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Supply Side Constrains in Production of Pulses in India: A Case Study of Lentil[§]

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Abstract

In India, annual production of pulses ranges from 11 Mt to 15 Mt, with yield of about 600 kg/ha. Due to the wide gap between supply and demand, import of pulses has increased from 0.38 Mt in 1993 to 2.82 Mt in 2008. Lentil is an important *rabi* pulse crop with a production of 0.85-0.95 Mt in India, after gram. The study has used both secondary and primary data collected from on-farm demonstrations and farmers' fields to examine the ways to enhance the domestic supply of lentil. The study has found that there is a scope of increasing area under lentil during the *rabi* season, as its cost per hectare is less with higher net returns than the competing crops like wheat, gram and mustard in water-deficit and resource-poor conditions. There are large returns for adoption of disease management (80 per cent increase in net return), and improved small-seeded varieties (about 40 per cent increase in net return) in lentil. The study has found that lentil-based cropping systems are profitable and also have high water productivity, hence are suitable for mostly un-exploited rice-fallows under water-deficit conditions. Even though marketed surplus ratios have increased in recent years, there is a post-harvest loss to the extent of 7 per cent of production which needs to be curtailed to increase overall supply for final consumption. There is a case for larger institutional and policy support for pulse crops, keeping visible effects of pulse crops in increasing yield of subsequent crops in crop rotations.

Introduction

In India, pulses are grown on 22-23 million hectare area with annual production of 11-15 million tonnes and yield of about 600 kg/ha. India accounts for about 33 per cent of world area and 22 per cent of world production of pulses. About 90 per cent of the total global pigeonpea, 65 per cent of chickpea and 37 per cent of lentil areas fall in India with the corresponding global production of 93 per cent, 68 per cent and 32 per cent, respectively. However India's rank in productivity is low, 24th in chickpea, 9th in pigeonpea, 23rd in lentil and 98th in total pulses (Reddy, 2004). The growth rate of area under pulse crops is just 0.04 per cent during the period 1967-68 to 2009, as a result pulses' share in the total food grain production has reduced from 17 per cent in 1961 to 7 per cent in 2009. The net availability of pulses has come down from 60 g/day/capita in 1951 to 31 g/day/capita in 2009 (ICMR recommends 65 g/day/capita) due to stagnant/decreasing production and rapid increase in population. Due to the mismatch between supply and demand of pulses, prices of pulse crops have increased exorbitantly. To meet the demand for pulses, India has been importing a large quantity of pulses in recent years. The import of pulse crops increased from 0.38 Mt in 1993 to 2.8 Mt in 2008 (about 16 per cent of the domestic consumption). During the post-WTO regime, the export potential lentil has increased since India is the largest producer of pulses in the world. It indicates the need for wider adoption of low-cost technology

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among all pulse crops so as to meet the growing domestic as well as global demand.

Under the scenario, the study was undertaken with the following objectives:

- To study the trends in production, export and import and cost and returns of lentil,
- To compare the cost of lentil with competing crops,
- To quantify yield gaps between research station, on-farm demonstrations and farmer's fields and find sources of yield/net return gap,
- To compare the cost-benefits of cropping systems which include lentil cultivation and to examine the scope for expansion of area under rice-fallows, and
- To quantify economies of utilization and post-harvest losses in lentil production.

Even though pulses are very important for India in terms of share of production and consumption, in term of importance, both farmers and government have ignored them. In India, the irrigated area under pulses was only 12 per cent, while under wheat and paddy, it was more than 60 per cent of the total area. Another critical input, credit was Rs 85 /ha for pulses, whereas it was Rs 458/ha for paddy and Rs 90/ha for wheat in 2001 (Materne and Reddy, 2007; Reddy, 2009). The use of fertilizers and pesticides is minimum in pulse crops. The R&D in pulses is accorded less attention by both international and multinational corporations in funding. Further, pulse crops are susceptible to many biotic and abiotic stresses due to indeterminate plant type, which makes development of biotic and abiotic stress resistant varieties difficult and have attracted less attention by the private research efforts.

Importance of Lentil

Out of 14 Mt of pulses production, lentil contributes about 1.0 Mt. Lentil is an important *rabi* pulse crop next only to gram. Its share in the acreage and production of total *rabi* pulses is about 12 per cent, whereas in the overall pulses production, its share is about 6 per cent. Lentil has shown a positive growth rate during both the periods (6.67 per cent per annum during 1982-1993 and 1.45 per cent per annum during 1994-2009). In the global context, India is the largest producer of lentil. During TE 2005, about 27 per cent of 3.65 Mt world's lentil production was contributed by India from about 35 per cent of 4.1 Mha harvested area in the world. Besides, the important position held by Indian lentil crop in domestic pulses production, it has another distinctive significance of holding net exportable surplus, in the face of surging total pulse imports. Among all pulses, lentil is the most actively traded pulse crop (about 25 per cent of world production is internationally traded). Lentils have proven to be invaluable in crop rotation, helping to control weeds, diseases and insects, as well as improving soil texture and fertility.

Supply and Demand Gap of Lentil

Studies on demand and supply projections of pulse crops for the year 2020, have predicted that the domestic supply would be 9 per cent short of domestic demand under most optimistic scenario, and about 26 per cent under the pessimistic scenario. Hence, even by considering only the projected domestic demand, ignoring the export potential, there is an urgent need for increasing the supply of lentil. However, there is a mismatch between the supply and demand for lentil. The projected supply estimates of lentil under three different scenarios are: (i) supply with historical growth rate since 1960s, (ii) supply projections based on growth since 1980s (best case scenario), and (iii) supply of lentil assuming production growth rate of 1990s (business as usual). Demand forecast is carried out in two ways: (i) by assuming the annual growth rate of 2.98 per cent (Kumar, 1998), and (ii) based on actual consumption growth since 1970s. Supply projections under all the three scenarios (including best case scenario) are short of demand projections (1.55 Mt) based on estimations of Kumar (1998) in the year 2020, while all supply estimates are way ahead of demand projection (1.19 Mt) based on historical consumption growth rate. However, given the fact that historical consumption growth rates are not reliable estimates of future demand under restricted supply and high price scenario, we have compared demand and supply using Kumar (1998) method. Following Kumar (1998) demand scenario, there will be a deficit in the supply of lentil to the extent of 8.4 per cent to 20.6 per cent of domestic demand under different supply scenarios.

The annual output of lentil is about 0.79 - 0.95 Mt (with CV of 13.8 per cent) on an area of about 1.4 Mha (with CV of 8.5 per cent) (Table 1). It is almost double the level of production during 1980s. Productivity

Table 1. Area, production and productivity of lentil across major states in India: TE 1995-TE2005

State	Area (lac ha)			Production (lac tonnes)			Yield (kg/ha)			Per cent share in total production TE 2005
	TE 1995	TE 2005	Change, %	TE 1995	TE 2005	Change, %	TE 1995	TE 2005	Change, %	
Uttar Pradesh	5.26	5.99	13.8	3.92	4.93	25.7	745	823	10.5	50.9
Madhya Pradesh	3.74	4.81	28.8	1.76	2.23	26.8	471	464	-1.6	23.0
Bihar	1.77	1.93	9.0	1.41	1.53	8.2	798	791	-0.8	15.8
West Bengal	0.56	0.67	19.2	0.36	0.45	25.1	638	669	4.9	4.6
Rajasthan	0.14	0.2	43.4	0.12	0.21	81.3	821	1038	26.5	2.2
Assam	0.11	0.21	84.3	0.08	0.12	48.7	684	552	-19.3	1.2
Haryana	0.13	0.07	-46.9	0.08	0.06	-23.3	628	906	44.3	0.6
Punjab	0.06	0.04	-42.6	0.04	0.02	-45.9	642	606	-5.7	0.2
India	11.92	14.15	18.7	7.8	9.68	24.1	654	684	4.7	100.0
CV (%)	8.5		13.8		7.8					

Source: Directorate and Economics and Statistics (2006) Statistical Data Base

of lentil is about 684 kg/ha (with CV of 7.8 per cent) as against average *rabi* pulses yield of 723 kg/ha. In India, lentil is mainly cultivated in three northern states of Uttar Pradesh (51 per cent), Madhya Pradesh (23 per cent) and Bihar (16 per cent). Between TE 1995 and TE 2005, the area, production and productivity of lentil increased by about 9 per cent, 14 per cent and 8 per cent, respectively, turning India from net importer to net exporter of lentil. Significant growth in yield has been recorded in Haryana (44 per cent), Rajasthan (27 per cent) and UP (11 per cent). It is also remarkable to note that the growth of area under lentil was witnessed in all the three major producing states (Table 1). During TE 2005, lentil productivity in Uttar Pradesh and Bihar was 823 kg/ha and 791 kg/ha, respectively, which is higher than the all-India productivity of 684 kg/ha. But in Madhya Pradesh, the productivity level of lentil is nearly two-thirds of the national average and its growth trend is negative. It grows well on the light loamy and alluvial soils of north India and in well-drained light black soils of Madhya Pradesh.

Relative Profitability of Lentil vis-a-vis Competing Crops

The lentil being a *rabi* crop, the main competing crops are wheat, gram, and mustard. The relative profitability of these crops has been presented in Table 2 in different states during 2001-03. Cost C2 per hectare has been found less for lentil compared to other crops, which indicates that the crop is more suitable for the resource-poor regions and farmers. Cost C3 is lower than minimum support price in Bihar and MP, and higher in UP. Higher profitability of lentil in Bihar and MP has also been revealed from higher net returns over C2 costs, compared to wheat and mustard, while net returns are negative in UP.

Yield Gap Analysis

The most important way to increase production in the short-run is to eliminate/reduce yield gaps between research station, on-farm demonstration and farmer's fields. Zone-wise yield gap analysis was carried out between small-seeded and large-seeded lentil varieties on research station trails and results are presented in Table 3. A large yield gap, viz. about 30 per cent in North West Plain Zone (NWPZ) to 103 per cent North Hill Zone (NHZ) existed between small-seeded and large-seeded types of lentil in research stations. This indicates that small-seeded varieties have higher yield potential at research stations and need measures to expansion of area under small-seeded varieties. Considering the wider adoption of small-seeded varieties among farmers across the zones and higher yield potential, yield gap analysis was carried out only for small-seeded varieties on research stations, on-farm trials and zonal average (farmer realized yield). Yield gap I, which is the gap between research station and on-farm trial yields, was highest in the NWPZ (45 per cent) and lowest (17 per cent) in the NHZ. Yield gap II, which is the gap between on-farm trials and zonal average yields, was large in all the zones, ranging from 24 per cent in the NEPZ to 69 per cent in the NHZ.

Table 2. Relative profitability of lentil vis-a-vis competing crops: 2001-03

State	Lentil			Gram			Mustard		Wheat		
Year	Bihar	UP	MP	Bihar	UP	MP	UP	MP	Bihar	UP	MP
A2+FL/ha	4757	6096	4784	4964	6972	6710	7789	6634	9899	11161	8266
C2/ha	9501	10180	8568	9534	12040	11428	13466	11225	14574	17160	12997
A2+FL/q	512	834	592	500	610	680	658	700	371	305	390
C2/q	1016	1385	1058	956	1052	1156	1131	1206	546	469	612
C3/q	1126	1541	1174	1065	1169	1277	1244	1327	609	525	675
Yield(q)/ha	9.35	7.35	8.1	9.97	11.44	9.6	11.91	9.31	26.69	36.59	21.24
MSP/q	1273	1273	1273	1173	1173	1210	1277	1277	617	617	617
A2+FL % of MSP	40.2	65.5	46.5	42.6	52	56.2	51.5	54.8	60.1	49.4	63.2
C3 %of MSP	88.5	121.1	92.2	90.8	99.7	105.5	97.4	103.9	98.7	85.1	109.4
GR(Rs)/ha	11903	9357	10311	11695	13419	11610	15209	11889	16468	22576	13105
NR over A2+FL/ha	7146	3261	5527	6731	6447	4900	7420	5255	6569	11415	4839
NR (Rs) over C2/ha	2402	-823	1743	2161	1379	182	1743	664	1894	5416	108

Cost A1: All actual expenses in cash and kind incurred in production by owner

Cost A2: Cost A1+ Rent paid for leased-in land

Cost A2+FL= Cost A2+ Imputed value of family labour

Cost B1= Cost A1+ Interest on value of owned capital assets (excluding land)

Cost B2= Cost B1+ Rental value of owned land (net of land revenue) rent paid for leased-in land

Cost C2= Cost B2+ Imputed value of family labour

Cost C2*= Cost C2 estimated by taking into account statutory minimum or actual wage whichever is higher

Cost C3= Cost C2*+ 10Per cent of cost C2* on account of managerial functions performed by farmers

Table 3. Yield gap analysis of lentil

Zone	Research station-Large-seed (kg/ha)	Research station-Small-seed (kg/ha)	Yield gap between large-seeded & small-seeded (Research station) (%)	Small-Seeded			
				On-farm trial (kg/ha)	Zonal mean (kg/ha)	Yield gap I (between research station and on-farm trial) (%)	Yield gap II (on-farm trial and zonal mean) (%)
NHZ	538	1095	103.5	940	556	16.5	69.1
NWPZ	1432	1859	29.8	1287	868	44.5	48.3
NEPZ	1076	1840	71.0	1434	1158	28.3	23.8

Source: AICRP on MULLaRP(2006)

NHZ=North Hill Zone; NWPZ=North West Plain Zone; NEPZ= North East Plain Zone

The wider yield gap II indicated a large gap between on-farm demonstration yield and zonal average yield, which can be bridged by wider adoption of technology by the farmers. The existing technology has the potential of increasing production by at least 50 per cent at the national level without increasing area under lentil if farmers adopt recommended package of practices.

Farmer's Practices and Recommended Practices in Lentil Cultivation

After noticing large yield gaps between on-farm demonstrations and farmers-realized yield, yield gap and cost benefit analysis was carried out for each recommended practice and results were compared with farmers' practices (Table 4). The study used the data

Table 4. Yield gap under different management practices between improved practice and farmers' practice in lentil cultivation: 2005

Type	Yield			Incremental	Net returns (Rs/ha)		
Management practice	Farmers' practice	Improved practice	Yield gap (%)	costs of improved package (Rs/ha)	Farmers' practice	Improved practice	Net returns gap (%)
Variety	981	1224	24.8	750	7195	10741	49.3
Weed management	1100	1363	23.9	560	11172	13047	16.8
Fertilizer management	1310	1553	18.5	475	9380	12000	27.9
Rhizobium management	1236	1459	18.0	574	11560	14540	25.8
Irrigation management	1024	1227	19.8	600	7892	10332	30.9
Disease management	780	1138	45.9	600	7415	13490	81.9
Package technology	1037	1656	59.7	3689	8794	16500	87.6

Notes: Variety (Improved Practice (IP): Improved variety; Farmers' Practices (FP)

Weed management (Improved Practices (IP) P-Pendimethalin @1.25 kg a.i./ha; Farmers' Practice(FP) P-one hand weeding 25-30 DAS)

Fertilizer management (IP-100 kg DAP+100 kg gypsum/ha; FP-100 kg DAP/ha)

Rhizobium management (IP-inoculation with *rhizobium* culture; FP- No inoculation)

Disease management (IP-chemical control; FP-No control)

Irrigation management (IP-one irrigation at flowering; FP- No irrigation)

of a field survey which was conducted in the Vidhokar village of Fatehpur district in Uttar Pradesh for the year 2005 under the project "Measurement of Externalities of Pulse Crops in Cropping Systems". This village has been adopted by the Indian Institute of Pulses Research (IIPR) under its institute-village linkage program. A total of 120 farmers were selected, 60 were under the on-farm demonstrations and 60 were not under demonstrations.

Farmers' Practices

Under farmers' practices, the total cost was Rs7830/ha with variable cost as Rs 3690/ha (~ 47 per cent of the total cost). Most of the operations, including land preparation, were performed manually. Seed rate was 30 kg/ha, but most of the farmers practised less than the recommended seed rate. Fertilizer was either applied in suboptimal doses or was not applied at all. Generally, farmers did not spray any insecticide and fungicide; many farmers practised manual weeding. Most of the operations were carried out by the family labour with the help of neighbouring farmers on exchange basis. Only harvesting and threshing was done on contract basis, with payment in kind (1:11 of the harvested grain was given for harvesting and threshing). Almost the entire crop was cultivated under residual moisture with no irrigation. Most of the farmers used their own seeds or procured them from the neighbouring farmers. Seed replacement rate was very low (less than 5 per cent). There was no availability of certified seeds at private seed shops or government seed agencies. The average yield obtained in the study area was 880 kg/ha. At a selling price of Rs 16/kg, the gross revenue was Rs 16080/ha and net profit over total cost was Rs 8250/ha. The cost of production of lentil was about Rs 890/q. The variability in yield was quite high depending on residual moisture during crop growth, temperature and disease and pest attack.

Recommended Practices

The recommended practices were divided under six heads: (i) Improved variety, (ii) Weed management, (iii) Fertilizer management, (iv) *Rhizobium* management, (v) Disease management, and (vi) Irrigation management. All packages and cost benefit analysis were worked out for on-farm demonstrations with recommended practices and are presented in Table 4. In demonstrations, except the package under test, all other practices were as per farmers' practice. However, only 10 farmers practised the entire package

Table 5. Economics of pulse-based cropping systems vs non-pulse-based cropping systems

(Amount in thousand Rs)

Crop rotation	Gross returns ('000 Rs/ha)	Cost ('000 Rs/ha)	Net returns ('000 Rs/ha)	B/C ratio	Fertilizer ('000 Rs/ha)	Pesticide ('000 Rs/ha)	Labour (man days)	Irrigation charges ('0000 Rs/ha)	GR/unit water
Non-pulse-based with assured irrigation									
Til-coriander-chilli	81.0	32.6	48.4	2.49	3.7	0.6	234	7.5	10.8
Maize-potato-cucurbit	88.0	35.5	52.5	2.48	4.2	2.0	289	8.7	10.1
Til-coriander-tomato	64.5	30.1	34.4	2.15	1.6	0.0	229	4.9	13.2
Maize-potato-wheat	78.2	41.8	36.4	1.87	4.8	2.0	302	7.6	10.3
Sugarcane	58.8	34.1	24.7	1.73	6.4	0.6	140	8.4	7.0
Til-wheat	31.2	22.3	8.9	1.40	1.8	0.0	132	6.3	4.9
Jowar-wheat	29.4	21.6	7.7	1.36	1.8	0.0	132	5.6	5.2
Paddy-wheat	45.2	38.5	6.7	1.17	3.2	1.0	222	12.6	3.6
Mean	59.5	32.0	27.5	1.86	3.4	0.8	210	7.7	7.7
Pulse-based cropping system with little or no irrigation									
Pigeonpea+sorghum	25.8	6.5	19.3	3.94	0.0	0.2	74	0.7	36.9
Maize-lentil	37.0	10.0	27.0	3.71	0.3	0.5	72	0.7	52.9
Moong-lentil	42.5	13.7	28.9	3.11	0.2	0.5	122	0.7	60.8
Urd-potato-tomato	89.5	41.8	47.7	2.14	3.4	2.0	366	4.8	18.6
Urd-wheat	45.0	25.3	19.7	1.78	1.7	0.0	182	5.6	8.0
Moong-wheat	43.5	25.3	18.2	1.72	1.7	0.0	182	5.6	7.8
Pigeonpea-wheat-mung	51.5	32.7	18.8	1.57	1.7	0.3	268	6.5	7.9
Paddy-lentil	41.4	26.9	14.5	1.54	1.7	1.5	162	7.7	5.4
Paddy-veg.pea	52.0	35.0	17.0	1.49	2.7	1.7	221	12.6	4.1
Paddy-wheat-moong	60.2	46.1	14.1	1.31	3.2	1.0	308	12.6	4.8
Mean	48.8	26.3	22.5	1.86	1.7	0.8	196	5.8	8.5

and it was marked as "package technology". Response to disease management was higher in both increases in yield (46 per cent) and in net return (82 per cent), followed by improved variety with increase in yield by 25 per cent and net returns by 49 per cent. Overall, responses to all management practices individually and in package form were economically viable as increase in net returns are in the range of 17 per cent for weed management to 82 per cent for disease management. For the package as a whole, the yield increased by 59 per cent and net returns by about 88 per cent with additional cost of just Rs 3689/-.

Cost-benefit Analysis of Lentil Based Cropping Systems with Non-pulse Based Cropping Systems

A comparison of economics of pulse-based cropping systems (with lentil) with non-pulse-based cropping systems has been given in Table 5. The figures clearly depict that pulse-based cropping systems were less input-intensive. Input utilization (fertilizers, pesticides, labour and water) was less for the pulse-based cropping systems. The benefit-cost ratio was almost same (1.8) for both the cropping systems. Both gross returns and net returns per unit area were higher for non-pulse-based cropping systems (as they are mostly irrigated and high input-intensive) but returns to each rupee invested on irrigation were higher for pulse-based cropping systems (8.6) compared to non-pulse based cropping systems (7.7). Overall, pulse-based cropping systems are more suitable for resource-poor farmers and water scarce regions in the study area. However, returns to pesticide use and irrigation are higher for the pulse-based cropping systems and hence, policy options have to be evolved to increase application of pesticide, fertilizer and irrigation under pulse-based

Table 6. Residual effects of legumes on the yield of subsequent crops

Pulse crop	Subsequent crop	Yield increase* (%)
Arhar (early)	Wheat	18
Black gram	Rice	15
Gram	Rice	25
Lentil	Maize	35

*Increase in yield of subsequent crop after legume has been compared to that after fallow/wheat.

(lentil) cropping systems. The pulse-based cropping systems are environmentally sustainable also, as they require lower use of fertilizers, pesticides and irrigation in addition to enhancing the productivity of cropping systems by increasing yield of subsequent crops (Table 6).

Considering the higher profitability and scope for lentils as *rabi* crop in the cropping systems under unirrigated conditions, the extent of rice-fallows which can be put under lentil cultivation during the *rabi* season has been depicted in Table 7. There are vast fallow lands in MP (4.4 Mha), Bihar (2.2 Mha) and WB (1.7 Mha) which are highly suitable for lentil cultivation.

Majority of the farmers who continued lentil cultivation for more than three years cited low cost (25 per cent of respondents), ready market (17 per cent), remunerative price (8 per cent) and suitability under low resource conditions (7 per cent) as prime reasons; while citing reasons for discontinuation of lentil cultivation in crop rotations, majority responded that availability of better alternative crops (20 per cent of farmers who discontinued lentil cultivation in last three years), lack of improved varieties (16 per cent), low yield (15 per cent) and high risk (15 per cent) as prime reasons. This emphasizes the importance of R & D, market infrastructure and availability of seed at local level.

Marketable Surplus and Post-harvest Losses of Lentil

According to a survey conducted by the Directorate of Economics and Statistics (Ministry of Agriculture) during TE 1998-99, the marketed surplus was around 50 per cent of the lentil production at all-India level (Directorate of Economics and Statistics, 2000). The highest marketed surplus has been recorded in MP (69.4 per cent), followed by UP (44.1 per cent) and Bihar (23.4 per cent). The share of direct sales by the producers to consumers was 1.43 per cent. The co-operatives purchased only 0.17 per cent. Out of the total sales, 27.22 per cent sales were within villages. The survey has revealed that the farm-family requirement, including losses of about 7 per cent, was 49.87 per cent of the total production. However, marketed surplus ratios increased to 79 per cent for all-India level in TE 2005, while it increased to 85 per cent in MP, 82 per cent in UP, and 76 per cent in Bihar (Table 8), which may be due to the higher market prices for pulses compared to the consumption of their substitutes like vegetables.

Conclusions

Pulses have been suffering from supply side constraints; consequently their imports have increased to the tune of 3 Mt in recent years. Among pulse crops, there is a growing opportunity to expand area and production of *rabi* pulses, mainly lentil on a large scale

Table 7. Estimates of rice-fallow area during *rabi* 1999-2000 for major lentil growing states in India

State	*Kharif*-rice area ('000 ha)	*Rabi*-fallow ('000 ha)	Rice-fallow area as % of *kharif* rice area	% of total *rabi*-fallow area
MP	5596	4382	78.3	37.6
Bihar	5974	2196	36.8	18.9
WB	4617	1719	37.2	14.8
Assam	2234	539	24.1	4.6
UP	6255	353	5.6	3.0
Others	15,508	2,463	15.9	21.0
Total	40,184	11,652	29.0	100

Source: ICRISAT(2009)

Table 8. Total production, marketed surplus, marketable surplus and total post-harvest losses of lentil TE 2005

(in ’000 tonnes)

Name of state	Total production	Marketed surplus		Marketable surplus		Total post-harvest losses	
		Qty	Per cent	Qty	Per cent	Qty	Per cent
UP	493.0	404.1	82.0(44.1)	410.6	83.3	42.4	8.6
MP	223.0	191.4	85.8(69.4)	194.5	87.2	13.6	6.1
Bihar	153.0	116.8	76.4(23.4)	118.7	77.6	8.7	5.7
WB	45.0	35.6	79.0(59.1)	36.1	80.3	2.9	6.5
Rajasthan	21.0	16.0	76.0(66.3)	16.2	77.2	1.3	6.4
Assam	12.0	1.9	16.0(10.1)	2.0	16.3	1.2	9.8
Others	8.0	6.3	79.0(40.5)	6.4	80.3	0.5	7.2
India	968.0	765.3	79.1(49.3)	777.7	80.3	68.7	7.1

Source: Directorate of Economics and statistics (2006)

Note: Figures within the parentheses in column number 4 are marketed surplus ratios for TE 1999

as lentil has shown higher profitability and lower cost compared to its competing crops like wheat, gram and mustards. On-farm demonstrations at IIPR, Kanpur, have shown existence of significant yield gaps, especially in small-seeded lentil. Adoption of disease management and improved varieties have depicted larger impact on yield and net returns. There is also a large scope for expanding area and production through introducing lentil in cropping systems which increase profitability and also water productivity under water scarce regions and vast rice fallows in the states of UP, MP and Bihar. There is a case for larger institutional and policy support for pulse crops, keeping the role of pulse crops in enhancing soil fertility and its visible effect in terms of yield increase of subsequent crops in the pulse-based crop rotations. Even though marketed surplus ratio has increased in recent years, there is a post-harvest loss to the extent of 7 per cent of production which needs to be managed to increase overall supply for final consumption.

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