Economic Affairs, Vol. 66, No. 3, pp. 467-472, September 2021
DOI: 10.46852/0424-2513.3.2021.16

AESSRA

Research Paper

Growth and Decomposition analysis of *Rabi* Pulse Crops in Rajasthan

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Received: 27-06-2021 **Revised:** 02-08-2021 **Accepted:** 25-08-2021

ABSTRACT

The present study was conducted to analyze the growth rate and source of output growth in area, production and productivity of *rabi* pulse crops *viz*., gram and lentil crops in Rajasthan. The study was solely based on secondary time series data. The study period (1988-89 to 2017-18) has been divided into four periods namely period-I (1988-89 to 1997-98), period-II (1998-99 to 2007-08), period- III (2008-09 to 2017-18) and overall period (1988-89 to 2017-18). Exponential growth and principal decomposition models were used to measure the growth rates and relative contribution of factors in production of gram and lentil crops. The area, production and productivity of gram showed mixed pattern of growth at the rate of -0.46, 1.86 and 2.33 per cent, respectively during overall period. However, the area, production and productivity of lentil were reported positive growth with the magnitude of 11.94, 12.72 and 0.93 per cent, respectively in the state. The study revealed that the mixed growth rate was observed in area, production and productivity of gram while increasing growth was observed in area, production and productivity of lentil. During all the study periods, the expansion in area was effective to increase the production of lentil in Rajasthan. During period-I and II, the production of gram was mainly contributed by expansion in area while in the case of period-III and overall, the interaction effect was more dominant.

Highlights

- More growth rate was observed in production of gram and lentil.
- Area effect was more dominant of gram and lentil.

Keywords: Growth rate, decomposition, production, pulse crops, Rajasthan

Production of pulses is one of the important segments of Indian agriculture after cereals and oilseeds. The pulses comprise of Chickpea, Pigeon pea, Lentil, Green gram, bean, Black gram bean and Field pea. These pulses are an important commodity group of crops that provide high quality protein with complementing cereal proteins for predominantly substantial population of the country. Pulses are popularly known as "*Poor man's meat*" and "*rich man's vegetable*" as a result of being a major source of proteins, vitamins and minerals especially for vegetarian diets in India (Singh *et al.* 2016). Pulses prove to be a boon for mankind as they are highly nutritive processing important gift of nature. They not only increase the fertility of the soil by nitrogen fixation but also increase the porosity of the soil due to their invasive tap root system. Although there is low requirement of water and ability to withstand draught, the production of pulses decreased leading to decline in protein intake and therefore malnutrition (Shalendra *et*

How to cite this article: Balai, H.K., Singh, H., Bairwa, K.C., Meena, G.L., Sharma, L. and Burark, S.S. (2021). Growth and Decomposition analysis of Rabi Pulse Crops in Rajasthan. *Economic Affairs*, **66**(3): 467-472.

Source of Support: None; **Conflict of Interest:** None

al. 2013). India is presented about 24 percent of undernourished populace in the universe (Sharma *et al.* 2016 and Ahlawat *et al.* 2016). To make the public aware of the nutritional benefits of pulses as part of sustainable food production aimed at food security and nutrition, The United Nations declared 2016 as "International year of pulses (IYP)". India is the largest producer, consumer and importer of the pulses in the world. India was the largest producer (25%), consumer (27%) and importer (14%) of pulses in the world (Mohanty and Satyasai, 2015).

The pulse crops were cultivated in 85.40 million hectares area and producing about 87.40 million tonnes production with average productivity of 1023 kg/ha (Anonymous, 2018). Chickpea, pigeon pea and lentil crops are prime contributor with 16.69, 10.40 and l7.72 percent shares, respectively in total pulses production of the World (Anonymous 2018).

In the world's total pulses area and production, the India has secured lead position in area and production with the share of 35 and 29 percent, respectively. Madhya Pradesh state is dominant in production with the contribution of about 25 per cent followed by Rajasthan (16%), then Maharashtra (15%), and Karnataka (11%) (Anonymous, 2018). In Rajasthan, the soil, weather and climate conditions are found suitable for cultivation of *rabi* and *kharif* pulse crops. Gram and lentil crops are cultivated in rabi season throughout the state. About 234 and 432 million tonnes production of lentil and gram were produced on 123 and 432 million hectare area respectively in the state (Anonymous, 2018). The area production of gram and lentil has changed over the year in Rajasthan (Anonymous, 2018). Therefore, it could be better to estimate the growth rates and factors responsible for changing scenario of gram and lentil crops in Rajasthan. The present study was

Considering decomposition analysis in agricultural output, it has remained an important part of interest to researchers and policymakers. A breakdown of growth into various components of area and yield facilitates in output projection with alternative targets and policies (Jamal and Zaman, 1992). Thus, decomposition of agricultural growth among its constituent forces is of great importance. The paper is divided in two sections. It begins with examinations of growth in area, production and productivity of *rabi* pulse crops namely gram and lentil in Rajasthan. Secondly, the estimates of the relative contributions of area, yield and their interaction to produce the output of gram and lentil in Rajasthan. There are many studies such as Mathur and Henry (2005), Singh and Ranu (2009), Sharma *et al.* (2013) and Bairwa *et al*. (2020) have presented growth performance of pulses at national level. It is a prime component of researchers and policy makers to frame at the state level improved technology and improved varieties. Consequently, farmers can get benefits for improving their skills and living standards in the society through improved technology. Therefore, the present study is confined to Rajasthan state only.

The major challenge in Rajasthan is to provide an improved production technology for achieving sustainable production of pulse crops. The present study has been conducted to answer the research questions whether there was significant growth in area, production and productivity of pulse crops in Rajasthan over the period as well as contribution of area and yield towards change in total pulses production.

MATERIALS AND METHODS

The study was based on secondary data collected from different sources i.e. Directorate of Agriculture and cooperation, GOI, Directorate of pulses development Bhopal, various issues of Agriculture Statistical Year Book and Agriculture Statistics at a Glance, etc. The time series data of area, production and productivity of selected pulse crops have been taken for 30 years from 1988-89 to 2017-18. The study period (1988-89 to 2017-18) was divided into four periods i.e. period-I (1988-89 to 1997-98), period-II (1998-99 to 2007-08), period- III (2008-09 to 2017-18) and overall period (1988-89 to 2017-18). Two different analyses had been carried out in the study *viz.* (a) Compound annual growth rates in area, production and yield of selected pulses; and, (b) Decomposition analysis. Compound growth rates (CGR) of area, production and productivity of selected pulse were worked out for different periods as well as for the entire period of analysis by fitting exponential function. To measure the relative contribution of area and yield towards the total output change with respect of individual pulse crop, Minhas and Vaidyanthan (1965) model had been used. The study was restricted to major *rabi* pulse crops *viz.*, gram and lentil. Both crops

accounted more than 38 and 59 per cent of total pulse crops cropped area and production in Rajasthan (Anonymous 2018).

Compound Growth Rate

Compound annual growth rate was estimated to know the growth pattern on area, production and productivity of major *rabi* pulse crops in Rajasthan. The growth rate was estimated by using exponential trend model (Veena, 1996).

Exponential trend equation: $Y = ab^x$

The compound growth rate was obtained for the logarithmic form of the equation as below:

$$Log\ Y = log\ a + t\ log\ b$$

Where,

Y = area/production/yield

a = Intercept

b = regression coefficient / (1 + r)

x = Year

r = Compound growth rate / (*Antilog* b) – 1

The percent compound growth rate (r) will be as,

$$r = [(Anti\ log\ of\ b) - 1] \times 100$$

Student 't' test was used for testing significance level of growth in area, production and productivity of selected *rabi* pulse crops (Dhakre and Sharma 2010).

$$t = \frac{CGR}{SE(CGR)}$$

Where,

't' = Student 't' test

CGR = Compound growth rate

SE (CGR) = Standard error of Compound growth rate

Standard error of Compound growth rate is calculated by using following formula;

$$SE(CGR) = \frac{100b}{\ln 10} \times SE(\ln b)$$

Decomposition Analysis

To study the contribution of area, yield and the interaction of area and yield towards increasing the pulses production in India, a decomposition analysis was used as expressed below (Minhas and Vaidyanthan, 1965):

$$\Delta P = AB*\Delta Y + YB*\Delta A + \Delta A*\Delta Y$$

= (Yield effect) + (Area effect) + (Interaction effect)

Where,

$\Delta A = AC - AB$

$\Delta P = PC - PB$

$\Delta Y = YC - YB$

AB, PB and YB are the area, production and yield of pulses for the base year.

AC, PC and YC are the area, production and yield of pulses for the current year.

ΔA = Change in area

ΔP = Change in production

ΔY = Change in yield

RESULTS AND DISCUSSION

Compound Annual Growth Rate: The growth rate in area, production and productivity of *rabi* crops i.e. gram and lentil for the study period from 1988-89 to 2017-18 were calculated. Gram is an important *rabi* pulse crop of Rajasthan. The result of compound annual growth rate in area, production and productivity of gram and lentil in Rajasthan were presented in the Table 1. It was revealed from the table that area, production and productivity of gram increased at the rate of -0.46, 1.86 and 2.33 per cent per annum respectively, in the overall period. The productivity of gram reported significant growth rate in overall period.

During period-I, the area and production of gram showed significant growth rate in Rajasthan with the magnitude been 11.69 and 17.49 per cent per annum respectively while the performance of productivity was non-significant with growth rate of 5.20 per cent per annum. During period-II, the area, production and productivity of gram declined and were non-significant at the rate of -5.16, -10.46 and -5.81 per cent per annum respectively. During period-III, the performance of gram in area and

production showed non-significant growth rate at 2.09 and 10.15 per cent per annum respectively. Bairwa *et al.* (2020) reported similar findings in his study on the growth in area and production of gram in India during 1998-99 to 2017-18.

Throughout the study period, the growth performance of lentil in area and production showed significant growth rate at 11.94 and 12.72 per cent respectively (Table 1). At the same time the productivity of lentil was positive but non-significant in Rajasthan. During 1988-89 to 1997-98, the growth performance of lentil was positive and significant in all aspects *viz.*, area, production and productivity at 28.53, 40.93 and 9.40 per cent respectively. While in period-II, the area, production and productivity of lentil showed negative growth rate with the magnitude of -20.02, -26.72 and -8.80 per cent respectively, in Rajasthan. The area and production of lentil reported positive and significant growth in period-III. In the mean time, the area and production growth rate of lentil were 38.36 and 39.96 per cent per annum respectively in the state. Ahmad *et al.* (2018) reported similar findings in the growth rate of total pulses area in Eastern India. Simultaneously, Kalmakar (2001), in his study reported almost similar pattern of growth rate in area, production and productivity of gram in Maharashtra during 1961-62 to 1997-98. Further, Agarwal *et al.* (2012) quoted in their study that productivity of lentil was positive and significant in India during 1970-71 to 2007-08 period.

Decomposition Analysis

Gram: Table 2 presents the relative contribution of area, yield and their interaction to the output growth of gram crop. It could be seen from this table that interaction effect was mainly responsible than the area and yield effect for output growth of gram, accounting for 43.88 per cent followed by yield effect (30.62%) and area effect (25.50%) during the overall period. The growth in production of gram during period –I was mainly achieved through area expansion. The contribution of area in production growth in this period was about 68.62 per cent followed by yield effect (19.04%) and interaction effect (12.34%). During period-II similar findings were found as in period-I. During period-III similar results were reported as in observed in the overall period. Similar findings were reported by More *et al*. (2015) and Kumar *et al.* (2009) in area effect, yield effect and their interaction effect of gram in Gujarat state during 1960-61 to 2010-11.

Lentil: Results of growth decomposition of lentil output are presented in the Table 2. From the Table it was observed that during the overall period, area expansion was comparatively more instrumental in increasing production of lentil while yield and interaction effect were next in order with 20.23 and 0.19 per cent contribution respectively, to the output growth of lentil. Area accounted for 79.58 per cent of the output growth. During period-I, contribution of area effect was more than yield and their interaction effect with the magnitude of 57.28,

Table 1: Compound annual growth rate in area, production and productivity of *rabi* pulse crops in Rajasthan (CAGR in Per cent)

Period	Area		Production		Productivity	
	Gram	Lentil	Gram	Lentil	Gram	Lentil
Period- I (1988-89 to 1997-98**)**	11.69** (0.019)	28.53* (0.028)	17.49** (0.029)	40.93* (0.037)	5.20 (0.016)	9.40** (0.013)
Period- II (1998-99 to 2007-08**)**	-5.16 (0.053)	-20.02 (0.061)	-10.46 (0.056)	-26.72*** (0.065)	-5.81 (0.024)	-8.80** (0.012)
Period- III (2008-09 to 2017-18**)**	2.09 (0.029)	38.36* (0.026)	10.15 (0.038)	39.96* (0.025)	7.89*** (0.016)	1.62 (0.012)
Overall (1988-89 to 2017-18**)**	-0.46 (0.007)	11.94* (0.01)	1.86 (0.009)	12.72* (0.012)	2.33** (0.004)	0.93 (0.003)

Source: *Author's own commutation from compiled time series data.*

Note: *Figures in parenthesis are standard error of selected growth model.*

** Significant at 1 per cent level of significance and **significant at 5 per cent level of significance and ***significant at 10 per cent of significance.*

Table 2: Relative contribution of area, yield and interaction on production of *rabi* pulses in Rajasthan (In per cent)

Period	Area effect		Yield effect		Interaction effect	
	Gram	Lentil	Gram	Lentil	Gram	Lentil
Period- I	68.62	57.28	19.04	27.85	12.34	14.87
Period- II	75.88	94.15	19.77	13.32	4.35	-7.47
Period- III	14.83	87.03	36.30	22.23	48.87	-9.26
Overall	25.50	79.58	30.62	20.23	43.88	0.19

Source: *Author's own commutated from compiled time series data.*

27.85 and 14.87 per cent, respectively. As seen in the Table, area and yield emerged as the most powerful factor in increasing lentil crop production in the Rajasthan at period-II with its contribution to the total output growth been 94.15 and 13.32 per cent, respectively. The interaction effect was negative with a magnitude of -7.47 per cent. During period-III similar results were reported as in period-II. Similar findings were reported by Kumar *et al.* (2009) in area effect, yield effect and their interaction effect of gram in Gujarat state during 1960-61 to 2010-11. Also, similar results were reported by Kumar *et al.* (2009) in area effect, yield effect and their interaction effect of lentil in India during 1970-71 to 2006-07.

CONCLUSION AND RECOMMENDATION

Therefore, it can be concluded from the analysis that throughout the study period, the growth rates in area, production and productivity of gram showed mixed growth pattern. Consequently, increase in the growth of lentil in Rajasthan. During period-I area, production and productivity increased over the year of gram and lentil while area and production significantly increased in gram. Subsequently, positive and significant increased of lentil in Rajasthan. In case of period-II, all aspects *viz.*, area, production and productivity of gram showed a negative growth rate for gram and lentil in Rajasthan. In case of period-II, the negative growth rate was observed in all aspects *viz.*, area, production and productivity of lentil crop in the state. At the same time area and production of lentil increased significantly subsequently productivity of gram also increased significantly

Thus it can be inferred from the above analysis that area effect was the prime contributor in period-I and II but in case of period-III overall interaction effect was major contributor to increase in the production of gram in Rajasthan. For lentil, area effect was mainly responsible for increase in the production.

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