### ****Original research article****

### ****DYNAMICS IN PRODUCTION OF SOYBEAN IN YAWATMAL DISTRICT OF MAHARASHTRA,India****

### ****ABSTRACT****

### Yawatmal is among the major Soybean producing districts in the Maharashtra state. In year 2021-22, Yawatmal contributed to 6.26 per cent of total area under Soybean cultivation and 5.23 per cent of total production of Soybean in Maharashtra which is among the largest producer states of Soybean crop in India. In year 2022-23, Yawatmal had the total area under Soybean cultivation of 282912 hectare and the production of 230745 tonnes. However the yield was observed to have considerably decreased to 0.82 ton per hectare in 2022-23 from 1one ton per hectare in 2021-22. This research concerns with the various factors responsible for the change/ increase or decrease in production of Soybean in Yawatmal district. The present research was aims at analysing the changes in soybean production. **The study was carried out in Yawatmal district of Maharashtra for the period of 15 years from 2007-08 to 2021-22. The study used time series secondary data on area, production and Yield of Soybean in Yawatmal district collected from authorized government sources for the duration of 15 years. The additive model of decomposition was incorporated with a bit of improvement wherein, the contribution of each of area and yield effect over the change in production viz., increase/decrease in Soybean production was studied. The present research was worked out with the view of determining the drivers behind the production of Soybean in Yawatmal district of Maharashtra. In the present study it was revealed that, the yield effect was the major contributing factor during the overall study period which was observed from the average annual growth rate of 15.04 percent and the contribution of 85.58 percent by yield of Soybean crop in Yawatmal district of Maharashtra. Whereas the average annual growth in area was observed to be negative at -2.92 percent with the contribution of 14.42 percent over the study period both collectively resulted in the average annual growth of Production to be 12.12 percent. The crop was found to have unstable yield over the years and more often the yield derived was very low from the very high coefficient of variations and thus it was suggested to increase and stabilizing the yield of Soybean crop in the select district.** The present study concluded that, the increase or decrease in Soybean production was due to the yield effect in Yawatmal district of Maharashtra throughout the study period and the suggestions were made in response as to increasing and stabilizing the yield of Soybean crop to improve the overall performance of Soybean in Maharashtra.

### Keywords: Decomposition, area effect, yield effect, Soybean production, growth.

**1. INTRODUCTION**

Soybean is a crucial crop in Maharashtra as well as India. Soybean alone contributed to kharif oilseed crop production of 12.98 million tonnes under the area of 12.146 million hectare (Department of Agriculture and farmers welfare, 2024). **Yavatmal district** plays a key role in the state's production. In the year **2021-22**, Yavatmal cultivated **287432 hectares** of soybean, yielding **287875 tonnes** with a productivity of **one ton per hectare**. However, the area decreased to 282912 hectare which also resulted in decrease in production to 230745 tonnes in 2022-23. Yawatmal district alone contributes to 6.26 percent of total area under Soybean cultivation and 5.23 percent of total Soybean production in Maharashtra. This positions Yavatmal as a major contributor to Maharashtra's soybean output, making it an important region for understanding production dynamics. The Soybean crop is widely cultivated for its oil and protein contents along with its industrial use as well as in animal feeds. This study employs **decomposition analysis** using the **Additive decomposition model** to dissect the factors influencing changes in soybean production in Yavatmal. Specifically, it examines the contributions of **area effect** and **yield effect**, providing insights into the role of area expansion and yield improvements in shaping production trends. Yavatmal district shows its significance in this research in its substantial agricultural output, making it a representative case for the broader trends in soybean farming in Maharashtra. By applying this decomposition model, the study aims to identify the key drivers of the change in production, offering valuable projections and recommendations for enhancing productivity and formulating targeted agricultural policies.

**2. MATERIAL AND METHODS**

 The study was based on the time series secondary data on area, production and yield of Soybean crop in Yawatmal District of Maharashtra. The data was collected for 15 years from 2007-08 to 2021-22. The previous works of Sharma (2016) and Tiwari et al. (2022) used growth rate analysis to determine the growth of Soybean crop production as well as defined the change in area under cultivation as well as yield of Soybean in Maharashtra and other major Soybean producing states of India. Whereas, Datarkar et al. (2016) and Pathrikar et al. (2022) calculated the growth rate of Soybean area, production and yield of Soybean in major Soybean producing regions of Maharashtra. However, some studies viz., Ninawe *et al.* (2020), Datarkar *et al.* (2017), Hazari (2015) and Tayade *et al.* (2013) used the decomposition analysis to determine the effect of area and yield as well as their interaction on the production of Soybean in Maharashtra. The present research was aimed to study the dynamics change in production of Soybean crop. The decomposition analysis was used to work out the change in production of Soybean in Yawatmal district of Maharashtra.

**Decomposition analysis**

 Decomposition analysis is used to assess the individual contributions of various factors to the change in crop production. In this research, it is applied to Soybean production in Yawatmal district of Maharashtra to break down the changes in output into **area effect** and **yield effect.** In the present research, the decomposition analysis was worked out using the additive decomposition model by Minhas and Vaidyanathan (1965) in the book by Vani et al. (2019). The original additive decomposition model consists of the area effect, yield effect and the interaction effect between the area and yield. However, the results from the model were not considered to be absolute since, the model possesses the residual effects caused by the interaction effect. Hence, the results cannot absolutely define whether the area effect or the yield effect is the driver behind the production change. However, in the present research this residual effect has been removed by reconstructing the additive decomposition model. The original additive decomposition model was written as

$$∆Q\_{t}=∆A\_{t}Y\_{t-1}+∆Y\_{t}A\_{t-1}+∆A\_{t}∆Y\_{t}$$

Where,

ΔQt represents the change in production,

ΔAt and ΔYt represent the changes in area and yield, respectively.

The present research aims to determine the drivers behind the change in production of Soybean in Yawatmal district of Maharashtra. Here, to remove the residual effects, the interaction effect was divided in two equal halves also called partial interaction effect and added to both area effect and yield effect. Hence, the change is production is called as absolute change since the error term has been removed. The reconstructed model is written as

∆Qt = (∆AtYt-1 +0.5∆At ∆Yt)+(∆YtAt-1 +0.5∆At ∆Yt)

This equation was further be decomposed as

∆Qt = [(At - At-1)Yt-1+ 0.5(At - At-1)(Yt - Yt-1)]+[(Yt - Yt-1)At-1+ 0.5(At - At-1)(Yt - Yt-1)]

Thus, the expression explains that, the absolute change in production is equal to the sum of area effect and yield effect. The area effect and yield effect found can be explained as-

**Area effect:** It is the effect of change in area on production keeping yield constant at previous year values with added partial interaction effect.

Area Effect = ∆AtYt-1+0.5∆At ∆Yt

**Yield effect:** It is the effect of change in yield of the crop on the production while keeping area under crop constant at previous year values with added partial interaction effect.

Yield Effect= ∆YtAt-1+0.5∆At ∆Yt

The present study also calculated the average annual growth of area, production and yield to get the better understanding of how individual components affect the Soybean production in Yawatmal district. Hence, the factors responsible for the change in Production of the Soybean crop were determined.

**3. RESULT & DISCUSSION**

 The research study is concerned with the effect of area effect and yield effect and their contribution in production of Soybean in Yawatmal district of Maharashtra. The results of the study revealed that, over the period of study the area under Soybean cultivation increased steadily from 266600 hectare in 2007-08 to 287432 hectare in 2021-22. However, the production of Soybean was fluctuating as observed from the production of 333500 tonnes in 2007-08 to 287875 tonnes in 2021-22. However, the yield of Soybean crop was always inconsistent throughout the study period and it can be observed from the scenario that suggested the yield decreased from 1.25 in 2007-08 to 1.00 ton per hectare in 2021-22 which further decreased to 0.82 ton per hectare. Throughout the study period the yield was inconsistant.

**Table 1. Area and yield effect on change in production of Soybean in Yawatmal**

|  |  |  |
| --- | --- | --- |
| Parameters | Average | Effect |
| Area | 271611.60(12.23) |

|  |
| --- |
| 3229.61 |
| (1091.38) |

 |
| Yield | 0.91(46.14) |

|  |
| --- |
| -6271.27 |
| (-2268.89) |

 |
| Production | 236168.13(38.97) |

|  |
| --- |
| -3041.67 |
| (-3875.86) |

 |

 *Note: Figures in parentheses are the coefficient of variation in percentage*

 In table 1. it was observed that the average area under Soybean cultivation in Yawatmal was 271611.60 hectare during the study period with the C.V. of 12.23 suggesting less fluctuations in area. The average yield was 0.91 ton per hectare however, with the large fluctuations of 46.14 percent. This also affected the production with the fluctuations of 38.97 percent where the average production in Yawatmal was observed to be 236168.13 tonnes. The fluctuation in production was mainly due to the yield aspects of the Soybean production.

 The average effect of area on change in production was found to be 3229.61. The area effect was observed to be negative in year 2010-11, 2015-16 and 2016-17 at -100942, -5158 and -32018 respectively. During this period the yield effect was observed to be positive and significant. The average yield effect during the study period of 2007-08 to 2021-22 was -6271.27. The average change in production during the study period was -3041.67 fluctuation in the change in production reflected the fluctuations and the effect of yield over the production.

 It was observed that five out of six times when the yield effect was negative the production was found to have decreased [Appendix table 1.]. Every negative change in production was related to the negative yield effect. In year 2010-11 and year 2016-17 when the change in production was observed maximum at 146500 and 141500 respectively, the yield effect was found at its maximum at 247442 and 173518 respectively even when the area effect was negative. The can also be observed in figure 1.

 The average annual growth in area was -2.92 per cent contributing -24.05 percent to the total average change in production. The average annual growth in yield was 15.04 percent which contributed to the 87.58 percent of the total average change in production. The average change in production was 12.12 percent [table 2.]. The fluctuation in yield also reflected the fluctuation in the production of Soybean production in Yawatmal district of Maharashtra. During the overall study period the contribution of area effect was found dominant in the year 2011-12 and year 2021-22 at 124.68 percent and 84.43 percent.

**Table 2. Growth and contribution of area effect and yield effect**

|  |  |  |
| --- | --- | --- |
| Parameters | % Growth | % Contribution |
| Area | -2.92(-790.07) | 12.42(800.15) |
| Yield | 15.04(475.22) | 87.58(59.35) |
| Production | 12.12(440.49) | 100 |

 *Note: Figures in parentheses are the coefficient of variation in percentage*

 Tayade et al. (2013) revealed the highest growth in productivity/yield of Soybean at 17.75 percent during the period of 1985 to 1995 however the growth was observed to be high in area and production of Soybean during the period of 1995 to 2007. Similarly, Datarkar et al. (2017) revealed that the yield effect contributed to the increase in production of Soybean in the study area more than that of the area effect. Contrary to these, Sharma (2016), Hazari (2015), Ninawe et al. (2020), Pathrikar (2022) and Datarkar et al. (2016) were of the view that the change in production of Soybean was greatly due to the increase in area under Soybean cultivation. Tiwari et al. (2022) revealed that though the area effect was found dominant in the study; the yield of Soybean was found to be increasing gradually. However the yield was found inconsistent throughout the study period in the study area viz., major Soybean producing states in India and hence suggested stabilizing the yield of Soybean by incorporation of yield promoting varieties and technologies in cultivation of Soybean crop.

 The present research thus concluded that the growth in production of Soybean was majorly due to the growth in yield of Soybean as were the result obtained from appendix table 1. When the growth of Yield was observed to be negative during the study period of 15 years from 2007-08 to 2021-22, the area and yield of Soybean showed average annual growth rate of -2.92 per cent and 15.04 per cent respectively. However, the yield showed very high coefficient of variation. The production of Soybean showed the growth of 12.12 per cent.

Similarly, area and growth individually contributed to 12.42 per cent and 87.58 per cent of total production stating that, yield contributed more to the production of Soybean in Yawatmal district of Maharashtra. It was concluded that the yield effect contributed to 87.58 percent to the average total change in production and it is also the driver behind the change in production of Soybean in Yawatmal district of Maharashtra. It was thus suggested to increase the yield of Soybean through various technological interventions rather than increasing the acreage under Soybean cultivation though the area effect also played a significant role in increasing the production of Soybean in Yawatmal district of Maharashtra during the study period. However, the negative yield effect strictly suggested the need to increase the acreage under Soybean cultivation in Yawatmal district of Maharashtra.

**4. Policy implication:**

 The present research revealed that the yield viz., productivity of Soybean played a key role in increasing the production of Soybean in Yawatmal district. Though area effect also contributed, it was found that the yield effect was the driving factor behind the change in production of Soybean in Yawatmal district. Thus, it was suggested to increase the acreage under Soybean cultivation in Yawatmal district of Maharashtra. It was suggested to increase as well as stabilizing the yield of Soybean in Yawatmal district through increased acreage as well as use of technological innovations.

**5. Conclusion:**

 The research concluded that, during the study period of 15 years from 2007-08 to 2021-22, the area and yield of Soybean showed average annual growth rate of -2.92 per cent and 15.04 per cent respectively. However, the yield showed very high coefficient of variation. The production of Soybean showed the growth of 12.12 per cent. Similarly, area and growth individually contributed to 12.42 per cent and 87.58 per cent of total production stating that, yield contributed more to the production of Soybean in Yawatmal district of Maharashtra. Hence, the yield effect was concluded to be the driving factor behind the change in production of Soybean in Yawatmal district. The research revealed the negative average yield effect affecting the production negatively. The study concluded the direct relationship between the decrease in yield of Soybean to the decrease in growth of production of Soybean in Yawatmal district of Maharashtra. Thus, it was suggested to increase the yield of Soybean in Yawatmal district with an effort in stabilizing the yield of Soybean.

**Disclaimer**

I, Rode Payal Sewakram, hereby declare that no generative AI technologies such as large language models viz., ChatGPT, COPILOT, etc. and text-to-image generators have been used during the writing or editing of the manuscript.

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**APPENDIX**

**Table 1: Change in production of Soybean in Yawatmal district of Maharashtra**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year** | **Area effect** | **Yield effect** | **Change in Production**  | **Growth in area** | **Growth in Yield** | **Growth in production** | **% Share area effect** | **% Share** **yield effect** |
| 2007-08 | 0.0 | 0.0 | 0.0 | 0.00 | 0.00 | 0.00 | - | - |
| 2008-09 | 35787.6 | -265587.6 | -229800.0 | 10.73 | -79.64 | -68.91 | -15.57 | 115.57 |
| 2009-10 | 0.0 | 22900.0 | 22900.0 | 0.00 | 22.08 | 22.08 | 0.00 | 100.00 |
| 2010-11 | -100941.7 | 247441.7 | 146500.0 | -79.73 | 195.45 | 115.72 | -68.90 | 168.90 |
| 2011-12 | 31169.8 | -6169.8 | 25000.0 | 11.41 | -2.26 | 9.15 | 124.68 | -24.68 |
| 2012-13 | 23019.8 | 67980.2 | 91000.0 | 7.72 | 22.80 | 30.53 | 25.30 | 74.70 |
| 2013-14 | 53472.1 | -285972.1 | -232500.0 | 13.74 | -73.50 | -59.75 | -23.00 | 123.00 |
| 2014-15 | 8846.2 | -67846.2 | -59000.0 | 5.65 | -43.32 | -37.68 | -14.99 | 114.99 |
| 2015-16 | -5157.9 | 48457.9 | 43300.0 | -5.28 | 49.65 | 44.36 | -11.91 | 111.91 |
| 2016-17 | -32018.4 | 173518.4 | 141500.0 | -22.72 | 123.15 | 100.43 | -22.63 | 122.63 |
| 2017-18 | 1445.1 | -77545.1 | -76100.0 | 0.51 | -27.46 | -26.95 | -1.90 | 101.90 |
| 2018-19 | 22885.7 | 98020.3 | 120906.0 | 11.09 | 47.51 | 58.61 | 18.93 | 81.07 |
| 2019-20 | 7571.0 | -100310.0 | -92739.0 | 2.31 | -30.66 | -28.34 | -8.16 | 108.16 |
| 2020-21 | 0.0 | 50607.0 | 50607.0 | 0.00 | 21.58 | 21.58 | 0.00 | 100.00 |
| 2021-22 | 2364.8 | 436.2 | 2801.0 | 0.83 | 0.15 | 0.98 | 84.43 | 15.57 |