

**RESEARCH PAPER**

Cropping pattern and crop diversification in Bhopal division of Madhya Pradesh

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Abstract : The present study was based on secondary data collected from various government publications and pertains to a period of 22 years *i.e.* from 1997-98 to 2018-19. The present study has examined the growth rates of area, production and productivity of major crops, the trend in crop diversification, changes in cropping pattern and advantageous crops in different districts of Bhopal division of Madhya Pradesh. The compound growth rates of area, production and productivity of major crops were estimated for two sub-periods *i.e.* Period-I (1997-98 to 2007-08), Period-II (2008-09 to 2018-19) and overall period (1997-98 to 2018-19). Co-efficient of variation was used for analytical tools. Simple tabular analysis was used to examine the changes in cropping pattern in Bhopal division and districts of Bhopal division *i.e.* Bhopal, Sehore, Vidisha, Rajgarh and Raisen. In order to study the crop diversification Herfindahl index have been used. In order to work out the advantageous crops, land concentration ratio in different districts with comparative advantage was computed for last 10 years *i.e.* from 2008-09 to 2017-18. In majority of districts of Bhopal division *i.e.* Bhopal, Sehore, Vidisha, Rajgarh and Raisen crop diversification has significantly increased during the study period. The diversification from subsistence crop to more crops were took place in selected districts and in division also. Results of the study revealed that growth rate of area of Lentil crop was highest during Period-I *i.e.* 45.58 per cent in Bhopal division as compared other crops. In case of production pigeonpea, wheat, pea and Lentil showed increased growth rate of production by 9.42, 11.02, 59.91 and 53.15 per cent per annum. In Bhopal division pea was showed highest variation in area, production and productivity during period-II *i.e.* 78.36, 79.30 and 65.87 per cent per annum. Wheat was showed lowest variation in area and production during period-I *i.e.* 6.54 and 13.91 per cent as compared other crops. Result of study revealed Soyabean is most advantageous crop in Bhopal, Sehore and Rajgarh district and wheat is advantageous crop in all district of Bhopal division. In Bhopal division soyabean crop showed highest percentage change of area *i.e.* 38.34 per cent from (1998-99 to 2018-19) and Lentil showed highest percentage change of area over base period collected from various government publications and pertains to a period of 22 years *i.e.* from 1997-98 to 2018-19. The compound growth rates of area, production and productivity of major crops were estimated for two sub-periods *i.e.* Period-I (1997-98 to 2007-08), Period-II (2008-09 to 2018-19) and overall period (1997-98 to 2018-19). Co-efficient of variation was used for analytical tools. In order to study the crop diversification Herfindahl index have been used. In order to work out the advantageous crops, land concentration ratio in different districts with comparative advantage was computed for last 10 years *i.e.* from 2008-09 to 2017-18. In majority of districts of Bhopal division *i.e.* Bhopal, Sehore, Vidisha, Rajgarh and Raisen crop diversification has significantly increased during the study period. The diversification from subsistence crop to more crops were took place in selected districts and in division also. Results of the study revealed that growth rate of area of Lentil crop was highest during Period-I *i.e.* 45.58 per cent in Bhopal division as compared other crops. In case of production pigeonpea, wheat, pea and Lentil showed increased growth rate of production by 9.42, 11.02, 59.91 and 53.15 per cent per annum. In Bhopal division pea was showed highest variation in area, production and productivity during period-II *i.e.* 78.36, 79.30 and 65.87 per cent per annum. Wheat was showed lowest variation in area and production during period-I *i.e.* 6.54 and

13.91 per cent as compare to other crops. Result of study revealed Soyabean is most advantageous crop in Bhopal, Sehore and Rajgarh district and wheat is advantageous crop in all district of Bhopal division. In Bhopal division soyabean crop showed highest percentage change of area *i.e* 38.34 per cent from (1998-99 to 2018-19) and Lentil showed highest percentage change of area over base period *i.e.* is 94.07 per cent. There existed wide temporal changes in the cropping pattern of Bhopal division.

Key Words : Cropping pattern, Crop diversification

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INTRODUCTION

The study of cropping pattern assumes a great significance as it is one of the important path for balanced development of agriculture to meet the requirements. The adoption of better cropping pattern optimally suited to the technological changes is an important one for augmenting agricultural growth. Cropping pattern of a particular area either state region, districts, etc. emerges through the interaction of physical, social, economic, technological, and infrastructural factors. It is a function of climatic elements, their periodicity expressed in terms of seasons, nature of soils, physiographic and man introduced factors like irrigation, fertilizers, etc. amongst the climatic factor, precipitation, its distribution and periodicity has a greater determinant value. The impact of each of these factors would differ depending upon the prevailing situation of a place. Cropping pattern indicates the per cent age of area occupied by different crops. The variation in cropping pattern is also influenced by economic conditions and behaviour of farmers who decide the type of crops to be grown. Farmer might choose such crops combination it will be best suited to his field under the given conditions. Change in cropping pattern would be an integral part and popular mode of diversification and resource mobilization available to cultivators for higher agricultural production.

Objective :

- To study the performance of major crops in different districts of Bhopal division.
- To assess the changes in cropping pattern in different districts of Bhopal division.
- To estimate the crop diversification in different districts of Bhopal division.
- To work out the advantageous crops in different

districts of Bhopal division.

MATERIAL AND METHODS

For the present study the secondary data were collected from various published sources. Time series secondary data on the area, production, productivity of selected crops, farm harvest prices and other agricultural data were obtained from various published sources.

Analytical tools and technique :

Exponential model :

For examining the performance of different crops growth rates of area, production and productivity of major crops were estimated using exponential model.

$$Y = ab^t$$

where,

$$Y = \text{area/ production/ productivity}$$

a and b = Parameters to be estimated from exponential model

$$\text{Compound growth rate} = [\text{Antilog}(\log b) - 1] \times 100$$

Co-efficient of variation (C.V) :

Co-efficient of variation of area, production and productivity were calculated by using the following formula :

$$C. V. = \text{Standard deviation} / \text{Mean} \times 100$$

Analysis of changes of cropping pattern :

The changes in cropping pattern were studied by simple tabular analysis for all the major selected crops. Cropping pattern in terms of per cent age share of individual crops in gross cropped area in districts Bhopal division were worked out at different points of time. The extents of crop diversification were studied by using Herfindahl diversification index.

RESULTS AND DISCUSSION

The compound growth rates of area, production and productivity of major crops of Bhopal division are presented in Table 1.

It is observed from the table that during Period-I, the area under soyabean, maize, pea, lentil were increased significantly by 1.15, 3.33, 18.54 and 45.58 per cent per annum, respectively. During Period-II, the area under all crop showed increased rate over period except maize and gram. Both were showed stagnancy in growth rate of area over period-II. At overall level the area under soyabean wheat, pea, and lentil were significantly increased at (1%) and (5%) level of significant *i.e.* 3.22, 0.43, 12.53 and 10.30 per cent. The highest growth rates of area was observed in lentil during period-I and Period-II *i.e.* 45.58 and 44.58 per cent per annum followed by pea *i.e.* 18.54 and 42.24 per cent. In case of production, During period-I, the growth rates of production under pea and lentil were significantly increased by 65.87 and 39.43 per cent per annum respectively, while soyabean, pigeonpea, maize, wheat and gram showed stagnancy over period. During period-II. The growth rate of production under all crops were increased significantly except soyabean and maize. Both were showed stagnancy over period. At overall level,

the growth rates of production, under wheat and gram were significantly increased at (1%) level of significance by 6.57 and 2.57. Under soyabean maize and lentil it significantly increased at (5%) and (10%) level of significant by 2.17, 3.56 and 10.76 per cent. where remaining crops shows tagnancy over the period. The highest growth rates of production among all the crop were observed in pea during period-I *i.e.* 65.87 per cent followed by lenti *i.e.* 53.15 per cent as compared to other period. In case of productivity, the growth rates under all the crops increased significantly at (1%), (5%) and (10%) level of significance during overall period and during period-II, except soyabean and pigeonpea. both were showed stagnant growth rate of productivity. During Period-I, the growth rate of productivity of wheat, pea and lentil were increased significantly at (5%) level of significance by 2.36, 84.82 and 92.38 per cent per annum, while it was observed stagnancy in soyabean and maize crops. The highest growth rates of productivity among all the crop were observed in pea during period-II, *i.e.* 107.22 per cent as compared to other period.

Co-efficient of variation in area, production and productivity of major crops in Bhopal division :

Results on co-efficient of variation of area are presented in Table 2. As revealed from table, during

Table 1: Compound growth rates of area, production and productivity of major crops in Bhopal division (%)

Sr. No.	Crops	AREA			Production			Productivity		
		Period I	Period II	Overall	Period I	Period II	Overall	Period I	Period II	Overall
1.	Soyabean	1.15**	0.75*	3.22***	0.94	-1.45872	2.17**	0.82	-3.49	-0.44
2.	Pigeonpea	-2.42	4.75*	0.86	-5.36	9.42**	0.86	14.87	4.63	0.86
3.	Maize	3.33***	-0.74	0.18	2.13	7.46	3.56**	-2.00	6.92**	1.91**
4.	Wheat	0.71	3.21***	0.43***	0.40	11.03***	6.57***	2.36***	8.63***	3.97***
5.	Gram	-0.07	0.07	-0.75	0.58	2.59*	2.75***	0.18	3.16**	1.23***
6.	Pea	18.54***	42.24***	12.53***	65.87***	59.91**	12.72	84.82**	95.14***	19.52*
7.	Lentil	45.58**	44.85**	10.30**	39.43**	53.15***	10.76*	92.38**	107.22**	21.24*

Note : *, ** and *** indicate significance of values at P=0.05, 0.01 and 0.1, respectively

Table 2 : Co-efficient of variation in area, production and productivity of major crops in Bhopal division

Sr. No.	Crops	AREA			Production			Productivity		
		Period I	Period II	Overall	Period I	Period II	Overall	Period I	Period II	Overall
1.	Soyabean	6.60	8.06	16	17.07	22.66	26.93	15.87	25.52	20.80
2.	Pigeonpea	9.18	28.20	31.98	23.74	51.55	49.25	14.87	32.64	26.12
3.	Maize	15.72	29.37	23.15	17.24	51.78	49.76	24.00	28.54	28.29
4.	Wheat	6.54	13.56	17.01	13.91	33.41	50.26	8.60	27.17	31.14
5.	Gram	11.09	28.00	20.59	14.71	18.09	24.24	7.84	15.13	13.84
6.	Pea	51.56	78.36	102.25	50.35	79.30	79.76	50.24	65.87	71.08
7.	Lentil	50.13	29.89	39.74	51.16	52.73	56.81	49.88	30.28	46.28

period-I period-II and overall period the value of variation in area was highest in pea *i.e.* 51.56, 78.36 and 102.25 per cent during followed by lentil *i.e.* 50.13, 29.89 and 39.74 per cent. It means pea and lentil were most unstabled crops in area as compare to other crops. Maize crop also showed highest variation after pea and lentil during period-II and overall period *i.e.* 29.37 and 23.15 per cent. Thus, it is clear from the study that the pea was most unstabled crops in area as compare to other crops during study period. Among the periods under study During period-II and overall period has highest variation of production *i.e.* 79.30 and 79.76 per cent incase of pea followed by lentil *i.e.* 52.73 and 56.81 per cent. It means pea and lentil were most unstabled crops in production as compare to other crops during period-II and overall period. During the first period co-efficient of variation was highest in case of lentil *i.e.* 51.16 per cent followed by pea *i.e.* 50.35 per cent. Thus, it is clear from the study that variation of production in pea was higher for the overall period compared than other periods.

As seen from Table 2, the variation of productivity for pea were highest during overall period *i.e.* 71.08 per cent followed by lentil *i.e.* 46.28 per cent followed by wheat *i.e.* 31.14 per cent. It means pea and lentil were most unstabled crops in productivity as compare to other crops during overall period. During period-II the variation

of productivity for pea were highest *i.e.* 65.87 per cent followed by pigeonpea *i.e.* 32.64 per cent followed by lentil *i.e.* 30.28 per cent. The variation of productivity during period-I was higher in pea *i.e.* 50.24 per cent followed by lentil *i.e.* 49.88 per cent followed by maize *i.e.* 24.00 per cent. Thus, it is clear from the study that variation of productivity in pea was higher in overall period than the other periods.

Changes in cropping pattern in Bhopal division :

The changes in cropping pattern in Bhopal division during 1998-99 to 2018-19 are presented in Table 3. Figures shown in first period *i.e.* 1998-99 revealed that soyabean, wheat and gram contributed 34.39, 34.76 and 25.92 per cent of gross cropped area. In the span of 22 years cropping pattern has changed substantially. The proportion of soyabean was 34.39 per cent in the year 1998-99 and it has increased to 38.34 per cent in 2018-19. incase of wheat and gram, its share over gross cropped area has reduced to 33.60 and 19.24 per cent in 2018-19 from 34.76 and 25.92 per cent in 1998-99. Both were still emerged as the major crop in the division. The constant proportion of area under maize over gross cropped was highest in 2008-09 *i.e.* 3.01 per cent. The proportion of area under pea was constant during period-I (1998-99) and period-II (2008-09), it's increased during

Sr. No.	Crops	Area ("00"ha)			per cent age changes over base period
		Years			
		1998-99	2008-09	2018-19	
1.	Soyabean	781.5 (34.39)	979.3 (39.16)	1220.6 (38.34)	35.97
2.	Pigeon Pea	38.3 (1.69)	34.8 (1.39)	67.41 (2.12)	43.18
3.	Maize	63.4 (2.79)	75.3 (3.01)	77.1 (2.42)	17.77
4.	Wheat	790 (34.76)	702 (28.07)	1069.9 (33.60)	26.16
5.	Gram	589 (25.92)	602.5 (24.09)	612.67 (19.24)	3.86
6.	Pea	4.6 (0.20)	8 (0.32)	40.1 (1.26)	88.53
7.	Lentil	5.7 (0.25)	98.8 (3.95)	96.09 (3.02)	94.07
Gross cropped area		2272.50 (100.00)	2500.70 (100.00)	3183.87 (100.00)	28.62

(Figures in the parenthesis are precentages over gross cropped area) Note : Base period 1998-99 had taken for all crops

District/ Year	(1997-98 to 2007-08)	(2008-09 to 2018-19)
Bhopal	0.34	0.33
Sehore	0.34	0.39
Vidisha	0.28	0.29
Rajgarh	0.33	0.32
Raisen	0.30	0.31
Bhopal division	0.29	0.31

2018-19 by 1.26 per cent, pea contributed very negligible proportion of area over gross cropped area. Proportion of area under pigeonpea has increased from 1.69 per cent in 1998-99 to 2.12 per cent in 2018-19. It means gross cropped area increased by 0.43 per cent.

Proportion of area under lentil has increased from 0.25 per cent in 1998-99 to 3.02 per cent in 2018-19. It means gross cropped area increased by 2.77 per cent. The per cent age change over base period 1998-99 of lentil and pea was 94.07 and 88.53 per cent. It indicates increase of acre age under these crops. There is positive change in soyabean by 35.97 per cent, maize by 17.77 per cent, pigeonpea by 43.18 per cent, wheat by 26.16 per cent, gram by 3.86 next to lentil and pea over base period 1998-99. The gross cropped area has increased by 28.62 per cent over base period 1998-1999.

Measurement of crop diversification by Herfindahl Index :

Herfindahl Index is a measure of crop diversification. The value of Herfindahl Index varies from zero to one. It takes the value one when there is complete specialization and value zero when there is perfect diversification. The Table 4 revealed that in Bhopal, Sehore, Vidisha, Rajgarh and Raisen districts and Bhopal

division as a whole, the value of Herfindahl Index were found low *i.e.* less than 0.5. It means in all selected districts diversification took place. The diversification from subsistence crop to more commercial crops were taken place in these districts. Therefore, from the foregoing analysis that, the hypothesis has been proved, respectively crop diversification are taken place over a period of time.

Conclusion:

Area production and productivity under wheat was exhibiting a significant positive growth by 0.43, 6.57 and 3.97 per cent per annum at (1%) level of significance in Bhopal division from 1998-99 to 2018-19. During study period highest variability of area, production and productivity was observed in pea crop by 102.25, 79.76 and 71.08 per cent in Bhopal division. The study found that the cropping pattern in Bhopal division had changed over the study period and that the area under crops such as soyabean, pea, lentil, pigeonpea, had increased by 35.97, 43.18, 88.53 and 94.07 per cent over base period 1998-99. Wheat is more advantageous crop followed by soyabean in Bhopal division over a period of study. Cropping pattern has changed and crop diversification has increased significantly in Bhopal division.

