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# Dynamics of Oilseeds Production and Decomposition of output Components of Oilseeds in Bihar

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**ABSTRACT**

India is the fourth largest producer of oilseeds and accounts for about 15-20 percent of global oilseeds area, 6-7 percent vegetable oil production and 9-10 percent of total edible oils consumption. Among different oilseeds, groundnut, rapeseed-mustard and soyabean accounts for about 80 percent of area and 87 percent of production of oilseed in the country during 2018-19. Currently, share of oilseeds are 14% of the total area under major crops. Day by day, the demand for consumption of vegetable oil is increasing in Bihar but the area under cultivation of oilseeds is decreasing. In Bihar, the area under cultivation of oilseeds was 228.3 thousand hectares in 1986-87 and it has decreased to 113.14 thousand hectares in 2019-20. This paper investigates the trends in area, production and yield of oilseeds in the State of Bihar. The study period was from 1990-91 to 2019-20 and it had divided into 3 periods: 1990-91 to 1999-2000, 2000-01 to 2009-10 and 2010-11 to 2019-20 to have an understanding of decadal performance. The results clearly showed that the growth rate performance of area, production and yield of oilseed in the region declined sharply from period 1 to 3. The study witnessed that more than half of the area under the crop in the State suffered from low growth rate in area. The comparison of production growth rates of all the major oilseeds revealed that Sunflower showed better performance followed by rapeseed and mustard, During the study period from 1990-91 to 2019-20, only yield (2.02%) showed positive growth rate whereas area (-2.6%) and production (-0.62%) showed negative growth rate. The decomposition analysis of growth suggests that sources of output growth in Bihar was the same in all the three periods as the major contribution was yield effect followed by area effect. Reduction in yield gap and adoption of new technology can improve Bihar as well as India's oilseeds production and make India self-sufficient in oilseeds production and consumption.

**HIGHLIGHTS**

- From 1990-91 to 2019-20, only yield (2.02%) showed positive growth rate whereas area (-2.6%) and production (-0.62%) showed negative growth rate.
- The State (Bihar) faces almost 96% deficit in oilseed production as per its current requirement.
- More than half of the area under oilseed crops in the State suffered from low growth rate in area.
- During the last three decades, Sunflower and Rapeseed-mustard have showed better performance than other oilseed crops.
- Sources of output growth was the same in all the three decades and major contribution was yield effect (49%) followed by area effect (40%) and interaction effect (11%).

**Keywords:** Consumption, Oilseeds, Growth rate, Trend and Decomposition analysis

Oilseed crops are the second most important determinant of agricultural economy, next only to cereals within the category of field crops. The self-sufficiency in oilseeds attained through "Yellow Revolution" during early 1990's, could not be sustained beyond a short period. Despite being the fifth largest oilseed crop producing country in the world, India is also one of the largest importers of vegetable oils today. There is a spurt in the vegetable oil consumption in recent years in respect of both edible as well as industrial usages. The demand-

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supply gap in the edible oils has necessitated huge imports accounting for 60 per cent of the country's requirement. India imported 520.81 thousand tonnes of oilseeds for 2019-20 valued at ₹ 2838 crore as against 159.33 thousand tonnes worth of ₹ 758 crore in 2016-17. Major oilseeds imported to India include soybean, sesame seed and cotton seed whereas groundnut was the largest exported oilseeds followed by sesame seed. India is the largest imported of vegetable oils and above 60% of domestic demand is met through imports. India imported palm oil from Indonesia and Malaysia while Soya oil and Sunflower oil are imported from Argentina, Brazil, Ukraine and Russia. Despite commendable performance of domestic oilseeds production of the nine annual crops (Compound Annual Growth Rate of 3.89%), it could not match with the galloping rate of per capita demand (6%) due to enhanced per capita consumption (18 kg oil per annum) driven by increase in population and enhanced per capita income.

Bihar produced 124.7 thousand tonnes of oilseeds from an area of 113.14 thousand hectares during the year 2019-20 (DAC, MOA&FW, GOI, 2020-21). Thus, the average productivity of the State during the above period was around 1102 Kg/ha which is below the national average of 1224 Kg/ha. Out of the nine major oilseeds produced in this country, Bihar is cultivating seven (7) vegetable oils namely, groundnut, rapeseed and mustard, linseed, castor, safflower, sesame and sunflower. The State faces a deficit of 2774 thousand tonnes of oilseed as per 2021 population (Estimated population 13.14 crore) which is met by supply of oilseed from other parts of the country. Though India used to be self-sufficient of edible oil until 1990s, the State of Bihar has been being deficit since 1960s till date. Hence, a study to analyse growth of oilseed crops in Bihar was found necessary so as to suggest suitable strategies to increase the production of oilseed in the State and simultaneously working out measures for taking the advantage of trade openness which could reduce the dependence on output supply and also benefit the farmers. With the above background and with the broad objectives of analysing the growth rates of oilseed production, the present study was undertaken with the specific objective to analyse temporal growth in area, production and productivity of oilseeds in the state of Bihar.

## Data and Methodology

The present investigation is mainly based on secondary data of area, production and productivity of oilseeds retrieved from different published sources covering a period of 30 years from 1990-91 to 2019-20. The period was subdivided into three sub-periods i.e. 1990-91 to 1999-2000, 2000-01 to 2009-10 and 2010-11 to 2019-20 to have an understanding of decadal performance. The methods used in the study included estimation of growth rate with its test of significance, decomposition of growth components, confirmation of acceleration, deceleration or stagnation of growth and instability analysis.

## Growth Rate Estimation

The growth rate was measured following the procedure adopted by various authors, Mohamed Elamin Abd Ellatif Mahir *et al.* (2010), J.S. Sonnad *et al.* (2011), Abhey Singh Godara *et al.* (2013), Edwin Kenamu *et al.* (2014) and many others and the steps foolowed are presented below. By taking time as independent variable and area, production and productivity of the crops as dependent variables, the compound growth rates were estimated.

$$Y = A\,(1 + r)^t$$

Where,

$Y$ denotes dependent variables like area, production and productivity in the year '$t$' for which growth rate is estimated.

$A$ is a constant

$r$ is the rate of annual increment.

## Estimation of instability index

Instability is the deviation from trend. In various literature researchers have applied the coefficient of variation (CV %) as measures of instability. Instability indices were worked out to examine the extent of instability in area, production and yield of oilseed crops grown in Bihar. Only CV does not explain suitable trend component inherent in the time series data, hence, the instability index was computed applying measure of variability suggested by Cuddy- Della Valle index (Cuddy and Valle 1978). The formula for computation is given as under:

$$\text{Instability Index} = CV * \sqrt{1 - R^2}$$

$$CV = \frac{\text{Standard deviation of the variable}}{\text{Mean of the variable}} \times 100$$

If the estimated coefficient of regression equation is not significant, then the *CV* itself is taken as instability index.

Where, *CV* is coefficient of variation and $R^2$ is the coefficient of determination from a time series trend regression adjusted by the number of degrees of freedom.

### Decomposition of Growth Components

Total production of crop output is determined mainly by area, yield and the interaction effect of its area and yield. To measure the relative contribution of area and yield towards the total production change with respect to individual crop, the technique of decomposition was adopted. The change in the production of crop between any two periods can be expressed as:

*Change in production = Yield effect + Area effect + Interaction effect*

Thus, the total change in production is attributed to area and yield that can be decomposed into three effects viz; yield, area and interaction effects.

## RESULTS AND DISCUSSION

### Growth rates of area, production and productivity

To estimate the growth performance of area, production and yield of different oilseeds in Bihar during the period 1990-91 to 2019-20, time series data on area, production and productivity was analyzed. The whole period was divided into three decades to understand the decadal performance. The periods 1990-91 to 1999-2000, 2000-01 to 2009-10 and 2010-11 to 2019-20 have been referred to as period 1, period 2 and period 3 respectively from here onwards.

### Period 1 (1990-91 to 1999-2000)

In this period highest and significant growth rate in area was observed in Sunflower (44.77%) followed by safflower (3.87%) and Groundnut (1.01%). Negative growth rate in area was found highest in Castor seed (-3.92%) followed by Linseed (-3.24%) and Rapeseed- mustard (-0.59%). In the production of oilseeds in Bihar, Sunflower registered highest growth rate of 66.52% followed by Sesamum (10.51%), Safflower (8.32%) and Groundnut (6.18%). In the productivity front, all the Oilseed crops showed positive growth rate. Among the seven oilseed crops, highest yield growth rate was observed in Sunflower (15.02%) followed by Castor seed (10.51%), Sesamum (8.32%) and Safflower (4.91%). This period was better performer as compared to other two periods because technology mission on oilseeds (TMO) was operational and other policy initiatives helped to increase area and productivity of oilseeds.

### Period 2 (2000-01 to 2009-10)

Groundnut registered the highest positive growth rate in area (22.36%) followed by Sunflower (9.41%) and Castor seed (1.01%). Negative growth rate in area was found in Safflower (-8.60%), Linseed (-3.92%) and Sesamum (-3.92%). In the production of oilseeds in Bihar, Groundnut registered highest growth rate of 23.36% followed by Sunflower (9.41%), Castor seed (3.04%) and Rapeseed-mustard (1.82%). Highest negative growth rate in production was found in Safflower (-4.87%) followed by Linseeds (-1.98%) and Sesamum (-0.69%). In productivity front, all the Oilseed crops showed positive growth rate except Sunflower (-0.10%). Among the seven oilseed crops, highest yield growth rate was observed in Safflower (3.97%) followed by Sesamum (3.04%) and Rapeseed-mustard (2.83%).

### PERIOD 3 (2010-11 TO 2019-20)

In this period, only Groundnut showed positive growth rate in area (3.04%). Highest negative growth rate in area was found in Castor seed (-13.92%) followed by Linseed (-11.30%), Sunflower (-8.60%), Safflower (-7.68%) and Sesamum (-6.76%). Groundnut registered highest positive growth rate of 3.04% in production followed by Rapeseed-mustard (0.30%). Negative growth rate in production was found in Linseed (-11.30%), Castor seed (-11.30%), Sunflower (-8.60%), Safflower (-8.60%) and Sesamum (-5.82%). All most all the oilseeds

**Table 1:** Compound Growth Rate (%) of area, production and productivity (yield) of major oilseeds crops in Bihar during the different Periods

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **1990-91 to 1999-2000** | | | | | | | |
| | **Groundnut** | **Linseed** | **Rapeseed & Mustard** | **Safflower** | **Sesamum** | **Sunflower** | **Castor seed** | **Total Oilseeds** |
| A | 1.01*** | -3.24* | -0.59 | 3.87* | 1.01 | 44.77* | -3.92 | -0.99* |
| P | 6.18* | -0.49 | -0.39 | 8.32 | 10.51* | 66.52 | 6.18** | 0.39 |
| Y | 4.08* | 2.02* | 0.10 | 4.91* | 8.32* | 15.02 | 10.51* | 2.02** |
| | **2000-01 to 2009-10** | | | | | | | |
| | **Groundnut** | **Linseed** | **Rapeseed & Mustard** | **Safflower** | **Sesamum** | **Sunflower** | **Castor Seed** | **Total Oilseeds** |
| A | 22.36* | -3.92* | -0.89* | -8.60* | -3.92** | 9.41** | 1.01 | -0.59 |
| P | 23.36* | -1.98** | 1.82 | -4.87 | -0.69 | 9.41** | 3.04 | 2.02** |
| Y | 0.06 | 2.02* | 2.83** | 3.97 | 3.04* | -0.10 | 2.02 | 2.02* |
| | **2010-11 to 2019-20** | | | | | | | |
| | **Groundnut** | **Linseed** | **Rapeseed & Mustard** | **Safflower** | **Sesamum** | **Sunflower** | **Castor Seed** | **Total Oilseeds** |
| A | 3.04 | -11.30 | -1.48* | -7.68 | -6.76* | -8.60 | -13.92 | -1.98* |
| P | 3.04 | -11.30 | 0.30 | -8.60 | -5.82* | -8.60 | -11.30*** | -1.58* |
| Y | 0.04 | -0.39* | 1.19** | -0.19 | 0.50 | -0.10 | 3.04* | 1.10*** |

**Significant at 1 per cent level **Significant at 5 per cent level ***Significant at 10 per cent level.*

**Table 2:** Instability (CV) in area, production and productivity of different oilseeds produced in Bihar from 1990-91 to 2019-20

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **1990-91 to 1999-2000** | | | | | | | |
| | **Groundnut** | **Linseed** | **R & M** | **Safflower** | **Sesamum** | **Sunflower** | **Castor seeds** | **Total Oilseeds** |
| Area | 6.62 | 6.82 | 3.16 | 13.24 | 2.90 | 34.85 | 23.83 | 5.25 |
| Production | 15.33 | 13.09 | 13.56 | 10.14 | 14.63 | 32.24 | 19.68 | 10.46 |
| Yield | 10.38 | 7.86 | 12.96 | 9.48 | 16.60 | 14.16 | 32.82 | 8.61 |
| | **2000-01 to 2009-10** | | | | | | | |
| Area | 46.49 | 8.16 | 4.68 | 47.44 | 11.98 | 11.88 | 41.27 | 4.09 |
| Production | 23.67 | 7.45 | 10.60 | 41.93 | 19.09 | 11.68 | 39.60 | 7.63 |
| Yield | 62.96 | 4.74 | 8.22 | 25.71 | 8.14 | 3.38 | 6.21 | 5.03 |
| | **2010-11 to 2019-20** | | | | | | | |
| Area | 25.16 | 5.86 | 3.12 | 172.56 | 15.23 | 6.66 | 137.11 | 4.65 |
| Production | 25.24 | 6.10 | 5.74 | 164.40 | 15.98 | 6.75 | 43.62 | 4.01 |
| Yield | 0.85 | 1.13 | 5.98 | 1.90 | 3.1768 | 0.59 | 28.42 | 5.04 |

crops in Bihar showed positive growth rate in yield except Linseed (-0.39%), Safflower (-0.19%) and Sunflower (-0.10%). Highest positive growth rate in yield was found in Castor seed (3.04%) followed by Rapeseed and mustard (1.19%), Sesamum (0.50%) and Safflower (0.59%). To increase the area of under oilseeds particularly Mustard, Groundnut, Linseed, Sesamum and Safflower, Rashtriya Krishi Vikas Yojana (RKVY) programme started in *Rabi* 2016 for promotion of oilseeds to bring additional area under cultivation.

## Instability estimates

Agriculture growth and instability have always been a major issue of concern to the agricultural economists in India now a day. Increasing production of oilseed crops is the need of the hour both at national and international levels for meeting food and nutritional

requirements of the growing population. Increasing instability has adverse effect for several reasons. It up scales the production risks and affects the income of the farming community. It also restricts the cultivator from making investment in farming and adopting high paying technologies. Instability in agricultural and food production is also important for food management and macroeconomic stability (Chand *et al.* 2008).

**Period 1 (1990-91 to 1999-2000)**

In this period, highest instability in area was found in Sunflower (34.85%) followed by Castor seed (23.83%) and Safflower (13.24%). In production of various oil seeds, Sunflower (32.24%) showed maximum instability followed Castor seed (19.68%) and Groundnut (15.33%). Among instability of yield, Castor seed (32.82%) showed highest instability followed by Sesamum (16.60%) and Sunflower (14.16%). During the first period lowest instability in area was found in Sesamum (2.90%) followed by Rapeseed-mustard (3.16%) and Groundnut (6.62%). In case of production, Saflower (10.14%) showed the lowest instability followed by Linseed (13.09%) and Rapeseed-mustard (13.56%).

**Period 2 (2000-01 to 2009-10)**

Bihar showed moderate instability of area, production and yield of oilseeds in this period and the value were 4.09%, 7.63% and 5.03% respectively. Safflower registered the highest instability in area (47.44%), production (41.93%) whereas Groundnut registered highest instability in yield (62.96%). In area instability analysis, Rapeseed-mustard showed

**Table 3:** Contribution of area, productivity (yield) and their interaction of oilseeds in Bihar during the different Periods

| Variable | Groundnut | Linseeds | Rapeseed -mustard | Safflower | Sesamum | Sunflower | Castor seeds | Total |
|---|---|---|---|---|---|---|---|---|
| **1990-91 to 1999-2000** | | | | | | | | |
| $\Delta P$ | 1600 (100) | -11300 (100) | -6700 (100) | 200 (100) | 4600 (100) | 17300 (100) | 400 (100) | -10000 (100) |
| $A_0\Delta Y$ | 1358.49 (84.90) | 3498.43 (-30.95) | 2754.17 (-41.10) | 85.71 (42.85) | 3437 (74.72) | 176.19 (1.01) | 1400 (350) | 26546.09 (-265.46) |
| $Y_0\Delta A$ | 188.24 (11.76) | -13608.2 (120.42) | -9151.24 (136.58) | 80 (40) | 671.42 (14.59) | 6200 (35.14) | -222.22 (-55.55) | -31035.3 (310.35) |
| $\Delta A\Delta Y$ | 53.27 (3.33) | -1190.19 (10.53) | -302.93 (4.52) | 34.28 (17.14) | 491.07 (10.67) | 10923.81 (63.14) | -777.77 (-194.4) | -5510.81 (55.10) |
| **2000-01 to 2009-10** | | | | | | | | |
| $\Delta P$ | 500 (100) | -7860 (100) | 5000 (100) | -100 (100) | 1400 (100) | 15870 (100) | 100 (100) | 10357.73 (100) |
| $A_0\Delta Y$ | -25 (-5) | 6858.68 (-87.26) | 14171.8 (283.43) | 30.76 (-30.76) | 728 (52) | -638 (108.40) | 100 (100) | 26562.19 (256.44) |
| $Y_0\Delta A$ | 600 (120) | -11863.6 (150.93) | -7853.17 (-157.06) | -113.33 (113.33) | 572.73 (40.91) | 17204.44 (108.40) | 0 (0) | -13474.4 (-130.09) |
| $\Delta A\Delta Y$ | -75 (-15) | -2855.05 (36.32) | -1318.65 (-26.37) | -17.43 (17.43) | 99.27 (7.09) | -695.61 (-4.38) | 0 (0) | -2730.05 (-26.35) |
| **2010-11 to 2019-20** | | | | | | | | |
| $\Delta P$ | 457.82 (100) | -13825.4 (100) | -190.12 (100) | 9.02 (100) | -962.07 (100) | -11715 (100) | -105.95 (100) | -10344.7 (100) |
| $A_0\Delta Y$ | 8 (1.74) | -1027 (7.42) | 13887.7 (-7304.7) | -3.16 (-35.03) | 265.2 (-27.56) | -318.11 (2.71) | 3.2 (-3.02) | 8195.50 (-79.22) |
| $Y_0\Delta A$ | 441 (96.32) | -13463.1 (97.37) | -12186.8 (6410.06) | 12.85 (142.54) | -1089.67 (113.26) | -1155.3 (98.63) | -107.35 (101.31) | -17479.4 (168.96) |
| $\Delta A\Delta Y$ | 8.82 (1.92) | 664.74 (-4.80) | -189.02 (994.64) | -0.67 (-7.50) | -137.60 (14.30) | 158.44 (-1.35) | -1.80 (1.70) | -1060.81 (10.25) |

***Note:*** *The values within the parentheses are percentage share of Column total (P= Production in '000 tonnes, A= Area in '000 ha, Y= Yield in tonnes/ha, $\Delta P$, $\Delta A$ and $\Delta Y$ are Change in Production, Area and Yield respectively.)*

lowest instability (4.68%). In production of different oilseed crops, Linseed showed lowest instability (7.45%). In yield, Sunflower (3.38%) showed lowest instability followed by Linseed (4.74%) and Rapeseed-mustard (8.22%).

**Period 3 (2010-11 to 2019-20)**

In this period, Bihar showed lowest instability in area (4.65%), production (4.01%) and yield (5.04%) of oilseeds as compared to other two periods 1 and 2. Among the crop-wise analysis, Safflower showed highest instability in area (172.56%) and production (164.40%). Lowest instability in area was found in Rapeseed-mustard (3.12%) followed by Linseed (5.86) and Sunflower (6.66%). Highest instability in yield was found in Castor seed (28.42%). The lowest instability in yield was found in Sunflower (0.59%) followed by Groundnut (0.85%) and Linseed (1.13%).

**Contribution of area, productivity and their interaction**

The growth analysis (area, production and yield) of oilseed revealed the general pattern of growth but this analysis does not evaluate the contribution of area and yield towards the production growth. So, it was necessary to examine the sources of output growth. To find out the sources of output growth, the change in production is divided into three effects i.e., area effect, yield effect and interaction effect. With the help of this additive decomposition model the relative contribution of area, productivity and their interaction on oilseeds production in Bihar (1990-91 to 1999-2000, 2000-01 to 2000-01, 2010-11 to 2019-20) has been estimated and presented in Table 3.

As Table 3 reveals during period 1, major contribution in the change of oilseed production of groundnut, Sesamum and castor seed was the yield effect, all being more than 50%. Linseed and rapeseed-mustard had area effect and sunflower had interaction effect. In the period 2, no clear cut effect was found for changes in oilseed production. In the period 3, area effect (96.32%) was found more responsible for production changes in groundnut. Similar trend was also observed in linseed, rapeseed-mustard, safflower Sesamum, sunflower and castor seed. In fact, Production of oilseed decreased due to reduction in area of different oilseed crops.

## CONCLUSION

The results clearly show that the growth rate performance of area, production and yield of oilseed in Bihar, declined sharply from period 1 to 3. It implies that more than half of the area under the crop in the region suffered from low growth rate in production. For overall period (1990-91 to 2019-20), growth rate of area, production and yield of oilseeds in Bihar showed that area and production was decreasing at a Compound Growth Rate -2.59% and -0.62% respectively. Only yield showed positive increasing trend at a Compound Growth Rate of 2.02% annually. The comparison of growth rates of area, production and yield in all the periods revealed that Sunflower show better performance in production growth followed by Rapeseed-mustard. In instability analysis, Period 3 showed lowest instability in production (6.47%) and yield (6.22%) of oilseeds as compared to other two periods 1 and 2 whereas period 2 showed lower instability (4.17%) in area as compared to other two periods 1 and 3. The results of decomposition analysis for examining the sources of output growth show that sources of output growth were almost same in all the periods. For Bihar, yield effect was the major contribution followed by area effect in first two periods whereas period 3 showed area effect for changes in oilseed production.

**Policy implications**

The first national programme on Oilseeds was launched in 1986 as Technology Mission on Oilseeds (TMO). After that production of oilseeds started increasing and early 1990s Bihar achieved its highest production and area under oilseed crops. When the TMO was later restructured in 2004 as Integrated Scheme of Oilseeds, Pulses, Oil palm and Maize (ISOPOM) the Bihar State got some encouragement and productivity of oilseed crops start increasing. At present, there is not much scope to expand the area under cultivation but productivity can be increased further. Based on a yield gap study, there exists a tremendous potential for enhancing the yield of seven oilseed crops grown in Bihar (yield gap of 45.8 per cent). Based on a rough estimate, 3.6 million tonnes of additional oils can be produced by means of bridging the yield gap assuming 1.5 tonnes per hectare as a realizable yield. The continuing shortage of vegetable oils would suggest that the

Oilseeds Technology Mission, OPP and growing oil palms have had little impact in Bihar as well as in the nation. Bihar has the potential to increase the domestic production of oilseeds which could reduce the dependency from outside supply and also benefit the oilseed growers. The government of India as well as Govt. of Bihar have taken many steps and measures to increase the production of edible oil seeds such as National Mission on Oilseeds and oil palm (NMOOP), oil palm area expansion under RKVY, increasing the minimum support prices of oilseed crops, creation of buffer stocks for oilseed crops, cluster demonstration of oilseed crops are being implemented by the government to boost the domestic production. Non-availability of adequate quantity of quality seeds of improved varieties and lack of use of inputs like fertilizer, weed control and disease and pests protection are major constraints in oilseeds production in the state. A second yellow revolution is need of the hour which will boost the oilseed production in the country to make Bihar as well as India self-sufficient in edible oil production.

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