

Research Paper

Multilevel growth assessment of mungbean production in Madhya Pradesh

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ABSTRACT

The present study aimed to examine the growth performance of mungbean in Madhya Pradesh, which is the second-highest pulse-producing state in India. With the development of short-duration mungbean varieties, the crop can be cultivated in spring/summer along with *Kharif* and *Rabi* seasons. The district-wise time series data on the area, production, and productivity of mungbean in Madhya Pradesh was collected. The growth performance and instability were analyzed using the Compound Annual Growth Rate and Cuddy Della Valle Index. Further, the decomposition analysis was performed to examine the sources of growth in mungbean production. The growth performance was also examined for major mungbean-producing districts of Madhya Pradesh viz; Narmadapuram (Hoshangabad), Sehore, Harda, Narshingpur, and Raisen districts. The growth performance of mungbean in Madhya Pradesh was examined for sub-period I (2000-01 to 2009-10) and sub-period II (2010-11 to 2019-20). The study revealed that the Narmadapuram division of Madhya Pradesh recorded the highest growth rate in area and production for the period 2010-11 to 2019-20. Higher growth rate and instability in the area, production, and productivity was observed in sub-period II which may be attributed to the incentives under NFSM-pulses and area coverage under summer mungbean cultivation during the last decade.

Key words: Decomposition analysis, Growth performance, Instability index, Mungbean, NFSM-P

INTRODUCTION

Pulses in India are referred to as the “poor man’s meat” and the “rich man’s vegetable” and are commonly recognized as an essential source of proteins, vitamins, dietary fibre, and minerals (Singh *et al.* 2015). The nutritional value of pulses and various methods of consumption can significantly impact efforts to eradicate world malnourishment (Gurusamy *et al.* 2022). Pulses continue to play a vital role in sustainable agricultural production due to their ability for biological nitrogen fixation, minimal water and carbon footprints, and resilience to adverse weather conditions (Ahlawat *et al.* 2016). Pulses captured the attention when the UN General Assembly (UNGA) declared 2016 as the International Year of Pulses (IYP 2016) with the objectives of increasing public awareness about the importance of these plants and emphasizing their role in promoting healthy diets, providing livelihood security to farmers, improving soil health and protecting the environment (Calles *et al.* 2019).

Post 1991, for two decades, pulse production in India almost stagnated at around 14 million tonnes (Rimal *et al.* 2015). The low level of attention and

inadequate policy framework were cited as the cause of the lower pulse productivity (Shukla and Mishra 2020). As a consequence of the country’s mission mode approach, India has significantly increased pulse production during the last 15 years (Gaur 2021). Chickpea (49.61%), pigeonpea (15.46%), mungbean (11.60%), urdbean (10.17%), and lentil (4.65%) are major pulses, which together contribute 91.48% of total pulse production (27.3 million tons) in India during 2021–22. Mungbean (183%) recorded the highest production growth, followed by chickpea (114%), urdbean (93%), pigeonpea (83%), and lentil (40%) in 2021–22 over the base year 2006–07.

Mungbean has a good characteristic of short-duration maturity and adaptability in multiple sowing seasons. Due to these, it fits very well in the prevailing crop rotation. With the early maturing varieties (60 days), an additional crop of mungbean can be assimilated in the un-cultivated period between *Rabi* and *Kharif* seasons (Rehman *et al.* 2019). Mungbean is the third most important pulse crop in India with a 16% share of the total area under pulse cultivation. With an average of 2016–

17 to 2020-21, Rajasthan contributes highest i.e. 46% and 45% to total country's mungbean area and production followed by Maharashtra (9% & 8%), Madhya Pradesh (9% & 14%), Karnataka (9% & 6%), Odisha (5% & 4%) and Bihar (4% & 5%) Tamil Nadu (4% & 3%), Gujarat (3% & 4%), Andhra Pradesh (3% & 3%), Telangana (2% & 2%) and others (6% & 7%). Madhya Pradesh among these states along with Rajasthan has shown an increase in area under cultivation while all other states registered a negative growth in the area in the last two decades (Green Gram Outlook report- Jan to May 2021). With this background, the present paper has explored the district and division-level analysis of the growth performance of mungbean in Madhya Pradesh.

MATERIALS AND METHODS

The time series data (2000-01 to 2019-20) of area, production, and productivity of mungbean in Madhya Pradesh was collected from the Farmers' Welfare and Agricultural Department of Madhya Pradesh. District-wise time series data (2010-11 to 2019-20) of area, production, and productivity of mungbean in Madhya Pradesh was also collected from the Directorate of Economics and Statistics, Government of India. The district-wise data was compiled at the divisional level for the comparative analysis. The study examined the growth rate and instability by using the Compound Annual Growth Rate (CAGR) and Cuddy Della Valle index (CDVI) respectively (Kiran *et al.* 2018, Sood *et al.* 2020 and Rani *et al.* 2023). The growth performance of mungbean in Madhya Pradesh was analyzed for two sub-periods viz; sub-period I: 2000-01 to 2009-10 and Sub period II: 2010-11 to 2019-20 which can be compared as pre and post-NFSM-P period.

Exponential growth function:

$$Y = ab^t$$

$$\ln Y = \ln a + t \ln b$$

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

Where, Y is area/production/productivity, a is intercept, b is regression coefficient and t is time variable (1, 2, ..., n).

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

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

σ = Standard deviation of variable

μ = Mean value of the variable

R^2 = Adjusted coefficient of determination from time trend regression

It can be classified under three broad categories based on CDVI values viz; low instability (0-15), medium instability (15-30), and high instability (greater than 30) (Sah *et al.* 2021).

To measure the relative contribution of area and yield to the total change in production, the decomposition analysis model was employed (Jagannath *et al.* 2013 and Wasnik *et al.* 2022).

$$\text{Production} = (A_0 \Delta Y / \Delta P) * 100 + (Y_0 \Delta A / \Delta P) * 100 + (\Delta A \Delta Y / \Delta P) * 100$$

Where, A_0 and Y_0 represent the area and yield in the base year. Δ shows the difference between the current and base year values. Thus, the total change in production can be decomposed into yield effect, area effect, and interaction effect.

RESULTS AND DISCUSSION

Madhya Pradesh is the second largest Indian state in size with 75% of the population dependent on agriculture. Madhya Pradesh has 55 districts which are grouped into ten divisions (Table 1).

Table 1. Districts under different divisions in Madhya Pradesh

S. No.	Division	Districts
1.	Bhopal	Bhopal, Raisen, Rajgad, Sehore and Vidisha
2.	Gwalior	Ashok Nagar, Datia, Guna, Gwalior and Shivpuri
3.	Narmadapuram	Harda, Hoshangabad* (Narmadapuram) and Betul
4.	Chambal	Morena, Sheopur, Bhind
5.	Indore	Alirajpur, Barwani, Burhanpur, Dhar, Indore, Jhabua, Khnadwa, Khargone
6.	Jabalpur	Balaghat, Chhindwara, Jabalpur, Katni, Mandla, Narshingpur, Seoni, Dindori
7.	Rewa	Rewa, Satna, Sidhi, Singrauli and Mauganj
8.	Sagar	Chhatarpur, Damoh, Panna, Sagar, Tikamgad and Niwari
9.	Shahdol	Shahdol, Umariya, Anuppur
10.	Ujjain	Dewas, Mandsaur, Neemuch, Ratlam, Shajapur, Ujjain and Agar Malwa

*The name of district Hoshangabad has been changed to Narmadapuram from February 2022

Source: Government of Madhya Pradesh

The cereals & millets, pulses, cotton, and oilseeds are the major crops cultivated in Madhya Pradesh. Based on the average of 2016-17 to 2020-21, Madhya Pradesh ranks first both in area and production (21% & 25%) of pulses, followed by Rajasthan (20% & 16%) and Maharashtra (15% & 15%). In the case of *Kharif* pulses, with a 16%

contribution to the country's total *Kharif* pulses area and production each, Madhya Pradesh ranks second after Rajasthan (28 and 20%). In the case of *Rabi* pulses, chickpea, urdbean and lentil, Madhya Pradesh ranks first in the total country's area and production. In the case of mungbean, the state ranks third in area and second in production (Table 2).

Table 2. Pulses' Scenario in Madhya Pradesh (Average 2016-17 to 2020-21)

Pulses	Area (Lakh ha)	Production (Lakh tons)	Rank in India
Kharif Pulses	22.32 (16%)	13.60 (16%)	II
Rabi Pulses	38.41 (26%)	46.10 (30%)	I
Chickpea	28.00 (28%)	36.16 (34%)	I
Pigeonpea	4.04 (9%)	4.72 (11%)	III
Mungbean	4.18 (9%)	3.46 (14%)	III (A) & II (P)
Urdbean	17.23 (36%)	8.61 (31%)	I
Lentil	4.93 (35%)	4.73 (35%)	I
Fieldpea	1.97 (26%)	1.73 (19%)	II

Source: Annual Report, Directorate of Pulses Development 2021-22; A: Area; P: Production

Inter divisional variation in total mungbean in Madhya Pradesh

District-wise available data on area, production, and productivity of mungbean was collected and compiled into respective divisions for the period 2011-12 to 2019-20. The interdivisional Triennium Ending (TE) data is presented in Table 3. The table reveals that the total area has increased by 64% in TE 2016-17 and 174% in TE 2019-20 over TE 2013-14. Similarly, the production has increased by 107% and 688% in TE 2016-17 and TE 2019-20 respectively over TE 2013-14. Further, the Narmadapuram division

has the highest area and production in TE 2013-14 and TE 2019-20 whereas in TE 2016-17, the Indore division has led the state in area and production. The divisional area, production, and productivity of mungbean has been increased in TE 2019-20 which may be attributed to area expansion under summer mungbean cultivation.

Interdivisional growth performance of mungbean in Madhya Pradesh

The growth rate and instability in area, production, and productivity of mungbean across the divisions of Madhya Pradesh were examined for the period 2010-11 to 2019-20 (Table 4). The table reveals that the Narmadapuram division recorded the highest CAGR in the mungbean area (59.30%) and production (78.52%). In the case of productivity, the Chambal division recorded the highest growth rate of 16.09%. The Narmadapuram division with the highest growth rate is also accompanied by the high instability index in both the area and production of mungbean.

Interdistrict growth performance of mungbean in Madhya Pradesh

Based on the decadal average production (2010-11 to 2019-20) of mungbean in Madhya Pradesh, Narmadapuram, Harda, Sehore, Narshingpur, and Raisen districts were identified as the leading districts. The share of these districts in total area and production of mungbean in Madhya Pradesh during TE 2019-20 is presented in Figure 1.

The growth rate and instability in the area, production, and productivity of mungbean were examined in these districts from the 2010-11 to 2019-

Table 3. Inter-divisional area, production, and productivity of mungbean in Madhya Pradesh

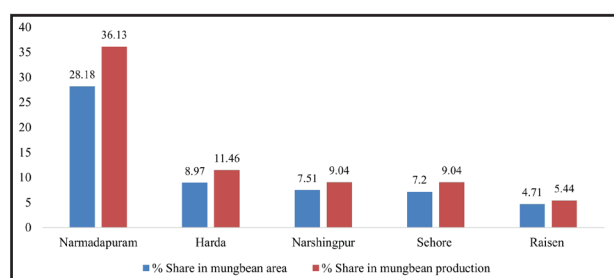
Division	Area (000 ha)			Production (000 tons)			Productivity (q/ha)		
	TE 2013-14	TE 2016-17	TE 2019-20	TE 2013-14	TE 2016-17	TE 2019-20	TE 2013-14	TE 2016-17	TE 2019-20
Bhopal	16.42	27.08	48.41	5.64	11.60	52.86	3.11	4.27	8.48
Gwalior	9.41	14.00	15.85	3.36	6.90	10.48	3.52	4.60	7.22
Narmadapuram	25.89	28.67	125.09	11.57	12.00	162.71	3.61	4.58	9.21
Chambal	2.13	8.00	5.42	1.05	4.10	5.93	5.11	5.49	9.49
Indore	22.70	33.67	24.35	8.88	14.49	16.51	4.00	4.15	6.28
Jabalpur	11.68	19.67	48.77	3.29	10.57	55.55	3.17	5.00	9.38
-Rewa	9.33	27.67	20.50	2.21	11.83	9.57	2.38	3.99	4.48
Sagar	21.03	27.67	26.38	5.90	11.67	12.69	2.84	4.14	4.68
Shahdol	0.16	2.00	1.00	0.06	0.89	0.48	3.74	3.93	3.72
Ujjain	2.45	10.67	15.84	1.08	5.10	12.46	4.43	4.52	6.93
Total	121.19	199.08	331.56	43.05	89.16	339.24	3.31	4.36	8.56

Source: Authors' compilation

Table 4. Inter divisional growth performance and instability of mungbean in Madhya Pradesh

Division	Area		Production		Productivity	
	CAGR (%)	CDVI	CAGR (%)	CDVI	CAGR (%)	CDVI
Bhopal	25.98**	71.31	39.57**	115.99	10.68	56.92
Gwalior	7.58	40.62	17.80**	57.15	9.51*	38.10
Narmadapuram	59.30***	121.44	78.52***	180.48	12.07*	58.56
Chambal	0.16	61.98	16.29	132.07	16.09**	39.75
Indore	-4.35	38.33	4.19*	64.12	8.93*	30.74
Jabalpur	22.8**	87.99	38.44**	129.25	12.74**	47.20
Rewa	13.04**	50.14	22.76**	75.76	8.60**	25.56
Sagar	4.93	36.12	13.22**	56.10	7.90**	26.20
Shahdol	19.82	131.90	15.16	157.69	-3.89	44.18
Ujjain	20.25	109.47	26.64	134.16	5.32	28.35

***, ** and * denote significance at 1%, 5% and 10% level

**Fig. 1.** Share of districts in total area and production of mungbean in Madhya Pradesh

20. The highest growth rate, as well as instability, was reported for the district Harda for all areas, production, and productivity of mungbean followed by Narmadapuram, Sehore, Raisen and Narshingpur districts (table 5).

Growth performance of mungbean in Madhya Pradesh

The growth performance and instability index of mungbean for Madhya Pradesh were analysed for sub-period I (2000-01 to 2009-10), sub-period II

(2010-11 to 2019-20), and total period (2000-01 to 2019-20) and presented in Table 6.

The table reveals that the growth rate in area (16.36%), production (32.03%), and productivity (13.47%) were greater in the sub-period II which may be attributed to the new initiatives included under NFSM during 2016-17 for enhancing pulses production and productivity. The high instability index was observed in all areas, production and productivity of mungbean during sub-period I (except area), II, and total which may again attributed to several factors contributing to enhanced area and production of mungbean in Madhya Pradesh.

Decomposition analysis of mungbean production in Madhya Pradesh

The growth analysis reveals the general pattern of growth and direction of changes in area, production, and yield. Parallely there is a need to examine the sources of output growth. The relative contribution of area and yield towards mungbean production was examined and presented in Table 8.

Table 5. Inter-district growth performance of mungbean in Madhya Pradesh

Particulars		Narmadapuram	Sehore	Harda	Narshingpur	Raisen
Average Area (000 ha)		41.45	13.27	11.74	11.82	8.08
Average Production (000 tons)		42.75	12.32	13.52	11.21	7.10
Average Productivity (q/ha)		5.90	5.80	4.40	6.20	5.30
CAGR (%)	Area	81.33***	44.67	92.01***	29.08**	41.27***
	Production	101.83***	67.11*	120.17***	42.85**	62.36***
	Productivity	11.30	15.12**	14.31*	10.67	14.64*
CDVI	Area	113.98	85.37	176.08	39.92	67.10
	Production	200.48	113.69	235.08	93.05	108.45
	Productivity	69.68	50.58	69.01	46.40	62.29

***, ** and * denote significance at 1%, 5% and 10% level

Table 6. Growth performance of mungbean in Madhya Pradesh

	Particulars	Sub period I	Sub Period II	Total
Area	Initial Year (000ha)	82.00	86.72	82.00
	End Year (000 ha)	76.34	464.49	464.49
	CAGR (%)	-0.44	16.36*	7.29**
	CDVI	11.95	53.21	61.90
Production	Initial Year (000 tons)	21.30	30.07	21.30
	End Year (000 tons)	24.51	590.13	590.13
	CAGR (%)	0.48	32.03**	12.19***
	CDVI	105.46	103.93	143.44
Productivity	Initial Year (q/ha)	2.60	3.52	2.60
	End Year (q/ha)	3.16	6.71	3.16
	CAGR (%)	0.93	13.47**	4.56***
	CDVI	80.85	45.87	48.07

***and ** denote significance at 1% and 5 % level

Table 8. Growth decomposition in mungbean production (%)

Divisions/ Districts/State	Yield Effect	Area Effect	Interaction Effect
Divisions (2010-11 to 2019-20)			
Bhopal	4.46	27.82	67.72
Gwalior	78.50	8.54	12.96
Narmadapuram	0.54	21.48	77.97
Chambal	205.57	-37.89	-67.68
Jabalpur	7.08	31.81	61.11
Rewa	20.93	47.66	31.40
Sagar	68.81	22.18	9.01
Sahdol	195.10	-433.06	337.96
Ujjain	12.25	50.57	37.18
Leading Districts (2010-11 to 2019-20)			
Hoshangabad	0.21	21.87	77.92
Sehore	0.35	26.97	72.68
Harda	0.12	16.13	83.74
Narshingpur	3.72	38.86	57.42
Raisen	2.87	26.17	70.96
Madhya Pradesh (2000-01 to 2019-20)			
Sub Period I	156.52	-45.72	-10.80
Sub Period II	14.30	23.39	62.31
Total	14.57	17.47	67.96

Table 8 reveals that the interaction effect was the dominating source of change in mungbean production in the case of Bhopal, Narmadapuram, Jabalpur, and Sahdol divisions whereas the area effect was the major driving force in the case of Gwalior, Chambal, and Sagar divisions. The yield effect contributed more to the change in production in the Rewa, Indore, and Ujjain divisions. It further shows the different picture in the case of leading

mungbean-producing districts of Madhya Pradesh. In all these districts interaction effect was found to be the dominating source of change in mungbean production. In the case of Madhya Pradesh as a whole, again interaction effect was the major driving force during sub-period II and total period.

CONCLUSION

The present study has examined the mungbean status in Madhya Pradesh, the state with the second highest production of pulses in India. The study revealed that the Narmadapuram division of Madhya Pradesh has recorded the highest growth rate in area and production of mungbean during 2010-11 to 2019-20. The Narmadapuram, Sehore, Harda, Narshingpur, and Raisen districts were found to be potential districts of Madhya Pradesh with respect to average production (2010-11 to 2019-20) of mungbean. The highest growth rate and instability in area and production was recorded for the district Harda for the said period. The study further recorded a higher growth rate in area, production, and productivity of mungbean in Madhya Pradesh in sub-period II (2011-12 to 2019-20) as compared to sub-period I (2000-01 to 2009-10). Sub-period II witnessed the success of NFSM pulses launched during 2007. The higher growth rate in area and production in sub period II may be attributed to the increased number of districts covered under NFSM pulses in Madhya Pradesh during 2016-17. In addition, new initiatives under NFSM-pulses, program on Additional Area coverage, increase in incentives for seed production, increase in Minimum Support Prices and pulses procurement under price stabilization scheme (PSS) etc. may also contribute to a higher growth rate in the mungbean area and production in sub-period II. The study further

unveils that the interaction effect between area and yield has been a major driving force in the change in mungbean production in major districts of Madhya Pradesh. With these findings, it can be concluded that more incentives and extension activities towards enhancing summer mungbean cultivation with the adoption of zone/state-specific summer mungbean varieties (like 'IPM 205-07 (Virat)' and 'IPM 410-3 (Shikha)' for Madhya Pradesh) can further explore the unexplored opportunities leading towards self-sufficiency in pulses production.

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