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Trends of Area, Production and Productivity of Soybean crop in Madhya Pradesh

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ABSTRACT: *Madhya Pradesh is one of the forerunner states in soybean production. Contribution of Madhya Pradesh was more than fifty percent in the total area and production of soybean. The study measured the growth performance, instability and decomposition approach in area, production and productivity of soybean crop in Madhya Pradesh based on secondary data during 1996-97 to 2012-13. The tools used for analysis were compound growth trend, instability indices and decomposition analysis. The area, production and productivity of soybean registered positive and significant growth trend during the study period. The Instability Index suggested that there was highest inter-annual fluctuation in soybean production followed by variation in productivity and area during study period. Further the study conducted a decomposition analysis to determine the contribution of different components to the growth rate. The decomposition analysis suggested that area was one of the important factors in overall growth of soybean production followed by interaction effect. The productivity contribution to total soybean production in state was very low.*

Key words: *Soybean, Compound Growth Rate, Instability, Decomposition Analysis.*

INTRODUCTION

Soybean has emerged as golden bean of 21st century and it is largely used as oilseed. It is the single largest oilseed grown in the different agro-climatic conditions. Soybean is looked upon not merely as a means to supply food for humans and animals, but it also improves the soil fertility by fixing atmospheric nitrogen (Jaiswal and Hugar 2011). Soybean, with over 40 per cent protein and 20 per cent oil, has now been recognized all over the world as a potential supplementary source of edible oil and nutritious food. The protein of soybean is called a complete protein, because it supplies sufficient amounts of the kinds of amino acids required by the body for building and repair of tissues. Its food value in heart disease and diabetes is well known. In India soybean cultivation has increased manifold as compared to any other oilseed crop and stands next only to groundnut, though commercial production of soybean began in 1971-72. The five major soybean producing countries in the world are USA, Brazil, Argentina, China and India. World's soybean production in 2011 was 251.5 million metric tonnes out of this USA has a lion share of 83.2 million metric tonnes (33 per cent) followed by Brazil, Argentina, China and India (72.0, 48.0, 13.5 and 11.0 million metric tonnes, respectively). India contributes about four per cent of total world soybean production and it stands at fifth position in terms of production (soy stats 2012). Out of total area and production in India, share of Madhya Pradesh was 56.03 and 51.43 percent respectively (GOI, 2013). The studies undertaken by research workers at various times is mostly related to cereal crop like paddy and wheat and very limited work has been done on soybean which is the major oil seed crop, especially of Madhya Pradesh. Thus considering the importance and need, the present study had been taken up to analyze the trends in the production of soybean in Madhya Pradesh. (Solmon and Paul 2013). The specific objectives of the study were as follow: [1] To examine the growth rate in area, production and productivity of soybean crop; [2] To measure the instability in production of soybean crop; and [3]To

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estimate the relative contribution of area and productivity in production of soybean crop.

MATERIALS AND METHODS

Present study was based on secondary data and confined to the period of 1996-97 to 2012-13. Data related to area, production and productivity of soybean crop of Madhya Pradesh was collected from Directorate of Economics and Statistics Government of India.

ANALYTICAL PROCEDURE

In order to examine the growth performance, instability and degree of relationship in area, production and productivity of soybean crop in Madhya Pradesh, various statistical measures such as mean, correlation coefficient and coefficient of variation were worked out.

GROWTH TREND

Growth rates are worked out to examine the tendency of variable to increase, decrease or remain stagnant over a period of time. It also indicates the magnitude of the rate of change in the variable under consideration per unit of time. For the present study, compound growth trend was used to estimate the growth in area, production and productivity of soybean crop. The algebraic form of the function as suggested by Kalita (2011) is given below:

$$Y = a*b^t$$

The log form of the above exponential equation can be expressed as,

$$\text{Log (Y)} = \text{Log (a)} + t\ \text{Log (b)}$$

Now, CGR (%) can be expressed as

$$\text{CGR (\%)} = [\text{Antilog (b)-1}]*100$$

Where, Y is the variable for which growth rate is calculated, it may be area, production or productivity as per case; a is the constant; b is the regression coefficient of 'Y' on't' and t is time variable (rank was given to year concerned; ranking of the year was done in their ascending order as per case.

MEASUREMENT OF INSTABILITY

An index of instability was computed for examining the nature and degree of instability in area, production and productivity of soybean in Madhya Pradesh. Simple CV does not explain properly the trend component inherent in the time series data so the Instability Index suggested by Cuddy-Della Valle (1978) was used as a better measure of variability.

$$II = CV \times \sqrt{(1 - \bar{R}^2)}$$

Where,

II = Instability index

$\bar{R}^2$ = Adjusted coefficient of multiple determination

CV = Co-efficient of variation

DECOMPOSITION ANALYSIS

To estimate the effect of area, productivity and their interaction on the overall growth performance of soybean production, decomposition approach was used (Agarwal and Singh, 2014). The algebraic form of equation is given below:

$$P = A_0(Y_n - Y_0) + Y_0 (A_n - A_0) + \Delta A \Delta Y$$

$$1 = [(Y_0\ \Delta A)/P] + [(A_0\ \Delta Y)/P] + [(\Delta A \Delta Y)/P]$$

Where,

P = Change in production

A_0 = Area in base year

A_n = Area in current year

Y_0 = Yield in base year

Y_n = Yield in current year

ΔA = Change in area ($A_n - A_0$)

ΔY = Change in yield ($Y_n - Y_0$).

RESULTS AND DISCUSSION

The percentage change over the year during the study period for the production of soybean in Madhya Pradesh had a positive value except five years i.e. 1998-99, 2000-01, 2002-03, 2004-05, and 2011-12. This negative growth was mainly due to negative productivity growth. The highest positive growth was observed in 2003-04 i.e. 74.01 per cent which was highly attributed by productivity growth (73.11 per cent) and contribution of area growth was neglible for the same i.e. 0.52 per cent. (Table 1)

The degree of relationship between area and production of soybean crop is measured by correlation test. It was observed that correlation coefficient (r) of area and production of soybean over the period i.e. 1996-97 to 2012-13 is 0.91 (Table 2), which is highly significant at one per cent level implying that the production of soybean crop is highly influenced by increment area.

The growth performance of soybean production in Madhya Pradesh is presented in Table 3. The compound growth trend analysis for soybean area, production and productivity was found to be positive and significant during the study period i.e. 1996-97 to 2012-13. Soybean area, production and productivity

Table 1
Area Production and Productivity of Soybean in Madhya Pradesh Over the period from 1996-97 to 2012-13

Year	*Area*	*% change*	*Production*	*% change*	*Productivity*	*% change*
1996-97	4165.80		3946.20		947.29	
1997-98	4469.70	7.30	4843.30	22.73	1083.59	14.39
1998-99	4588.70	2.66	4637.00	-4.26	1010.53	-6.74
1999-2000	4439.40	-3.25	4741.60	2.26	1068.07	5.69
2000-01	4475.50	0.81	3435.20	-27.55	767.56	-28.14
2001-02	4449.70	-0.58	3735.00	8.73	839.38	9.36
2002-03	4190.60	-5.82	2673.70	-28.41	638.02	-23.99
2003-04	4212.40	0.52	4652.60	74.01	1104.50	73.11
2004-05	4485.30	6.48	3747.10	-19.46	835.42	-24.36
2005-06	4255.30	-5.13	4500.70	20.11	1057.67	26.60
2006-07	4756.60	11.78	4784.90	6.31	1005.95	-4.89
2007-08	5024.40	5.63	5480.50	14.54	1090.78	8.43
2008-09	5124.00	1.98	5849.80	6.74	1141.65	4.66
2009-10	5349.50	4.40	6406.30	9.51	1197.55	4.90
2010-11	5559.90	3.93	6669.80	4.11	1199.63	0.17
2011-12	5669.10	1.96	6280.60	-5.84	1107.87	-7.65
2012-13	6031.70	6.40	7800.10	24.19	1293.00	16.71

in the state were growing with a compound growth rate of 1.9, 3.8 and 1.8 per cent per annum respectively. Growth performance of soybean production during study period was 3.8 per cent per annum, which is mainly attributed by area and productivity growth.

For the estimation of inter annual fluctuation in area, production and productivity of soybean in Madhya Pradesh, the Instability index was used. It is well known that fluctuation in area and production are interrelated, if other factor remain constant than the increment in area gives the highest production but variation in productivity may be due to many reasons such as weather conditions, technological changes etc. Some exogenous factor like price also brings the variation in production of crop. The coefficient of variation and Instability Index in area, production and productivity of soybean for Madhya Pradesh is presented in Table 4. It was analyzed that inter-annual fluctuation was highest in case of soybean production i.e. 19.66 followed by variation in productivity (14.71) and area (6.78) during 1996-97 to 2012-13. It was concluded that the variability in production is the compound result of fluctuation in productivity and area.

To determine how contribution of area, productivity and their interaction are responsible for the overall growth of soybean production in Madhya Pradesh during the study period, decomposition analysis was carried out. It was revealed that the area under soybean production in Madhya Pradesh plays a major role in growth of soybean production due to area effect (55.96 per cent) (Table 5). The productivity effect was influencing soybean production in the state by 33.72 per cent, whereas interaction effect was very low to enhance soybean production in the state. The analysis suggested that area was one of the important factors in overall development of soybean production followed by productivity effect.

Table 2
Relationship between Area and Production of Soybean

criteria	*Value of correlation*	*P (T<t) two- tail*
Area Vs Production	0.91	0.01

Table 3
Compound Growth Rate in Area, Production and Productivity of Soybean Crop in Madhya Pradesh

Particulars	*Area*	*Production*	*Productivity*
CGR (%)	1.9*	3.8*	1.8**
R^2 (%)	70.4	49.1	26.0
t value	5.96	3.80	2.29

* : Significant at 1 per cent level of significance
** : significant at 5 per cent level of significance
CGR: Compound Growth Rate

Table 4
Instability in Area, Production and Productivity of Soybean

Statistical tools	*Area*	*Production*	*Productivity*
AM	4779.27	4952.02	1022.85
SD	577.06	1321.46	170.02
CV (%)	12.07	26.68	16.62
Instability Index	6.7	19.66	14.76

Table 5
Share of Area Effect, Productivity Effect and Interaction Effect on Production Growth of Soybean Crop

	Area effect (%)	*Productivity effect (%)*	*Interaction effect (%)*
Soybean production	55.99	33.72	10.29

CONCLUSION

The above discussion throws light on the fact that the growth performance of area, production and productivity of soybean crop in the state was positive and statistically significant. Inter annual fluctuation in soybean production was 19.66 which was mainly augmented by unstable productivity level. The area under soybean production in Madhya Pradesh was one of the important factors which influenced the overall growth of soybean production in the state during the study period. Therefore it is necessary to increase the sustainable soybean production in state and to take up productivity enhancing measures in soybean crop like varietal improvement, appropriate technologies.

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