RESEARCH PAPER

Decomposition analysis of soybean in Amravati division

■ **P. S. PARDHI, D. H. ULEMALE AND S. M. SARAP**

ABSTRACT

In this study an attempt has been made to study the growth and instability of soybean crop in Amravati division. The study was based on secondary data on area, production and productivity of soybean crop collected from various government publications. The study revealed that compound growth rate for area and production of soybean was recorded very high during period I. The co-efficient of variation with regards to area and production (37.59% and 22.23 %) were lowest in Amravati district. However, Coppock's instability index with regards to area and productivity (13.01% and 18.84 %) were lowest in Amravati division as a whole. At overall period, the area effect was most stronger factor for increasing production of soybean in all the districts and division as a whole.

KEY WORDS : Compound growth rates, Co-efficient of variation, Instability, Production, Productivity

Agriculture is an important sector of the Indian economy, accounting for 14 per cent of the nation's GDP, about 11 per cent of its exports, about half of the population still relies on agriculture as its principal source of income and it is a source of raw material for a large number of industries. In India during 2012-13 area, production and productivity of soybean was 10.84 Mha, 14.68 Mt and 1354 kg/ha, respectively. In Maharastra during 2012-13 area, production and productivity of soybean 3063900 ha, 4689800 t and 42015 kg/ha, respectively. Vidarbha during 2012-13 area, production and productivity of soybean 1745300 ha, 2504300 t and 13440 kg/ha, respectively. In Amravati division during 2012-13 area, production and productivity of soybean 11771 ha, 19198 t and 8319 kg/ha, respectively.

The present study was undertaken with following objectives :
– To study the growth rates in area, production and productivity of soybean crop.
– To study instability in rates in area, production and productivity of soybean crop.
– To study contribution of area and yield on production of soybean crop.

METHODOLOGY
Selection of crop :

For the present study soybean crop was selected. This crop accounted 44.29 per cent share to the gross cropped area of Amravati division and also play important role in cropping pattern of Amravati division.

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Selection of period :

In case of soybean as this crop was introduced in the year 1980's. The sufficient data was not available in the study area for the first period analysis *i.e.*1983-84 to 1992-93. Therefore, only two periods 1993-94 to 2002-03 and 2003-04 to 2012-13 were selected for the analysis of area, production and productivity of soybean crop.

Nature and source of data :

Data used for the present study was collected from various published sources. Time series secondary data on the area, production and productivity of soybean crop and other relevant data were obtained from various Govt. published sources.

Analytical techniques employed for analyzing the data :

The present study is based on time series secondary data of soybean crop in Amravati division.

Growth rate analysis :

The compound growth rates of area, production and yield for soybean was estimated for two sub periods. The period I was 1993- 94 to 2002- 03 and period II was 2003-2004 to 2012-13.

The district-wise compound growth rates were estimated to study the growth. It was estimated with the following exponential model.

$$Y = ab^t$$
$$Log\ Y = log\ a + t\ log\ b$$
$$CGR\ (r) = [Antilog(log\ b)\ -1]\ x\ 100$$

where,

CGR = Compound growth rate

t = Time period in year

y = Area/ production / productivity

a and b = Regression parameters.

Instability analysis :

To measure the instability in area, production and productivity, an index of instability was used as a measure of variability.

The co-efficient of variation (CV) was calculated by the formula :

$$C\,V\,(\%) = \frac{Standard\ deviation}{Mean} x\,100$$

The simple co-efficient of variation (CV) often contains the trend component and thus, overestimates the level of instability in time series data characterized by long-term trends. To overcome this problems, we used the instability index (II) given by Coppock's instability index of variation.

Coppock's instability index is a close approximation of the average year to year per cent variation adjusted for trend.

The algebraic form of equation is :

$$CII = \sum \left[(Anti\ log\sqrt{V\ log}) - 1\ x\ 100 \right]$$

$$V\ log = \sum \frac{[log\frac{(x_{t+1})}{x_t} - m]^2}{N-1}$$

where,

X_t = Area/ production/ productivity in the year 't'

N = Number of year

m = Arithmetic mean of difference

V log = Logarithmic variation of the series.

Decomposition analysis :

To measure the relative contribution of area, yield to the total output change for the major crops, Minhas (1964), the decomposition analysis model as given below was used. Sharma (1977) redeveloped the model and several research workers (Kalamkar *et al*., 2002) used this model and studied growth performance of crops on state. The method state that if A_0, P_0 and Y_0, respectively area, production and productivity in base year and A_n, P_n and Y_n are values of the respective variable in n^{th} year item.

$$Po = Ao\ x\ Yo\ and$$
$$Pn = A_n\ x\ Y_n \qquad\qquad .... (1)$$

where,

A_o and A_n represent the area and Y_o and Y_n represents the yield in the base year and n^{th} year, respectively.

$$P_n - P_o =\ UP,$$
$$A_n - A_o = UA$$
$$Y_n - Y_o = UY \qquad\qquad ....(2)$$

From equation (1) and (2) we can write

$$P_o + UP = (A_o + UA)\ (Y_o + UY)$$

Hence,

$$P = \frac{A_0\ Y}{P} x\ 100 + \frac{Y_0\ A}{P} x\ 100 + \frac{Y\ A}{P} x\ 100$$

Production = Yield effect + Area effect + Interaction effect

Thus, the total change in production can be decomposed into three components *viz.,* yield effect, area effect and the interaction effect due to change in yield

and area.

ANALYSIS AND DISCUSSION

The results obtained from the present investigation have been presented in the following sub heads :

Growth performance :

In this study, the growth in area, production and productivity of soybean crop was estimated using compound growth rates as indicated in the methodology. In this analysis, the general growth performance of the soybean crop in Western Vidarbha zone (*i.e.* Amravati division) was examined by fitting exponential growth function with time normalization on area, production and productivity. The growth performance of the crop pertaining to two periods and overall is discussed separately for each district as under.

Growth performance of soybean :

The growth performance of soybean pertaining to two period and overall was presented in the Table 1, which revealed due to introduction of soybean in the region during period I, the growth in area, production and productivity was recorded positive in all district except in productivity for Amravati district. The highest increasing trend in area, production and productivity was recorded in Akola district *i.e.* 35.34 per cent per annum, 38.70 per cent per annum and 13.84 per cent per annum, respectively. The lowest increase in area was recorded in Amravati district *i.e.* 13.69 per cent per annum. Statistically area of all district and Amravati division as a whole shows significance at 1 per cent level. Production of Akola, Buldhana, Yavatmal districts and Amravati division as a whole shows significance at 1 per cent level.

In case of production of Amravati district shows significance at 5 per cent level. Productivity of Akola district was significant at 1 per cent level of significance and Amravati division as a whole was significant at 5 per cent level.

The result in the period II, revealed that there was positive growth rate in area, production and productivity *i.e.* 9.33 per cent, 14.85 per cent, 4.07 per cent in Amravati district 9.45 per cent, 12.34 per cent, 3.94 per cent in Akola district, 11.73 per cent, 15.86 per cent, 3.43 per cent in Buldhana district, 7.05 per cent, 10.87 per cent and 2.79 per cent per annum in Yavatmal district. In the Amravati division as a whole, in this period growth rate of area, production and productivity has registered positive. Statistically, compound growth rate of area of Amravati, Akola and Buldhana district was significant at 1 per cent level, Yavatmal shows significant in area at 5 per cent level. Growth rate in production for all district and Amravati division as a whole shows significance at 5 per cent level.

The growth rate was also worked for the overall period (pooled period of 20 years) for soybean where almost all found positive. Statistically, compound growth rate in area and production, all districts showed significance at 10 per cent level and productivity of Akola district was significant at 5 per cent level. Whole Amravati division showed significance in area and production with 10 per cent level of significance.

In whole Amravati division, Akola district showed highest increase in area, production and productivity in soybean (Raghuvanshi *et al.,* 2008).

Instability in soybean :

One should not be obvious of instability by taking the growth rates only. Because the growth rates will

Table 1 : Districtwise compound growth rate for soybean						
Particulars		Amravati	Akola	Buldhana	Yavatmal	Amravati division
Period I	Area	13.69***	35.34***	20.34***	21.85***	19.80***
	Production	12.89**	38.70***	21.30***	23.38***	21.25***
	Yield	-0.70	13.84***	0.70	1.26	4.65**
Period II	Area	9.33***	9.45***	11.73***	7.03**	9.29***
	Production	14.85**	12.34**	15.86**	10.87**	12.96**
	Yield	4.07	3.94	3.43	2.79	3.43
Overall period	Area	8.60***	21.27***	17.61***	15.95***	14.35***
	Production	8.57***	21.09***	17.68***	13.03***	13.81***
	Yield	0.24	3.84**	0.06	-2.30	0.75

*, ** and *** indicate significance of value at P=0.01, 0.05 and 0.1, respectively

explain only the rate of growth over the period, whereas, instability will Judge, whether the growth performance is stable or unstable for the period for the pertinent variable.

In Amravati district co-efficient of variation for the area is 37.59 per cent per annum where as co-efficient of variation for the yield 22.23 per cent per annum. Highest co-efficient of variation for area, production and yield was found in Akola district *i.e.* 73.62 per cent per annum, 79.08 per cent per annum an 43.58 per cent per annum, respectively (Table 2). As a whole Amravati division has got co-efficient of variation of 48.00 per cent, 53.63 per cent and 23.44 per cent per annum, respectively for the area, production and productivity. In the same way CII was found highest for area, production and productivity in the Yavatmal district *i.e.* 20.29 per cent, 32.83 per cent and 25.36 per cent per annum, respectively. On the other hand it shows CII in the range of 5 to 35 per cent per annum which indicate inconsistent in the area, production and productivity of soybean in all the districts of Amravati division.

On the other hand high production instability than area and yield instability was estimated for all the districts of Western Vidarbha zone as well as a whole have contributed towards production fluctuation in the period I (Agarwal and Singh, 2014 and Pal, 1989).

Instability in area and production was found to be decreased in the period II for all districts and instability

in yield was found to be increasing in period II for all districts. Instability in area is increasing only in case of Buldhana district *i.e.* 32.04 per cent per annum. Similarly instability in production was found to be increasing in case of Buldhana district *i.e.* 61.69 per cent per annum. CII was highest for area, production and yield in Yavatmal district *i.e.* 22.61 per cent 42.69 per cent and 43.68 per cent per annum, respectively. In this period least CV and CII were obtained for Akola and Buldhana districts *i.e.* 27.85 per cent and 13.05 per cent per annum, respectively.

During the overall period *i.e.* 20 years as a whole, Amravati district recorded lowest degree of instability in area and production *i.e.* 48.56 per cent and 67.05 per cent per annum, respectively. Similarly in yield Amravati division as a whole was recorded with lowest instability *i.e.* 33.95 per cent per annum. Whereas highest instability in area was recorded in Buldhana district *i.e.*77.83 per cent per annum, highest instability in production was recorded in Buldhana district *i.e.* 99.93 per cent per annum whereas in yield highest instability was recorded in Akola district *i.e.* 44.86 per cent per annum. In production Amravati district recorded lowest CV *i.e.* 67.05 per cent per annum. Lowest CII for production and yield were found in Amravati division as a whole *i.e.* 34.14 per cent per annum and 33.76 per cent per annum, respectively. On the other hand lowest CII for area was found in Buldhana district *i.e.*15.68 per cent

Name of district	Particulars	Period I		Period II		Overall period	
		CV	CII	CV	CII	CV	CII
Amravati	Area	37.59	15.47	31.40	18.48	48.56	19.20
	Production	56.14	54.44	55.56	42.28	67.05	45.63
	Yield	22.23	28.13	40.40	39.34	34.37	34.35
Akola	Area	73.62	18.58	27.85	14.26	77.12	24.03
	Production	79.08	18.47	51.71	40.97	91.17	35.76
	Yield	43.58	24.11	43.97	43.07	44.86	40.68
Buldhana	Area	55.95	16.44	32.04	13.05	77.83	15.68
	Production	65.80	21.21	61.69	46.90	99.93	37.58
	Yield	22.63	22.55	44.71	48.12	37.89	37.89
Yavatmal	Area	48.51	20.29	28.75	22.61	71.41	25.05
	Production	60.02	32.83	52.06	42.69	74.96	40.39
	Yield	25.67	25.36	44.16	43.68	35.97	34.35
Amravati division	Area	48.00	13.01	28.43	15.51	66.26	16.95
	Production	53.63	21.22	52.88	39.61	79.55	34.14
	Yield	23.44	18.84	42.34	41.61	33.95	33.76

Table 2 : Districtwise instability indices for soybean

per annum. Highest CII for area was found in Yavatmal district *i.e.* 25.05 per cent, for production was found in Amravati district *i.e.* 45.63 per cent per annum and for yield was found in Akola district *i.e.* 40.68 per cent per annum. The analysis indicated the inconsistency in terms of area, production and productivity of soybean during overall period of 20 years.

Decomposition analysis of soybean :

A quantitative assessments of contribution of the various factors to growth of crop at districts and Amravati division level is helpful in reorienting the programmes and setting priorities of agricultural development so as to achieve higher growth rates of agricultural production. There are many factors which affect the growth of crop output. These factors believed to affect the production of crop *viz.,* area, yield and their interaction have been considered in present study. The result of decomposition scheme was worked out for three sub period and overall period.

During period I, result clearly indicated that yield effect has got domination over the area effect only in Amravati and Buldhana district. In Amravati division as a whole area effect was found only 67.54 per cent where as yield effect was 72.52 per cent and interaction effect was -40.06 per cent. Lowest area effect was found in the Amravati district 28.37 per cent and highest yield effect was found in Buldhana district with 100.93 per cent. In all the districts yield effect was positive except Yavatmal district which shows negative yield effect *i.e.*-4.79 per cent. It also recorded in this period that interaction effect was positive in Amravati, Akola and Buldhana districts except Yavatmal and Amravati division as a whole. That means the production of soybean in Amravati division is increased due to both increased in

area and yield.

Period II was also recorded as like the period I bit area effect has been more prominent over yield and interaction effects except, Amravati and Buldhana districts. In Amravati division area effect, yield effect and interaction effect were recorded 70.33 per cent, 42.52 per cent and -12.75 per cent, respectively. Highest area effect was seen in Akola district *i.e.* 161.04 per cent. Akola district and Amravati division whole were showed negative interaction effect *i.e.* -50.25 per cent and -12.75 per cent, respectively. Highest yield effect and lowest area effect was recorded in Amravati district *i.e.* 174.38 per cent and -92.41 per cent, respectively. So, the result indicated that in this period area, yield and interaction effect was highly fluctuating (Table 3).

During overall period, it is observed that yield effect not increased in proportion to area effect. Positive area effect was recorded in all four districts with highest area effect was recorded in Amravati district *i.e.* 95.20 per cent. Similarly positive yield and interaction effects were recorded with highest yield effect in Amravati district *i.e.* 1.28 per cent and interaction effect in Akola district *i.e.* 60.59 per cent, respectively (Sadeesh *et al.*, 2006 and Shende *et al.*, 2011).

At overall level in all districts of Amravati division and in Amravati division as a whole the production of soybean in increased due to increased in area.

Conclusion :

Thus, it is concluded from the above study that the compound growth rate for area under soybean has decreased in all the districts of Amravati division. However, the growth rate for production has also decreased in all the districts of Amravati division except for Amravati districts in period II. Compound growth

Period	Particulars	Amravati	Akola	Buldhana	Yavatmal	Amravati division
Table 3 : Per cent contribution of area, yield and their interaction for increasing production of soybean						
Period I	Area effect	28.37	69.03	-7.86	115.6	67.54
	Yield effect	44.80	5.28	100.93	-4.79	72.52
	Interaction effect	26.83	25.69	6.93	-10.81	-40.06
Period II	Area effect	-92.41	161.04	-16.44	38.97	70.23
	Yield effect	174.38	-10.79	105.17	3.87	42.52
	Interaction effect	18.03	-50.25	11.27	57.16	-12.75
Overall Period	Area effect	95.20	39.14	91.35	55.86	70.38
	Yield effect	1.28	0.27	0.19	0.51	0.57
	Interaction effect	3.52	6.59	8.46	43.63	29.05

rate for yield has increased in period III as compared to period I and overall period. At overall period area effect was most responsible factor for increasing production of soybean in Amravati division.

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