

Original Research Article

Growth in Area, Yield and Production of Major Crops in Malwa Plateau Agro Climatic Zone of Madhya Pradesh

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ABSTRACT

The analysis of growth is usually used in economic studies to find out the trend of a particular variable over a period of time and used for making policy decision. Malwa Agro climatic zone of Madhya Pradesh is major contributor of major *Kharif* and *Rabi* crops. The growth rate in area, yield and production of different *Kharif* crops (Oilseed: soybean, cereals: maize, sorghum and pulse crop: pigeon pea) and *Rabi* crops (cereal crop: wheat and pulse crop: chick pea) in Malwa Agro climatic zone and Madhya Pradesh state were estimated using the compound growth function. The necessary secondary data were collected for the period of 15 years from 1999-2000 to 2013-14. Growth rate for crops were studied for how each affected by the other in the season during the selected period of 15 years. Coefficient of Variation (CV) for Malwa plateau agro climatic zone and MP state were calculated to determine the stability of the crops with respect to area, yield and production. Based on the results of the study suitable measures have also been suggested.

Keywords

Growth rates,
C.V., major crops,
area, yield and
production

Introduction

In India, agriculture and other allied activities contribute significantly to the Gross Domestic product (GDP), accounting for nearly 14.5 per cent of the total GDP. It provides employment to around 64 per cent of the total work force while contributing 18 per cent of total export. India, with only 2.3 per cent of world's total land supports 18 per cent of human and 15 per cent of livestock population in the world. The country has made an impressive progress on the food front, which has resulted in increased production of food grains (Anon, 2010).

The state of Madhya Pradesh occupies a total geographical area of 44.348 m ha out of which 55.9 % (24.804 m ha) is under major *Kharif* and *Rabi* crops. The state is

predominantly rain fed farming state, as only 29.5% of the net cultivated area (6.07 m ha) is irrigated. The state of Madhya Pradesh is blessed with varied agro-climatic conditions which permits the farmers' of the state to cultivate a number of crops like cereals, pulses, oilseeds, commercial crops and horticulture crops across different seasons of the year.

Malwa plateau agro climatic zone comprises 8 entire districts and part of Dhar (Dhar, Badnawar, Sardarpur Tehsil) and Jhabua (Petlawad Tehsil) districts of Madhya Pradesh. The soils of the area are medium, deep and shallow black and contain 40-60% clay. pH ranges from 7-8, CEC 33-55 c mol kg⁻¹ and bulk density varies from 1.2-1.6

Mgm⁻³, low in N, medium to high in P and high in K, S and Zn deficiency are very common. Infiltration: 1.55-3.66 cm / hr (Low-Medium). Major crops are soybean (*Kharif*); chickpea and wheat (*Rabi*). Other crops are maize, sorghum, pigeon pea (*Kharif*) and spices, opium, medicinal crops (*Rabi*). The present study aims at examine the growth in area, production and productivity of major crops in Malwa plateau ACZ of the state of Madhya Pradesh.

Materials and Methods

The secondary data on area, yield and production of *Kharif* and *Rabi* crops Malwa plateau agro climatic zone in the state of Madhya Pradesh and the state Madhya Pradesh were used to analyze the trends. The time series data on area, yield and production of *Kharif* and *Rabi* crops from 1999-2000 to 2013-14 was used for the study which was collected from various publications from the Directorate of Agriculture, Madhya Pradesh, Bhopal.

Estimation of compound growth rate

The compound growth rate of the crops was estimated using the exponential curve:

$$Y = ab^x$$

Where,

Y= Dependent variable in period (Area, yield, production)

a= Intercept

b= Regression coefficient

x= year which takes values (1,2 ...n)

It has been estimated as linear equation after taking the log for both sides. The data used

for the period was 1999-2000 to 2013-14 i.e. 15 years.

$$\text{Log } y = \text{log } a + x (\text{log } b)$$

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

The compound growth rates were tested for their significance by the F test

Estimation of Co-efficient of Variation

To examine the stability with respect to yield kg/ha of the crops, mean standard deviation and coefficient of variation has been calculated.

$$\begin{aligned} \text{Coefficient of variation (CV)} \\ = \frac{\text{Sd}(y)}{\text{mean}(y)} \times 100 \end{aligned}$$

Where,

S d (y) =Standard deviation of Dependent variable in period (Area, Productivity)

Mean(y) =Average of Dependent variable in period (Area, Productivity)

Results and Discussion

Kharif crops

Madhya Pradesh state is known as the soybean sate in the country; contributes major part in area, yield and production of soybean in India. The average area under soybean crop in the state during the study periods was 4878.23 thousand ha (Table 1). The minimum fluctuation in the area under soybean in the state appeared as the coefficient of variation was only 12.8 per cent. The growth rate of area under soybean crop in the state recoded as 2.54 per cent increase per annum which was statistically significant. The area under soybean crop in Malwa plateau ACZ was 2356.20 thousand

ha (Table 2) and it was 48.3 per cent of the state's soybean crop area. Coefficient of variation with respect to soybean area was 7.8 per cent whereas annual compound growth rate was estimated as 1.48 per cent in the zone. Gupta and Athavale (1993) also of the opinion that area was the dominant factor for increase in the production of soybean in all major soybean growing states in the country.

The average yield of soybean crop in the M.P. recorded as 1032 kg/ha with 3.04 per cent significant increase /annum and 18.53 percent fluctuation during the period of study. The mean yield, annual compound growth rate and coefficient of variation with respect to soybean yield in Malwa plateau ACZ noted as 1020 kg/ha, 2.17 per cent and 21.1 per cent, respectively. Athavale (2000) in a study concluded that decline in yield and reduction in price were the main causes for low production in Malwa ACZ of M.P. Kumar and Gupta (2004) reported that the growth rates of area and production of Malwa plateau agro climatic zone were significant in most of the districts despite of slow growth of productivity.

The average production of the soybean in MP state was registered 5104.55 thousand tons. The coefficient of variation value 28.8 per cent indicated high level of fluctuation in soybean production while value of compound growth rate (5.66 per cent) showed significant increase in production during the study period (Table 1). The mean soybean production in Malwa plateau ACZ was 2526.3 thousand tones. Thus shared 49.5 percent of soybean production in the state. The coefficient of variation and annual compound growth rate for soybean production in Malwa plateau ACZ was estimated 25.8 per cent and 4.20 percent, respectively showed high fluctuation and significant increase in production.

The average maize area occupied in the state was 856.24 thousand ha. The state registered low level of fluctuation (CV 3.1 per cent) and slight increase in annual compound growth rate in maize area over the years during study period. 400 thousand ha area of maize was under recorded Malwa plateau ACZ which is 46.73 percent of the state area under maize. 12.1 per cent fluctuation and negative annual compound growth rate (-2.16 per cent) for the maize area in Malwa plateau ACZ was observed. The mean maize grain yield in the state noted as 1611.4 kg/ha with coefficient of variation 26.7 per cent and compound growth rate as 0.28 percent where as in Malwa plateau ACZ the respective values estimated were 1432.8 kg/ha, 21.6 per cent and -1.20per cent /annum respectively. The production of maize registered in Malwa plateau ACZ was 584.1 thousand tones and showed negative trend (-3.22 per cent) with regards to compound growth rate.

The mean area of 554.35 thousand ha of sorghum registered in the state having compound growth rate of -4.34 per cent /annum and fluctuation of 22.80 per cent during the period of 1999-2000 to 2013-14. The mean yield of the sorghum crop was 1139 kg/ha and high level of fluctuation (25.52 per cent) and significant increase in compound growth rate (4.84 percent) during study period. The mean production of sorghum recorded as 598.84 thousand ha having slight per annum CGR (0.048 per cent) and high CV (17.64 per cent) in study period of 15 years. Similar trend of CV and CGR for area, yield and production of sorghum in Malwa plateau ACZ were estimated during study period. (Table 2).

Pigeon pea is one of the major pulse crops grown in the MP state occupied 349.52 thousand ha area. 3.02 per cent CGR show significant increase in the area under this

crop during the study period. Fluctuation of the area estimated as 21.16 per cent in this crop. Whereas the production recorded was 250.06 thousand tons with CGR 1.96 per cent and CV 18.94 per cent. The compound growth rates for area and production of pigeon pea in Malwa plateau ACZ showed negative trend whereas the slightly increasing trend in yield was noted (Table 2). Jayant Kumar (2012) also reported that pigeon pea crop show negative relative change during the entire period of study and this was mainly attributed to yield reduction in the area.

Rabi crops

The mean area under wheat crop in the Madhya Pradesh recorded as 4240.20 thousand ha. The 2.02 per cent per annum significantly increase in compound growth rate and the coefficient of variation was noticed as 14.34 per cent. Malwa plateau agro climatic zone having 749.50 thousand ha area under wheat which contributed 17.66 per cent to the state's wheat area. Malwa plateau agro climatic zone has significant compound growth rate (5.96 per cent)per annum for area, but the coefficient of variation estimated to the tune of 36.9 per cent.

Thus, the area fluctuated year to year due to facility of irrigation, favorable environmental condition etc.

Average wheat yield of the M.P. recorded 1964 kg/ha during the study period and show significantly increase in compound growth rate 2.93 per cent per annum and the coefficient of variation of the yield estimated as 20.64 per cent. The average yield in Malwa plateau agro climatic zone was 2287 kg/ha. The main reason was facility of irrigation, fertilizer application; high yielding varieties etc. which were

provided to farmers. The Malwa plateau agro climatic zone contributed compound growth rate of 8.90 per cent. Thus, significant increase the production but the coefficient of variation was high i.e. 53.34 per cent show high level of fluctuation. Kumar Jayanta (2012) observed that the increased production of wheat was recorded and this was mainly due to 17.89 per cent increase in area followed by 61.4 per cent increase in productivity of wheat.

Chickpea is a major Rabi pulse crop in the Madhya Pradesh. The average area under this crop in the state was 2675.94 thousand ha. There was increase in compound growth rate with respect to area (1.51 per cent per annum).The coefficient of variation noted as 9.94 per cent which indicate stability. Malwa plateau agro climatic zone has comparatively high coefficient of variation (36.2 per cent) and significant increase in compound growth rate in area (6.53 per cent per annum).

The average yield of chick pea recorded as 914 kg/ha. The compound growth rate of 1.25 per cent per annum and the coefficient of variation estimated 16.12 per cent for the yield.

The average yield was 812 kg/ha in Malwa plateau agro climatic zone which was lower than the state's average yield. The compound growth rate recorded as 1.54 per cent per annum and coefficient of variation calculated 14.4 per cent.

The state has 2466.1 thousand tons chick pea grain production; significant compound growth rate (2.75 per cent per annum); 23.24 per cent CV of grain production of the chickpea. Malwa agro climatic zone has 526 thousand tons production; compound growth rate 7.62 per cent per annum and 44.54 per cent coefficient of variation.

Table.1 Growth in Area, Yield and Production of major crops in Madhya Pradesh State (1999-2000 to 20013-14)

Crops	Area			Yield			Production		
	Mean Area (000'ha)	CV (%)	CGR (%)	Mean Yield (kg/ha)	CV (%)	CGR (%)	Mean Production (000'Tonnes)	CV (%)	CGR (%)
Kharif									
Soybean	4878.23	12.80	2.54**	1032	18.53	3.04**	5104.55	28.82	5.66**
Maize	856.24	3.10	0.064	1611	26.74	0.28	1327.23	27.53	0.33
Sorghum	554.35	22.80	-4.34**	1139	25.52	4.84**	598.84	17.64	0.048
Pigeon pea	349.52	21.16	3.02**	749	10.49	-0.496	250.06	18.94	1.96
Rabi									
Wheat	4240.22	14.34	2.02*	1964	20.64	2.93**	8286.1	38.23	5.28**
Gram	2675.94	9.94	1.51*	914	16.12	1.25	2466.1	23.24	2.75*

Note: C.V. - coefficient of variation, CGR- compound growth rate,* denotes significant at 5 per cent, ** denotes Significant at 1 per cent.

Table.2 Growth in Area, Yield and Production of major crops in Malwa Agro climatic Zone (1999-2000 to 20013-14)

Crops	Area			Yield			Production		
	Mean Area (000'ha)	CV (%)	CGR (%)	Mean Yield (kg/ha)	CV (%)	CGR (%)	Mean Production (000'Tonnes)	CV (%)	CGR (%)
Kharif									
Soybean	2356.20	7.8	1.48**	1023	21.1	2.17*	2526.3	25.82	4.20**
Maize	400.90	12.1	-2.16**	1433	21.6	-1.20	584.1	31.74	-3.22
Sorghum	128.40	39.8	-6.76**	1102	17.1	2.43*	132.6	52.23	-2.84
Pigeon pea	22.21	10.40	-0.79	566	13.70	0.39	13.09	15.82	-1.52
Rabi									
Wheat	749.50	36.9	5.96*	2287	20.2	2.66*	1805	53.34	8.90*
Gram	609.40	36.2	6.53*	812	14.4	1.54	526	44.54	7.62*

Note: C.V. - coefficient of variation, CGR- compound growth rate,* denotes significant at 5 per cent, ** denotes Significant at 1 per cent

Fig.1 Compound growth rate (per cent) of area under Madhya Pradesh and Malwa Plateau Agroclimatic zone

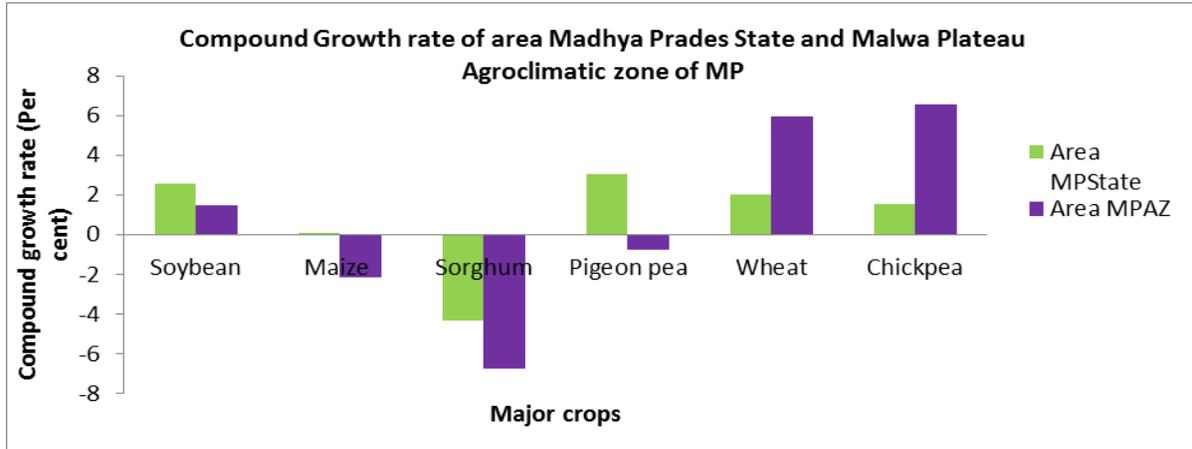


Fig.2 Compound growth rate (per cent) of yield under Madhya Pradesh and Malwa Plateau Agroclimatic zone

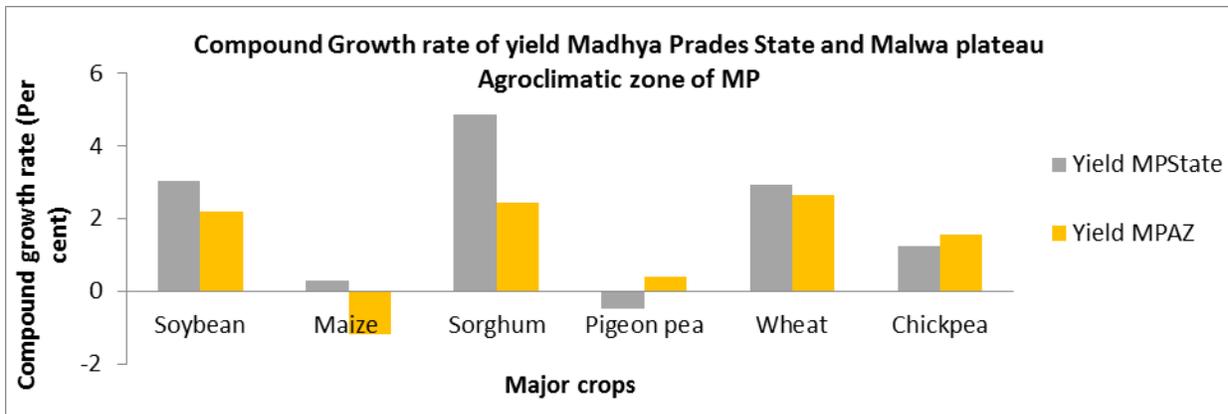
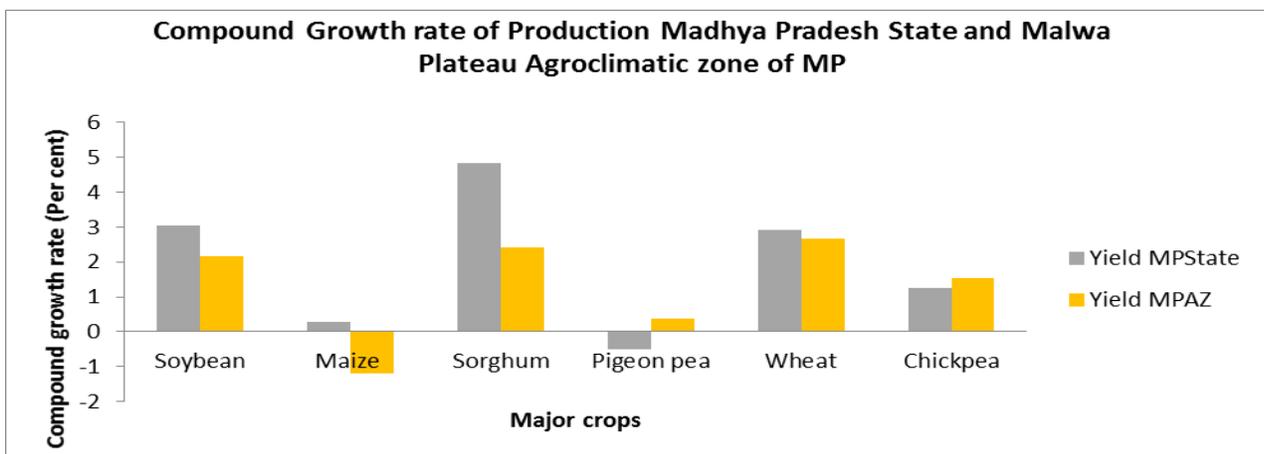


Fig.3 Compound growth rate (per cent) of Production under Madhya Pradesh and Malwa Plateau Agroclimatic zone



Compound growth rate and coefficient of variation for area, productivity and production of major crops grown in Madhya Pradesh and Malwa plateau agro climatic zone of Madhya Pradesh viz., soybean in oil seed crops, maize, sorghum and wheat in cereals and pigeon pea, chick pea in pulses were studied using 15 years secondary data (1999-2000 to 2013-14). Following conclusions and suggestions have been made.

Oil seed

Soybean

The area, productivity and production of soybean registered positive significant growth in M.P. and Malwa plateau agro climatic zone of Madhya Pradesh.

However, high level fluctuations in production during the period under study revealed that measures like timely application of recommended contingent practices during aberrant weather conditions in climate change scenario must be popularize.

Cereals

Maize

Insignificant positive trend was observed in area, yield and production in the state. Significant negative in area and insignificant negative in yield and production in Malwa plateau agro climatic zone of Madhya Pradesh.

High coefficient of variation was noticed for yield and production in state and MPACZ of MP. These can be improved by intercropping of maize with soybean and pigeon pea along with introduction of short duration hybrid varieties.

Sorghum

Compound growth rate show Significant negative in the area in the state and Malwa plateau agro climatic zone of Madhya Pradesh ;Significant positive in productivity in the state and Malwa plateau agro climatic zone of Madhya Pradesh; and Insignificant positive in production in state and insignificant negative in Malwa plateau agro climatic zone of Madhya Pradesh. High coefficient of variation values indicate measures as stated for maize

Wheat

Significant positive in area, yield and production in state and Malwa plateau agro climatic zone of Madhya Pradesh., however, the high level of fluctuations were noted. Attempts required to narrow down the fluctuations in area, yield and production of wheat in state and Malwa plateau agro climatic zone of Madhya Pradesh by developing the irrigation sources for adequate number of irrigations, popularize the efficient method of irrigation like sprinkler, drip etc.

Pulse: pigeon pea and chick pea

The trend of pigeon pea towards growth in terms of area, yield and production in state suggest emphasizing to raise productivity and production for the pigeon pea in the state and ACZ may be through high yielding varieties, method of cultivation and irrigation.

Similarly in case of Chick pea the high production recorded in state and ACZ and it was seems be due to increase in area. The need of improvement in productivity through introduction new varieties of Chickpea and plant protection measures may be suggested which will reduce the

fluctuation in yield and production in state and Malwa plateau agro climatic zone of Madhya Pradesh.

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