

## **GROWTH OF PRODUCTION AND PRODUCTIVITY OF DIFFERENT PULSES IN JHARKHAND**

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*The present study indicates that there has been positive changes in the area of pulses crops. The annual compound growth rate in the area was estimated to be 8 per cent, 62 per cent, 0.80 per cent and 0.20 per cent in pea, lentil, chickpea and pigeonpea respectively. The production growth rate in the same crop was observed to be 9.2 per cent, 6.8 per cent, 3.5 per cent and 3.9 per cent as compound annual rate in the State. The yield growth rate for these crops was further estimated to be 1.20 per cent, 0.05 per cent, 0.20 per cent and 2.20 per cent. The variability in the area was observed to be high in pea followed by lentil and pigeonpea and minimum in chickpea. Similarly, variability in yield was also found to be high in pea followed by chickpea, lentil and minimum in pigeonpea, respectively.*

**Keywords :** Pulses, Peas, Lentil.

### **INTRODUCTION**

In spite of being the largest producer of pulses, India has to import these to the tune of two million tonnes every year to meet the domestic requirement. Latest estimates for 2003-04 indicate that the production of pulse in the country was 15.24 million tonnes from an area of 24.25 million hectares, an increase of 36 percent over the last year production of 11.14 million tonnes. The two most important pulse, chickpea and pigeonpea recorded production of 5.77 million tonnes and 2.43 million tonnes during the year. In chickpea and pigeonpea, India contributes 67 percent and 75 percent to the global production respectively. In spite of having the largest area under chickpea, pigeonpea, lentil, drybeans and total pulses in the world, India's position in average productivity is yet to see a major breakthrough. The average productivity of pulses, other than chickpea and pigeonpea, is significantly low in the country. The most important states for pulses are Madhya Pradesh, Uttar Pradesh, Maharashtra, Andhra Pradesh, Karnataka and Bihar, which together account for 80 percent of the production.

The production of pulses, which was 8.41 million tonnes in 1951, has increased to 13.11 million tonnes in 2005-06. Similarly, the productivity has increased from 441 kilogram per hectare in 1951 to 623 kg/ha in 2003. This shows that had there not been an improvement in yield, at least 10 million hectare of additional land would have been required to harvest of the present production level. The positive growth statistics in different periods shows the positive growth of 1.41 percent and 0.76 percent in production of pulses in pre-green revolution (1950-65) and post-green revolution (1968-04) periods, respectively. The decreasing per capita availability of pulses from 69 gm in 1961 to 37 gm in 2004 in the country has been of serious concern. To make up the shortfall in supply, at least 23.88 million tonnes of pulses are required by 2015 and it is expected to touch 29.30 million tonnes by 2020. This necessitates an annual growth rate of 4.2 percent in pulse

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production.

In Jharkhand state the total area under pulses was 290 thousand hectares in 2004-2005. Among the pulse crops, the maximum area was under arhar which covered 88.64 thousand hectares during 2004-05 followed by gram, pea and masoor which occupied 33.17, 19.33 and 15.47 thousand hectares of land respectively. Overall, pulses covered about 290.92 thousand hectare of area during the same period which was about 100 percent more than in the year 1999-2000.

There has been a continuous increase in the production of pulses in the past few years. Maximum production was contributed by arhar (62.47 thousand tonnes) during 2004-05 followed by gram 29.26, pea and masoor 19.81 thousand tonnes. The overall production of pulses during 2004-05 was 190.11 thousand tonnes, which was about 62 percent more than that during 1999-2000.

But there has been a decreasing trend in the average productivity of pulses. During 1999-2000, the productivity of pulses was recorded to be 812 kg/ha which decreased to 19.58 percent, exhibiting 653 kg/ha during 2004-05. The maximum productivity was seen in pea (994 kg/ha) followed by gram, arhar and masoor, 882, 705 and 596 kg/ha. The average productivity of arhar was higher than the average productivity of this crop at the national level. Overall average productivity of pulse in the state crops is at par with the national average or marginally higher than the average of national level. The present study was undertaken to examine the growth rate in area, production and productivity of pulses in the state and also to examine variability in area, production and productivity of these crops.

## METHODOLOGY

Jharkhand state consists of three sub agro-climatic zones i.e. Zone 1, Zone 2 and Zone 3, which were purposively selected. The study was based on secondary data collected from various sources (Various issues of *Bihar through Figures*, published by the Directorate of Statistics and Evaluation, Patna, Bihar, Directorate of Agriculture, Govt. of Bihar, Agricultural Development of Jharkhand – At a Glance through Figures : 2006.) through personal contact. To estimate the growth rate in area, production and productivity of pulse crops under study, the periods were divided into four groups.

Period I	:	Represents from 1970-71 to 1979-80.
Period II	:	Represents from 1980-81 to 1989-90.
Period III	:	Represents from 1990-91 to 1999-2000.
Period IV	:	Represents from 2000-01 to 2004-05.
Period V	:	Represents from 1970-71 to 2004-05.

(Pooled data)

## ESTIMATION OF GROWTH RATES

For estimating the growth rates of major pulses crops with respect to area, production and productivity, compound growth rate model was selected for further analysis.

Compound growth rates in area, production and productivity between different periods were calculated using the following formula :

$$\frac{P_t}{P_o} = \left[ 1 + \frac{r}{100} \right]^t$$

Where,

$P_t$  = Area, production and productivity in  $t^{\text{th}}$  time period

- $P_o$  = Area, production and productivity in the base year  
 $R$  = Compound growth rate  
 $T$  = Time in year

### ESTIMATION OF CO-EFFICIENT OF VARIATION

To examine the variability with respect to area, production and yield of the crops, mean, standard deviation and coefficient of variation were worked out for the four different periods.

$$\text{Coefficient of variation} = \frac{\sigma}{\bar{X}} \times 100$$

Where,

- $\sigma$  = Standard deviation  
 $\bar{X}$  = Mean of the Sample data

$$\text{Standard deviation } [\sigma] = \sqrt{\frac{\sum X^2}{n-1}}$$

Where,

- $X$  =  $[X_i - \bar{X}]$   
 $N$  = Number of observation

### RESULTS AND DISCUSSION

#### GROWTH RATE OF AREA, PRODUCTION AND YIELD

The estimated compound growth rate of pigeonpea, chickpea, lentil and pea in respect to area, production and yield of the state for the following four periods i.e. period I (1970-71 to 1979-80), period II (1980-81 to 1989-90), period III (1990-91 to 99-2000) and period IV (2000-01 to 2004-05) have been presented in Table no.1.

The overall growth rate in the area of different pulses crops revealed that the maximum growth rate per annum was observed in the case of pea being nearly 8 percent per annum as compound rate followed by lentil (6 %), chickpea (0.8 %) and minimum (0.2 %) in the case of pigeonpea (arhar). The period-wise analysis further revealed that the maximum growth rate in area for all crops, except lentil, was observed during period IV in comparison to other periods. The crop-wise analysis further shows that the growth rate in the area of pigeonpea crop was observed to be high in period IV and it increased at the rate of nearly 22 percent per annum as compound rate. Against this, the area under the same crop during period I declined at a maximum rate of 14 percent per annum and a negative growth rate was also observed in period II (-3.1 % per annum). In case of chickpea, the growth rate in area was observed to be high in period I and same rate of growth was observed in period IV also, while negative growth rate was observed for the same crop during period II. The growth rate in area in the case of lentil was observed to be high in period II and it increased at a rate of nearly 20 percent per annum as compound growth rate. In case of pea, the growth rate in area was about 36 percent in period IV revealing that the area under this crop increased at the rate of 36 percent per annum as compound rate. Period I was also favourable for this crop and the area under this crop increased at the rate of 10 percent per annum, while the declining growth rate in area of this crop was observed during period II and period III. The decline in area may be due to shifting of area under vegetable crops and climatic factors.

The overall growth rate in production of different pulses' crops shows that maximum growth has been exhibited by pea which was 9.2 percent per annum as compound growth rate followed by lentil (6.3 %), pigeonpea (3.9 %) and chickpea (3.5 %). Now, the period-wise analysis shows that the maximum growth in production was observed during period IV in all pulses and during this period, this was maximum in case of pea and lentil. The crop-wise analysis further shows a continuous growth in lentil throughout the study period. The other crops show a fluctuating trend in the growth of production. The growth was negative for chickpea during period II while during period I, there was negative growth for pigeonpea and lentil showing -2.6 percent and -1.2 percent as compound growth rates.

**Table No. 1, Annual Compound Growth in Area, Production and Productivity of Pulses Crops**

(in %)

	PERIOD-I	PERIOD-II	PERIOD III	PERIOD IV	OVERALL
<b>PIGEONPEA</b>					
AREA	-13.6	-3.1	1.2	21.6	0.2
PRODUCTION	-2.6	4.2	0.6	16.5	3.9
YIELD	7.0	6.0	-7.2	9.2	2.7
<b>CHICKPEA</b>					
AREA	3.4	-0.9	1.5	3.1	0.8
PRODUCTION	7.7	-13.4	1.7	3.7	3.5
YIELD	12.8	2.2	-4.9	-0.1	0.2
<b>LENTIL</b>					
AREA	7.2	19.6	3.0	14.2	6.2
PRODUCTION	-1.2	6.6	7.3	29	6.8
YIELD	-7.8	-22.7	1.9	-1.7	0.5
<b>PEA</b>					
AREA	10.3	-2.4	-6.1	35.6	7.9
PRODUCTION	3.4	1.5	18.3	29.9	9.2
YIELD	-6.3	1.5	16.2	3.9	1.2

The overall compound growth rate in case of yield was observed to be high in pigeonpea (2.7 %) followed by pea (1.2 %), lentil (0.5 %) and chickpea (0.2 %) as compound growth rates per annum. The period-wise analysis further indicates that growth rate in yield of lentil and pea was high during period III. For chickpea it was high in period I and for pigeonpea, period IV was a favourable period from the yield point of view. The crop-wise analysis further indicates that maximum growth in yield of pigeonpea has occurred in period IV while in chickpea, it was maximum in period I. Period III exhibited maximum growth in yield for lentil as well as pea.

### MEAN OF AREA OF PULSES

The mean of the area of selected pulses' crops is shown in Table 2. The average area under pigeonpea was estimated to be nearly 35 thousand hectares, which was more than other pulses' crops. The fluctuating trend was observed in the area of this crop during the study period. During

**Table No. 2 , Mean of the Area of Different Pulses**

('000' ha.)

Crops	Period I	Period II	Period III	Period IV	Overall
PIGEONPEA	35.57	24.14	25.02	57.92	34.69
CHICKPEA	35.14	27.42	28.97	31.74	30.90
LENTIL	3.42	4.42	6.49	13.58	6.47
PEA	3.70	4.42	5.41	13.80	6.24

period I (1970-71 to 1979-80), the area under this crop was about 36 thousand hectares which came down to 24 thousand hectares during period II (1980-81 to 1989-90) and remained unchanged in period III (1990-91 to 99-2000) and strongly increased during period IV (2000-01 to 2004-05), showing 63 percent positive change.

The table further reveals that the area under chickpea was nearly 31 thousand hectares. Again, a fluctuating trend was observed during the study periods. The area under period I was estimated to be 35 thousand hectares, which decreased to a level of 27.42 thousand hectares during period II and slightly improved during period III and IV.

The area under lentil was found to be 6.47 lakh hectares in the state. A positive trend was observed throughout the study periods in the area of this crop. The area under this crop was about 3.42 lakh hectares, which registered an increasing trend in period II (4.42 lakh hectares), and further maintained an increasing trend during periods III and period IV. The average increase was nearly 295 percent in the area of this crop during the study period.

Like lentil, pea also showed a positive trend throughout the study periods. The average area under this crop was 3.70 thousand hectares during period I, which increased to 4.42 thousand hectares in period II, rose to 5.41 thousand hectares and reached a maximum level of 13.80 thousand hectares in the Period IV.

### MEAN OF PRODUCTION

The average mean of the production of selected pulses' crops has been presented in Table 3. A perusal of the table shows that the overall production of pigeonpea was 23.82 thousand metric tonnes during 1970-71 to 2004-05. An increasing trend was observed throughout the period in the production of pigeonpea. The average production during period I was recorded to be 14.25 thousand metric tonnes, which registered an increasing trend in period II and III and reached a level of 40.38 thousand metric tonnes during period IV.

In case of chickpea, a fluctuating trend was observed during the study period. The highest production of this crop was recorded during period IV (2000-01 to 2004-05), while a minimum production of this crop was observed during period II (1980-81 to 1989-90) and this was probably due to a reduction in area and unfavourable climatic condition. The overall production was recorded to be 19.23 thousand metric tonnes per year in the state.

An increasing trend was observed in the case of lentil crop in all periods except period II (1980-81 to 1989-90). The average production increased from 1.50 thousand metric tonnes during period I (1970-71 to 1979-80) to 7.01 thousand metric tonnes in period IV (2000-01 to 2004-05). The average annual production was recorded to be 3.70 thousand metric tonnes. The total average production during period II was less in comparison to period I, probably due to the effects of climate change.

**Table No. 3, Mean of the Production of Different Pulses**

('000' mt. tonnes)

Crops	Period I	Period II	Period III	Period IV	Overall
PIGEONPEA	14.25	16.60	24.86	40.39	23.81
CHICKPEA	15.66	13.97	19.80	27.49	19.22
LENTIL	1.49	1.23	5.07	7.02	3.70
PEA	1.24	1.02	3.01	1.53	5.31

In case of pea, the average production per year was reported to be 5.31 thousand metric tonnes in the state. Under this crop a fluctuating trend was observed. During period I, the average production recorded was 1.25 thousand metric tonnes, which fell down to 1.01 thousand metric tonnes during period II, jumped to a level of 3.71 thousand metric tonnes and further maintained an increasing trend and reached a maximum level of 15.28 thousand metric tonnes in period IV. The maximum production during period IV was mainly due to the increase in area during the period.

### MEAN OF YIELD

The mean of yield of the selected pulses' crops is presented in Table no. 4. The average yield per hectare of pigeonpea was recorded to be 1891 kilograms between 1970-71 to 2004-05, which varied from 1558 kilograms to 2242 kilograms. The average yield during period I and II was much higher than in period III and IV. A declining trend in the yield of pigeonpea was observed during the study period. This may be probably be due to climatic factors. In case of chickpea, the average productivity was recorded to be 1458 kilograms per hectare. Again a decreasing trend was observed during the entire period. The average yield of lentil was found to be 709 kilograms per hectare. In this crop, an increasing trend was recorded in all periods except in period IV. Similarly, the average productivity of pea shows that productivity showed an increasing trend during the study period except in period II and this may be probably be due to climatic factors. The average productivity was about 545 kilograms in the state.

**Table No. 4, Mean of the Yield of Different Pulses**

(Kg/ha)

Crops	Period I	Period II	Period III	Period IV	Overall
PIGEONPEA	2241.60	2180.40	1589.40	1558.40	1890.75
CHICKPEA	2071.40	1503.20	1338.00	921.00	1458.40
LENTIL	553.92	756.30	894.87	629.40	708.62
PEA	402.15	283.75	528.79	964.54	544.79

### VARIABILITY IN AREA

An analysis of variability in the area under major pulses' crops is presented in table no.5. The two statistical methods used are the standard deviation, which gives an absolute measure of variability, and coefficient of variation, which indicates the relative change in variability. The entire period of study was split into four parts : Period I (1970-71 to 1979-80), Period II (1980-81 to 1989-90), Period III (1990-91 to 99-2000) and Period IV (2000-01 to 2004-05). The deviation of total time is divided into four periods for measuring whether the growth rate of crop production as well as productivity of crops like pigeonpea, chickpea, lentil and pea has increased since the inception of the green revolution programme.

**Table No. 5, Standard Deviation and Coefficient of Variation of Area of Different Pulses in Different Periods**

<i>Crops</i>	Period I		Period II		Period III		Period IV		Overall	
	S.D.	CV.	S.D.	CV.	S.D.	CV.	S.D.	CV.	S.D.	CV.
PIGEONPEA	20.95	58.90	3.28	13.60	3.55	14.20	23.50	40.70	19.69	56.78
CHICKPEA	7.35	20.90	5.22	19.05	13.37	46.16	4.49	14.16	8.12	26.28
LENTIL	1.71	50.20	1.81	41.00	4.28	65.95	3.53	26.00	4.96	72.59
PEA	1.38	61.30	1.39	31.60	1.89	34.94	8.05	58.35	5.83	93.42

S.D. = Standard Deviation in 000 ha

C.V. = Coefficient of Variation in percentage

It is evident from Table no. 5 that among pulses crops under study, the variability in area was observed to be maximum in pigeonpea (20.95 thousand hectares), followed by chickpea (7.35 thousand hectares), lentil (1.71 thousand hectares) and minimum in case of pea (1.38 thousand hectares) during Period I. It was further observed that in Period II, the maximum variability was obtained in case of chickpea, followed by pigeonpea. The maximum variability was observed in case of chickpea followed by lentil during Period III. In Period IV, the maximum variability was again observed in case of pigeonpea followed by pea and the minimum has been 3.53 thousand hectare in lentil. The overall variability shows that the maximum variability was found in case of pigeonpea followed by chickpea, pea and lentil, respectively.

The table further indicates that in terms of percentage, the variability was observed to be high in pea during period I and period IV. In case of chickpea, the maximum variability was observed during period III. Similarly, in case of lentil, the maximum variability was observed to be high in period III, nearly 66 percent, while in case of pea, period I and IV were registered to be highly unstable periods (61 % and 58 %). The overall variability analysis indicates that the maximum variability was registered in case of pea, followed by lentil, pigeonpea, and the minimum in chickpea. This high variability in the area under pluses may be due to lack of soil moisture condition and other natural factors.

### VARIABILITY IN PRODUCTION

The analysis of variability in production of selected pulses crop is presented in Table no.6. The table reveals that the overall variability in terms of quantity was recorded to be high in pigeonpea followed by chickpea, pea and minimum in lentil. The period-wise analysis further indicates that in case of pigeonpea, the maximum variability (18.76 thousand tonnes) was recorded in period IV and minimum (3.85 thousand tonnes) in period I. In case of chickpea, the maximum variability was observed during period III (9.98 thousand tonnes) and minimum (5.23 thousand tonnes) in period I. It was also observed that maximum variability in case of lentil was observed during period IV and minimum in period II. It was also found that period IV was the most disadvantageous period for pea and least affected during period II.

In terms of percentage, the maximum variability was observed in case of pea (139 %) followed by lentil (87 %), pigeonpea (60 %) and chickpea (46 %) respectively during the overall period (1970-71 to 2004-05). The period-wise analysis further indicates that in case of pigeonpea, the maximum variability was recorded during period IV and the minimum in period II. In case of chickpea, the maximum variability was recorded during period II and the minimum in period IV,



**Table 6 , Standard Deviation and Coefficient of Variation of Production of Different Pulses in Different Period**

<i>Crops</i>	Period I		Period II		Period III		Period IV		Overall	
	S.D.	CV.	S.D.	CV.	S.D.	CV.	S.D.	CV.	S.D.	CV.
PIGEONPEA	3.86	27.05	2.89	17.35	8.09	32.53	18.76	46.44	14.32	60.00
CHICKPEA	5.23	33.41	6.08	43.55	9.98	50.39	8.42	30.63	8.34	45.96
LENTIL	1.11	74.29	0.17	14.23	2.07	40.79	3.66	52.09	3.20	86.52
PEA	0.63	50.36	0.03	3.34	3.53	95.00	8.58	56.12	7.36	138.58

S.D. = Standard Deviation in '000' mt tonnes

C.V. = Coefficient of Variation in percentage

while in case of lentil, the maximum variability was recorded in period I and the minimum in period II.

### Variability in Yield

The yield variability of the selected pulses crops is presented in Table no.7. It was found that the overall variability in terms of quantity in case of pigeonpea, chickpea, lentil and pea was recorded to be nearly 812 kgs, 873 kgs, 350 kgs per hectare and 335 kgs per hectare, respectively, in the overall period (1970-71 to 2004-05). The period-wise analysis further reveals that the maximum variability was observed during period I and the minimum during period II in case of pigeonpea, while in case of chickpea the maximum variability was observed in period I and the minimum in period IV. In case of lentil, the maximum variability was observed in period II and the minimum in period IV. Similarly, the maximum variability was recorded during period III and the minimum in period II for pea. The yield variability analysis in terms of percentage was observed to be high in case of pea (62 %) followed by chickpea (60 %), lentil (49 %) and pigeonpea (43 %) during the overall period (1970-05). The period-wise analysis further reveals that the maximum variability in terms of percentage was observed to be high in period I and the minimum in period II for pigeonpea, while in case of chickpea, the maximum variability was observed in period I and the minimum in period II. In case of lentil, the maximum variability was recorded in period II and the minimum in

**Table No. 7, Standard Deviation and Coefficient of Variation of Yield of Different Pulses in Different Period**

<i>Crops</i>	Period I		Period II		Period III		Period IV		Overall	
	S.D.	CV.	S.D.	CV.	S.D.	CV.	S.D.	CV.	S.D.	CV.
PIGEONPEA	1351.50	60.29	250.47	11.48	658.87	41.45	547.17	35.11	812.13	42.95
CHICKPEA	1604.20	77.44	280.21	18.64	338.60	25.30	58.33	6.30	873.16	59.87
LENTIL	363.01	65.53	570.10	75.38	193.90	21.66	49.86	7.92	349.69	49.35
PEA	187.21	46.55	88.92	31.33	386.43	73.00	100.46	10.42	335.18	61.52

S.D. = Standard Deviation in kg/ha

C.V. = Coefficient of Variation in percentage



period IV. For pea, the maximum variability was found in period III and the minimum in period IV. The reason for variability in the yield of pulses' crops was again due to climatic factors.

## CONCLUSION

The study reveals that a positive growth rate in the area of all pulses' crops has been observed in the state, however, the growth rate is higher in pea and low in pigeonpea. The yield growth rate further reveals that there has been a substantial change in the yield of all pulses crops, except chickpea and lentil. The yield of pigeonpea has increased as compound rate of 2.70 per cent in the state. However, variability in area and yield obtained are quite high in all pulses crops, which affects the volume of production. There is a need to evolve such varieties of pulse crops, which would be drought, pest and disease resistant and also suited to the climatic condition of various agro-climatic sub-zones of the state.

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