



Livelihood analysis of lentil (*Lens culinaris*) farmers in Chanduali district of Uttar Pradesh

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ABSTRACT

Lentil (*Lens culinaris* Medik.) is one of the most important pulse crops in India, which plays a major role in supplementing the income of small and marginal farmers of Chanduali district of Uttar Pradesh. One of the major constraints of pulses in India and also in lentil is low productivity due to non-adoption of recommended package and practices and improved varieties. In India, lentil is grown about 1.42 million hectare of land with production of 1.13 million tonnes in 2012-13. But yield of Indian lentils (797 kg/ha) is far below the world average (1 139 kg/ha) which require strong research as well as extension. The results of improved technological intervention brought out that the yield of lentil could be increased by 28.56% to 49.24%, if proper package and practices are followed.

Key words: Demonstrations, Lentil, Problems and constraints, Technology and extension gap

Government of India, (GOI) is implementing need based programs to increase pulses production from time to time, like Technology mission on oilseed and pulses (TMOP), Accelerated Pulse Production Program (A3P) and newly introduced National Food Security Mission (NFSM) on Pulses in 2007-08 onwards.

There was a significant increase in total pulse production of 18.45 million tonnes (MT) during 2012-13. The NFSM-pulses program helped Indian farmers to increase area and production by adopting improved varieties and using quality seeds as well other inputs. Mission was launched to bridge the yield gap in pulses through dissemination of improved technologies and farm management practices with focus on districts which have high potential but low level of productivity performance at present.

Mission has also brought International Organization like ICARDA and ICRISAT to work with Indian National Agricultural Research Systems (NARS) partners for yield enhancement by sharing their experiences at farm level. This synchronizing effect of CGIAR institutes and NARS partners not only helped Indian farmers in increasing the productivity by bringing the new technology but also enriching the skills of Indian farmers and scientists' by capacity building programmes.

Lentil (*Lens culinaris* Medik.) is one of the most important winter legume crops which is grown in rainfed cropping systems, tolerant to drought, and is commonly grown in the world (Sarker *et al.* 2003). But yield of Indian Lentils (678 kg/ha) is far below the world average (1 139 kg/ha) which require strong research as well extension.

The present investigation was carried out with the objective of assessing the current state of lentil production, existing farming practices and small farmer livelihoods; and disseminates the improved package of practices to boost productivity.

MATERIALS AND METHODS

With the financial support from NFSM of Government of India, International Center for Agricultural Research in the Dry Areas (ICARDA) did a project in Chanduali district of Uttar Pradesh for technology enhancement in lentil. Chanduali district being a high potential district was purposely selected. Seventy two farmers in first year and 85 farmers in second year from Sahabganj and Chanduali block were selected for project interventions. Small holder farmers, who were resource poor but are lentil growers, were selected in accordance with the local village leaders. In first year, baseline data was collected by personal interview, collected information was analyzed and interpreted. Technology gap, extension gap and technology index were worked out (Samui *et al.* 2000) and Dayanand *et al.* (2012) as given below.

Technology gap = Potential yield (P_1)-Demonstration yield (D_1);

Extension gap = Demonstration yield (D_1) - Farmers yield (F_1) and

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$$\text{Technology index} = \frac{(\text{Potential yield} - \text{Demonstration yield})}{\text{Potential yield}} \times 100$$

RESULTS AND DISCUSSION

Baseline information

Chandauli district has a good agricultural base and a reasonably good infrastructure of various facilities. Agriculture is the mainstay of population and more than 70% of the population is dependent upon agriculture and its related activities.

The whole district is divided in two parts on natural basis, first plain area of Ganga and their auxiliary rivers, and secondly the plateau area of Naugarh. Irrigation has special importance in the development of agriculture. From Table 1, it was clear that district has all basic agricultural infrastructure available within 1-3 km distance but *krishi mandi's* and cold stores are located at a longer distance. Farmers reported that there are very less govt. shops which are selling seeds, fertilizers and other needed inputs and market is dominated by private shops and there is irregularity in their prices.

The main sources of irrigation in the district are canals, followed by Govt/private tube wells, pump sets, wells and ponds etc. Similar trend was reported in the survey, more than 60% of farmers reported canal as their main source of irrigation, wherever applicable. In Chakia tehsil, most part is rocky, so establishment of tube wells is very difficult. Due to this, most of the areas in the district are irrigated by canals.

The three harvests of the district are known by their usual names, *rabi*, *kharif* and *zaid*. The *kharif* crops are sown in June–July and harvested in September–October, while *rabi* are sown from October–November and harvested in Feb–March. The main crop of the *kharif* is paddy and of *rabi* is wheat. Other crops are maize and barley in cereals and among pulses, lentil, mung, chickpea and pigeonpea are the major crops. In all crops, productivity has increased

Table 1 Basic agricultural infrastructure in Chandauli district

Particulars	Within village	> 1km	1-3 km	3-5 km	<5km
Agriculture service centre	35	37	226	271	859
Village market	49	46	305	366	662
<i>Krishi mandi</i>	3	0	57	73	1295
Cold store	2	4	25	37	1360
Seed selling centre	121	53	402	368	484
Fertilizer selling centre	326	7	212	301	582
Insecticide/pesticide selling centre	31	8	149	307	933

Source: Field survey and statistical outline of Chandauli, district 2011-12 .

Table 2 Productivity of major crops in Chandauli district (q/ha)

Crop	2009-10	2010-11	2011-12
Rice	20.28	27.5	27.18
Wheat	20.68	25.42	25.45
Barely	19.58	18.49	19.56
Maize	22.92	17.94	16.42
Mung	5.48	10.45	6.76
Lentil	9.34	6.39	9.48
Chick pea (<i>desi</i>)	8.99	9.57	12.44
Pigeon pea	5.87	7.74	9.02
Total Pulses	8.62	7.97	10.16
Total Food grains	19.25	24.83	24.95

Source: Economic and statistics division, Chandauli, Uttar Pradesh 2012-13.

from 2009-10 to 2011-12, because of the government run schemes and efforts put by other agencies. Also the overall productivity for pulses has increased from 8.62 to 10.16 q/ha from 2009-10 to 2011-12.

Similarly, as reported in Fig 1 lentil production has increased from 3 880 to 10 153 MT in year 2011-12 from 2004-05, registering an increase of more than 100%. On an average, production is about 6 600MT and area of about 10 054 ha in last 10 years. But productivity, is on increasing trend, it was 3.28 q/ha in 2004-05 and now it is 9.93 q/ha in 2011-12. Except year 2010-11 which was a bad year for pulses throughout country, as rainfall was there during crop maturity in *rabi* crops, otherwise it is on increasing trend.

Table 3 represents the socio-economic profile of the selected farmers in first year of the project. The intent was to assess the level of knowledge and existing status of the lentil farmers.

The data projected in Table 3 indicates that almost all the respondents were literate (can write and read) out of which 28% of the farmers were educated up to primary and 24% were up to senior secondary. Graduate farmers were only 13% of the total. This could be attributed to better awareness about the importance of education as well as better education facilities. The similar findings were reported by Desai *et al.* (2012).

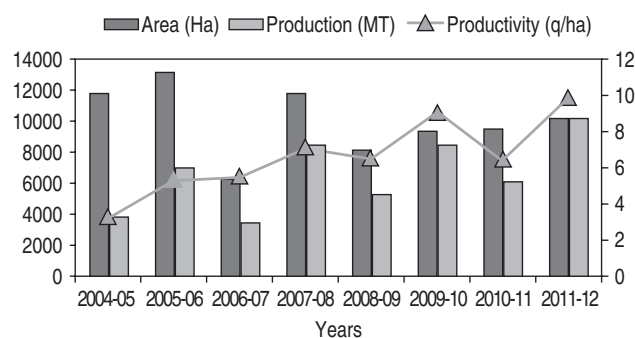


Fig 1 Lentil APY over the years in Chandauli. Source: Economic and statistics division, Chandauli, Uttar Pradesh 2012-13.

Table 3 Socio-economic profile of selected farmers (n=72)

Particulars	Frequency	Percentage
Education		
Up to primary	20	28
Middle	14	19
Matric	12	17
Senior secondary	17	24
Graduate and above	09	13
Mean	14.4	
SD	4.28	
Family size		
>5 members	40	55
5-10 members	23	32
< 10 members	09	13
Mean	24	
SD	15.52	
Land holding		
Marginal (<1 hac)	17	24
Small (1-2 hac)	28	39
Medium (2-3 ha)	19	26
Large (> 3 ha)	8	11
Mean	18	
SD	8.21	
Farming experience (years)		
Less than 10	17	24
11-30	35	39
31-50	12	17
51 and above	8	11
Mean	18	
SD	11.91	

Source: Field survey.

On family size, it was reported that majority of the farmers were living in nuclear families rather joint families which is reported by many authors because of the division of families. 55% of the farmers were having 5 or less family members, 32% were having 5-10 family members and only 13% reported to have more than 10 family members. The findings revealed that majority (39%) farmers were having small (1-2 hac) land holding.

The experience in farming is an important parameter for adopting a technology, 39% of the farmers were having experience of 11-30 years, 24% less than 10 years and 17% were having more than 30 years. Since, more experience is linked with higher age, also it was found that old age members of the family could have come forward to share the information for the study. Similar findings were reported by Senthil Kumar *et al.* (2005) and Desai *et al.* (2012).

Seed is important input for the crop and it is recommended that seed should be replaced more often. It revealed from Table 4, that majority of the farmers changes their seed after 5 years or even more also there is no farmer who replaces seed every year. About 29% of farmers changes seed in 4-5 years. It was also found that farmers were using old seed and not aware that which variety they

Table 4 Seed use pattern practiced by farmers

Particulars	Frequency	Percentage
Change every year		
After 2-3 years	07	10
After 4-5 years	20	29
After 5-10 years	45	63
Total	72	100

Source: Field survey.

Table 5 Sources of information on improved practices used by farmers

Particulars	Frequency	Percentage
Farmer to farmer, relatives and friends	28	39
Local Trader	18	25
Scientist from BHU/State Department/ extension events (like mela, goshti, training camp, etc.)	17	24
From Radio, TV and News Paper	12	17
Total	72	100

Source: Field survey.

are using, also it was a mix of many varieties/mix of local and improved. Even some of the farmers don't remember when they have purchased seed. It shows that farmers grow improved seeds or HYV of other crops but for pulses and usually for lentil they use the local varieties only, as it is a low input crop but still gives good results.

Table 5 emphasize the various source of information being used by farmers. It was found that farmer to farmer (including relatives and fellow farmers) were the most important followed by local traders. Scientists/extensionists from Banaras Hindu University (BHU)/State and ICT tools were the other sources of information. The role of Government agencies like State Department and BHU were not good among the selected farmers and only 24% reported to have them as major source. It also means the both BHU and state department need to invest more and put more and more efforts to improve the gaps.

Problems and constraints faced by farmers

It was observed from the study that there were number of problems and constraints, which were responsible for the low productivity and lower adoption of lentil practices in the study area. These were classified into following four categories; namely, (i) seed and seed treatment, (ii) fertilizer application, (iii) weed/disease management and (iv) others. Under seed and seed treatment which constitute of mainly problems related to seed and its application, it was found that lack of knowledge of soil testing was a major constraint and none of the farmers was aware of this. Also, lack of knowledge of rhizobium application in pulses (94%) and lack of knowledge of improved variety (88%) were other major problems. Similar findings were reported by Burman *et al.* (2010) and Avinashilingam (2013) in case of pigeon pea adoption. Majority of the farmers were growing old/

Table 6 Major problems and constraints faced by farmers

Particulars	Percentage of respondents
Seed and Seed treatment	
Lack of knowledge of improved suitable varieties	88
Lack of knowledge of soil testing	100
Lack of knowledge about rhizobium culture	94
Unavailability of quality seeds	81
High seed prices	49
Lack of knowledge of seed treatment	46
<i>Fertilizers application</i>	
Lack of knowledge of recommended doses of fertilizers	72
High cost of fertilizers	63
Unavailability of suitable fertilizers on time	83
<i>Weed/diseases management</i>	
Lack of knowledge of appropriate weedicide, insecticide and pesticides	85
Losses due to insect-pest	32
Losses due to weeds	17
Poor quality of insecticide/pesticides	54
<i>Others</i>	
Non-remunerative prices	75
Lack of storage facilities	44
Less support from Government	40

Source: Field survey.

traditional varieties' of lentil and have never used improved ones. Another problem which emerged is the high seed prices (49%) and lack of knowledge of seed treatment (46%).

With regard to the problems with fertilizers and its application, it was found that majority farmers (72%) were not aware about the recommended doses of fertilizers. High costs of the fertilizers were the next constraints reported by 63% of the farmers. But more than 80% of the farmers reported that suitable fertilizers were not available when it was required. Some of the farmers also reported that private shopkeepers also raise the prices at time of more demand during peak season. Similarly, lacks of knowledge of weedicides were reported as major problem by the farmers. Sharma *et al.* (2003) and Burman (2010) also reported the similar findings.

Other problems were lack of storage facilities which resulted to distress sale by farmers to earn quick money to meet their immediate demand for coming season. Also more than 75 farmers reported that farmers are not getting appropriate prices for their hard work and even government is not giving enough minimum support prices and this is same for all the *rabi* pulses, which do not encourage farmers to take more area under pulses so when even there is a chance of irrigation farmer shift to cereals from pulses.

Keeping, the above mentioned point in to consideration and farmers experiences as well, a technology package was developed which includes different varieties, their seed rate, sowing methods, fertilizer doses, insect-pest measure, weed management etc. A comparative picture between the existing

practice and recommended practices were recorded and explained in Table 7.

Performance of lentil

The main crop of the *kharif* is paddy and of *rabi* is wheat, other main crops are maize, barley, pearl millet, pigeonpea, gram and lentil etc. Total 200 demonstrations have been conducted with an area of 92.63 ha. HUL 57, IPL 81, NDL 1, Moitree, KLS 218 and PL 6 lentil varieties were given to the involved farmers during project period. On an average 51.56% higher yield was recorded in demonstration plot over local check. KLS 218 performed best with 76.84% higher yield followed by Moitree with 64.03% and NDL-1 with 56.04% higher yield than farmers' own practices.

Percentage increase in yield

It was revealed from the data that improved varieties performed better than the farmers' variety under existing conditions. On the basis, of overall mean of yield, demonstration plots have given 1 078.83 kg/ha, which was 51.56% higher than the farmers' local varieties (711.83 kg/ha) due to adoption of improved technologies. Under different varieties, yield in demonstration plots ranged between 640 kg/ha (PL 6) to 1 109 kg/ha (HUL 57). The increase in per cent of yield was ranging between 4.92 for PL 6 and highest for KLS 218. Similar results were found by Singh (2003) observed at KVK Chitrakoot (U.P.) during 1998-2002 with introduction of crop production technologies through demonstrations, trainings and other such extension methods increase in lentil crop yield was varied from 55-65% over the traditional practices. Afzal *et al.* (2004) reported that the average yield of improved varieties of lentil (Barimasur) was 1 073 kg/ha, a yield increase of about 25% in the demonstration plots. Gautam *et al.* (2007) reported that the highest percentage increase in yield was noted in green gram (46.05%) followed by lentil (32.85%) and gram (31.57%). Krishi Vigyan Kendra (Bongaigaon), Asom (2008-09) reported that lentil variety B 77 has given 20.3% higher yield than farmers practice. DARE/ICAR (2009-10) reported that the percentage increase in yield varied from 23.14 in lentil to 52.19 in horse gram and on an average pulse crops under demonstration gave 34.69% more yield than farmers' practice. Singh *et al.* (2010) found that improved genotypes of mung bean yield of 781 kg/ha, which was 22.08% higher than the local varieties. Yield enhancement by using technological interventions has been documented by Sagar and Chandra (2004) on sesame, Mishra *et al.* (2009) on potato and Hiremath and Nagaraju (2009) on Onion. Also it was reported by Ali and Gupta (2012) that with adoption of improved practices yield in all pulses can increase from 20 to 40% or even more.

Technology and extension gap

The technology gap is the difference between potential yield and yield of demonstration field (Mishra *et al.* 2007). Technological gap was worked out for only those varieties which were given over the years and have performed well.

Table 7 Level of use and gap in adoption of lentil technologies in study area

Crop operations	Improved package of practices	Farmers practices	Gap*	Approx. adoption rates (%)
Variety	HUL 57, IPL 81, NDL 1*, Moitree*, KLS 218*, PL 6*	Local	Full gap	5-10
Soil testing	Have been done in all locations	Not in practice	Full gap	
Seed rate	40-45 kg/ha for bold seeded and 50-60 kg/ha for relay cultivation	32-60 kg/ha	Partial gap	15-20
Seed priming	Seed priming was performed for better germination. Seeds were soaked during night for 6-8 hours with natural water, drained out excess water and dried in shade before sowing.		Full gap	
Seed treatment	Seed was treated with rhizobium culture @ of 5 packets/ha. It was also treated with Thiram @ 2-3g /kg seeds or carbendazim @ 1 g /kg seed and with insecticide, i.e. chloripyriphos @8-10g /kg seed.		Full gap	
Sowing method	Relay, Zero-tillage, Normal Sowing	Broadcasting	Partial gap	20-25
Sowing time	15 th October to 15 th November and in the rice fallows 15 th November to 7 th December	second fortnight of second fortnight of October to second fortnight of November	Partial gap	20-25
Fertilizer dose	Fertilizer @ 20 kg N, 40 Kg, P ₂ O ₅ and 40 Kg.	Nil/without recommendation	Partial gap	10-15
Weed management	In case of relay cropping, only post-emergence herbicide, Quinzalofop-ethyl (TARGASUPER @ 40-50 gm/ ha at 15-20 DAS), Pendimethaline P.E. @ 1.5 kg a.i./ha was applied immediately after sowing.	Hand weeding/ rarely used	Partial gap	20-15
Urea spray	Foliar spray of 2% Urea just before flowering and repeated after 20-25 days specially when there was lack of atmospheric and soil moisture.		Full gap	
Plant protection	Need based in case of severe infestations of aphids foliar application of endosulfan, dimethoate and other systemic insecticides.	No application of chemicals/rarely used and without knowledge	Partial gap	10-15

*Gap between recommended and existing practices.

Table 8 Performance of lentil varieties during 2010-11 and 2011-12

Variety	Area (ha)	No. of demonstrations	Average yield (kg/ha)		% increase
			Demonstration	Local check	
HUL 57	41.85	87	1109	714	55.32
IPL 81	26.9	64	1011	731	38.30
NDL 1*	9.2	23	852	546	56.04
Moitree*	11.35	21	1181	720	64.03
KLS 218*	1.5	2	1680	950	76.84
PL 6*	1.83	3	640	610	4.92
Total/Average	92.63	200	1078.83	711.83	51.56

* provided for one year only.

Table 9 Yield, technology gap, extension gap and technological index % in lentil

Variety	Yield (kg/ha)			% increase over local	Technology gap (kg/ha)	Extension gap (kg/ha)	Technology index (%)
	Farmers' local	Demonstration	Potential				
HUL 57	714	1109	2200	55	845.66	629.94	38.44
IPL 81	731	1011	2250	38	991.00	528.00	44.04

2012-13 have not taken in to account due to crop failure.

On an average, it was higher for IPL-86 (846) than HUL-57 (991). The technology gap observed may be attributed to dissimilarity in the soil fertility status, agriculture practices and local climatic situation (Mishra *et al.* 2007). Similar studies were reported by the Singh *et al.* (1996) in mustard and Waris and Reddy (1999) in groundnut, Thakral and Bhatnagar (2002) in Chick pea, Dhaka *et al.* (2010) in maize and Kumar *et al.* (2012) in ginger. It was suggested that, to minimize the technology gap, farmers have to adopt the scientific package of practices of lentil and to achieve this dissemination of the information in a proper way is required.

The extension gap is the difference between demonstration yield and farmers' yield. On average basis the extension gap was 630 for HUL 57 and 528 for IPL 86. It was observed that there is a wide gap between potential and demonstration yields in lentil. To minimize this wider extension gap there is a need to educate the farming community by various extension means, to make them aware about the new varieties of crop with improved production technologies etc. By following the suggested package of practices farmer can increase the production and productivity of the lentil and reduce extension gap. Similar findings were also recorded by Sagar and Chandra (2004) in mustard, Chandra (2010) in greengram, Balai *et al.* (2012) in rapeseed-mustard, Rai *et al.* (2012) in barley, Ahmed *et al.* (2013) in Indian mustard and Ojha and Singh (2013) in *kharif* onion.

Technology index (%)

The technology index shows the feasibility of the variety at the farmer's field. The lower the value of technology index less is the gap and more is the feasibility (Hiremath and Nagaraju 2009). Higher technology index, reflected higher gap and thus more efforts are required for transferring proven technology to farmers, and insufficient work of extension services to transfer technology (Dayanand *at el.* 2012). The technology index varied from 38% to 44%, which is a closer gap, indicates that almost similar type of gap existed between different varieties on both technology evolved and technology adoption at farmer's field. This gap in technology index may be due to better adoption or suitability of HUL-57 in adverse conditions also. Moreover, HUL-57 is a variety which fits to all conditions easily and since it is released from Banaras Hindu University (BHU), chances of its acceptance are more than any other variety. Similar studies were also done by Sharma and Kushwah (2001) in gram, Singh *et al.* (2007) in mustard, Sagar and Chandra (2004) in sesame and Meena *et al.* (2010) in rapeseed-mustard.

It was concluded from the study that with the introduction of NFSM-Pulses there was a positive impact on the farmers economy; by using the improved lentil variety and scientific package of practices, farmers can increase lentil yield and get more profit, by which they can improve their socio-economic condition. The results of improved technological intervention brought out that the increase in yield of lentil could be increased by 28.56% to

49.24%. From the above outcomes, it can be concluded that use of improved package of practices can decrease the technology gap by which productivity of the crop can be increased. To achieve this target, extension agencies of the concern area have to provide appropriate technical support time to time to the farmers.

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