Growth Performance and Instability of Pulses in the State of Rajasthan

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ABSTRACT
The study aims to examine the growth performance of pulses in Rajasthan. The study was entirely based on secondary data collected from various publications of the state government. The trends in area, production, and yield of major pulses in Rajasthan were worked out through compound growth rate, instability index, and decomposition analysis for the last eighteen years from 2000-01 to 2017-18, which was further divided into two sub-period decade wise i.e. period I (2000-01 to 2008-09) and period II (2009-10 to 2017-18). Results have shown that pulse area in the state considerably increased. Area under moong bean registered a significant growth rate of 6.66 per cent which was highest compared to other pulse crops. Growth rate for area, production, and productivity of chickpea was found to be significantly positive. Chickpea and pigeon pea crops were more stable compared to other pulse crops in the state. Expansion in area was the major reason for the increase in production of chickpea, moong bean, and urd bean in the state. The production of chickpea increased more due to area effect and the production of pigeon pea increased because of improvement in the yield and its interaction with area.

Key words: Decomposition analysis, Growth Rate, Instability, Pulses.

INTRODUCTION
Pulses are an important source of protein for the poor as well as for the vegetarians which constitute major population of the country and also an important crop in farm production system as they improve fertility of soil by adding nitrogen in the soil. These pulses mainly include chickpea, pigeon pea, lentil, moong bean, urd bean, and field pea. The split grains of pulses called dal are excellent source of high quality protein, essential amino and fatty acids, fibers, minerals, and vitamins. Pulses are the second main source of protein after cereals in Indian diet (Narayan and Kumar, 2015). The carbohydrates provided by pulses are released slowly when compared to cereals and thus have a high value for maintaining optimal blood sugar levels and restoring cereal energy over a long period of time after the meals.

The share of pulses to total food grain basket is around 9-10 per cent and is a critical and inexpensive source of plant-based proteins, vitamins, and minerals. India occupies the first place, both in terms of the area (34%) and production (26%) of pulses in the world. Pulses were grown over more than 29 million ha of area and recorded the highest ever production of 25.23 million tonnes with a productivity level of 841 kg/ha during the year 2017-18. The country is leading importer and about 20% of the total pulse demands are met by imports only due to the stagnant production over the years (shukla and Mishra, 2018). The major pulse producing states in the country are Madhya Pradesh (33%) followed by Maharashtra (13%), Rajasthan (12%), Uttar Pradesh (9%), Karnataka (8%), and Andhra Pradesh (5%) (Anonymous 2018).

In the state, pulses were grown in sizable area of 58.60 lakh ha with 36.15 lakh tonnes production and 617 kg/ha productivity. Rajasthan ranks second in area (16%) and third in pulse production (12%) during 2017-18. Pulses are an important group of food crops that play a vital role to achieve food and nutritional security and also tackle environmental challenges. It was with this background that the trends and instability in area, production, and yield of selected pulse crop was studied in the state.

MATERIALS AND METHODS
The study was relied mainly on the secondary data i.e. time series data on area, production, and yield of chickpea, pigeon pea, urd bean, moong bean, and total pulses in the state of Rajasthan. The data for a period of 18 years from the year 2000-01 to 2017-18 were collected from various published sources like Rajasthan Agricultural Statistics at a Glance etc. The entire study was split into two sub-periods. The sub period was framed as period I (2000-01 to 2008-09), period II (2009-10 to 2017-18) and Overall period (2000-01 to 2017-18).

Growth Rate
The compound annual growth rates were worked out to examine the growth in area, production, and productivity of
The state has a geographical area of 3.42 lakh square kilometer out of which 8.03 per cent area was under forest and 5.68 per cent area was under non agricultural uses (Table 1). The area not available for cultivation in the state accounts for 12.67 per cent of the total area. The state has total cropped area of 2,50,13,704 hectares (73% of the geographical area) and net sown area of 1,80,24,363 hectares (about 53% of the geographical area) with the cropping intensity of 139 per cent.

**Growth rates in area, production and yield of selected pulse crop**

The growth performance of selected pulse crop has been analyzed for the different period’s viz., period-I (2000-01 to 2008-09), period-II (2009-10 to 2017-18) and the overall period (2000-01 to 2017-18). The growth rate of selected pulse crops over the period 2000-01 to 2017-18 in the state have been shown in the Table 2.

In overall period the area under chickpea significantly increased with the growth rate of 4.37 per cent per annum. On the other hand, the production of chickpea has increased in all the periods and growth rate was found significant in the overall period (6.99%). The yield of chickpea significantly increased during period-II (4.19%) and the overall period (2.51%) but decreased in the first period. The area under pigeon pea showed a significant decrease in period-II (5.13%) and in overall period (2.72%). The production of pigeon pea also increased with the growth rate of 6.30 per cent in period-I, 2.13 per cent in period-II and 1.12 per cent in the overall period. The yield of pigeon pea increased significantly in second (7.69%) and in the overall period (3.93%). More *et al.* (2015) reported the similar results in the state of Gujarat where area under pigeon pea decreased and chickpea area increased. Area expansion was a major reason for increase in production of chickpea in the state.

The area under moong bean recorded a significant increase of 7.98 per cent per annum, 10.38 per cent per annum and 6.66 per cent per annum during the first, second and the overall period, respectively. As a result of an increase in area under moong bean, production also increased significantly with the growth rate of 26.90 per cent per annum in second period and 12.88 per cent per annum in the overall period. The yield of moong bean was found to be positive during first (11.54%), second (14.91%) and the overall period (5.84%). The analysis clearly shows that there was a remarkable increase in the production of moong bean in the state and this increase was mainly due to significant increase in the area under moong bean. The same results were obtained where area sown contributed more to rising levels of output than increases in yield (Bharathi *et al.* 1992).

The area under urd bean significantly increased with the growth rate of 22.31 per cent during period-II and 6.91 per cent per annum during the overall period but decreased in the first period. The result for the production of urd bean was same as that of area. The production also increased significantly in the first (27.35%) and in the overall period (10.83%). The yield of urd bean was found to be significantly increased during overall period with the growth rate of 4.38 per cent per annum.

**RESULTS AND DISCUSSION**

**Land utilization pattern of the state**

The state has a geographical area of 3.42 lakh square kilometer out of which 8.03 per cent area was under forest and 5.68 per cent area was under non agricultural uses (Table 1). The area not available for cultivation in the state accounts for 12.67 per cent of the total area. The state has total cropped area of 2,50,13,704 hectares (73% of the geographical area) and net sown area of 1,80,24,363 hectares (about 53% of the geographical area) with the cropping intensity of 139 per cent.

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The area under urd bean significantly increased with the growth rate of 22.31 per cent during period-II and 6.91 per cent per annum during the overall period but decreased in the first period. The result for the production of urd bean was same as that of area. The production also increased significantly in the first (27.35%) and in the overall period (10.83%). The yield of urd bean was found to be significantly increased during overall period with the growth rate of 4.38 per cent per annum.
Total pulses have shown a significant increase of 3.68 per cent, 7.66 per cent and 3.85 per cent per annum in area, production and yield in the overall period. From this table it is clear that there has been increase in the area under total pulses in the state continuously during the period from 2000-01 to 2017-18. This also led to a significant increase in the production of pulses.

**Instability in area, production and yield of selected pulse crop**

The index of instability was computed to study the variability in area, production and productivity of selected pulse crops in Rajasthan. The instability index indicates the high risk of cultivation of that crop. Instability indices for selected pulse crops have been shown in Table 3.

The instability for area under chickpea was quite low in period-I (18.15%) compared to period-II (24.91%). The instability was found to be 23.32 per cent at the state level which implies that area under chickpea has remained stable in the state. The instability in the production of chickpea was to the extent of 31.07 per cent in the state level while it was low in the period-I (27.65%). Instability in the yield of chickpea was found to be highest in period-I (20.83%), and 18.21 per cent at the state level. Thus, it can be clearly seen from the table that the instability in production mainly attributed to variability in area at the state level. Reddy and Mishra (2006) reported the same result for instability in chickpea and concluded that instability is more in production when compared to area and yield.

The instability index for area under pigeon pea was found to be 12.60 per cent in period-I and 13.64 per cent in period-II which also implies that the area under pigeon pea has remained stable in state over the years. The higher instability in production of pigeon pea was found during period-II (34.83%) compared to period I (25.41%). This instability in production of pigeon pea was mainly attributed...
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Table 3: Instability in area, production and yield of selected pulse crops. (per cent)

| Crop       | Period-I | Period-II | Overall |
|------------|----------|-----------|---------|
| Chickpea   |          |           |         |
| Area       | 18.15    | 24.91     | 23.32   |
| Production | 27.65    | 31.28     | 31.07   |
| Yield      | 20.83    | 14.23     | 18.21   |
| Pigeonpea  |          |           |         |
| Area       | 12.60    | 13.64     | 13.47   |
| Production | 25.41    | 34.83     | 22.36   |
| Yield      | 27.51    | 22.75     | 27.00   |
| Moong bean |          |           |         |
| Area       | 14.22    | 27.13     | 28.81   |
| Production | 54.90    | 40.50     | 49.79   |
| Yield      | 49.91    | 37.20     | 41.80   |
| Urd bean   |          |           |         |
| Area       | 30.63    | 73.69     | 61.39   |
| Production | 53.12    | 54.47     | 83.86   |
| Yield      | 33.52    | 19.10     | 30.17   |
| Total      |          |           |         |
| Area       | 17.47    | 18.87     | 18.33   |
| Production | 37.49    | 30.77     | 33.65   |
| Yield      | 26.07    | 22.51     | 23.55   |

Decomposition analysis of selected pulse crops

Table 4: Decomposition analysis of pulse crops in Rajasthan, 2000-01 to 2017-18.

Production (000’tonnes/ year)

| Crop       | Annual Change in Production | Yield Effect | Area Effect | Interaction Effect |
|------------|-----------------------------|--------------|-------------|-------------------|
| Chickpea   | 112.53(100)                 | 24.71(21.96) | 75.68(67.25) | 12.15(10.79)       |
| Pigeonpea  | 1.09(100)                   | 0.96(87.61)  | -0.78(-71.56)| 0.92(83.95)        |
| Moong bean | 49.80(100)                  | -4.72(-9.46) | 32.29(64.83) | 22.23(44.63)       |
| Urd bean   | 30.33(100)                  | 8.60(28.36)  | 19.39(63.93) | 2.34(7.70)         |
| Total Pulses | 298.37(100)              | 18.98(6.36)  | 91.73(30.74) | 187.66(62.89)      |

The instability index for area under moong bean was found to be 28.81 per cent at the state level which was 14.22 per cent in period-I and 27.13 per cent in period-II which also implies that the area under moong bean has remained stable in state over the years. The higher instability in production of moong bean was found during period-I (54.90%) compared to period-I (40.50%), while it was 49.79 per cent at the state level. This instability in production was mainly attributed to variability in yield having instability index of 41.80 per cent at the state level. The similar result was obtained for moong bean where instability caused fluctuations in yield (Bharathi et al. 1992).

Instability index of urd bean for area (61.39%) and production (83.86%) were found to be very high at the state level which clearly shows that urd bean was highly instable pulse crop. This variability in production was attributed to high variability in area as the instability in yield of urd bean was quite low i.e. 30.17 per cent per annum in the state.

Instability figures for total pulses showed moderate level of instability in area and yield which were 18.33 per cent and 23.55 per cent, respectively, while the instability in the production of total pulses was high with the instability index of 33.65 per cent at the state level. This instability in production was attributed to variability in yield of total pulses in the state (Table 3).

The decomposition analysis has been carried out to examine the yield effect, area effect and interaction effect on the production of selected pulse crops. This type of analysis enables to comprehend the change in the production of a particular crop and whether this change is attributed more to the expansion of area or to the improvement in the yield.

The decomposition analysis carried over for pulse crops over a period of 2000-01 to 2017-18 have been carried out and the results are presented in Table 4.

The production of chickpea in the state as increased by 112.53 thousand tonnes per year over a period from 2000-01 to 2017-18. This increase in area contributed to 67.25 per cent while interaction effect was 10.79 per cent. There was a meager yield effect to the tune of 21.96 per cent. This clearly shows that the yield under chickpea has not increased to that extent and increase in production was mainly due to area effect. Pigeon pea production also increased by 1.09 thousand tonnes per annum which was mainly due to yield effect (87.61%) and the interaction effect was to the tune of 83.95 per cent while the area effect was negative. The decomposition analysis revealed that production of moong bean increased by 49.80 thousand tonnes per year. This increase was mainly due to area effect (64.83%) and interaction of area in to yield (44.63%) while the yield effect was negative. The production of urd bean increased by the 30.33 thousand tonnes over the period from 2000-01 to 2017-18. It was clearly seen that, area extension was a major foundation behind increase in the
production of urd bean followed by improvement in yield. It is pleasing to note that the pulses production has increased in the state at the rate of 298.37 thousand tonnes per annum which was mainly attributed to interaction effect of 62.89 per cent per annum followed by area effect (30.74%) and yield effect (6.36%).

CONCLUSION
The potential of pulses to help and address the future food security, nutritional and environmental sustainability needs has been acknowledged through UN declaration 2016 as international year of pulses. It can be concluded from the results that chickpea emerged as the major pulse crop of the state and it performed better as the time passes. The positive growth rate in yield of all pulse crops during the study period indicates that technological support has been positive towards the production of pulse crops in Rajasthan. The negative growth rate in area under pigeon pea indicates adverse impact of policies in promoting the production of pigeonpea crop in the state. The high inter-year instability in yield of urd bean indicates that yield stabilizing technologies are vital for urd bean. Overall performance of pulse crops was quite impressive which can be seen by positive growth rate and reduced instability, which is good sign for achieving food and nutritional security.

REFERENCES
Anonymous. (2018). Pulses revolution from food to nutritional security. Ministry of Agriculture and Farmers Welfare, Department of Agriculture, Cooperation and Farmers Welfare. Government of India.
Bharathi SV, Shareefi SM and Raju VT. (1992). Instability of pulses production in Andhra Pradesh - an economic analysis. Agricultural Situation in India. 47: 631-635.
More SS, Singh N and Kuthe SB. (2015). Performance of pulses crops in Gujarat state - a decomposition analysis. International Journal of Agriculture Sciences. 7: 510-515.
Narayan P and Kumar S. (2015). Constraints of growth in area production and productivity of pulses in India: an analytical approach to major pulses. Indian Journal of Agricultural Research. 49:114-124.
Reddy AA and Mishra D. (2006). Growth and instability in chickpea production in India: a state level analysis. Agricultural Situation in India. 230-145.
Sharma MK, Sisodiya BVS and Lal K. (2013). Growth and trends of pulse production in India. Journal of Food Legumes. 2 6: 86-92.
Shukla UN and Mishra ML. (2018). Present scenario, bottlenecks and expansion of pulse production in India: a review. Legume Research. 1-9.