of chickpea in Gujarat. *Legume Research* **34**(4): 304–7.

Passioura J B. 2006. Simulation models: science, snake oil, education, or engineering? *Agronomy Journal* **88**: 690–716.

Rao P Parthasarathy, Birthal P S, Bhagavatula S and Bantilan M C S. 2010. Chickpea and Pigeonpea Economies in Asia: Facts, Trends and Outlook. International Crops Research Institute for the Semi-Arid Tropics. Patancheru Andhra Pradesh, India. 76 p.

Raj A D, Yadav V and Rathod J H. 2013. Impact of front line demonstrations (FLD) on the yield of pulses. *Int. J. of Scientific and Research Publications* **3**(9): 2250–3153.

Rodriguez D. and Sadras V O. 2007. The limit to wheat water use efficiency in eastern Australia. I. Gradients in the radiation environment and atmospheric demand. *Aust. J. Agric. Res.* **58**: 287–302.

Sankhyakiya Patrika, Uttar Pradesh, NIC (2016). http://www.updes.up.nic.in/spatrika/spatrika.htm.

Sharda V N, Dogra Pradeep and Dhyani B L. 2012. Indicators for assessing the impacts of watershed development programmes in different regions of India. *Indian Journal of Soil Conservation* **40**(1): 1–12.

Van Ittersum M K and Rabbinge R. 1997. Concepts in production ecology for analysis and quantification of agricultural input-output combinations. *Field Crops Research* **52**: 197–208.

Van Ittersum M K, Cassman K G, Grassini P, Wolf J, Tittonell P and Hochman Z. 2013. Yield gap analysis with local to global relevance—A review. *Field Crops Research* **143**: 4–17.

Venkattakumar R, Ramana Rao S V, Padmaiah M and Madhuri P. 2010. Production constraints and information needs of growers in Andhra Pradesh. *Agric Extn Review* (April-June): 21–4.