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Full Length Research Paper

Changing spatial pattern, trend and regional imbalances in pulse production in Eastern Uttar Pradesh, India

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Inspite of being the major source of protein and staple food for the majority of population the production of pulses is stagnated at all India level between 12 and 15 million tonnes. It is believed that the demand of pulses will increase upto 20 million tonnes during 2020 A.D. Thus, a need arise to find out the causes for such stagnation and to suggest some remedial measures for increasing the area and production under pulses. The objectives of the present study is to analyze the trend and spatial pattern of area, production and yield of pulses in Eastern Uttar Pradesh during 1990-1992 to 2007-2009, including the regional imbalances in the availability of pulses per head per day in grams on the basis of recommendations given by Indian Council of Medical Research (ICMR) Hyderabad. Changes in the area and production of pulses are compared to those of major cereals to draw conclusions to ascertain, whether the trend is in the same direction or opposite. Finally, the study concluded that the area (except lentil) and production (except black gram and lentil) of the pulses has been decreased during the study period.

Key words: Green revolution, cereals, pulses, districts, regional imbalance.

INTRODUCTION

Subsistence farming, primitive technique and low yield have been the characteristics of Indian agriculture for centuries. In spite of the fact, that most of the land is devoted to foodgrains production, the deficit could not be removed and in many areas starvation and famines were frequent (Chakravarti, 1973). After independence, the major break through achieved, in the history of Indian agriculture was Green Revolution. Due to rapid increase in the country's population a need was felt to increase the food production (Shafi, 2006). The introduction of high yielding varieties of seeds has facilitated a significant increment in foodgrains production and Indian agriculture appears on the threshold of a great change. But the sudden technological change in the agricultural scenario has brought a great imbalance among the foodgrains crops and this technical breakthrough in the production of cereals has been impressive but the same cannot be said for the pulses (Rao and Ray, 1985). No doubt Green Revolution is responsible for a significant increase in the foodgrains production but the increase is only confined up to the cereal crops. On one hand, the area, production and yield of cereals is on the rise and on the other, it is accompanied by loss in the acreage and production of pulses (Kumar, 1978).

India accounts for 33% of the world's area under pulses and 22% of the production and if we compare the net availability of foodgrains then we find that, the net availability of pulses came down from 60.7 g per head per day in 1951 to 31.9 g per head per day in 2000 and at the same time the net availability of rice increased from 158.9 g per head per day to 206.4 g and that of wheat increased from 65.7 to 161.1 g per head per day (Reddy, 2004). Indian Council of Medical Research (ICMR) during 1968 has recommended that a balanced diet should contain 70 g of pulses which

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Abbreviations: ICMR, Indian Council of Medical Research; **NFSM,** National Food Security Mission.

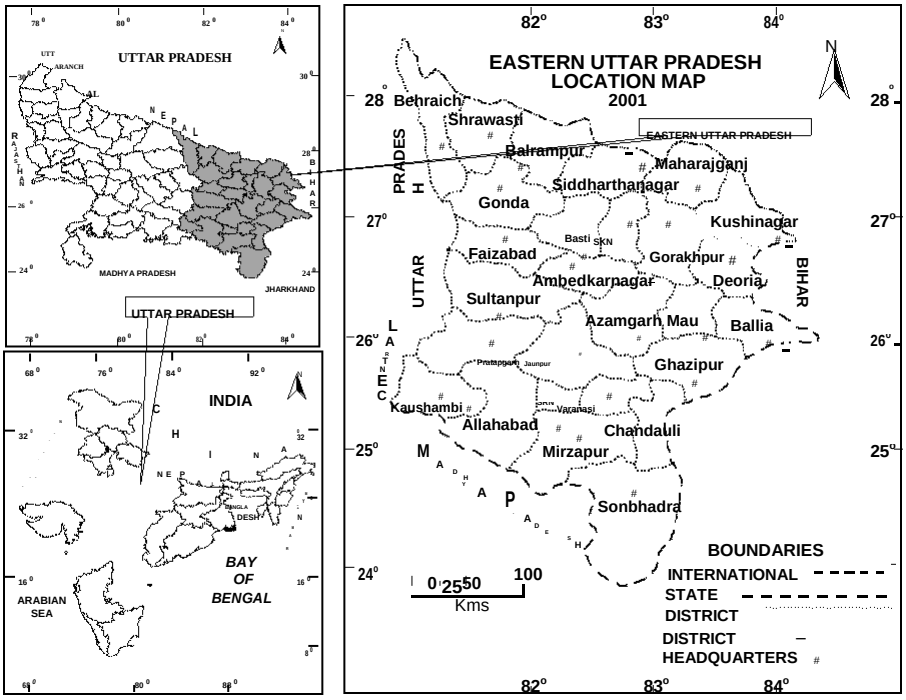

Figure 1. Eastern Uttar Pradesh location map.

later was revised and observed that a balanced diet should contain 50 g of pulses during 1980 but unfortunately both cannot be met (Munir et al., 2005). Further ICMR has recommended a daily intake of 43 g of pulses per capita per day and this level also barely be met unless and until some special efforts are made to increase the production of pulses (Verma, 2011). With the advent of Green Revolution the growth in the production of pulses is rather disappointing and has given way to the problem like rise in the prices of pulses (Mundinami, 1989) and have serious impact on the state of food security because pulses are generally consumed by majority of population as staple food (Mohammad, 1989).

The data shows that the availability of pulses is on decline. Pulse production has shown a wide range of fluctuation and has been stagnated between 11 to 15 million tonnes during the last decade (Reddy, 2005; Verma, 2011), while the demand for pulses by the end of the Eleventh plan (2002-07) would grow to 16.1 million tonne and it would reach 19.1 million tonnes by the year 2020-21 (Chand, 2007). Even though India has achieved food security successfully, such a stagnation and decline in pulses production has a great threat to nutritional security which continues to be a cause of concern and on behalf of production, pulses are unable to maintain the pace with population growth (Chaturvedi and Ali, 2002).

Pulses constitute one of the most important components of human diet. It is the major source of protein particularly for the vegetarian population. Since pulses are cheaper than meat (animal protein) they are often referred to as 'poor man's meat' in developing countries like India. If we compare the percentage of protein in most of the pulses with that of superior cereals like wheat and rice then we find that Gram, Black gram and Lentil contains 17.1, 24.0 and 25.1%, respectively, whereas, wheat and rice have only 11.8 and 8.5% of protein respectively (Kachroo, 1970). Besides their nutritional value, pulse crops are gifted with unique property of maintaining and restoring soil fertility through biological nitrogen from the atmosphere as well as of conserving and improving physical properties of soil by virtue of their deep and well spread root system (Khanna and Gupta, 1988). Pulses crops provide not only the beans but also green vegetables and in addition, these leguminous crops are important for feeding animals, providing both grazing and hay (Wrigley, 1982).

Study area

The Eastern Uttar Pradesh has been taken as the study area which is a homogenous alluvial tract which forms an important part of Indo Gangetic Plain. Geographically, the Eastern Uttar Pradesh lies between the latitudes of 25° 10′ and 26°21′ N and longitude of 82° 10′ and 84° 40′ E. The northern boundary of Eastern Uttar Pradesh runs along Himalayas touching Nepal and is also well defined by River Ghagra and the western border is the political boundary of the districts Faizabad, Sultanpur, Pratapgarh and Allahabad (Shafi, 1960). The eastern boundary is

bordered by the state of Bihar, on the south it is bordered by Madhya Pradesh and to the south-east by Chhattisgarh and Jharkhand (Figure 1).

The Eastern Uttar Pradesh is also popularly known as 'Purvanchal' and is most vulnerable part of the state because of its various and multi-faceted agro-ecological situations characterised by frequent flood and drought. Due to high fertile plain of Ganga the region has a high population density and dominance of agriculture as economic activity (Sisodia and Kumar, 2004). The Eastern Uttar Pradesh has a maximum population density of 776 persons per sq km (Census of India, 2001) against the whole of India, that is, 324 persons per sq km. In terms of agriculture, of the total production of foodgrains in Uttar Pradesh, about 34% comes from Eastern Uttar Pradesh while its area accounted for about 35 to 37% of the total foodgrain area.

Objective

This paper explores the uncertainty in production, decreasing area and low yield of the pulses crop which discourage the farmers to restrict the area under these crops. As the area and production of the pulses crop vary from district to district, an indepth study on inter district variation assume great practical significance. The main objectives of the study are as follows:

(i) To examine the district wise variation in area, production and yield of major pulse crops viz. Black gram, Green gram, gram, lentil, total pulses etc in Eastern Uttar Pradesh.
(ii) To examine the availability of pulses in grams per head per day.
(iii) To examine the areas of high, medium and low pulse production.
(iv) To suggest remedial measures and policy decisions to increase the pulse production.

METHODOLOGY

The present study is based on the secondary sources data and all the data required is taken from Bulletin of Agricultural Statistics of Uttar Pradesh for various years, published by the Directorate, Ministry of Agriculture, Department of Statistics and Economics, Lucknow, U.P. from 1990-92 to 2007-09. Three years moving average has been used to remove the weather abnormality and fluctuation in the data of foodgrain production. Growth rates of pulses crops have been calculated by using the following equation.

$$GR = V_{t0} - V_{tn} / V_{tn} * 100$$

Where GR is the growth rate of pulses; V_{t0} is the pulse production of the succeeding year and V_{tn} is the pulses production of the succeeding year.

The data regarding population has been taken from Census of India 1991 and census on India 2001. The population has been projected for taking out per head per day availability of pulses, by using the analytic method of population estimation (Khan, 1998) for projecting district wise population for the year 2008. The formula assumes, that population has been increasing at a constant rate, observed during the census period, that is, 1991 to 2001, thus:

$$PP = P_1 + n/N * (P_2 - P_1)$$

Where PP is the projected population; P_1 is the population of the previous census; P_2 is the population of succeeding census; N is the number of years between the censuses; n is the number of years between the previous census and the year for which population would be projected.

The availability of pulses have been calculated in grams per head per day (on the basis of recommendation given by ICMR, Hyderabad and the standard pulse intake per head per day is 43 g). For showing the variation in the pulse availability per head per day the districts are categorised in high, medium and low on the basis of mean and standard deviation method.

RESULTS AND DISCUSSION

Pulses in Eastern Uttar Pradesh

During the period 1990-1992 Eastern Uttar Pradesh has produced 30% of the total pulses from 29% of the total area under pulses and during 2000-2002 it has produced 30% of the total pulses from 28% of the total area under pulses in Uttar Pradesh. The percentage of the total area declined to 26%, while the production remained more or less stagnant to 29% during 2007-2009. The percentage share of pulses in total foodgrains production declined from 6.2% in 1991-1992 to 4.3% in 2000-2002 and further to 3.2% in 2007-2009. The area has also dwindled from 11.3% in 1991 to 9.7% in 2001 and further to 7.9% in 2009. Table 1 show the data regarding area and production under pulses which has continuously declined through out the study period. During 1990-1992 the area and production of pulses was 865.71 thousand ha and 77.36 lakh quintals, which decreased to 762.93 thousand ha and 70.02 lakh quintals during 2000-2002 and further decreased to 601.07 thousand ha and 51.82 lakh quintals in 2007-2009. This continuous fall in the area under pulses is because of inaccessibility and inadequate supply of quality seeds which is a major obstacle in their wide spread adoption and production has declined because of low productivity, lack of government support and low procurement price (Sundaram, 2010). This situation has a serious implication on the nutritional security of the people because pulses are the staple food and major source of protein for the majority of vegetarian population in the study area.

Bengal Gram (*Cicer arietinum*, Chickpea)

Generally pulses and particularly gram are quite sensitive to salinity and alkalinity and it is drought loving crop (Tomer and Lal, 1980). It is often grown as winter crop on residual soil moisture. Sometimes it is grown as single

Table 1. Growth in area, production and yield of pulses (1990-92 to 2007-09).

S/N	Name of Districts	1990-1992			2000-2002			2007-2009			Growth rate								
											1990-1992 to 2000-2002			2000-2002 to 2007-2009			1990-1992 to 2007-2009		
		A	P	Y	A	P	Y	A	P	Y	A	P	Y	A	P	Y	A	P	Y
1	Allahabad	98.76	11.09	1122.63	62.47	7.05	1129.01	51.24	4.57	890.52	-36.74	-36.38	0.57	-17.98	-35.24	-21.12	-48.12	-58.8	-20.68
2	Kaushambi	Did not exist as a separate district			27.28	3.73	1367.28	26.45	2.71	1032.14				-3.02	-27.38	-24.51			
3	Pratapgarh	40.64	3.39	833.12	37.59	3.35	891.3	26.02	1.95	747.89	-7.51	-1.05	6.98	-30.78	-41.8	-16.09	-35.98	-42.41	-10.23
4	Varanasi	53.93	5.88	1090.92	13.52	1.41	1040.18	11.56	1.06	919.62	-74.94	-76.1	-4.65	-14.51	-24.35	-11.59	-78.57	-81.92	-15.7
5	Chandauli	Did not exist as a separate district			18.73	1.31	697.47	17.47	1.35	779.88				-6.73	3.13	11.82			
6	Ghazipur	42.84	4.74	1106.38	36.91	3.77	1022.47	28.44	2.78	984.55	-13.84	-20.38	-7.58	-22.94	-26.3	-3.71	-33.61	-41.32	-11.01
7	Jaunpur	37.84	3.83	1011.21	34.23	3.64	1063.53	27.12	2.45	907.17	-9.56	-4.88	5.17	-20.76	-32.56	-14.7	-28.33	-35.85	-10.29
8	Mirzapur	43.86	4.29	977.4	41.48	4	963.83	38.49	3.56	923.06	-5.42	-6.73	-1.39	-7.22	-10.97	-4.23	-12.25	-16.97	-5.56
9	Sonbhadra	28.91	1.97	682.62	41.21	3.05	740.83	33.55	2.29	686.87	42.53	54.69	8.53	-18.59	-25.04	-7.28	16.04	15.95	0.62
10	SRN	Did not exist as a separate district			8.12	0.89	1095.8	6.31	0.54	867.09				-22.26	-38.77	-20.87			
11	Azamgarh	38.31	3.78	987.45	25.41	2.78	1095.02	20.15	1.78	883.94	-33.69	-26.47	10.89	-20.67	-36.13	-19.28	-47.4	-53.04	-10.48
12	Mau	12.46	1.19	959.07	8.84	0.9	1020.25	5.6	0.51	919.57	-29.06	-24.53	6.38	-36.63	-43.94	-9.87	-55.04	-57.69	-4.12
13	Ballia	42.92	4.51	1049.96	32.52	3.38	1039.56	29.86	2.92	980.96	-24.22	-24.97	-0.99	-8.18	-13.78	-5.64	-30.42	-35.31	-6.57
14	Gorakhpur	25.77	1.83	709.73	18.65	1.58	848.55	10.87	0.79	739.49	-27.62	-13.46	19.56	-41.72	-50.15	-12.85	-57.82	-56.86	4.19
15	Maharajganj	26.12	1.98	756.67	19.23	1.59	828.48	12.06	0.89	738.35	-26.4	-19.41	9.49	-37.29	-44.28	-10.88	-53.85	-55.1	-2.42
16	Deoria	23.82	1.73	728.15	14.86	1.22	820.49	9.43	0.66	699.85	-37.62	-29.71	12.68	-36.51	-46.02	-14.7	-60.39	-62.06	-3.89
17	Kushinagar	Did not exist as a separate district			6.83	0.58	852.02	5.56	0.41	732.54				-18.69	-30.1	-14.02			
18	Basti	38.12	3.24	850.45	21.08	2.01	953.01	17.83	1.46	822.77	-44.72	-38.05	12.06	-15.41	-27.41	-13.67	-53.24	-55.03	-3.25
19	Siddharth	25.23	1.96	777.35	19.32	1.84	951.68	12.48	1.02	819.3	-23.44	-6.27	22.43	-35.39	-44.5	-13.91	-50.53	-47.98	5.4
20	SKN	Did not exist as a separate district			10.75	1.01	941.37	8.23	0.71	863.12				-23.44	-30.18	-8.31			
21	Faizabad	41.13	3.55	862.75	19.68	1.76	893.18	11.44	0.93	813.48	-52.14	-50.46	3.53	-41.86	-47.21	-8.92	-72.18	-73.84	-5.71
22	Ambedkar Nagar	Did not exist as a separate district			14.87	1.25	3513.17	11.71	0.99	845.87				-21.2	-21.02	-75.92			
23	Sultanpur	47.23	4.72	858.07	45.21	4.98	1101.66	39.36	3.71	941.07	-4.26	5.58	28.39	-12.94	-25.61	-14.58	-16.65	-21.47	9.67
24	Gonda	93.93	6.54	696.36	40.62	2.94	724.17	24.98	2.07	829.51	-56.75	-55.02	3.99	-38.51	-29.79	14.55	-73.4	-68.42	19.12
25	Balrampur	Did not exist as a separate district			45.79	3.31	723.34	34.59	3.41	977.05				-24.45	2.82	35.07			
26	Behraich	103.89	7.14	687.27	63.53	4.21	662.63	54.41	4.75	872.94	-38.84	-41.04	-3.59	-14.35	12.87	31.74	-47.62	-33.45	27.02
27	Shrawasti	Did not exist as a separate district			34.2	2.47	722.77	25.84	1.59	615.27				-24.45	-35.72	-14.87			
	Total	865.71	77.36	893.58	762.93	70.02	917.84	601.07	51.82	862.14	-11.87	-9.48	2.72	-21.22	-26	-6.07	-30.57	-33.01	-3.52

Source: Directorate Ministry of Agriculture, Deptt. of Statistics and Economics, Lucknow, Uttar Pradesh. A - Area in '000' hectares. P - Production in lakh quintals. Y - Yield in Kg/ha. SRN - Sant Ravidas Nagar. SKN - Sant Kabir Nagar.

crop and sometimes it is inter-cropped with cereals. Per 100 g of the edible portion of this pulse contains protein (20.8 g), fat (5.6 g), carbohydrate (59.8 g), minerals and vitamins (2.7 g) (Aykroyd, 1962).

It is evident that, in area and production gram is the first ranking crop among all the pulses in Eastern Uttar Pradesh. It occupies nearly 36.35% of the total area and 35.77% of the total production of pulses during 1990-1992. Both area and production dropped off to 22.73 and 22.58% during 2000-2002 which further reduced to 14.50 and 16.21% in 2007-2009, respectively. The pulse gram has experienced a continuous fall in the area and production from 314.66 thousand ha

and 27.67 lakh quintals during 1990-92 to 173.38 thousand ha and 15.81 lakh quintals in 2000-2002 which further decreased to 87.16 thousand ha and 8.40 lakh quintals during 2007-2009, respectively (Figures 2 and 3 and Tables 2 and 3).

In the opinion of Kumar (1978), Mohammad, Bhalla and Tyagi (1989) and Reddy (2009) the factor responsible for such a continuous decline in the area and production of gram is HYV of wheat and some other remunerative crops like mustard, sugarcane, potato etc. Wheat is the most important substitute crop of gram in rabi season of Uttar Pradesh and an increase in the area and production of wheat was claimed mainly by acquiring the area under pulses, which was previously sown by gram. In case of yield, thesituation is reversed because it has registered an increase from 879 kg/h in 1990-92 to 911 kg/h in 2000-2002 and further moved upto 963 kg/h during 2007-9. In Uttar Pradesh the yield of gram is high because it is usually grown as a mixed crop with wheat and had received manure, on the other hand yield of the soul crop is low because they are rarely manured (Nene 2006). The percentage growth in area, production and yield during 1990-1992 to 2000-2002 was -44.90, -42.86, and 3.70% and during 2000-2002 to 2007-2009 it has been found at -49.73. -46.88 and + 5.67, respectively.

Lentil (*Lens Culinaris*, Masur)

Lentil is mainly grown in north India on a wide range of soil from sandy to heavy clay, light loams and black cotton. Alluvial soils are also preferred with high fertility. In Uttar Pradesh the cultivation is most extensive in the damper regions, sown in all kind of soil but chiefly in low lying land (Kachroo, 1970). The yield decreases when it is grown as a mixed crop from 1100 to 350-650 kg/h (Wrigley, 1982). Per 100 g of the edible portion of this lentil contains protein (25.1 g), fat (0.7 g), carbohydrate (59.0 g), minerals and vitamins (2.1 g) (Aykroyd, 1962). During 1990-1992 it occupies 20 percent of the total area and 17% of the total production under pulses in Eastern Uttar Pradesh while in 2000-2002 the percentage share increased to 29.27% in areaand 24.77% in production which further increased to 34.05 and 33.97% respectively in 2007-2009 (Figures 2 and 3). The availability of short duration varieties of lentil has assisted them to adopt rapidly in diverse environment and now it is also cultivated on the rice-fallow areas which must have received manure and this in turn must have benefitted lentil to increase the production through out the study period (Uttar Pradesh Development Report, 2007). The area and production increased from 172.95 thousand ha and 13.12 lakh quintals to 223.34 thousand ha and 17.35 lakh quintals during 1990-1992 to 2000-2002 but during the period of 2000-2002 to 2007-2009 the area decreased to 204.67 thousand ha and production noticed a slight increment upto 17.60 lakh quintals (Table 2). The percentage growth in area, production and yield in 1990-1992 to 2000-2002 was +29.14, +32.23 and 2.39% which decreased to -8.36, +1.47 and +10.73%, respectively in 2007-2009 (Table 3).

Green gram (*Vigna radiata*, Moong)

It is grown in deep loam and also adapted to clay and black cotton soil. It can tolerate heat but cannot tolerate frost and matures in 2.5 to 4-5 months. Per 100 g of the edible portion of this pulse contains protein (24.5 g), fat (1.2 g), carbohydrate (59.9 g), minerals and vitamins (3.5 g) (Aykroyd, 1962). Green gram is among the least cultivated pulse crop of Eastern Uttar Pradesh. It shared only 1.98% of the total area and 1.24% of the total production under pulse in 1990-1992 and it dwindled to 1.69 percent in area and 1.06 percent in production in 2000-2002. But in 2007-09 it made a slight increase in area and production to 1.82 and 1.30, respectively. However an important point noted here regardingGreen gram is that, during the study period the area and production both continuously decreased from 17.14 thousand hectares and 0.96 lakh quintals in 1990-1992 to 12.88 thousand hectares and 0.74 lakh quintals in 2000-2002 and further decreased to 10.91 thousand hectares and 0.68 lakh quintals in 2007-2009, but their was a continuous increase in the productivity from 560 to 575 kg/h to 618 kg/h during the same period. Inspite increase in the yield of the Green gram the production has decreased because the area under cultivation has decreased sharply. The percentage growth in area, production and yield of the Green gram during 2000-2002 to 2007-2009 was -15.27, -8.78 and +7.66% in the study area (Table 3).

Black gram (*Vigna mungo*, Urd)

Black gram is the highly popular pulse of high caste Hindus. It is grown in black cotton soil in India and also in deep loams and paddy soils. It is quick growing pulse, inter-cropped with maize, sorghum cotton and sometime in pure stand (Wrigley, 1982). Per 100 g of the edible portion of this pulse contains protein (24.0 g), fat (1.4 g), carbohydrate (59.6 g), minerals and vitamins (3.2 g). The percentage share in area, production and yield of Black gram among the total pulses produced in the study area has increased during study period. During 1990-1992 the area devoted to Black gram was 48.13 thousand ha and production was 2.17 lakh quintals with the yield of 451 kg/h and during 2000-2002 their was a slight increase in the area upto 54.23 thousand ha and production goes upto 2.60 lakh quintal with the yield of 479 kg/h, while during 2007-2009 the area decreased to 46.83 thousand ha but the production maintained the increase to 2.56 lakh quintal because of increase in yield 546 kg/h. The

Table 2. Area, production and yield of different pulses (1990-1992 to 2007-2009).

S/N	Crops	1990-1992			2000-2002			2007-2009		
		A	P	Y	A	P	Y	A	P	Y
1.	Black gram	48.13	2.17	450.86	54.23	2.60	479.44	46.83	2.56	545.54
2.	Green gram	17.14	0.96	560.09	12.88	0.74	574.53	10.91	0.68	618.53
3.	Lentil	172.95	13.12	758.55	223.34	17.35	776.72	204.67	17.60	860.04
4.	Bengal gram	314.66	27.67	879.36	173.38	15.81	911.87	87.16	8.40	963.56
5.	Peas	104.83	11.25	1073.40	107.88	12.00	1112.43	88.01	9.64	1095.76
6.	Red gram	207.90	22.18	1066.89	191.17	21.53	1126.18	162.79	12.91	793.22
Eastern U.P.		865.71	77.36	893.58	762.93	70.02	917.84	601.07	51.82	862.14
Uttar Pradesh		2967.06	256.81	865.54	2691.11	237.05	880.81	2282.16	179.61	787.02

Source: Directorate, Ministry of Agriculture, Department of Statistics and Economics, Lucknow, U.P. A – Area in '000' ha, P – Production in lakh quintals, Y – Yield in Kg/ha.

Table 3. Percentage growth in area, production and yield of different pulses.

S/N	Crops	1990-1992 to 2000-2002			2000-02 to 2007-2009			1990-1992 to 2007-2009		
		A	P	Y	A	P	Y	A	P	Y
1.	Black gram	12.67	19.82	6.34	-13.64	-1.73	13.79	-2.69	17.74	21.00
2.	Green gram	-24.85	-22.92	2.58	-15.27	-8.78	7.66	-36.33	-29.69	10.43
3.	Lentil	29.14	32.23	2.39	-8.36	1.47	10.73	18.34	34.18	13.38
4.	Bengal gram	-44.90	-42.86	3.70	-49.73	-46.88	5.67	-72.30	-69.65	9.57
5.	Peas	2.91	6.65	3.64	-18.42	-19.64	-1.50	-16.04	-14.29	2.08
6.	Red gram	-8.04	-2.93	5.56	-14.85	-40.02	-29.57	-21.70	-41.78	-25.65
Eastern U.P.		-11.87	-9.48	2.72	-21.22	-26.00	-6.07	-30.57	-33.01	-3.52
Uttar Pradesh		-9.30	-7.70	1.76	-15.20	-24.23	-10.65	-23.08	-30.06	-9.07

Source: Directorate, Ministry of Agriculture, Department of Statistics and Economics, Lucknow, U.P. A – Area in '000' ha, P – Production in lakh quintals, Y – Yield in Kg/ha.

availability of short duration varieties of black gram has made easier for them to adopt in diverse environment which in turn has increased the production (Table 2).

Red gram (Arhar)

Red gram locally known as 'tur', ranks high among the pulse crop of India and is eaten by a considerable number of people. Due to its susceptibility to frost and being a native of tropics and subtropics it does not survive in even light frost (Kachroo, 1970). Red gram is the second largest pulse crop after gram in respect of area and production in Eastern Uttar Pradesh. It occupies 24.0 percent of the total area and 28.7% of the total production of pulses in the study area in 1990-1992 which increased upto 25.0 and 30.8% in 2000-2002, while during 2007-2009 the percentage share of area increased to 27.0% but the percentage share of production decreased to 24.9% (Figures 2 and 3). Per 100 g of the edible portion of this pulse contains protein (22.3 g), fat (1.7 g), carbohydrate (57.6 g), minerals and vitamins (3.5 g). During 1990-1992 the area and production of red gram was 207.90 thousand ha and 22.18 lakh quintals which dropped to 191.17 thousand ha and 21.53 lakh quintals in 2000-2002 which again reduced to 162.79 thousand ha and 12.91 lakh quintals in 2007-2009, respectively (Table 2). The cause behind the decline in area and production of Red gram is rice because it is an important substitute cereal crop for Red gram for the kharif season in Uttar Pradesh. The growth rate in area and production of wheat is also on the rise and that of Red gram is on decline and because of this piece of evidence it can be proven that the area and production under Red gram in the districts of Eastern Uttar Pradesh is found to be continuous declining. (Rao and Ray, 1985).

Field peas (*Pisum sativum*, Matar)

Per 100 g of the edible portion of this pulse contains protein (24.9 g), fat (0.8 g), carbohydrate (60.1 g), minerals and vitamins (3.2 g). During 2000-2002 the area and production of pea has decreased from 107.88 thousand ha and 12.00 lakh quintals to 88.01 thousand

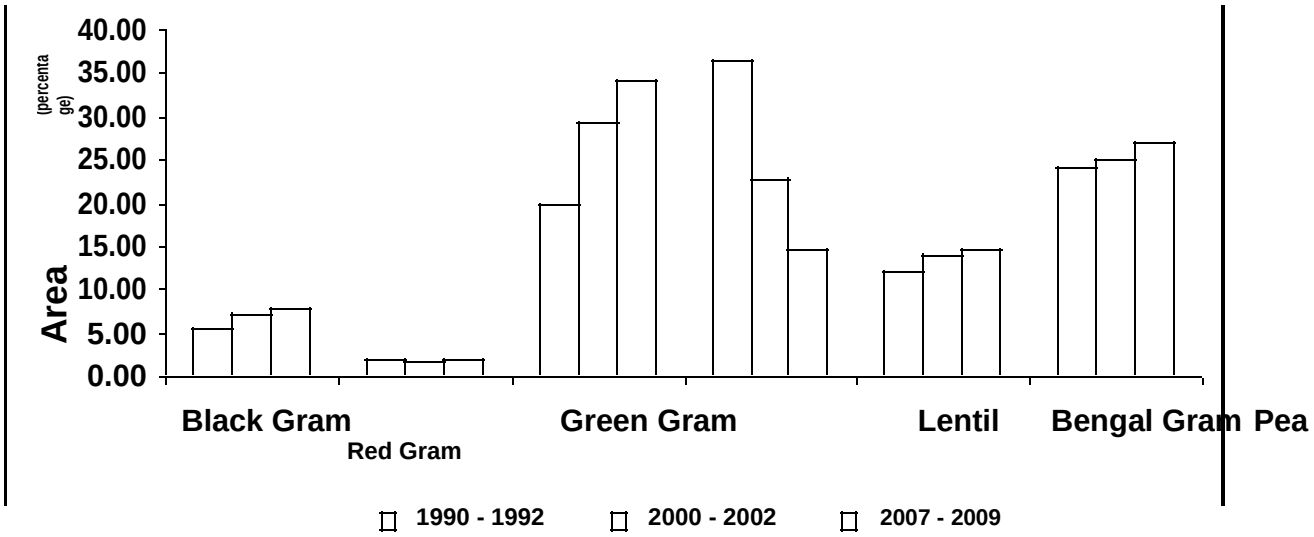

Figure 2. Percentage share of area under pulses in Eastern Uttar Pradesh 1990-1992 to 2007-2009.

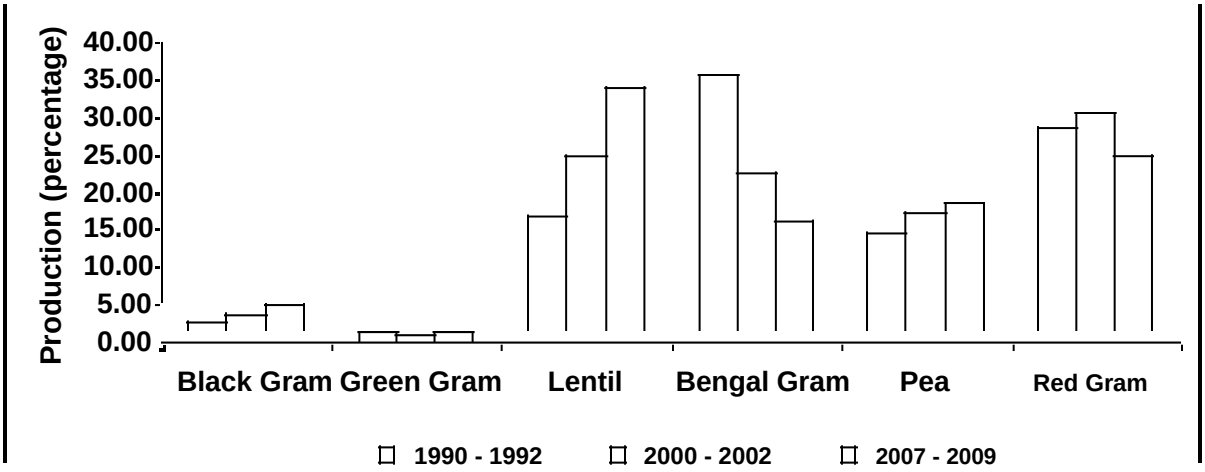

Figure 3. Percentage share of production under pulses in Eastern Uttar Pradesh 1990-1992 to 2007-2009.

ha and 9.64 lakh quintals during 2007-2009. The growth in area, production and yield in 1990-92 to 2000-02 was +2.91, +6.65 and +3.64% and from 2000-02 to 2007-09 is -18.42, -19.64 and -1.50%, respectively (Table 3). Like gram this crop has also faced competition with wheat in the irrigated areas. But still some scope of area expansion under this crop is possible in those areas where enough water is not available for growing of wheat crop (Reddy, 2009).

Changing spatial pattern in the per capita availability of pulses during 2000-2002 to 2007-2009

Per capita availability of pulses is a function of pulses production and population growth in the respective districts. The Availability of pulses has been calculated here in g per head per day. To illustrate the availability of pulses, all the districts of the study area has been arranged into three categories of high, medium and low on the basis of mean and standard deviation method.

It has been a long time since Green Revolution has come to India and it has been proved successful for the purpose it was applied for. The Eastern Uttar Pradesh is also positively affected by the same and is no exception; this can be easily reflected in the changing cropping pattern and the availability of pulses which is on a continuous decline since the time of green revolution. The availability of pulses or any other cereal increases only when the production increases or the population decreases. Here, in case Eastern Uttar Pradesh it is accompanied by both, that is, decrease in the pulse production and increase in the population. Here an attempt has been made to analyze the spatial pattern and

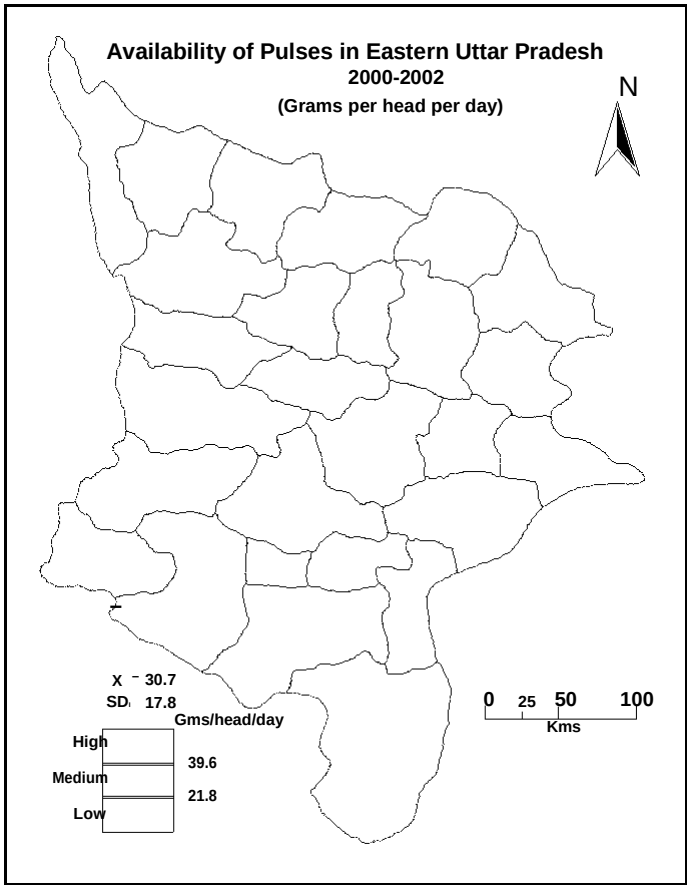

Figure 4. Availability pulses in Eastern Uttar Pradesh 2000-2002.

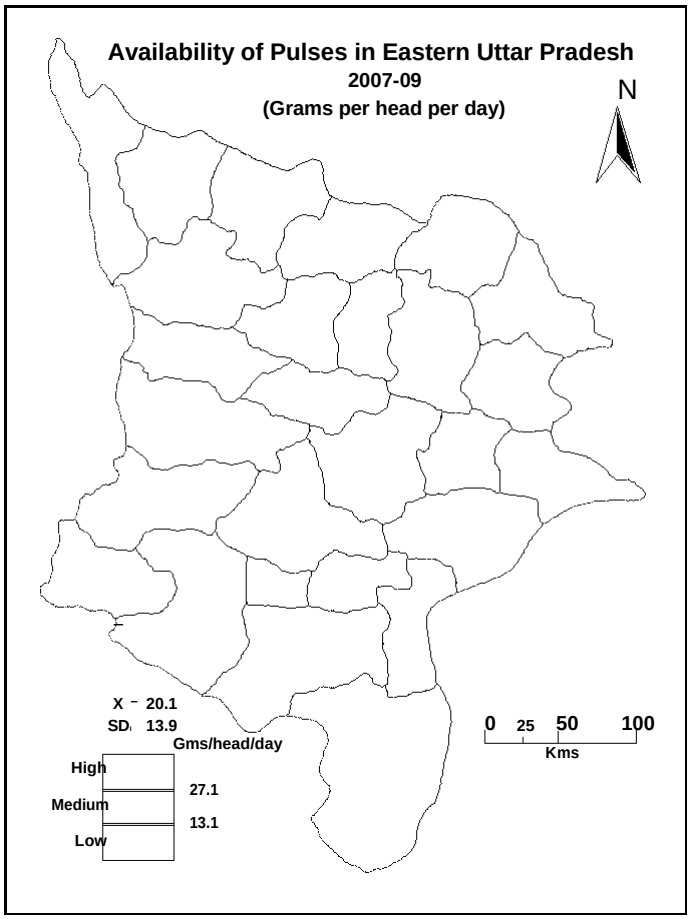

Figure 5. Availability pulses in Eastern Uttar Pradesh 2007-2009.

changing trend in the availability of pulses per head per day in g.

If we take 1990-1992 as a base year, then we find that 42% of the districts were having high category of pulses availability, 16% of the districts having medium and 42% of the districts having in low availability of pulses per head per day. The average net availability of pulses in Eastern Uttar Pradesh was 41.1 g per head per day in 1990-1992. District Mirzapur recorded highest availability of pulses with 70.9 g and district Deoria with 10.7 g got the lowest rank in the availability of pulses per head per day.

During 2000-2002 the situation regarding the availability of pulses was same as expected and as indicated by the trend seen till now. The average net availability of pulses decreased to 28.8 g per head per day. About 26% of the districts were having high availability of pulses and 33% of the districts recorded medium availability, while 41% of the districts were having low availability of pulses per head per day. During 2007-09 the average net availability of pulses further reduced to 18.16 g per head per day and the percentage of districts having high availability of pulses were 26% of the total, 30% of the districts recorded medium availability of pulses and the rest 44% got low pulse availability per head per day in Eastern Uttar Pradesh. While comparing the data for the two periods, that is, 2000 to 2002 to 2007 to 2009 it becomes evident that the districts which fall in the high category of pulse availability are same for both the periods (Figures 4 and 5).

During 2000-2002 the districts which fall in the high category, lies in north-west, west and southern part of the study area. The availability of pulses in these districts are high because the area devoted for the cultivation of pulses and the production is highest from rest of the districts. The districts which lies in the high category (that is, above 39.6 g/head/day) are Kaushambi which top the list of pulses availability with 79.0 g, followed by Shrawasti (57.6 g), Sonbhadra (57.2 g), Balrampur (53.9 g), Mirzapur (51.8 g), Behraich (48.4 g) and Sultanpur (42.4 g per head per day). The important thing is that, each districts discussed above maintained their position in the high category of pulse availability per head per day also during 2007-2009, in spite of decrease in the over all net availability of pulses. In 2007-2009 district Kaushambi maintaining its top position declined to 50.0 g, Balrampur (49 g), Behraich (47.2 g), Mirzapur (40.0 g), Sonbhadra

(36.1 g), Shrawasti (32.2 g), and Sultanpur (27.6 g per head per day). These districts maintained their position in the high category of pulses availability because the decrease in the area under pulses in these districts is lowest in comparison to those who have medium and low pulses availability. Thus the decrease in the production is also low in these districts, resulting into the high pulse availability per head per day. Another reason behind high pulse availability in the above mentioned districts is the National Food Security Mission (NFSM) 2007 under which it is decided to increase the production of pulses by two million tons at national level in the selected districts and the above mentioned districts of Eastern Uttar Pradesh are identified for the same (NFSM, 2009).

The districts which fall under the medium (that is, between 39.5 and 21.9 g/head/day) category of pulses availability are concentrated in the eastern, western and north-western part of the study area during 2000-2002 namely, Faizabad (23.1 g), Siddharth Nagar (24.7 g), Jaunpur (25.5 g), Basti (26.4 g), Gonda (29.1 g), Ballia (33.5 g), Pratapgarh (33.6 g), Ghazipur (34.0 g) and Allahabad with (39.1 g of pulses per head per day). The pattern of pulses availability during the year 2007-2009 for the districts of medium category (between 27.1 to 13.1 g/head/day) is almost the same as in 2000-2002. Only district Chandauli has promoted to medium category from the low category of pulses availability during 2000-2002 to 2007-2009. Apart from this, districts Siddharth Nagar and Faizabad has demoted from the category of medium to low pulses availability per head per day because here, the trio of area, production and yield has decreased during the study period, leading to low availability of pulses per head day.

During 2000-2002 the districts which lie in the low availability of pulses production (that is, below 21.8 g/head/day) are concentrated in the north-eastern part of the study area namely, Kushinagar having the lowest availability of pulses, that is 5.5 g, followed by Gorakhpur (11.5 g), Deoria (12.3 g), Varanasi (12.3 g), Mau (13.3 g), Ambedkar Nagar (16.9 g), Sant Ravidas Nagar (18.0 g), Azamgarh (19.3 g), Maharajganj (20.1 g), and Chandauli (21.8 g). The remarkable increase in the irrigational facilities and the development in the infra-structure of the agriculture have kept these districts into the category of low pulse availability because irrigation development has favoured the growth of high yielding varieties of wheat and rice because they are grown mostly for the export purpose and thus fetches better profits than pulses. Another reason behind low availability is the low minimum support price announced by the government for the pulses (Reddy, 2009). During 2007-2009 the pattern and the districts lying in the low category of pulse availability are more or less the same as in 2000-2002 because the decline in the area and production is lower than rest of the districts.

Here, due to increase in the production of pulses, only district Chandauli has managed to move from the category of low pulse availability to medium pulses availability, which was 21.8 g in 2000-2002 to 19.4 g per head per day in 2007-2009. This may apparently be seen as improvement in per capita availability of Chandauli districts but if we take an analytic look into this, the pictures becomes different. This indicate that there has been an overall decline in per capita availability from 2000-2002 to 2007-2009 in almost all the districts of the study area, which in fact is true because each and every district almost is characterized by negative growth in, production (Table 1), thus setting the categories at much lower level than earlier. Another factor which is responsible for decline in per head per day availability of pulses in district Chandauli is the population growth. The rate of growth of population is high in this district leading to decrease in the availability of pulses per head per day.

Conclusion

From the above study it can be concluded that Red gram, Lentil and Bengal gram dominates among all the pulses in terms of area. Table 2 shows that Lentil, Bengal gram and Red gram dominates in terms of production in the study area occupying first, second and third position respectively during 1990-1992 to 2000-2002. If we examine the production of individual pulses then only black gram and lentil have shown significant positive growth trend for the period and rest of the pulses is on decline (Table 3). The availability of short duration varieties of lentil and black gram has facilitated rapid adoption of these pulses in diverse environments, leading to increase in the area and production both. The highest average net per capita availability of pulses is recorded in district Kaushambi having 64.5 g of pulses per head per day and district Kushinagar witnessed the lowest net per capita availability of pulses having 4.4 g per head per day. The slow progress in the yield and fall in the area and production has made adverse effect in per capita availability of pulses. The districts of Behraich, Mirzapur, Balrampur, Sonbhadra, Shrawasti and Kaushambi in 2000-2002 and the district of Behraich, Balrampur and Kaushambi in 2007-2009 have pulses availability, over the standard recommendation of 43 g per head per day given by ICMR. The situation seems to be very critical because most of the districts of Eastern Uttar Pradesh fall below the standard recommendation and standing on the threshold of nutritional insecurity. And as the trend shows, the districts that are above this level will soon fall into the same category, until and unless some special efforts are made to increase the productivity and production of pulses. It has also been observed that, no district of Eastern Uttar Pradesh have made progress in per capita availability of pulses during 200-2002 to 2007-2009 and each and every district is characterised by the decline in per capita per head pulses availability. The cause behind such a decline in the pulse availability in

Table 4. Area, production and yield of cereals (1980-1982 to 2007-2009).

Crop	1980-1982			1990-1992			2000-2002			2007-2009		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y
Wheat	2527.3	348.2	1377.8	3034.8	593.2	1954.7	3315.2	809.1	2440.4	3395.3	884.3	2604.6
Rice	2837.7	219.4	773.2	3041.5	499.7	1643.0	3159.7	666.3	2108.7	3134.0	623.0	1987.8
Total cereals	6422.8	639.1	994.9	6823.0	1167.3	1710.8	7071.4	1543.1	2182.1	7023.9	1561.3	2222.8

Source: Directorate, Ministry of Agriculture, Department of Statistics and Economics, Lucknow, U.P. A – Area in '000' ha, P – Production in lakh quintals, Y – Yield in Kg/ha.

Table 5. Percentage growth in area, production and yield of cereals.

Crops	1990-92 to 2000-2002			2000-2002 to 2007-2009			1980-1982 to 2007-2009		
	A	P	Y	A	P	Y	A	P	Y
Wheat	9.24	36.38	24.85	2.42	9.31	6.73	11.88	49.08	33.25
Rice	3.89	33.33	28.34	-0.82	-6.50	-5.73	3.04	24.67	20.99
Total cereals	3.64	32.19	27.54	-0.67	1.18	1.87	2.95	33.75	29.92

Source: Directorate, Ministry of Agriculture, Department of Statistics and Economics, Lucknow, U.P. A – Area in '000' ha, P – Production in lakh quintals, Y – Yield in Kg/ha.

in the study area is green revolution. Due to the irrigational development both surface and ground water has increased area and shifted in favour of rice and wheat (Table 5). More emphasis is given to the cereal crops mainly high yielding and disease resistance varieties of wheat and rice which has encroached the better pulses growing areas. The farmers too are inclined towards the cereals crop because per hectare net returns from HYV of cereals are much higher than the net return on pulses. Huge subsidies on water, power and other inputs, assured output prices and procurement by the government favoured the cereals, leaving the pulses far behind in area, production and yield. Thus, on one extreme the area and production of the cereals has shown a continuous increase whereas the reverse trend is observed in the case of pulses.

If we take 1980-1982 as a base year, then we observe that the production of cereals has almost increased more than twice between 1980-1982 to 2007-2009 (Table 4), whereas the pulse production decreased from 66.87 lakh quintals to 51.82 lakh quintals during the same period. The production of cereals has shown a non-stop increase after 1990-1992 whereas an opposite trend is observed in production was at a higher rate, while the growth rate of case of pulses especially in gram and Red gram. During 1990-1992 to 2007-2009 the growth rate of the cereal pulses could never reach the level it had attained in 1990-1992. During the period of 1990-1992 to 2007-2009 the area under cereals showed an increase of 2.94% while the area under pulses showed a decline by 30% (Table 3).Between, 1990-1992 to 2007-2009 the yield of cereals increased by 29.9% while in case of pulses the yield decreased by 3.50% in the study area. This shows that the production of pulses is going down not because decrease in the area only but also due to decrease in the yield. The area, production and yield of pulses show a declining trend because pulses are generally grown under rain fed condition and due to the advancement inthe irrigation the pulses crops are replaced by the cereal crops because whenever the irrigation facilities are extended the farmers seems to shift such land for growing high yielding varieties of cereals like wheat and rice which are less risky and more profitable than pulses. Thus, due to availability of assured means of irrigation the area and production under pulses is overtaken by cereal crops. Wheat and rice is the most important substitute crop of gram and Red gram respectively in Rabi and Kharif season in most of the pulses growing districts of Eastern Uttar Pradesh. If we compare the growth rate of wheat with that of gram in the study area then we find that the growth rate of wheat is positive than that of gram during the study period. The comparative growth rate of rice with that of Red gram also shows the similar scenario.

It clearly shows the fact that while on one hand the area and production of pulses continues to decline and on the other hand certain important food crops increased in area and production at the cost of pulse crops. While comparing the per head per day availability of pulses of the district of Eastern Uttar Pradesh with that of state average (Uttar Pradesh) which was 39.0 g/head/day during 2000-2002 we find that, about 70% of the districts of the study area has pulses availability per head per day below the state average. During 2007-09 the value of state average declined to 26.6 g/head/day and about 74% of the districts of the study area noticed pulses availability per head per day below the state average (Table 6).

Table 6. Availability of pulses in Eastern Uttar Pradesh during (2000-2002 to 2007-2009) (Grams per head per day).

S/N	Districts	2000-2002	2007-2009	S/N	Districts	2000-2002	2007-2009
1.	Allahabad	39.1	22.1	16.	Deoria	12.3	5.8
2.	Kaushambi	79.0	50.0	17.	Kushinagar	5.5	3.3
3.	Pratapgarh	33.6	17.3	18.	Basti	26.4	16.4
4.	Varanasi	12.3	8.1	19.	Siddharth Nagar	24.7	12.3
5.	Chandauli	21.8	19.4	20.	Sant Kabir Nagar	19.5	12.0
6.	Ghazipur	34.0	21.9	21.	Faizabad	23.1	9.8
7.	Jaunpur	25.5	15.3	22.	Ambedkar Nagar	16.9	11.7
8.	Mirzapur	51.8	40.0	23.	Sultanpur	42.4	27.6
9.	Sonbhadra	57.2	36.1	24.	Gonda	29.1	17.9
10.	Sant Ravidas Nagar	18.0	9.7	25.	Balrampur	53.9	49.0
11.	Azamgarh	19.3	10.8	26.	Behraich	48.4	47.2
12.	Mau	13.3	6.5	27.	Shrawasti	57.6	32.2
13.	Ballia	33.5	25.7		Eastern U.P.	28.8	18.6
14.	Gorakhpur	11.5	5.1		Uttar Pradesh	39.0	26.6
15.	Maharajganj	20.1	9.6				

Source: Computed by Authors from Bulletin of Agricultural Statistics of Uttar Pradesh and Census of India, 2001.

Suggestions and policy implications

The production of pulses is stagnated between 12 to 15 million tonnes at the national level and it is estimated that the population of our country would be touching nearly 1350 million by 2020 A.D. and our minimum pulses requirement would be around 30.3 million tonnes. Uttar Pradesh being the most populous state and the largest producer of pulses and Eastern Uttar Pradesh being a part of it, will be the most affected by the shortage of pulses in future. This gigantic demand for pulses cannot be fulfilled under present condition unless and until some strict measures are taken for increasing the production. The following measures come into sight and deserve particular attention:

(i) Pulses like gram and Red gram are facing great competition with that of wheat and rice and also facing low stability of production in compare to cereals, thus it becomes obligatory to develop high yielding varieties of pulses that are stable and resistant to pest and diseases.
(ii) Pulses are not considered as a major cash crop because more than 50% of the production is consumed by the farmer's family level, thus their is an acute need of intensifying the research work, which may help to increase the yield and make the pulse cultivation equally feasible from the commercial point of view.
(iii) Further pulses are grown mostly under rain fed condition and only 19% of the total area under pulses is irrigated. Thus to remove the fluctuation caused by weather, it is crucial to enlarge the irrigation base of pulses.
(iv) Increasing area by reaching to new places, like rice fallows and wastelands is another possible option for increasing the availability of pulses.
(v) Most of the farmers are small and marginal with limited capital to invest for the modern agricultural technology. Thus, there is a need to strengthen existing rural credit institutions and promote the self help groups to mobilize savings and access credit for productive purpose.
(vi) Cereals are the main staple food and they get priority over pulses. Keeping in view the importance of crop and to attract pulse growers there is an urgent need to fix the procurement prices of pulses crops at higher level so that, the farmers should go for pulses.
(vii) Inspite of having more than 500 varieties of high yielding varieties of seeds the production of pulses is declining because inadequate supply of quality seeds remains a major stumbling block in their wide spread adoption.
(viii) As per rough estimates about 20% of the pulses are lost in various post harvest operations in which storage and milling contributes maximum. Thus reducing post harvest losses upto 10% about 1 million ton more pulses will be available for human consumption.

At last for summing up, it can be concluded that by putting into practice the suggested strategies for pulses research and development we can certify the sustainability of present production system and we can also increase the production of pulses for the increasing demand of the future.

REFERENCES

Aykroyd WR (1962). Nutritive value of Indian food and planning of satisfactory diet, Indian Council of Medical Research, New Delhi, pp. 52-53.

Bhalla GS, Tyagi DS (1989). Spatial pattern of agricultural development

in India, Economic and Political Weekly, 24(25): A46-A56.
Census of India (1991). Series 25, Uttar Pradesh, part II-B (i) Primary Census Abstract, General Population, Directorate of Census Operations, Uttar Pradesh.
Census of India (2001). Uttar Pradesh Administrative Atlas, Directorate of Census Operations, Uttar Pradesh, Vol. II.
Chakravarti AK (1973). Green revolution in India, Annals of the Association of American Geographers, 63(3): 319-330.
Chand R (2007). Demand for food grains, Economic and Political Weekly, 42(52): 10-13.
Chaturvedi SK, Ali M (2002). 'Poor man's meat' needs fresh fillip, The Hindu, Survey of Indian Agriculture, pp. 63-69.
Kachroo P (1970). Pulse crops of India, Indian Council of Agricultural Research, New Delhi. p. 4.
Khan N (1998). Quantitative methods in geographical research, Concept Publishing Company, New Delhi, India. pp. 58-59.
Khanna SS, Gupta RC (1988). Raising production of pulses, *Yojna*, Ministry of Information and Broadcasting, New Delhi, India. 32(17): 4-8.
Kumar BL (1978). Declining trend in production of pulses and factors affecting it. Economic and Political Weekly, 13(27): 1112-1114.
Mohammad A (1989). Food production and food problem in India, Concept Publications, New Delhi, India. p. 20.
Mundinami SM (1989). Production of Pulses, *Yojna*, Ministry of Information and Broadcasting, New Delhi, India. 33(19): 25.
Munir A, Rukhsana, Ashraf M (2005). Availability and imbalances in the production of pulses in Western Uttar Pradesh, The Geographer, 52(1): 17-28.
Nene YL (2006). Indian pulses through millennia, Asian Agric-History, 10(3): 179-202.
NFSM (2009). Operational guidelines. Government of India, Ministry of Agriculture, Department of Agriculture and Cooperation, India. Retrieved from http://nfsm.gov.in/pulses.aspx accessed on 10/09/2011.
Rao IVR, Ray AK (1985). Stagnation in production of pulses, Agricultural Situation in India, 40(5): 369-376.
Reddy AA (2004). Consumption pattern, trade and production potential of pulses. Economic and Political Weekly, 39(44): 4854-4860.
Reddy AA (2005). Pulse crops production technology, problems and opportunities, Agricultural Situation in India, 61(11): 779-788.
Reddy AA (2009). Pulses production technology: status and way forward. Economic and Political weekly, 44(52): 73-80.
Shafi M (1960). Land utilization in Eastern Uttar Pradesh, The Muslim Educational Press, Aligarh, India. p. 19.
Shafi M (2006). Green revolution: impact and consequences, Agricultural Geography, Dorling Kindersley, India), New Delhi, P 139.
Sisodia BVS, Kumar S (2004). Scenario of agricultural development in Eastern Uttar Pradesh. Agricultural Situation in India, 60(11): 715-721.
Sundaram IS (2010). India needs a pulses revolution, Facts for You, December, 10-12. Retrieved from http://www.efymag.com/admin/issuepdf/pulses_Dec10.pdf accessed on 08/09/2011.
Tomer YS, Lal S (1980). Kabuli gram for higher returns, Indian Farming, 30(1): 17-18.
Uttar Pradesh Development Report (2007). Planning Commission, Government of India, New Delhi. Vol. 1.
Verma P (2011). Pulses: increasing availability, *Yojna*, Ministry of Information and Broadcasting, New Delhi, India. 55: 58-60.
Wrigley G (1982). Tropical Agriculture-The Development of Production, Longman, London, pp. 116-127.