

Research paper

Mungbean in Rajasthan: Growth performance and decomposition analysis

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ABSTRACT

The present study was conducted to examine the growth performance and relative contribution of area and yield to the change in mungbean production in Rajasthan. Three districts, viz., Nagaur, Jodhpur, and Pali, which together contribute more than 50% of the total area under mungbean in Rajasthan, were selected for the study. Time series data were collected from 2000-01 to 2019-20 and to study the decadal performance, the entire period was bifurcated into two sub-periods: 2000-01 to 2009-10 (sub-period I) and 2010-11 to 2019-20 (sub-period II). The Compound Annual Growth Rate (CAGR), Cuddy Della Valle Index (CDVI), and Decomposition Analysis Model were employed for analysis. Results revealed that the growth rate was positive for area, production, and productivity of mungbean at the state and district levels. The instability index was found to be greater than 30 in most of the cases, which indicates the high variations in area, production, and productivity of mungbean during the reported period. The sub-period II witnessed a comparatively higher positive growth rate accompanied by a lower instability index than the sub-period I. The study further revealed that the area effect was greater than the yield effect in most of the cases, which indicates its greater share in the increase in mungbean production at state and sampled district levels. With the observed positive growth rate in area and its contribution to change in production, the state has scope to increase the area coverage under mungbean, as 55% of the districts in Rajasthan have less than 1% of the total area under cultivation.

Key words: Decomposition analysis, Growth rate, Instability index, Mungbean, Rajasthan

INTRODUCTION

India has had a long journey with pulses, from shortage to self-sufficiency in its production. It recorded 8.41 mt of production from 19.09 m ha of area in 1950-51, which reached a record high of 25.72 mt from 28.83 m ha of area during 2020-21 (Agricultural Statistics at a Glance, 2021). A number of factors are responsible for the rising production of pulses in India. It includes successful implementation of government programmes (National Food Security Mission-Pulses (NFSM-P) in rabi 2008; Accelerated Pulses Production Programmes (A3P) since Kharif 2010; 60000 pulse villages in dryland area under Rashtriya Krishi Vikas Yojna since 2010-11; etc.); quality seed production and distribution; improved production and protection technologies; regional and seasonal shift in cultivation; expansion of pulse area in rice fallows; availability of high yielding cultivars and increase in Minimum Support Price (MSP) etc. (Reddy, 2015; Rimal *et al.*, 2015; Gupta, 2016 and Gaur, 2021).

Mungbean is the third most important pulse crop in India, with a contribution of 11.38% after chickpea (49.66%) and pigeonpea (15.67%) in total pulse production (Directorate of Economics and Statistics, 2021-22). The crop is grown across different seasons, viz., *Spring/ Summer, Kharif, and Rabi* at different corners of the country. It is adaptable to a wide range of adverse soil and climatic conditions (Pratap *et al.*, 2013). With range of maturity groups, it meets the needs of different cropping systems, thus offers potential for adding additional area and production (Gowda *et al.*, 2015). According to the Green Gram Outlook report, from January to May 2021, Rajasthan, Maharashtra, Andhra Pradesh, Madhya Pradesh, and Bihar are important mungbean producing states in the country. Among these, only Madhya Pradesh and Rajasthan have shown an increase in mungbean area in the last two decades. In Rajasthan, the soil, weather, and climate conditions are found to be suitable for the cultivation of rabi and kharif pulse

crops (Balai *et al.*, 2021). Mungbean, mothbean (Kharif season), and gram (Rabi season) are the major pulses cultivated in Rajasthan. Sharma and Bhusan (2019) reported that after deducting the cost of subsidies, mungbean and gram registered the highest net returns in the arid and semi-arid zones of Rajasthan. Nagaur, Pali, Jodhpur, Jalore, Ajmer, Jaipur, and Tonk districts covered the maximum area in Rajasthan (Sharma *et al.*, 2017).

According to Dutta and Das (2005), measuring the instability of the area, production, and productivity of crops always helps in framing a proper agricultural policy in a country like India. Tuteja (2006) used the semi-log equation to estimate state-wise growth rates in the area, production, and yield of major pulses along with total pulses at all India levels from 1980-81 to 2000-2001. Sandeep *et al.* (2016) employed the decomposition analysis model to investigate the relative contribution of area and yield to total pigeonpea production in western Vidarbha, Maharashtra. Shivagangavva and Reddy (2018) used the exponential form of function to calculate the growth rate in the area, production, and productivity of red gram, black gram, green gram, and Bengal gram from 1980-81 to 2011-12. Bairwa *et al.* (2020) used the semi-log model, Cuddy Della Valle instability index, and decomposition analysis models to analyse the CAGR, instability, and relative contribution of area and productivity in total pulse production for the period 1998-99 to 2017-18.

Keeping the above facts in view, the present study was conducted with the objectives to examine the growth rate and instability in the area, production, and productivity of mungbean in Rajasthan, and to examine the sources of change in pulse production in Rajasthan.

MATERIALS AND METHODS

Twenty years (2000-01 to 2019-20) district-wise time series data of the area, production, and productivity of Mungbean (Kharif) in Rajasthan were collected from the Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare. To study the decadal performance, the entire period (2000-01 to 2019-20) was bifurcated into two sub-periods: 2000-01 to 2009-10 (sub-period I) and 2010-11 to 2019-20 (sub-period II). The Nagaur, Jodhpur, and Pali districts were sampled for this purpose, as the districts together contributed more than 50 percent of the total mungbean area in Rajasthan during 2015-20.

The growth rate in area, production, and productivity of mungbean at different levels was examined using the compound annual growth rate (CAGR) (Sharma *et al.*, 2013; Deb and Pramanik, 2015 and Rani *et al.*, 2021). CAGR was employed by fitting an exponential growth function of the following form:

$$Y_t = ab^t \dots \dots \dots (1)$$

$$\ln Y = \ln a + t \ln b \dots \dots \dots (2)$$

$$r = (\text{Anti log } (b) - 1) * 100 \dots \dots \dots (3)$$

where Y_t is the dependent variable, a is the intercept, b is the regression coefficient, and t is the time variable (1, 2, ..., n). The percent compound annual growth rate (r) was derived using the equation 3.

The instability was examined using the Cuddy Della Valle index (CDVI).

$$CDVI = CV * (1-R^2)^{1/2} \dots \dots \dots (4)$$

$$\text{Where, } CV = (\sigma / \mu) * 100 \dots \dots \dots (5)$$

σ = Standard deviation of the variable

μ = the mean value of the variable

On the basis of the value of the index, it can be classified under three broad categories: low instability (0-15), medium instability (15-30), and high instability (greater than 30) (Sah *et al.* 2021).

The relative contribution of area and yield towards the change in pulse production was measured by the decomposition analysis (Jagannath *et al.* 2013 and Kumar *et al.* 2018). The total change in production can be decomposed into three effects, viz., yield, area, and interaction effects, which can be presented as:

$$\Delta P = A_o \Delta Y + Y_o \Delta A + \Delta A \Delta Y \dots \dots \dots (6)$$

Change in production = Yield effect + Area effect + Interaction effect

where A_o and Y_o represent the area and yield in the base year. Δ shows the difference between the current and base year values.

RESULTS AND DISCUSSION

The are coverage under mungbean was collected for all 33 districts of Rajasthan and were grouped under five categories on the basis of their percentage share in total mungbean area in Rajasthan during 2015-16 to 2019-20 (Table 1). The data revealed that only three districts (Nagaur, Jodhpur, and Pali) covered more than 10% of the total average area each, while eighteen districts

covered less than 1% of the area under mungbean cultivation in Rajasthan.

Table 1. Per cent share to area coverage under mungbean cultivation during 2015-2020

Districts	Percent share
Nagaur, Jodhpur, Pali (3 nos.)	>10
Churu, Jalore, Jaipur, Ajmer (4 nos.)	5-10
Ganganagar, Tonk, Barmer (3 nos.)	3-5
Sikar, Jhunjhunu, Jaisalmer, Bikaner, Hanumangadh (5 nos.)	1-3
Bhilwara, Sirohi, Rajsamand, Chittorgadh, Swami Madhopur, Baran, Bundi, Jhalawar, Kota, Dholpur, Udaipur, Pratapgarh, Dausa, Dungarpur, Karauli, Pratapgarh, Banswara, Alwar (18 nos.)	<1

Source: Author's compilation

Nagaur, Jodhpur, and Pali, together contribute more than 50% of the total area under mungbean cultivation. Table 2 revealed that the maximum area under mungbean cultivation was covered by Nagaur (27%), followed by Jodhpur (13.57%), and Pali (12.18%) districts of Rajasthan.

Growth rate and instability of mungbean in Rajasthan

The growth rate and instability in the area, production, and productivity of mungbean in Rajasthan are presented in Table 3. In sub-period I, a positive growth rate was observed with 7.16% and 5.76% in area and production, respectively, whereas productivity showed a negative growth rate of -1.311%. Further, the instability index for production and productivity was high, while that for the area was medium. In sub-period II, the area and production increased at a rate of 12.63% and 13.55%, respectively, which was almost double the

previous decade. Also, productivity recorded a positive growth rate of 0.82%. Mungbean production recorded the highest growth rate (13.66%), followed by area (7.43%) and productivity (5.13%) during 2000-01 to 2019-20. Further, instability was recorded as medium for area and high for production and productivity of mungbean. The findings are consistent with those by Sood *et al.* (2020), who reported the positive growth rate of area, production and productivity of mungbean in Rajasthan.

Growth rate and instability of mungbean in Nagaur district of Rajasthan

Results revealed that in sub-period I, the area, production, and productivity showed positive growth rates of 11%, 11.97%, and 0.88%, respectively (Table 4). The decade witnessed very high instability in production and productivity, whereas low instability was recorded for area. The sub-period II recorded a comparatively higher growth rate in area (13.20%), production (19.57%), and productivity (5.63%), whereas, variations were less as compared to sub-period I. Overall, the period showed positive growth rates. Production recorded the highest growth rate (14.58%) followed by area (8.56%) and productivity (5.55%). The period witnessed very high instability in production and productivity, while the area was comparatively less unstable.

Growth rate and instability of mungbean in Jodhpur district of Rajasthan

In sub-period I, area and production recorded positive growth rates of 15.18% and 5.46%, respectively, while a negative growth rate of 8.44% was observed for productivity of mungbean

Table 2. Area under mungbean cultivation in selected districts of Rajasthan (in lakh ha)

S.No.	Districts	2015-16	2016-17	2017-18	2018-19	2019-20	Average	Rank
1.	Nagaur	3.82 (27.98)	5.58 (26.32)	6.18 (27.47)	6.52 (26.46)	6.31 (27.18)	5.68 (27.00)	I
2.	Jodhpur	1.73 (12.75)	2.77 (13.05)	3.18 (14.15)	3.42 (13.88)	3.17 (13.64)	2.86 (13.57)	II
3.	Pali	1.75 (12.82)	2.79 (13.14)	2.95 (13.12)	2.80 (11.35)	2.54 (10.92)	2.56 (12.18)	III

Note: Figures in parenthesis shows percentage share of average mungbean area in Rajasthan

Table 3. Growth rate and instability index of mungbean in Rajasthan

Years/Period	Area		Production		Productivity	
	CAGR	CDVI	CAGR	CDVI	CAGR	CDVI
Sub Period -I (2000-01 to 2009-10)	7.16	14.47	5.76	74.73	-1.31	66.88
Sub Period -II (2010-11 to 2019-20)	12.63	22.84	13.55	31.27	0.82	16.22
Total (2000-01 to 2019-20)	7.43	29.29	13.66	47.07	5.13	38.01

Table 4. Growth rate and instability index of mungbean in Nagaur district

Year/ Period	Area		Production		Productivity	
	CAGR	CDVI	CAGR	CDVI	CAGR	CDVI
Sub Period – I (2000-01 to 2009-10)	11.00	14.10	11.97	69.98	0.88	61.42
Sub Period-II (2010-11 to 2019-20)	13.20	23.00	19.57	38.57	5.63	35.31
Total (2000-01 to 2019-20)	8.56	29.31	14.58	52.25	5.55	42.79

Table 5. Growth rate and instability index of mungbean in Jodhpur district

Year/Period	Area		Production		Productivity	
	CAGR	CDVI	CAGR	CDVI	CAGR	CDVI
Sub Period – I (2000-01 to 2009-10)	15.18	32.32	5.46	85.33	-8.44	67.05
Sub Period-II (2010-11 to 2019-20)	18.55	25.41	22.39	36.53	3.24	42.57
Total (2000-01 to 2019-20)	11.65	64.19	20.71	82.57	8.11	32.62

Table 6. Growth rate and instability of mungbean in Pali district of Rajasthan

Year/Period	Area		Production		Productivity	
	CAGR	CDVI	CAGR	CDVI	CAGR	CDVI
Sub Period – I (2000-01 to 2009-10)	13.20	15.58	-3.20	78.38	-14.48	68.13
Sub Period-II (2010-11 to 2019-20)	14.05	24.34	9.72	37.40	-3.80	24.26
Total (2000-01 to 2019-20)	11.46	32.11	13.48	50.38	1.81	47.91

in Jodhpur district (Table 5). Further, very high instability was observed for areas, production, and productivity of mungbean. In sub-period II, higher growth rates and lower instability were observed in all three parameters as compared to sub-period I. The overall period witnessed positive growth rates in production (20.71%), area (11.65%), and productivity (8.11%) of mungbean.

Growth rate and instability of mungbean in Pali district of Rajasthan

The data revealed that in sub-period I, the growth rate in area was positive (13.20%) with medium instability (15.58%), whereas production and productivity had negative growth rates and high instability indices (Table 6). The sub-period II recorded a positive growth rate in area (14.05%) and production (9.72%), whereas productivity showed a negative growth rate of 3.80%. In this period, the instability was reduced to the medium range in area and productivity of mungbean, whereas in production, high instability was recorded; however, it was almost half of the previous decade. During the entire study period, mungbean production (13.48%) witnessed the highest positive growth rate, followed by area (11.46%) and productivity (1.81%). Further, the overall instability in all three parameters was high, with the lowest variation in area.

Decomposition analysis of mungbean production

The relative contribution of area and yield in

mungbean production was analysed and presented in Table 7. Table reveals that in sub-period I, the interaction effect was highest (165.30%), followed by the yield effect (162.72%). In sub-Period II, the area contributed the maximum (122.25%) to the change in mungbean production. Overall, the contribution of interaction effect (59.03%) was highest, followed by area (26.47%) and yield effect (14.50%) to the change in mungbean production in Rajasthan. Nagaur and Jodhpur districts unveiled similar results, with the highest yield effect and area effect in sub-periods I and II, respectively. Further, during 2000–01 to 2019–20), the interaction effect between area and yield contributed to the maximum change in mungbean production, followed by the area and yield effect in both districts. District Pali revealed a greater area effect than yield effect in both subperiods, whereas during the overall period, the area effect contributed more to the total change in mungbean production.

CONCLUSION

The present study examined the growth rate and instability in the mungbean area, production, and productivity in Rajasthan as well as its potential districts, viz., Nagaur, Jodhpur, and Pali during 2000–20. Decomposition analysis was also employed to examine the relative contributions of area and yield and their interaction effects on mungbean production. Time series data (2000–20) was collected and bifurcated into two subperiods, i.e., I (2000–01 to 2009–10) and II (2010–11 to 2019–

Table 7. Area, yield and their interaction effect (%) in mungbean production

	Years/Period	Yield effect	Area effect	Interaction effect
Rajasthan	Sub Period -I (2000-01 to 2009-10)	162.72	-228.01	165.30
	Sub Period -II (2010-11 to 2019-20)	-10.05	122.25	-12.20
	Total period (2000-01 to 2019-20)	14.50	26.47	59.03
Nagaur	Sub Period -I (2000-01 to 2009-10)	461.37	-1171.01	809.64
	Sub Period -II (2010-11 to 2019-20)	-4.53	109.99	-5.46
	Total period (2000-01 to 2019-20)	11.33	27.55	61.11
Jodhpur	Sub Period -I (2000-01 to 2009-10)	109.00	-84.53	75.53
	Sub Period -II (2010-11 to 2019-20)	1.81	94.33	3.85
	Total Period (2000-01 to 2019-20)	15.73	14.34	69.93
Pali	Sub Period -I (2000-01 to 2009-10)	125.41	-326.46	301.04
	Sub Period -II (2010-11 to 2019-20)	39.88	2.82	57.30
	Total Period (2000-01 to 2019-20)	5.18	57.11	37.71

20). Sub-period II (2010–11 to 2019–20) was reported to be better performing with the highest growth rate and a comparatively low instability index in area, production, and productivity of mungbean in Rajasthan as well as in selected districts. The high growth rate in area, production, and productivity can be attributed to interventions covered under NFSM-P in Rajasthan, which included free distribution of seed mini kits for newer varieties of pulses to farmers, the production of high-quality seed, the establishment of seed hubs at SAUs and KVKs, cluster front line demonstrations by KVKs, and the expansion of breeder seed production at ICAR institutes and SAUs (DAC & FW). It may be concluded that Rajasthan has the potential to increase mungbean production by increasing its area. The area coverage under mungbean in 18 out of 33 districts in Rajasthan state during 2015–20 was found to be less than 1% of the total area under mungbean cultivation in Rajasthan.

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