

Research Paper

Kharif Oilseed Crops Cultivation in Madhya Pradesh (India): Growth and Decomposition Analysis

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ABSTRACT

The study examined the growth in area, production, and productivity of major *kharif* oilseed crops and decompose the production growth into area and yield effect using secondary data collected for 30 years period from different government departments and other agencies. The compound growth rate was calculated by using an exponential trend model and decomposition analysis using a semi-log growth model. It is observed that compound annual growth rate (CAGR) in area, production, and productivity of soybean and sesamum were observed positive but non-significant. While, the positive and non-significant growth rate of groundnut was observed in production and productivity, a negative but significant growth rate was observed in the area. Decomposition analysis indicated that the yield effect of soybean and groundnut was more instrumental in increasing the production than the area and interaction effects. However, the area effect was observed more dominant in sesamum than the yield and interaction effects in the state.

HIGHLIGHTS

- ① Area, production and productivity of soybean and sesamum in Madhya Pradesh showed positive and non-significant annual growth pattern, whereas, a negative and significant growth was observed in area.
- ② Yield effect of soybean and groundnut were found to be more instrumental to increase the production, while, the area effect was observed more dominant in sesamum.

Keywords: Annual Growth rate, decomposition, *kharif* oilseed crops, Madhya Pradesh

Oilseed crop holds second most important determinant of agricultural economy next to cereal crops in the field crops category. The self-sufficiency in oilseed crops attained through "Yellow Revolution" during early 1990's, but it could not be sustained beyond a short period. India plays an important role in vegetable oil consumption in recent years in both edible as well as industrial usages. India stands as the largest importer of vegetable oils and above 60% of domestic demand was met through imports. India imported palm oil from Indonesia and Malaysia while, soybean oil and sunflower oil were imported from Argentina, Brazil, Ukraine and Russia (Roy *et al.* 2022). India produces a variety of crops like cereals, pulses,

oilseeds, fruits, vegetables, medicinal, aromatics, spices, sugar, fiber crops etc. Among which oilseed crops were the most important commercial crops in our country. They contain useful carbohydrates, vitamins, lipids, fatty acids and the rich source of proteins (40-60%) which contains 18 essential amino acids and trace elements. India accounts the fourth position in leading oilseed producing countries in the world after USE, China and Brazil (Reddy *et al.* 2017). The production of oilseed crops for about

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29 million tonnes per annum covered 27 million hectares of acreage with an annual average yield of 1058kg/ha. (Reddy *et al.* 2017). Edible oils were the concentrated source of energy (39.80 Mega Joule/kg) (Reddy *et al.* 2017). The oil seed crops could be grown in all kinds of soils and constitutes as a major part of crop rotation.

In India, the total area covered by oilseed crops accounts for 24507.90 thousand hectares whereas, production accounts for 31459.26 thousand tonnes with the yield of 1283.63 kg/ha. Highest share (27.10%) in area was contributed by Madhya Pradesh followed by Maharashtra (16.87%) and highest share in production was contributed by Madhya Pradesh with 22.09 per cent followed by Rajasthan with 19.43 per cent (Kolar *et al.* 2020).

Madhya Pradesh was one of the pioneer state in oilseed crops cultivation in India with an area of 4770 million hectares, production of 6451.69 million tonnes and productivity of 864 kg/ha, respectively. (Anonymous, 2021 objectives of the study are decomposition analysis of major oilseed crops in Madhya Pradesh).

MATERIALS AND METHODS

The study was based on secondary time series data collected from different sources i.e. Directorate of Agriculture, Cooperation and Farmer's Welfare, Government of India, Department of Economics and Statistics (DES), Directorate of Oilseed Crops, Bhopal, Agriculture Statistical yearly data books and Agriculture Statistics at a glance, ICAR, New Delhi; various publications and annual reports of Agricultural Ministry, etc. The data on area, production and productivity of selected *kharif* oilseed crops had been taken for 30 years from 1991-92 to 2020-21. The data used in the study was sub-divided into four periods i.e. Period-I (1991-92 to 2000-01), Period-II (2001-02 to 2010-11), Period-III (2011-12 to 2020-21) and overall period (1991-92 to 2020-21). Two different calculations have been carried out in this regards, CAGR in area, production and productivity of *kharif* oilseed crops were calculated by using exponential trend model and decomposition analysis was done by using semi-log growth model (Minhas and Vaidyanthan, 1965).

Compound growth rate

CAGR was estimated to know the growth pattern in area, production and productivity of *kharif* oilseed crops in Madhya Pradesh by using exponential trend model (Balai *et al.* 2021).

Exponential trend equation:

$$Y = ab^t$$

The logarithmic form of the equation is given as:

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

Where,

Y = area/ production/ yield

a = Intercept

b = regression coefficient

t = Time

r = compound growth rate

The per cent compound growth rate (r) would be given below;

$$r = [(Anti \text{ log of } b) - 1] \times 100$$

Student's 't' test was used for testing significance level of growth in area, production and productivity of selected oilseed crops;

$$t = CAGR / SE (CAGR)$$

Where,

't' = Student's 't' test

CAGR = compound growth rate

SE (CAGR) = Standard error of compound growth rate

Standard error of CAGR was calculated by using following formula (Rao *et al.* 1981);

$$SE(CAGR) = \frac{100b}{\ln 10} \times SE(\ln b)$$

Decomposition Analysis

To study the contribution of area, yield and the interaction of area and yield towards increasing the oilseed production in Madhya Pradesh, a

decomposition analysis was expressed as given below (Minhas and Vaidhyanthan, 1965):

$$\Delta P = AB * \Delta Y + Y\Delta * \Delta A + \Delta A * \Delta Y$$

= (yield effect) + (area effect) + (interaction effect)

Where,

$$\Delta A = AC - BC$$

$$\Delta P = PC - PB$$

$$\Delta Y = YC - YB$$

AB, PB and YB are the area, production and yield of oilseed for the base year. AC, PC and YC are the area, production and yield of oilseed for the current year.

ΔA = change in area

ΔP = change in production

ΔY = change in yield

RESULTS AND DISCUSSION

Compound Annual Growth

The growth rate in area, production and productivity of selected *kharif* oilseed crops i.e. soybean, groundnut and sesamum for the period from 1991-92 to 2020-21 were calculated by segregating into four periods and presented in Table 1.

Table 1: Compound growth rate of area, production and productivity of soybean in Madhya Pradesh (in per cent)

Periods	Area	Production	Productivity
Period-I (1991-2001)	14.80 (0.021)	17.40 (0.021)	2.33 (0.014)
Period-II (2001-11)	7.40 (0.005)	21.06* (0.015)	12.72 (0.015)
Period-III (2011-2021)	0.69 (0.010)	-7.74 (0.018)	-8.38 (0.024)
Overall (1991-2021)	5.40 (0.002)	6.17 (0.005)	0.69 (0.002)

Sources: Author's calculations.

Note: Figures in parenthesis are standard error of selected growth model.

*Significant at 1 per cent level and **significant at 5 per cent level.

Soybean: During overall period, the CAGR were 5.44, 6.17 and 0.69 per cent per annum, respectively but these were non-significant. Similar results were

observed in Period-I as in overall period in terms of growth in area (14.80%), production (17.40%) and productivity (2.33%). During Period-II, the growth performance of production and productivity showed positive and significant growth with the magnitude of 21.06 and 12.72 per cent per annum while, the performance of area showed positive but non-significant growth at the rate of 7.40 per cent. During period-III, the production and productivity reported declined and non-significant growth pattern at the rate of -7.74 and -8.38 per cent per annum whereas, the growth rate of area was found to be positive but non-significant at the rate of 0.69 per cent.

Sesamum: Throughout the entire study period, the growth performance in area, production and productivity recorded positive but non-significant growth pattern at the rate of 6.91, 15.61 and 8.17 per cent, respectively. During Period-I, the area and production observed negative and non-significant growth pattern at the rate of -11.90 and -7.10 per cent while, productivity showed the positive growth rate with the magnitude of 5.68 per cent. In the same time, similar results were found in Period-II as in overall period, the growth performance in area, production and productivity accounts for about 18.85, 2.80 and 12.72 per cent, respectively.

Table 2: Compound growth rate of area, production and productivity of sesamum in Madhya Pradesh (in per cent)

Periods	Area	Production	Productivity
Period-I (1991-2001)	-11.90 (0.007)	-7.10 (0.023)	5.68 (0.018)
Period-II (2001-2011)	18.85 (0.014)	2.80 (0.020)	12.72 (0.018)
Period-III (2011-2021)	4.95 (0.020)	0.46 (0.017)	-4.06 (0.010)
Overall period (1991-2021)	6.91 (0.006)	15.61 (0.007)	8.17 (0.003)

Sources: Author's calculations.

Note: Figures in parenthesis are standard error of selected growth model

*Significant at 1 per cent level and ** significant at 5 per cent level.

In Period-III, the growth pattern in area and production reported positive but non-significant growth rate of 4.95 and 0.46 per cent whereas, the

productivity accounts negative and non-significant growth rate of -4.06 per cent per annum. Similar findings were observed by Roy *et al.* (2022) in his study in Bihar for the period of 1991-2020.

Groundnut: During overall period, the growth in area observed to be negative but significant and the magnitude was -1.14 per cent, production reported positive and significant growth rate at the magnitude of 4.71 per cent and productivity showed positive but non-significant growth rate of 5.93 per cent. During Period-I, the growth performance in area showed negative but significant growth at the rate of -5.38 and production recorded negative and non-significant growth of -0.69 per cent, however, productivity accounts positive but non-significant growth at the rate of 4.95 per cent. During Period-II, the growth performance in area observed negative but significant at the rate of -2.73 per cent, production and productivity were found to be positive but non-significant growth with the magnitude of 5.68 and 8.64 per cent. During Period-III the growth in production and productivity were showed positive but non-significant growth pattern at the rate of 4.23 and 2.80 per cent per annum whereas, the growth performance of area was increased significantly at the rate 5.44 per cent. Similar findings were found in study of Roy *et al.*(2022) in Bihar, Bairwa *et al.* (2021) in Rajasthan, Kolar *et al.* (2020) in India and Singh *et al.* (2015) in North-East India.

Table 3: Compound growth rate of area, production and productivity of groundnut in Madhya Pradesh (in per cent)

Periods	Area	Production	Productivity
Period-I (1991-2001)	-11.90 (0.007)	-7.10 (0.023)	5.68 (0.018)
Period-II (2001-2011)	18.85 (0.014)	2.80 (0.020)	12.72 (0.018)
Period-III (2011-2021)	4.95 (0.020)	0.46 (0.017)	-4.06 (0.010)
Overall period (1991-2021)	6.91 (0.006)	15.61 (0.007)	8.17 (0.003)

Sources: Author's calculations.

Note: Figures in parenthesis are standard error of selected growth model.

*significant at 1 per cent level and ** significant at 5 per cent level.

Decomposition Analysis: The relative contribution of area, yield and their interaction effects to increase the output growth of selected *khari* oilseed crops were indicated in Table 4 to 6.

Soybean: The study revealed that in overall period, the yield effect was more dominant at the rate of 204.13 per cent than the area and interaction effects. During Period-I, interaction effect (75.58%) was found to be more instrumental to increase the production whereas, area effect accounts for about 12.24 per cent and the yield effect accounts for 12.18 per cent. During Period-II, area effect (56.52%) was comparatively more dominant than the yield effect (45.09%). During Period-III, area effect (126.00%) was found to be major contributor to increase the production of soybean as compared with interaction effect (43.07%).

Table 4: Relative contribution of area, yield and interaction effect on production growth of soybean in Madhya Pradesh (in per cent)

Periods	Area effect	Yield effect	Interaction effect
Period-I (1991-2001)	12.24	12.18	75.85
Period-II (2001-2011)	56.52	45.09	-1.61
Period-III (2011-2021)	126.00	-69.07	43.07
Overall period (1991-2021)	-70.54	204.13	-33.59

Sources: Author's calculation.

Sesamum: During entire study period, area effect was found to be more instrumental at the rate of 358.85 per cent as compared to the yield effect at 247.15 per cent. In Period-I, interaction effect reported 56.68 per cent and found to be primary contributor in the production of sesamum followed by yield effect (25.31%) and area effect (18.01%). In Period-II, about double and highest value of yield effect was found (59.76 per cent) than the area effect (34.09%) whereas, the interaction effect showed less contribution i.e. 6.15 per cent. During Period-III, yield effect was found to be the primary contributor i.e. 169.14 percent than the area effect, which was very less at 0.49 per cent. Similar findings were recorded by Singh *et al.* (2015) in his research work entitled estimation of growth rate and decomposition of output components of oilseed: A

comparative study among the states of North-East India during period 1982-2012.

Table 5: Relative contribution of area, yield and interaction effect on production growth of sesamum in Madhya Pradesh (in per cent)

Periods	Area effect	Yield effect	Interaction effect
Period-I (1991-2001)	18.01	25.31	56.68
Period-II (2001-2011)	34.09	59.76	6.15
Period-III (2011-2021)	0.49	169.14	-69.63
Overall period (1991-2021)	358.85	247.15	-506.00

Sources: Author's calculations.

Groundnut: It could be seen from Table 6 that the result of yield effect was noticed more dominant with 222.00 per cent as compared to area effect (142.52 per cent) in entire study period. During Period-I, the contribution of area effect was 403.73 per cent and found to be more dominant followed by yield effect and interaction effect. During Period-II, the area effect was reported major contributor to uplift the total production (111.71 per cent) as compared to interaction effect (25.89%). In Period-III, contribution of yield effect was observed more dominant (70.25%) followed by area effect (21.72%) and their interaction effect (8.03%). Similar findings were observed by Singh *et al.* (2015) in his research work on oilseed in the North-East India from period 1982 to 2012.

Table 6: Relative contribution of area, yield and interaction effect on production growth of groundnut in Madhya Pradesh (in per cent)

Periods	Area effect	Yield effect	Interaction effect
Period-I (1991-2001)	403.73	-256.03	-47.70
Period-II (2001-2011)	111.71	-37.60	25.89
Period-III (2011-2021)	21.72	70.25	8.03
Overall period (1991-2021)	142.52	222.00	-264.52

Source: Author's calculations.

Policy implication

Positive growth in area, production and productivity of oilseed crops namely soybean, sesame and groundnut in Madhya Pradesh state during the entire study period from 1991-1992 to 2020-21. Thus, there is need to give more attention on technological aspects as well as policy aspects to increase in area, production and productivity of these oilseed crops. Yield effect in soybean and sesame were found more dominant whereas area effect was found more dominant in groundnut than the interaction effect in Madhya Pradesh throughout the study period 1991-92 to 2020-21.

CONCLUSION

The above results clearly showed that the compound annual growth rate (CAGR) of soybean during the overall period in area, production and productivity of soybean were observed positive and non-significant growth pattern at the rate of 5.44, 6.17 and 0.69 per cent, respectively. Mean while, in the same time period similar findings were observed in area, production and productivity of sesamum with the magnitude of 6.19, 15.61 and 8.14 per cent, respectively. During overall study period, the positive and non-significant growth rate of groundnut was observed in production (4.17%) and productivity (5.93%), whereas, negative but significant growth rate were observed in area (-1.14%). Throughout the study period, the yield effect of soybean and groundnut were observed more instrumental to increase the production than the area and interaction effects however, the area effect was observed more dominant in sesamum than the yield and interaction effects in Madhya Pradesh.

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