Consumption Pattern, Trade and Production Potential of Pulses

This paper analyses regional patterns in the production and consumption of pulses in India and the potential for expansion of output. The paper notes the large differences in both production and consumption of pulses across regions, as well as the increase in imports in recent years. It argues that an improved package of practices, including technological interventions, and a region-specific approach are needed to alleviate the problem of short supply of pulses and chronic malnutrition among the people.

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I Introduction

India accounts for 33 per cent of the world's area under pulses and 22 per cent of production. About 90 per cent of the total global area under pigeonpea, 65 per cent under chickpea and 37 per cent under lentil fall within India, with a corresponding share of production of 93, 68 and 32 per cent, respectively. However, growth rate of the area under pulse crops has been just 0.04 per cent between 1967-68 and 2001. As a result, the share of pulses in total food grain production fell from 17 per cent in 1961 to 7 per cent in 2000. The net availability (calculated from production figures) of pulses came down from 60.7 gm/day/person in 1951 to 31.9 gm per day in 2000. At the sametime, net availability of rice increased from 158.9 to 206.4 gm/day per capita and that of wheat increased from 65.7 to 160.1 gm per day. The annual compound growth rate of pulses production was only 0.11 compared with for rice 0.78 and 2.11 for wheat during 1950 to 2001. As a result, annual growth rate of per capita consumption of pulses was negative (-0.0153 gm/day/person), while the growth rate of per capita consumption of rice is 0.0038 per annum and for wheat 0.0226 gm/day/person. Due to the mismatch between supply and demand for pulses (i e, shortage of supply) the prices of pulse crops increased sharply over the years.

To meet growing demand, India has been importing pulses in large quanties in recent years (6.5 lakh tonnes at about $168 million in 2001-02). Import of pulse crops increased from 1396.6 tonnes in 1960-65 to 7,65,150 tonnes during 1995-2000. Pulses exports increased more modestly from 10,052 tonnes to 60,863 tonnes during the same period. This high dependence on imports for an essential source of protein for the vegetarian population is a matter of serious concern. The supply shortage is reflected in the already low consumption levels of pulses in the Indian diet compared with the standards prescribed by the Indian Council of Medical Research (ICMR).

However, in terms of importance both farmers as well as the government have ignored pulse crops as, Tables 1 and 2 show. Of the critical inputs, i e, irrigated area was only 12 per cent of the total area under pulses, whereas for wheat and paddy the area under irrigation was more than 60 per cent. Another critical input, credit, was Rs 85/ha for pulses, whereas it was Rs 458/ha for paddy and Rs 90/ha for wheat.

Given this background, there is a greater need to understand the status of pulse crops in terms of production, consumption and trade. As pulse crops comprise a wide variety of crops, and production and consumption of pulse crops varies across regions and crops, there is a need to study regional patterns in production and consumption for different pulse crops. This will explore regional differences in pulse crop productivity and the comparative advantages of different regions. The paper also studies the import and export demand of the world and India for different pulse crops, as imports havae been surging in recent years on the one hand, and on the other, greater opportunities are opening up for Indian pulses exports.

II Consumption, Consumer Preferences and Nutrition Intake

The average consumption of pulses is 27 gm/day/person in rural India (Table 3). The major pulses-consuming states are Uttar Pradesh (35 gm), Maharashtra (32.67 gm) and Karnataka (31.67 gm). Lesser consumption has been reported in Orissa (15 gm), Kerala

Table 1: All-India Area, Production and Yield of Pulses

Year	Area (Mn Ha)	Production (Mn Tonnes)	Yield (Kg/Ha)	Per Cent Coverage Under Irrigation
1950-51	19.09	8.41	441	9.4
1960-61	23.56	12.7	539	8.0
1970-71	22.54	11.82	524	8.8
1980-81	22.46	10.63	473	9.0
1990-91	24.66	14.26	578	10.5
1996-97	22.45	17.24	635	12.7

Source: GoI (2002a).

Table 2: Scheduled Commercial Banks' Outstanding Advances Against Pulses, Wheat and Paddy

(Rs crore)

Year	Paddy	Wheat	Pulses
1995	651	109	58
	(152.07)	(42.48)	(25.18)
1996	709	149	53
	(165.50)	(59.58)	(23.79)
1997	1109	132	118
	(255.35)	(50.98)	(52.56)
1998	1630	223	134
	(375.10)	(83.52)	(58.59)
1999	2054	248	200
	(458.48)	(90.12)	(85.11)

Note: Figures in parentheses are rupees in advance/ha.
Source: NIAM (2001).

(15.33 gm) and West Bengal (15.33 gm). In rural India, consumption of red gram dal (7.67 gm) was highest, followed by lentil dal (4.67 gm) and gram (3.67 gm). The major red gram consuming states are Karnataka, Maharashtra and Andhra Pradesh. The major gram consuming states are Punjab, Haryana and Rajasthan. In Gujarat mostly green gram was consumed, and in Assam, Bihar and West Bengal lentil dal has been predominant. Black gram is a major food item in Tamil Nadu and Uttar Pradesh. This shows diversity in the consumption of pulse crops in terms of quantity and variety among different states.

A case study of Maharashtra (Table 4) for 1993-94 shows that pulses consumption was less among the poor (32 gm/consumer unit/day) than the rich (54 gm). Pulses consumption was less among scheduled castes (38 gm) compared with others (43 gm). It was also less among landless and marginal farmers (40 gm) than among large landholders (55 gm). Again, uneducated people consume less (41gm) than educated people (46 gm).

Pulses are a good source of proteins for a majority of the population in rural India. Proteins are essential for human health and better living, and the intake of required protein and hence pulses consumption is very important. The contributions of various food items in the total intake of protein vary across income groups and states due to differences in tastes and preferences as well as purchasing power. This ultimately affects the total intake of nutrients. This section tries to explore the differences in share of the principal sources of proteins and their impact on the food and nutritional security of different income classes at the all-India and state levels.

Average protein consumption in rural India is 73.4 gm (Table 5). Average consumption of protein in rural areas ranged from 96.1 gm in Rajasthan to 55.7 gm in Tamil Nadu. The average protein consumption in Assam (58 gm) Tamil Nadu (55.7 gm) Andhra Pradesh (61.2 gm) Orissa (62.1 gm) and West Bengal (63.1) is less than the ICMR-recommended dose of 65 gm per day. However, many among the uneducated, poor, landless and scheduled caste population were consuming below recommended protein intake.

Differences among states might be due to the varying levels of income or different consumption patterns. Even though most states and a majority of the society are above the poverty norm in terms of calorie intake, i e, 2,400k calories for rural areas,

Table 4: Status of Nutrient Intake and Population Deficient in Intake in Rural Maharashtra, (1993-94)

Social Group	Consumption of Pulses Gm/ Per Capita/Day	Protein Intake Gm/Per Capita/Day	Percentage of Population Deficient
Income group			
Very poor	32	57	32
Moderately poor	40	66	14
Non-poor – lower	45	73	9
Non-poor – higher	54	87	3
Social group			
Scheduled tribe	43	66	21
Scheduled caste	38	65	18
Others	43	71	15
Landholding class			
Landless	41	65	59
Sub-marginal	39	65	50
Marginal	41	69	48
Small	46	75	40
Medium	51	80	26
Large	55	88	19
Educational status of head of household			
Illiterate	42	67	19
Below primary	41	71	15
Above primary	43	71	15
Technical	46	77	8

Notes: Cut-off point for estimating protein deficiency is 60 grams of protein per day.
(1) Very poor < Rs 190, Moderately poor Rs 190-265, Non-poor (lower) Rs 265-355, Non-poor (higher) Rs 355 and above .
(2) Landless 0 acres, Sub-marginal < 1 acre, Marginal 1-2.5 acres, small 2.5-5.0 acres, Medium 5.0-10.0 acres, Large > 10.0 acres.
Source: Musabe and Kumar (2002).

Table 3: Statewise Consumption Pattern of Pulses in Rural India (1999-2000)
(gm/day/person)

Crop	Per Capita Pulse Consumption: Top Three States			Per Capita Pulse Consumption: Bottom Three States			All-India
Gram	Punjab	Kerala	Haryana	WB	AP	Assam	
	(5.33)	(2.67)	(2.00)	(0.00)	(0.33)	(0.00)	(1.00)
Red gram	Karnataka	Maharashtra	AP	WB	Assam	Punjab	
	(15.00)	(14.33)	(13.00)	(0.33)	(0.33)	(0.33)	(7.67)
Gram split	Haryana	Punjab	Rajasthan	WB	Kerala	WB	
	(6.67)	(5.67)	(5.67)	(0.33)	(0.33)	(0.33)	(2.67)
Green gram	Gujarat	Punjab	Rajasthan	UP	WB	Assam	
	(9.33)	(8.00)	(6.33)	(1.00)	(1.67)	(1.67)	(3.33)
Lentil	Assam	Bihar	WB	Gujarat	TN	Karnataka	
	(12.33)	(10.67)	(9.33)	(0.00)	(0.00)	(0.33)	(4.67)
Black gram	TN	UP	Kerala	WB	Bihar	Orissa	
	(7.00)	(6.00)	(4.33)	(0.33)	(0.67)	(0.67)	(3.00)
Khesari	Bihar	WB	MP				
	(2.33)	(2.00)	(1.67)	–	–	–	(0.67)
Peas	Maharashtra	UP	Kerala				
	(0.67)	(0.67)	(0.67)	–	–	–	(0.67)
Soyabean	Assam						
	(0.33)	–	–	–	–	–	–
Other pulses	Karnataka	Punjab	TN	AP	WB	Assam	
	(5.67)	(2.33)	(2.00)	–	–	(0.33)	(1.33)
Pulse products	Haryana	Rajasthan	Punjab	Assam	WB	AP	
	(6.00)	(4.00)	(3.00)	–	(0.33)	(0.33)	(1.67)
Total pulses	UP	Maharashtra	Karnataka	Orissa	Kerala	WB	
	(35.00)	(32.67)	(31.67)	(15.00)	(15.33)	(15.33)	(27.00)

Note: Figures in parentheses are per capita consumption in gm/day/person.
Source: NSSO (2002a).

the contribution of different food items varies across sections and sectors of the economy. Cereals contribute about 67 per cent of proteins followed by pulses (11 per cent), milk and milk products (9 per cent), meat products (4 per cent) and remaining 8 per cent comes from other sources (Table 5). In Bihar, Madhya Pradesh, Orissa and Rajasthan the contribution of cereals in total protein consumption is more than 70 per cent. This is not a healthy trend as cereal proteins lack essential amino acids that are present in pulses. However, in Gujarat, Haryana, Rajasthan and Punjab, the share of milk and milk products is high in total protein, which is a healthy development. These figures show on the one hand that there is a greater need for increasing protein consumption in Assam, Tamil Nadu, Andhra Pradesh, Orissa and West Bengal. On the other hand, there is a need to increase consumption of pulses in Haryana, Bihar, Madhya Pradesh, Orissa and Rajashtan, and also in Assam and Kerala where the contribution of pulses in total protein intake was less.

The percentage of protein intake from cereals is significant among all income classes. However, the contribution of cereals declines as income increases (Table 6). In case of protein intake, there was significant contribution from pulses, milk and milk products and egg, fish and meat products among higher income groups. However, there was no significant difference among income classes in pulses intake, i e, pulses contribute about 8.3 per cent in low income groups (up to Rs 225 income households) in rural India, whereas it was 12.7 per cent of protein intake for high income groups (Rs 615-775 income households). The contribution of eggs, fish and meat products also increases as income increases but not as sharply as is the case with milk and milk products. These figures show that there is a need to increase consumption of pulses among the poor to compensate for less consumption of meat and milk products.

III
Export and Import of Pulses

The tri-annual (1999-2001) average export of pulses was 1.8 lakh tonnes. The share of lentil was the highest (1.3 lakh tonnes), followed by gram split (7,000 tonnes) and red gram (6,000 tonnes) (Table 7). Pulse exports grew by over 420 per cent in 1999-2001 over 1992-94. The highest growth rate was recorded for small red beans, broader beans followed by lentil and peas. The highest price was recorded for green gram and tur in the 1999-2001 period. The highest price increase was recorded for beans, followed by lentil and green gram.

On the other hand, pulses imports were almost three times higher than exports (Table 8). However, imports declined slightly from 5,79,000 tonnes to 4,16,000 tonnes between 1994-96 and 1999-2001. The share of peas and beans was the highest in total imports, followed by chickpea and red gram. The unit value for all imports was less than the unit value of all exports, which indicates the low quality of our imports compared with exports over the period. Only peas and beans recorded an increase in imports between 1994-96 and 1999-2001. The unit value of all pulses imports increased, except for chickpea and gram split.

Overall, these figures indicate that India needs to increase productivity and production of beans and peas to check the increase in imports, for which we need to follow import substitution. On the other hand, there is a need to increase the area under lentil, gram and tur, as India had a comparative advantage in the export of these commodities reflected by the increase in recent years in the export of these pulses. In 2001-02, total pulses

Table 5: Protein Intake and Contribution of Various Food Items in Rural Areas 1999-2000

State	Intake of Protein (Gm)	Per Cent of Total Intake of Protein From				
		Cereals	Pulses	Milk and Milk Products	Egg, Fish and Meat	Other Sources
Andhra Pradesh	61.2	65.58	11.17	8.00	6.80	8.45
Assam	58.3	68.24	8.94	3.90	9.22	9.70
Bihar	73.0	73.17	10.57	5.77	2.38	8.11
Gujarat	67.1	64.44	12.90	13.55	1.13	7.98
Haryana	92.9	58.47	10.29	25.12	0.68	5.44
Karnataka	67.1	61.48	13.90	9.85	4.70	10.07
Kerala	65.8	49.66	7.94	7.81	20.81	13.78
Madhya Pradesh	72.3	74.1	11.56	6.36	1.27	6.71
Maharashtra	70.2	66.54	13.37	7.09	2.97	10.03
Orissa	62.1	77.26	7.20	2.49	4.33	8.72
Punjab	88.9	57.83	11.34	22.21	1.02	7.60
Rajasthan	96.1	70.66	6.58	17.18	0.88	4.70
Tamil Nadu	55.7	60.36	13.92	7.39	7.37	10.96
Uttar Pradesh	87.5	68.86	11.52	9.24	2.33	8.05
West Bengal	63.4	68.96	7.47	3.78	9.30	10.49
All-India	73.4	67.43	10.91	9.19	4.04	8.43

Source: NSSO (2002b).

Table 6: Percentage of Total Intake of Calories and Protein by Expenditure Class in Rural India

Monthly Per Capita Expenditure Class (Rs)	Per Cent of Total Intake of Protein from				
	Cereals	Pulses	Milk and Milk Products	Egg, Fish and Meat	Other Sources
0-225	81.04	8.31	1.64	2.01	7.00
225-255	78.86	9.21	2.25	2.22	7.46
255-300	76.07	9.9	3.26	3.31	7.46
300-340	74.81	9.86	4.54	2.96	7.83
340-380	72.29	10.35	6.28	3.35	7.73
380-420	70.82	10.31	6.45	4.4	8.02
420-470	68.44	10.75	8.17	3.82	8.82
470-525	67.03	10.78	10.01	3.97	8.21
525-615	64.3	11.61	11.01	4.14	8.94
615-775	60.32	12.73	13.65	4.74	8.56
775-950	57.72	12.04	15.89	5.29	9.06
Above 950	52.21	11.93	18.88	6.28	10.70

Source: NSSO (2002b).

Table 7: Change in Trend of Export of Pulses between 1992-94 and 1999-2001

Item	Quantity (Tonnes)			Unit Value (Rs/Kg)		
	Tri-Average		Per Cent	Tri-Average		Per Cent
	1992-94	1999-01	Change	1992-94	1999-01	Change
Peas	464.0	1716.0	269.83	16.50	16.38	-0.75
Chickpeas	2615.0	2293.67	-12.29	12.38	17.25	39.31
Beans of the spp vigna mungo	27.67	18.33	-33.76	10.22	23.85	133.41
Small red beans	-	2.67		-	6.46	-
Kidney beans	-	10.33		-	8.70	-
Guar seed	-	53.67		-	25.07	-
Other beans	46.67	108	131.41	15.21	20.46	34.52
Lentils	8622.33	135229.3	1468.36	19.31	21.37	10.65
Broad beans	0.33	79.67	24042.42	6.00	13.71	128.56
Gram (excl split)	375.67	2297.67	511.62	14.67	20.36	38.81
Gram split	4707.67	7333.33	55.77	13.32	20.56	54.33
Green gram	6640	5065.67	-23.71	15.79	29.66	87.9
Red gram	3862.33	6384	65.29	18.36	27.73	51.02
Black gram	4613.67	4463.67	-3.25	14.15	25.71	81.74
Others	2634	15162.67	475.65	14.69	22.13	50.65
Total	34609.34	180218.7	420.72	15.86	21.77	37.23

Source: GoI (2002b).

exports and imports were worth Rs 366 crore and Rs 3,155 crore respectively.

IV
Price Policy and Market Prices

The lack of an assured market is one factor in the poor performance of pulses. It has been reported that markets for pulses are thin and fragmented, in comparison with cereals in many parts of the country. Market price is always greater than the minimum support prices announced by the government, except during the harvest season, which gives scope for exploitation of farmers by middleman, as the farmers do not have (most of the time financial institutions and government bodies are biased against pulses farmers in comparison with wheat and paddy farmers in giving credit and storage facilities) the storage and financial capabilities to avoid forced sale. Table 9 shows the cost of production and minimum support price announced by the government, which indicates that cost of production was about 20-40 per cent higher than the minimum support price announced by the government for pulses. On the other hand, for wheat and paddy minimum support price was higher or equivalent to the cost of production. This shows a clear bias against pulses farmers in fixing minimum support prices in India. However, the prices are quite high and increasing each year due to mismatch between demand and supply. An analysis of price response reveals that there is an area response to price change in pulses but production has not responded due to lack of investment in yield-increasing inputs under risky rainfed conditions (Table 10). Rainfed pulses farmers are affected by several factors, including erratic rains, poor input supplies, marketing and government policies, which reduce their control over production.

A strategy has to be developed quickly keeping in view India's capabilities in marketing pulses, especially responding to export market needs. The technical issue of non-tariff barriers (NTBs) on export-worthy agricultural items is crucial if we have to survive and flourish in the global WTO regime. An integrated approach involving policy-makers, economists, extension specialists and agricultural scientists is urgently required to wrest the initiative in India's favour from competing countries such as Australia. Our future research ventures should be targeted by consciously keeping this most important global competitiveness concept in mind for making pulses technologies viable.

V
Environmental Benefits and Sustainable Development

Growing pulses also contributes to the increase in soil health in terms of higher organic matter content as well as by fixing atmospheric nitrogen to enrich soil fertility, thereby increasing productivity in terms of yield of the subsequent crop or cropping system as a whole. Table 11 depicts the yield increase of the subsequent crop (cereal) after a pulses crop compared with cereal crop or fallow. An average of 20-40 per cent increase in yield was observed in the Tarai region of Nepal. Similar results were reported in research studies by ICRISAT and IIPR. The composition of input use in crop production is also an indicator of environmental sustainability of the cropping system. From Table 12, we can conclude that in the production of gram lower

Table 8: Change in Trend of Import of Pulses between 1992-94 and 1999-2001

Item	Quantity ('000 Tonnes)			Unit Value (Rs/Kg)		
	Tri-Annual Average		Per Cent	Tri-Annual Average		Per Cent
	1994-96	1999-01	Change	1994-96	1999-01	Change
Peas	172.18	180.26	4.69	9.14	10.45	14.33
Chickpea	74.07	61.71	-16.69	18.44	15.85	-14.03
Beans of the spp vigna mungo	40.73	15.85	-61.08	12.46	18.23	46.35
Small red beans	0.19	1.08	468.42	9.34	16.33	74.83
Kidney beans	22.47	14.05	-37.47	11.93	15.66	31.26
Guar seed	-	0.86	-	-	13.08	-
Other beans	23.22	27.89	20.08	10.84	16.5	52.17
Lentils	30.04	24.67	-17.86	13.41	19.61	46.25
Broad beans	0.03	0.03	-20	3	9.68	222.67
Gram (ex split)	12.36	4.17	-66.3	12.25	19.5	59.16
Gram split	0.96	0.03	-96.52	13.49	6.33	-53.06
Green gram	33.57	17.78	-47.04	12.01	16.61	38.26
Red gram	96.2	36.26	-62.3	11.59	16.09	38.83
Black gram	35.14	4.88	-86.11	11.56	17.98	55.61
Others	37.97	27.35	-27.96	9.65	17.07	76.99
Total	579.12	416.86	-28.02	11.27	13.74	21.92

Source: GoI (2002b).

Table 9: Cost of Production and Minimum Support Price of Pulse Crops in Comparison with Cereals

Item	Cost of Production Rs/qt Average (1998-2001)	Minimum Support Price (2000-01)	Difference Per Cent
Black gram	1176.1	840	40.01
Red gram	986.5	840	17.44
Gram	774.6	740	4.67
Wheat	383.7	475	-19.22
Paddy	380.8	380	0.21

Source: GoI (2002).

Table 10: Price Elasticity of Pulses between 1960-61 and 1999-2000

Crop	Price Elasticity	
	Area	Production
Rice	-0.0075	-0.0435
	(-0.272)	(-0.435)
Wheat	-0.0263	0.0866
	(-0.363)	(0.725)
Pulses	0.1301*	0.0801
	(2.681)	(0.670)

Notes: Figures in parentheses denote t-ratios,
* Significant at 5 per cent level of probability.
Source: Ramasamy and Selvaraj (2002).

Table 11: Farmer's Perception of Residual Effects of Legumes on Yield of Subsequent Crops in Tarai Region

Location	Pulse crop	Subsequent crop	Yield increase* (Per Cent)
Morang	Khesari	Rice	20
	Lentil	Rice	15
Sunsari	Lentil	Rice	15-20
	Black gram	Rice	15-20
Sirah	Gram	Rice	25
Sarlahi	Lentil	Maize	50
Banke	Lentil	Rice	25
	Gram	Rice	35

Notes: * Increase in yield of crop after legume compared with that after fallow/wheat.
Source: Pande and Joshi (1995).

Table 12: Relative Variable Input Use (Per Cent of Total Inputs) for Gram (1999-2000)

Items	Bihar	Madhya Pradesh	Rajasthan	Uttar Pradesh
Human labour	32.5	33.1	46.4	39.9
Bullock labour	11.4	11.7	7.1	14.9
Machine labour	16.2	15.2	12.2	9.3
Seeds	24.6	25.2	16.2	29.5
Fertilisers	11.6	7.6	4.7	2.3
Insecticides	2.1	1.1	0.1	0.0
Irrigation bill	1.5	6.1	13.4	4.0

Source: GoI (2002a).

samounts of chemicals (pesticides and fertilisers) were used compared with paddy and cotton, and gram cultivation is more labour intensive and eco-friendly.

VI
Productivity and Area under Pulse Crops

Even though the yield levels of HYVs are quite impressive on research farms and demonstration fields, their adoption by farmers is not impressive. For example, the impact of the varieties and technologies developed under AICRP becomes visible when 15-25 per cent improvement in yield is achieved under front line-demonstrations (FLDs) conducted every year across the zones. Research extension efforts aimed at better utilisation of fallow areas have been highly successful [Kusmenoglu and Meyveci 1992]. Adoption of HYVs is minimal and there is very little use of fertilisers due to rainfed cultivation [Kelley and Rao 1994; Kerr 1996]. Studies show that fertiliser use in pulses did not result in reasonable pay-off as the fertiliser and moisture interaction was sub-optimal [Rangaswamy 1982]. The average use of fertiliser per hectare (ha) in rainfed areas is only 25 kg in India. Low growth in production is also attributed to the low spread of HYVs in rainfed areas. India's diversity of agro-ecological regions gives scope for area-specific production strategies for different pulse crops (Table 13).

Gram: Gram contributes about 40 per cent of total pulse production. The major gram producing states are Madhya Pradesh, Rajasthan, Maharashtra and Uttar Pradesh, which add up to 90 per cent of total production. Haryana and Karnataka are other important gram producing states. Even though in Madhya Pradesh and Maharashtra area increased in 1990s, in Rajashtan area decreased despite the increase in TFP. However, in Uttar Pradesh and Haryana both area and TFP decreased in the 1990s.

Red Gram: It is the second largest pulse crop after gram. The major red gram growing states are Gujarat, Madhya Pradesh, Maharashtra and Uttar Pradesh, contributing about 75 per cent of total red gram production. In Gujarat, both area and TFP was growing, while in Maharashtra TFP is negative, but area increased. In both Uttar Pradesh and Madhya Pradesh, TFP increased but area under gram decreased.

Black gram: In terms of its share the total, black gram comes third after chickpea and pigeonpea. The major black gram growing states are Andhra Pradesh, Maharashtra, Orissa, Madhya Pradesh, Tamil Nadu and Uttar Pradesh. Except Maharashtra and Madhya Pradesh, TFP growth rate was negative in the 1990s.

Green gram: The major green gram growing states are Andhra Pradesh, Maharashtra and Orissa. Only in Maharashtra was total factor productivity growth positive, and in the remaining green gram-growing states TFP growth was negative. Area under green gram can be increased in Maharashtra at less cost of production.

Lentil: Lentil is one of the minor pulse crops, grown mostly in Uttar Pradesh, Madhya Pradesh and Maharashtra. In Uttar Pradesh and Maharashtra, area under lentil decreased even though productivity increased in the 1990s. On the other hand, in Madhya Pradesh, productivity decreased while area increased during the 1990s. Increasing area under lentil in Uttar Pradesh and Maharashtra, where productivity of lentil is high and increasing, can effectively reduce the recent surge in imports of lentil.

Table 14 shows the marketed surplus recommended by the National Council of Applied Economic Research, New Delhi. For gram, marketed surplus was high for Rajasthan and Haryana, for black gram Madhya Pradesh, Tamil Nadu had the highest marketed surplus, Andhra Pradesh and Rajasthan had high marketed surplus for green gram, and Gujarat, Karnataka and Orissa had high marketed surplus in red gram.

VII
Yield Gap Analysis and Scope for Increasing Productivity

Generally, yield gap is defined as the difference between potential yield and actual yield. By using cost of cultivation scheme data of Tamil Nadu, Ramasamy and Selvaraj (2002) calculated yield gaps for 1999-2000 for major pulse crops (Table 15).

Table 13: Area and Total Factor Productivity Growth of Pulse Crops across States

Crop	Area Growth Rate 1990s	Total Factor Productivity Growth Rate in 1990s	
		Positive	Negative
Chickpea	Area (+)	Madhya Pradesh, Maharashtra	–
	Area (-)	Rajasthan	Haryana, Uttar Pradesh
Pigeonpea	Area (+)	Gujarat	Maharashtra
	Area (-)	Uttar Pradesh, Madhya Pradesh	–
Black gram	Area (+)	Maharashtra, Madhya Pradesh	Tamil Nadu, Uttar Pradesh
	Area (–)	–	Andhra Pradesh, Orissa
Green gram	Area (+)	–	–
	Area (-)	Maharashtra	Andhra Pradesh, Orissa, Madhya Pradesh, Rajasthan
Lentil	Area (+)	–	Madhya Pradesh
	Area (-)	Maharastra, Uttar Pradesh	–

Source: Compiled from Joshi and Saxena (2002).

Table 14: Marketed Surplus Ratio of Important Pulse Crops, Based on Cost of Cultivation Data of NCAER (1988-89)

State	Crops			
	Gram	Black Gram	Green Gram	Red Gram
Andhra Pradesh	NA	76.1	87.4	56.6
Bihar	44.0	NA	52.4	NA
Haryana	54.8	NA		NA
Gujarat	NA	NA	68.0	71.4
Karnataka	NA	NA	65.9	66.1
Madhya Pradesh	40.4	91.2	NA	58.2
Maharashtra	30.1	77.4	69.5	43.9
Orissa	NA	78.6	NA	66.4
Rajasthan	66.9	70.8	79.8	
Tamil Nadu		81.6	NA	65.4
Uttar Pradesh	46.6	47.9	NA	40.4
Average (of above states)	47.2	76.5	72.1	53.2

Source: NIAM (2001).

Table 15: Yield Gap in Irrigated and Rainfed Pulses (1999-2000)
(kg/ha)

Crops	Irrigated	Rainfed
Bengal gram	586	472
Red gram	640	624
Green gram	562	533
Black gram	566	492
Horse gram	525	498

Source: Ramasamy and Selvaraj (2002)

Yield gap existed in both rainfed and irrigated areas. It was more in irrigated crops than in rainfed crops. This means that by better management practices one can improve yield levels significantly with existing technology in both irrigated and rainfed pulses.

Table 16 shows the response in yield to different technological interventions compared with farmer's practices. High response (approximately 30 per cent increase in yield) was reported by adopting HYVs or application of irrigation (32.6 per cent), this was followed by insect management (26 per cent) and weed management (21 per cent). For all interventions, increase in yield was significant, i e, more than 10 per cent of local practice.

Table 17 reveals the increase in yield by adopting the full package of practices compared with local practices in various pulse crops from coordinated all-India demonstrations. It reveals that by adopting an improved package of practices, rajmash yield can be increased by about 60 per cent, chickpea yield by about 40 per cent, field pea by 41 per cent and black gram yield by 28 per cent.

Table 18 depicts the yield response and additional costs involved in improved methods and cost-benefit analysis of pigeonpea under the National Agricultural Technological Project (NATP). In unconstrained capital conditions, it is profitable to adopt both improved variety and improved practices, and absolute returns were highest. However, in the event of cost constraints it was advisable to adopt at least improved variety where incremental benefits were seven times more than incremental costs.

Table 16: Impact of Improved Technology on Productivity of Pulses (Mean of Frontline Demonstrations, 1993-98)

Type of Intervention	Number of Demonstrations	Per Cent Increase in Yield
Improved variety	5210	30.34
Fertiliser	423	14.31
Weed	280	21.01
Insect	386	26.08
Rhizobium culture	178	12.00
Irrigation	130	32.65

Source: IIPR (1998)

Table 17: Impact of Improved Package Technology on Productivity (Mean of Frontline Demonstrations Conducted all over the Country, 1990-98)

Crop	Grain Yield (kg/ha)		Per Cent Increase
	Improved Package of Practices	Local Practices	
Gram	1483	1054	40.7
Red gram	1258	1094	14.99
Field pea	1732	1224	41.5
Rajmash	1832	1115	64.3
Black gram	769	601	27.95

Source: IIPR (1999).

VIII
Summary and Conclusions

The above evidence clearly shows that there is a growing demand for pulses for consumption in the domestic market, as pulses contribute essential amino acids in the human diet. In future too, pulses will form a major source of protein for a huge section, of India particularly for the poor, backward classes and most of the traditionally vegetarian population. The recent surge in import of pulses is also costing heavily in terms of valuable foreign exchange. Short supply of pulse crops has led to increase in prices, thereby pushing pulses out of the reach of poor households, thus negatively affecting their nutrition and productivity. The remedy for these above problems is to identify the niches where pulse productivity and area can be increased with cost-effective technology and management methods. However, the evidence clearly shows that to increase pulses production and consumption, it is required to have a region-specific approach, as different pulse crops grow in different regions. The consumer preference for different pulse crops also varies widely across regions. The indirect benefits of pulse crops in maintaining soil fertility and sustainability of cropping systems need to be assessed and policies evaluated to internalise these external benefits of pulse crops. The growing international market for pulse crops is an opportunity as well as a threat for pulse farmers as the increase in productivity and competitiveness of pulse crops leads to a growing world demand for pulses exports. Existing high-yielding varieties have the potential to increase productivity by 25-30 per cent. However, there is a need to increase location specific efforts for wider acceptability of improved varieties among farmers through development of high-yielding, pest-resistant varieties, which ultimately increase the irrigated area under pulse crops as irrigated conditions contribute to about 30 per cent increase in yields on farmers' fields. The incremental benefits to farmers were as high as seven times the incremental costs, which is very high in comparable terms.

A definite thrust has to be placed on the improvement of the social well-being of the population, besides continuing with increases in agricultural production and productivity. A great challenge that faces us is how to eliminate malnutrition/under-nutrition in the country. Only increasing our competitiveness by producing at low cost, which is affordable to the mass population, can help accomplish this objective.

This needs efficient use of genetic resources, besides natural resources such as land and water, on a long-term sustainable basis. Strategies need to be in place to ensure that plant genetic resources are effectively conserved and utilised, and linkages and partnerships developed, to ensure that our crop improvement programmes continue to effectively serve the interests of the farmers. We must intensify our efforts towards further genetic enhancement of crop plants to develop varieties that meet specific requirements of

Table 18: Productivity of Red Gram Influenced by Improved Variety and Practices

Pigeon Pea Crop/Treatment	Grain Yield (kg/ha)	Increase in Yield (Per Cent)	Incremental Cost of Intervention (Rs/ha)	Gross Returns (Rs/ha)	Benefit-Cost Ratio	Incremental Benefit	Incremental Benefit/Incremental Cost
Farmer's variety/farmer's practices	816	-	-	8862	1.90	-	-
Farmer's variety/improved practice	1089	25.06	1500	12614	2.03	3752	2.50
Improved variety with farmer's practice	1351	39.60	1000	15926	2.70	7064	7.06
Improved variety with improved practice	1668	51.08	2500	19991	3.00	11129	4.45

Source: Author's calculations from CRIDA (2002).

farmers in different regions, seasons, situations and systems. Recent advances in molecular biology and biotechnology have a profound impact on our ability to genetically tailor pulse crops. In combination with conventional plant breeding, biotechnology has a key role to play in the genetic enhancement of crop plants, particularly in relation to pest resistance, drought and salinity tolerance, quality improvement and shelf-life enhancement. EPW

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