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**PC Tambe**

Ph.D., Scholar, Post Graduate Institute, Department of Agriculture Economics, MPKV, Rahuri, Maharashtra, India

**Dr. AV Gavali**

Associate Professor, Post Graduate Institute, Department of Agriculture Economics, MPKV, Rahuri, Maharashtra, India

**Dr. DB Yadav**

Head of Department, Department of Agriculture Economics, MPKV, Rahuri, Maharashtra, India

## Growth and instability in area, production and productivity of soybean in Maharashtra

PC Tambe, Dr. AV Gavali and Dr. DB Yadav

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**Abstract**

India is the fourth largest producer of oilseeds accounting for about 19% of the global area, 2.7% of global production in the world. Soybean is the leading oilseed produced globally. The soybean (*Glycine max*) is a species of legume, popularly known as the “golden bean” or “miracle bean” of the 21<sup>st</sup> century. The study has estimate the growth performance and instability in area, production and productivity in soybean in Maharashtra. The performance of soybean was quite satisfactory in respect of the area expansion and production in Western Maharashtra, Marathwada and Vidarbha region from the introduction of soybean in Maharashtra. The area under chickpea in Maharashtra state was found to be more stable and consistent rather than production and productivity.

**Keywords:** Soybean, trends, area, production, growth, instability

**Introduction**

The soybean (*Glycine max*) is a species of legume, popularly known as the “golden bean” or “miracle bean” of the 21<sup>st</sup> century. The plant is classed as an oilseed rather than a pulse. Soybean is an important source of high quality but inexpensive protein and oil. Soybean is the leading oilseed produced globally. India ranks 5<sup>th</sup> in the list of major soybean producing countries of the world by producing about 3-4 per cent of the global production. Soybean is fastest growing crop in India which replaced the crops like maize, cotton and pulses. Maharashtra stand second in soybean production after Madhya Pradesh. The area under soybean in Maharashtra 40 lakh ha.

**Objective:** To estimate the trends and instability of soybean in Maharashtra.

**Methodology**

This study was undertaken in Maharashtra state. Three regions of Maharashtra viz; Western Maharashtra, Marathwada and Vidharbha were covered under present study.

**Data**

Secondary time series data of yield were collected from various sources viz; Season and Crop Reports, Department of Economics and Statistics (DES), Government of Maharashtra. The data were collected for the years from 1986-87 to 2017-18.

**Analytical tools****Compound Growth Rate**

Compound growth rates of area, production and productivity of soybean were estimated by using non-linear equation.

$$Y = ab^t$$

**Where**

Y = Area, production and productivity

t = Time period

b = Regression coefficient

a = Intercept

**Corresponding Author:****PC Tambe**

Ph.D., Scholar, Post Graduate Institute, Department of Agriculture Economics, MPKV, Rahuri, Maharashtra, India

$$\text{CGR} = [(\text{Antilog } b_1) - 1] * 100$$

### Instability Analysis

Instability in the area, production, productivity of soybean was studied using two measures of instability such as Coefficient of Variation and Cuddy-Della Valle index.

$$\text{C.V} = (\text{standard deviation} / \text{mean}) * 100$$

Even though Coefficient of Variation (C.V) is the simplest measure of instability, it over-estimates the level of instability in time series data which are characterized by long-term trends.

The Cuddy Della Valle Index de-trends shows the exact direction of the instability. Hence, it is a better measure to capture instability in agricultural production. A low value of this index indicates low instability in area, production, productivity and vice-versa. The Cuddy-Della Valle index corrects the CV as:

$$\text{Cuddy - Della Valle Instability Index (\%)} = \text{CV} \sqrt{(1 - R^2)}$$

### Where

C.V is the Coefficient of Variation in per cent, and  $R^2$  is the coefficient of determination from a time trend regression adjusted for its degrees of freedom.

The ranges of instability are as follows: Low instability = between 0 to 15

Median instability = greater than 15 and lower than 30

High instability = greater than 30

### Results and Discussion

Performance soybean was studied with the help of compound growth rate and instability index. The Time series data on area (A), production (P) and productivity (Y) were divided into four sub periods as period I (1987-88 to 1996-97), period II (1997-98 to 006-07), period III (2007-08 to 2017-18) and overall period (1987-88 to 2017-18).

The region wise annual compound growth rates of area, production and productivity for the period of 30years (i.e. from 1987-88 to 2017-18) of soybean for overall Maharashtra state were calculated and depicted in Table1. It is revealed from the table that, the significant improvement in productivity by 16.94 and 2.11 per cent during the period I and overall period, respectively has non-significant declined productivity by 1.21 per cent and 1.7 per cent during period II and period III, respectively and significantly increased in area, production and productivity by 10.96, 13.31 and 2.11 per cent, respectively during the overall period under study in western Maharashtra region. A better picture of growth in area, production and productivity of soybean could be observed in western Maharashtra region

In case of *Marathwada*, significant growth in production by 50.91, 49.76 and 26.84 per cent, respectively during period I followed by overall period and period I was resulted due to significant expansion in area by 41.95, 52.96 and 27.04 per cent, respectively and significant improvement in productivity by 6.31 in period I, while non-significant improvement by 2.09, 6.51 and 0.16 during period II, period III and overall period, respectively. While in period III, area is significant and production and productivity were non-significant. Thus, the area expansion and productivity improvement have influenced the production of soybean in *Marathwada* region. Larger holding size and higher share of cultivable lands in *Vidarbha* region resulted into allocation of more acreage for soybean, which could be seen by higher and significant growth in area by 27.15, 9.08 and 10.83 per cent, respectively during period I, period II and overall period under study. The production of soybean has also increased significantly by 39.94, 8.95 and 11.61 per cent, respectively during period I, period II and overall period while area and production were non-significant in period-III. The increase in productivity of soybean was significant by 10.06 per cent in period I only while non-significant in all other period under study. Thus, in *Vidarbha* region, the enhanced production of soybean was mainly attributed due to area expansion as well as productivity enhancements.

The same picture of changes in area, production and productivity of soybean can be seen for overall Maharashtra state. During period I, the area, production and productivity has increased significantly by 30.12, 45.57 and 11.87 per cent, respectively. The area was positively significant in period II, period III and overall period i.e. 11.18 per cent, 6.03 per cent and 12.98 per cent, respectively while production were non-significant in period II and period III and significant in overall period. The productivity was non-significant in period II, period III and overall period. Thus, for the overall state, the increase in the production of soybean was the combined effect of area expansion and productivity enhancements.

To sum up, it could be concluded from the above discussion that, the growth of area, production and productivity was positive and significant for the overall period (1987-2017) in western Maharashtra. It indicates that the production of soybean was increased by both area expansion and productivity improvement in this region. However area and production was positive and significant in the *Marathwada*, *Vidharbha* and Maharashtra state as whole indicating that the production of soybean was increases only due to area expansion. Among the different periods the growth in area, production and productivity was not satisfactory in third period (2007-08 to 2017-18). It was mainly due to the irratic and irregular rainfall, dry spells and drought years during the period 2010-11 to 2017-18.

**Table 1:** Annual CGR of area, production and productivity for soybean in Maharashtra (1987-88 to 2017-18)

| Particulars                | Area      | Production | Productivity |
|----------------------------|-----------|------------|--------------|
| <b>western Maharashtra</b> |           |            |              |
| Period I                   | 40.93 *** | 64.81 ***  | 16.94 ***    |
| Period II                  | 8.03 ***  | 6.73 **    | -1.21        |
| Period III                 | 2.24 ***  | 0.5        | -1.7         |
| Overall period             | 10.96 *** | 13.31 ***  | 2.11 ***     |
| <b>Marathwada</b>          |           |            |              |
| Period I                   | 41.95 *** | 50.91***   | 6.31 ***     |
| Period II                  | 52.96 *** | 49.76 ***  | -2.09        |
| Period III                 | 7.25 ***  | 0.27       | -6.51        |
| Overall period             | 27.04 *** | 26.84 ***  | -0.16        |
| <b>Vidarbha</b>            |           |            |              |

|                    |           |           |           |
|--------------------|-----------|-----------|-----------|
| Period I           | 27.15 *** | 39.94 *** | 10.06 **  |
| Period II          | 9.08 ***  | 8.95 **   | -0.11     |
| Period III         | -1.05     | -3.96     | -2.95     |
| Overall period     | 10.83 *** | 11.61 *** | 0.7       |
| <b>Maharashtra</b> |           |           |           |
| Period I           | 30.12 *** | 45.57 *** | 11.87 *** |
| Period II          | 11.18 *** | 6.44      | -4.27     |
| Period III         | 6.03 ***  | 2.11      | -3.69     |
| Overall period     | 12.98 *** | 13.74 *** | 0.67      |

**Note:** \*, \*\* and \*\*\* Significant at 10, 5 and 1 per cent level, respectively,

**Source:** Epitome, Commissionerate of Agriculture, Govt. of Maharashtra, 2017

The Coefficient of variation and Cuddy Della and Vella instability index is used to measure the consistency and instability in area, production and productivity of soybean crop.

Coefficient of variation and Cuddy Della and Vella instability index of soybean for the period 1987-88 to 2017-18 for district, region and entire Maharashtra have been estimated and presented in Table 2.

Table 2 showed that for overall period (1987-2017) area under soybean is highly fluctuating and instable in all the districts of Maharashtra except Latur district. In case of chickpea production, coefficient of variation was instable during overall period (1980-2017) for all the districts of Maharashtra. The production is mainly depending on area under chickpea crop and productivity. However, the area is fluctuating in all the districts. The productivity was stable in the district *viz*; Nashik, Pune and Amravati district of the State.

In all the districts of Marathwada region, low to medium level

of instability in area, production and yield was recorded except in Osmanabad district where it was recorded high in production of soybean i.e.120 per cent. Area of soybean was relatively more stable than yield in the study area.

The Coefficient of variation and Cuddy Della and Vella instability index is used to measure the consistency and instability in area, production and productivity of soybean crop.

Coefficient of variation and Cuddy Della and Vella instability index of soybean for the period 1987-88 to 2017-18 for regions and entire Maharashtra have been estimated and presented in Table 2.

Table 2 showed that for overall period (1986-2017) area under soybean is medium instability in all the regions of Maharashtra. In case of soybean production, coefficient of variation was instable during overall period (1986-2017) for all the regions of Maharashtra. The production is mainly depending on area under soybean crop and productivity. However, the productivity is fluctuating in all the districts.

**Table 2:** Instability in area, production and productivity of Soybean in Maharashtra

| Period  |        | District            |       |       |            |        |       |           |       |       |             |       |       |
|---------|--------|---------------------|-------|-------|------------|--------|-------|-----------|-------|-------|-------------|-------|-------|
|         |        | Western Maharashtra |       |       | Marathwada |        |       | Vidharbha |       |       | Maharashtra |       |       |
|         |        | A                   | P     | Y     | A          | P      | Y     | A         | P     | Y     | A           | P     | Y     |
| I       | CV (%) | 72.35               | 86.52 | 43.81 | 102.66     | 106.32 | 23.11 | 62.82     | 80.73 | 32.45 | 65.89       | 82.64 | 33.5  |
|         | CDVI   | 22.97               | 29.88 | 21.1  | 46.53      | 41.7   | 13.68 | 9.56      | 22.76 | 22.06 | 12.28       | 22.26 | 19.14 |
| II      | CV (%) | 28.29               | 24.9  | 19.88 | 100.01     | 95.68  | 25.01 | 29.02     | 33.55 | 17.9  | 36.03       | 35.55 | 41.88 |
|         | CDVI   | 12.98               | 18.12 | 19.57 | 17.35      | 27.12  | 24.2  | 11.82     | 22.26 | 17.9  | 12.93       | 30.13 | 40.01 |
| III     | CV (%) | 10.22               | 16.14 | 12.47 | 22.89      | 51.01  | 52.09 | 8.84      | 43.2  | 45.64 | 19.87       | 35.33 | 38.78 |
|         | CDVI   | 6.38                | 16.05 | 11.49 | 4.2        | 51.01  | 49.35 | 7.94      | 41.95 | 45.03 | 8.86        | 34.9  | 37.62 |
| Overall | CV (%) | 61.26               | 63.56 | 27.51 | 106.49     | 121.07 | 36.61 | 63.23     | 73.79 | 34.76 | 77          | 82    | 33.1  |
|         | CDVI   | 29.44               | 36.8  | 23.74 | 30.01      | 43.72  | 36.59 | 26.76     | 42.86 | 34.35 | 23.36       | 38.89 | 32.72 |

## Conclusion

The performance of soybean was quite satisfactory in respect of the area expansion and production in Western Maharashtra, Marathwada and Vidharbha region from the introduction of soybean in Maharashtra. The area under chickpea in Maharashtra state was found to be more stable and consistent rather than production and productivity.

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