**Educational Administration: Theory and Practice**
2024, 30(4), 679-689
ISSN: 2148-2403
https://kuey.net/

**Research Article**

# Positive Dynamics Of Oilseed In India: An Appraisal Of Structural Stability Regression Model

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**Citation:** Dr. Krishnan Kutty. V (2024), Positive Dynamics Of Oilseed In India: An Appraisal Of Structural Stability Regression Model, *Educational Administration: Theory and Practice*, *30*(4), 679-689,
Doi: 10.53555/kuey.v30i4.1535

**ARTICLE INFO**

**ABSTRACT**

An economy's stability and contribution are reflected in the amount, area, and yield of oilseed agricultural output as well as in the growth, trend, and structural stability of oilseed agricultural production. This study aims to evaluate the oilseed output, area under cultivation, and yield per hectare in India before and after the new agricultural policy (1978–2000) in terms of growth, trend, and structural stability. (since 2001 until 2022). To achieve the goals, secondary data from the Reserve Bank of India's Handbook of Statistics on the Indian Economy (2021–2022) was used. The trend line, t test, and structural stability regression model were employed in the estimate process. From 1978–79 to 1999–2000, the growth rates of total production, area under cultivation, and yield per hectare of oilseeds were 105.7 percent, 36.2 percent, and 65.3%, respectively; from 2000–01 to 2021–22, the figures were 106.7 percent, 529 percent, and 61.9 percent. The yield, area, and productivity of oilseeds per hectare all show favourable correlations. The production, cultivated area, and yield per hectare of oilseeds in India have all changed structurally as a result of the new agricultural policy. The main goals should be to boost yield through technological innovation, enhance cultivation, training, and agricultural research and development, as well as better implement policy in India.

**KEYWORDS**: Structural Stability, Oilseed, Yield, Regression, Correlation.
**JEL**: Q13, Q17, Q18

## INTRODUCTION

Agriculture provides the principal source of income for over 58% of India's population. When the GDP is divided down by sector, agriculture and related industries make up 20.19 percent. India's vast population is guaranteed food security and nutrition by the agricultural sector, which also provides a substantial number of raw materials for the nation's industrial base and export surpluses. Producing food grains and commercial crops increased dramatically as a result of improved irrigation systems, pre-monsoon rainfall, new technological introductions, investment, mechanisation, seeds, pricing regulations, and other reasons. India's second-largest agricultural export after food grains is oil seeds, which represent a significant commercial crop in the nation. Oil seeds yield vegetable oils, which are becoming more and more preferred to animal fats as people become more health-conscious. India is a major producer of oilseeds and a major importer of edible oils. After the US, China, and Brazil, India has the fourth-largest vegetable oil economy in the world. As per the latest approximations, oilseeds currently constitute 13% of the total cultivated area, 3% of the GDP, and 10% of the overall agricultural output value. The crops division reports that the total production of oilseeds climbed from 101 million metric tonnes in 1978 to 2000 to 207.5 million metric tonnes with a 105 percent increase and from 184.4 million metric tonnes to 380 million metric tonnes in 2000–2022 with a 106.7 percent increase. In the same time frame, there was a 37.2 percent rise in oilseed cultivation area (measured in lakh hectares) and a 26.9 percent increase in yield (measured in kg per hectare), respectively. All states are implementing the National Food Security Mission to increase productivity and food and non-food grain production. The most widely used oilseeds are soybean, rapeseed, mustard, and groundnut. Groundnuts make up over half of India's significant oil seed production, making them the most important oil seed in the nation. Although it is also planted in Rabi, groundnuts are primarily grown in Kharif. In the 1978–79 season,

groundnut output, area, and yield were 62, 74, and 835, respectively; in the 2021–22 season, they were 101, 57, and 1777, with growth rates of 62.9%, -22.9 percent, and 112.8 percent. Similarly, India's two most important oilseeds are mustard and rapeseed. These seeds' oil is used as a lubricant, pickle preserver, cooking medium, and cosmetic. Common livestock feed, oil cake, can also be used as manure. Consequently, in 1978–79, mustard, rapeseed, and area and yield were 19, 35, and 525, respectively; in 2021–2022, they were 120, 80, and 1497, with growth rates of 128.6%, 185.1%, and 531.7 percent, respectively. Consequently, from 101, 177, and 516 in 1978–1979 to 380, 289, and 1312 in 2021–2022, the total oilseed output, area, and yield per hectare of oilseeds have increased by 376.2%, 63.3%, and 154.3%, respectively. The Indian government unveiled the New Agricultural Policy in July 2000. The government created this plan with the goal of encouraging the expansion and improvement of agricultural productivity and production, which will raise living standards, employment, and income levels. Supporting the general growth of the agriculture sector was the aim of this policy. The goal of the policy was to stimulate annual growth in the agriculture sector of more than 4%. Among the other goals are raising input productivity, raising value added per hectare, safeguarding the interests of small farmers, modernising the agricultural sectors, halting environmental deterioration, promoting agricultural research and training, and getting rid of red tape. By supporting commercially feasible, technically sound, ecologically benign, non-hazardous, and socially acceptable uses of the nation's natural resources, the new agricultural policy seeks to improve agricultural sustainability.

## OBJECTIVE

To examine the development and patterns of oilseed yield, area, and production prior to and following the implementation of the new agricultural policy.
To assess the level of structural stability in agricultural production and the amount of land used for oilseed farming.

## HYPOTHESIS

There is no structural change in agricultural productivity or area under cultivation of oilseeds before or after India's new agricultural strategy.
The average production, area, and yield of oilseeds are unchanged before and after India's new agricultural plan.

## PURPOSE

In particular, the study aimed to determine whether the structural stability of oilseeds both before and after the agricultural policy had any positive effects on the production, area, and yield of commercial crops, particularly oilseeds like groundnut, rapeseed, mustard, and soyabean, as well as overall oil production, area, and yield in India. Encouraging the growth and enhancement of agricultural productivity and production is the government's main objective in implementing this strategy, which will raise income levels, employment, and living standards.

## METHODOLOGY

To carry out the study's objectives of production, area under cultivation, and yield per hectare of oilseeds in India, we employed secondary data. The Reserve Bank of India's handbook of statistics on the Indian economy—2021–22 and the Government of India's Ministry of Agriculture and Farmers' Welfare provided data on the area under cultivation (in lakh hectares), oilseed production (in lakh tonnes), and yield per hectare of oilseed (in kg per hectare). The statistics included two time periods in India: 1978–79 to 1999–2000 (Period I) and 2001–2022 (Period II), which corresponded to the period before and after the country's new agriculture policy of 2000. Both periods, such as 1979 to 2022 in India, necessitate a thorough investigation. The Econometric Model, Chou Test (Gregory Chou), is a structural stability regression model that is used to quantify the structural stability of oilseeds like groundnut, rapeseed, mustard, and soyabean and the total oil production, area, and yield. It is calculated using a pooled sample, period I and period II, separately at a 5% level of significance. Before and after the new agricultural policy, the average, compound annual growth rate (CAGR), t test, and F test were used to estimate and compare the growth trend in the production, area, and yield per hectare of oilseed crops.

### Structural Stability Regression Model

The stability of the growth parameter was examined using the structural stability regression model both before and after the new agricultural policy.

$$W_t = Z_1 + Z_2 M_t + S_t$$

$W_t$, $W_{t(1)}$ and $W_{t(2)}$ = Production oilseed in pooled, period I and II.
$M_t$, $M_{t(1)}$ and $M_{t(2)}$ = Area oilseed in pooled, period I and II.

T = time period,
$Y_1$ and $Y_2$, $P_1$ and $P_2$, $Z_1$ and $Z_2$ = intercept and the growth parameter in pooled, period I & II.
$S_t$, $S_{t\,(1)}$ and $S_{t\,(2)}$ = Stochastic ingredient in the pooled, Period I & II.
$N_1$, $N_2$, $N_3$ = Residual sum of squares in pooled, period I & II.
$N_4 = N_2 + N_3$.
$N_5 = N_1 - N_4$.
R= Number of parameters.

$$F = \frac{N5/R}{N4/(n1+n2-2R)}$$

## LITERATURE REVIEW

Efficiency and Consequences in the Indian Edible Oilseed Industry, Mruthyunjaya et al., 2005. According to the study, the technical inefficiencies in oilseed production range from one-third to one-fourth on average. Scale and allocative inefficiencies are also present, along with even more at the farm/processing unit level. It is believed that there are half to two-thirds of technological inefficiencies in the oilseed sector overall. Soil quality, seed replacement, and education all contribute to oilseed production's technical efficiency. Higher oil recovery and sufficient raw material availability determine technical efficiency in oil production. Lack of a consistent and timely supply of high-quality seeds and processing raw materials, as well as an unreliable market for oilseeds, are the main causes of the oilseed industry's subpar performance. If oilseeds are to compete financially with other crops, they should be grown on irrigated land. "Performance of oilseeds in India: A temporal analysis" by Krishna Teja et al. (2017) states as much. Together with two non-edible crops, castor and linseed, which are grown all over the nation, the complete oilseed goods include groundnut, rapeseed-mustard, soybean, sunflower, sesame, safflower, and niger. It was discovered when oilseed performance was analysed that the yield component of all oilseeds performed very well at the national level. Despite a rapid upward and significant gain in area, productivity, and yield, total oilseeds grew slowly over the research period. Domestic demand for oilseeds outstrips supply, prompting us to import edible oils. To bridge the gap between oil seed production and consumption, the government must invest in technological advancements and boost oil seed productivity. (2017) Prem Narayan, An Analytical Approach to the Recent Demand, Supply, and Growth of Oilseeds and Edible Oil in India. Oilseeds are an essential component of a nutritionally balanced diet. In Indian cuisine, these are the main sources of edible oil and protein. Following cereals, oilseeds are the second-most important source of protein in the Indian diet. India imports and consumes edible oil on a net basis. India accounts for 13–15% of the oilseed area, 7-8% of the oilseed output, 4–6% of edible oil production, 12–14% of vegetable oil imports, and 10–12% of edible oil consumption. Indian agriculture has been studied in terms of accessible oil supply from oilseed and non-oilseed sources to suit the Indian population's vegetable oil requirements. To meet the nutritional fat needs of India's projected 168.5 million population by 2050, the country will need to produce 17.84 million metric tonnes of vegetable oil. An overview of the current trends in oilseed crop production. Sharma, Amod (2018) Oilseed crop cultivation was significantly riskier, as seen by the low CV. Oilseed crops had a CV of less than 43.68 percent for acreage, output, and productivity. The oilseed crop instability indexes for area, production, and productivity were all positive, implying a lower risk of producing oilseed crops in the future. During the study period, the increase in output was linked to both an increase in area and the interaction between area and oilseed crop yield. C.P. Verma and Kalpana Singh (2020). Study on Edible Oil Consumers' Interaction with the Category Sunflower oil is popular because it is believed to be excellent for the heart and cholesterol; similarly, soybean oil is popular because it is thought to be low in calories and is regularly suggested by doctors and retailers. Aside from cost and package size, groundnut and cotton seed oils are popular due to their aroma and colour. Cottonseed and palmolein oil are popular among low-income people, whereas mustard oil is purchased for its flavour and pungency, as well as the fact that it is regularly recommended by shopkeepers. Suresh A. Kurup et al. (2015). Technical and efficiency changes in India's oilseed sector: policy implications. The study discovered that groundnut, rapeseed/mustard, and soybean productivity growth slowed over period II (1996–2010) compared to period I (1996–2010). (1985-1995). Peanuts and rapeseed/mustard showed a positive TFP change over time; however, soybeans showed a negative trend. During Period II, the TFP changes of groundnut and rapeseed/mustard increased in two of the three states. Only one of the three big states saw a positive TFP change in soybeans. Technical changes accounted for the whole change in TFP across all crops, with no contribution from efficiency improvements. Padmavathi, A., and N. Peddobilesu (2019). Productivity Analysis of Oilseeds in Andhra Pradesh Oilseed production is vital to India's agricultural economy. The country boasts the world's longest oilseed production and accounts for 7% of global vegetable oil production, with a 14 percent share of the land. The country's oil seed status has evolved considerably since 1986, when the Technology Mission Oilseeds (TMO) was implemented. As a result, given the growing importance of oilseed production in ensuring inclusive growth and the need for self-sufficiency, the current study seeks to explore the trend of oilseed area, production, and productivity in the state of Andhra Pradesh.

## RESULTS AND DISCUSSION

As a result of the new agricultural policy, the structural stability of commercial crops such as oilseeds as well as the growth rates of output, area, and yield were examined.

**Table 1** Growth Rate of Production, Area and Yield of Oilseeds in India from Period I

| Year | Production of Total Oilseeds | Growth Rate | Total Area of Oilseeds | Growth Rate | Total Yield of Oilseeds | Growth Rate |
|---|---|---|---|---|---|---|
| 1978-79 | 101 | - | 177 | - | 516 | - |
| 1979-80 | 87 | -13.86 | 169 | -4.52 | 532 | 3.10 |
| 1980-81 | 93.7 | 7.70 | 176 | 4.14 | 532 | 0.00 |
| 1981-82 | 120.8 | 28.92 | 189.1 | 7.44 | 639 | 20.11 |
| 1982-83 | 100 | -17.22 | 177.6 | -6.08 | 563 | -11.89 |
| 1983-84 | 126.9 | 26.90 | 186.9 | 5.24 | 679 | 20.60 |
| 1984-85 | 129.5 | 2.05 | 189.2 | 1.23 | 684 | 0.74 |
| 1985-86 | 108.3 | -16.37 | 190.2 | 0.53 | 570 | -16.67 |
| 1986-87 | 112.7 | 4.06 | 186.3 | -2.05 | 605 | 6.14 |
| 1987-88 | 126.5 | 12.24 | 201.3 | 8.05 | 629 | 3.97 |
| 1988-89 | 180.3 | 42.53 | 219 | 8.79 | 824 | 31.00 |
| 1989-90 | 169.2 | -6.16 | 228 | 4.11 | 742 | -9.95 |
| 1990-91 | 186.1 | 9.99 | 241.4 | 5.88 | 771 | 3.91 |
| 1991-92 | 186 | -0.05 | 258.9 | 7.25 | 719 | -6.74 |
| 1992-93 | 201.1 | 8.12 | 252.4 | -2.51 | 797 | 10.85 |
| 1993-94 | 215 | 6.91 | 269 | 6.58 | 799 | 0.25 |
| 1994-95 | 213.4 | -0.74 | 253 | -5.95 | 843 | 5.51 |
| 1995-96 | 221.1 | 3.61 | 259.6 | 2.61 | 851 | 0.95 |
| 1996-97 | 243.8 | 10.27 | 263.4 | 1.46 | 926 | 8.81 |
| 1997-98 | 213.2 | -12.55 | 261.2 | -0.84 | 816 | -11.88 |
| 1998-99 | 247.5 | 16.09 | 262.3 | 0.42 | 944 | 15.69 |
| 1999-00 | 207.1 | -16.32 | 242.8 | -7.43 | 853 | -9.64 |

Source: RBI – Handbook of statistics on the Indian Economy – 2021-22.

Before the new agricultural policy was implemented, Table 1 shows the growth rates of oilseed production, area, and yield in India. The year 1988–89 had the highest output growth rate, at 42.53 percent, followed by 1981–82 at 28.9 percent and 1983–84 at 26.9 percent. The negative growth rates were 17.22%, -16.37%, and -16.32 percent in 1982–1983; 1985–1986; and 1999–2000, respectively. The yearly growth rate of oilseed cultivation was 8.79 percent in 1988–1989, 8.05 percent in 1987–1988, and 7.44 percent in 1999–2000. Similarly, the area under oilseed cultivation fell by -5.95 percent in 1994–1995; 6.08 percent in 1982–1983; and -7.43 percent in 1999–2000. The oilseed yield per hectare increased at a rate of 31% in 1988–89, 20.6 percent in 1983–84, and 20.11 percent in 1981–82 prior to the implementation of the new agricultural policy. Thereafter, the rate decreased to -16.7 percent in 1985–86, -11.89 percent in 1982–83, 1997–98, and -11.88 percent in 1997–98. There was a general trend in the yield per hectare, area, and growth rate of oilseed in 1988–89.

**Table 2** Growth Rate of Production, Area and Yield of Oilseeds in India from Period II

| Year | Production of Total Oilseeds | Growth Rate | Total Area of Oilseeds | Growth Rate | Total Yield of Oilseeds | Growth Rate |
|---|---|---|---|---|---|---|
| 2000-01 | 184.4 | - | 227.7 | - | 810 | - |
| 2001-02 | 206.6 | 12.04 | 226.4 | -0.57 | 913 | 12.72 |
| 2002-03 | 148.4 | -28.17 | 214.9 | -5.08 | 691 | -24.32 |
| 2003-04 | 251.9 | 69.74 | 236.6 | 10.10 | 1064 | 53.98 |
| 2004-05 | 243.5 | -3.33 | 275.2 | 16.31 | 885 | -16.82 |
| 2005-06 | 279.8 | 14.91 | 278.6 | 1.24 | 1004 | 13.45 |
| 2006-07 | 242.9 | -13.19 | 265.1 | -4.85 | 916 | -8.76 |
| 2007-08 | 297.6 | 22.52 | 266.9 | 0.68 | 1115 | 21.72 |
| 2008-09 | 277.2 | -6.85 | 275.6 | 3.26 | 1006 | -9.78 |
| 2009-10 | 248.8 | -10.25 | 259.6 | -5.81 | 958 | -4.77 |
| 2010-11 | 324.8 | 30.55 | 272.2 | 4.85 | 1193 | 24.53 |
| 2011-12 | 298 | -8.25 | 263.1 | -3.34 | 1133 | -5.03 |
| 2012-13 | 309.4 | 3.83 | 264.8 | 0.65 | 1169 | 3.18 |
| 2013-14 | 327.5 | 5.85 | 285.3 | 7.74 | 1153 | -1.37 |
| 2014-15 | 275.1 | -16.00 | 257.3 | -9.81 | 1037 | -10.06 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2015-16 | 220.9 | -19.70 | 219.3 | -14.77 | 968 | -6.65 |
| 2016-17 | 312.8 | 41.60 | 261.8 | 19.38 | 1195 | 23.45 |
| 2017-18 | 314.6 | 0.58 | 245 | -6.42 | 1284 | 7.45 |
| 2018-19 | 315.2 | 0.19 | 247.9 | 1.18 | 1271 | -1.01 |
| 2019-20 | 332.2 | 5.39 | 271.4 | 9.48 | 1224 | -3.70 |
| 2020-21 | 359 | 8.07 | 288 | 6.12 | 1247 | 1.88 |
| 2021-22 | 380 | 5.85 | 289 | 0.35 | 1312 | 5.21 |

Source: RBI – Handbook of statistics on the Indian Economy – 2021-22.

The growth rates of oilseed output, area, and yield are displayed in Table 2 following the computation of the new agricultural policy. 69.74 percent in 2003–04, 41.6 percent in 2016–17, and 30.55 percent in 2010–11 were the highest output growth rates, while -28.2 percent in 2002–03, -19.7% in 2015–17, and -16 percent in 2014–15 were the lowest. Comparably, oilseed cultivation grew by 19.38% in 2016–17, 16.3% in 2004–05, and 10.1% in 2003–04; however, growth rates were negative in 2015–16, -9.81% in 2014–15, and -6.4% in 2017–18. The oilseed yield per hectare increased at the fastest rates after the new agricultural policy, with the highest positive growth rates occurring in 2002–03, -16.8% in 2004–05, and -10.06 percent in 2014–15, and the lowest growth rates occurring in 2003–04, 24.53 percent in 2010–11, and 23.45 percent in 2016–17.

**Table 3** Moving average of Production, Area and Yield of Oilseeds in India from Period I

| Year | Production of Total Oilseeds | 5 yearly moving average | Total Area of Oilseeds | 5 yearly moving average | Total Yield of Oilseeds | 5 yearly moving average |
|---|---|---|---|---|---|---|
| 1978-79 | 101 | - | 177 | - | 516 | - |
| 1979-80 | 87 | - | 169 | - | 532 | - |
| 1980-81 | 93.7 | 100.5 | 176 | 177.74 | 532 | 556.4 |
| 1981-82 | 120.8 | 105.68 | 189.1 | 179.72 | 639 | 589 |
| 1982-83 | 100 | 114.18 | 177.6 | 183.76 | 563 | 619.4 |
| 1983-84 | 126.9 | 117.1 | 186.9 | 186.6 | 679 | 627 |
| 1984-85 | 129.5 | 115.48 | 189.2 | 186.04 | 684 | 620.2 |
| 1985-86 | 108.3 | 120.78 | 190.2 | 190.78 | 570 | 633.4 |
| 1986-87 | 112.7 | 131.46 | 186.3 | 197.2 | 605 | 662.4 |
| 1987-88 | 126.5 | 139.4 | 201.3 | 204.96 | 629 | 674 |
| 1988-89 | 180.3 | 154.96 | 219 | 215.2 | 824 | 714.2 |
| 1989-90 | 169.2 | 169.62 | 228 | 229.72 | 742 | 737 |
| 1990-91 | 186.1 | 184.54 | 241.4 | 239.94 | 771 | 770.6 |
| 1991-92 | 186 | 191.48 | 258.9 | 249.94 | 719 | 765.6 |
| 1992-93 | 201.1 | 200.32 | 252.4 | 254.94 | 797 | 785.8 |
| 1993-94 | 215 | 207.32 | 269 | 258.58 | 799 | 801.8 |
| 1994-95 | 213.4 | 218.88 | 253 | 259.48 | 843 | 843.2 |
| 1995-96 | 221.1 | 221.3 | 259.6 | 261.24 | 851 | 847 |
| 1996-97 | 243.8 | 227.8 | 263.4 | 259.9 | 926 | 876 |
| 1997-98 | 213.2 | 226.54 | 261.2 | 257.86 | 816 | 878 |
| 1998-99 | 247.5 | - | 262.3 | - | 944 | - |
| 1999-00 | 207.1 | - | 242.8 | - | 853 | - |

Source: RBI – Handbook of statistics on the Indian Economy – 2021-22.

The five-year moving average for the variations in oilseed production, area, and yield per hectare in India was shown in Table 3 prior to the implementation of the new agricultural policy. In the same time period, oilseed cultivation area increased from 177 lakh hectares to 242.8 lakh hectares, with a moving average of 177.74 to 257.86. Oilseed yields varied from 516 to 853 kg per hectare, with a moving average of 556.4 to 878 kg per hectare. Oilseed production increased from 101 lakh metric tonnes in 1978–79 to 207.1 lakh metric tonnes in 1999–2000.

**Table 4** Moving average of Production, Area and Yield of Oilseeds in India from Period II

| Year | Production of Total Oilseeds | 5 yearly moving average | Total Area of Oilseeds | 5 yearly moving average | Total Yield of Oilseeds | 5 yearly moving average |
|---|---|---|---|---|---|---|
| 2000-01 | 184.4 | - | 227.7 | - | 810 | - |
| 2001-02 | 206.6 | - | 226.4 | - | 913 | - |
| 2002-03 | 148.4 | 206.96 | 214.9 | 236.16 | 691 | 872.6 |
| 2003-04 | 251.9 | 226.04 | 236.6 | 246.34 | 1064 | 911.4 |
| 2004-05 | 243.5 | 233.3 | 275.2 | 254.08 | 885 | 912 |
| 2005-06 | 279.8 | 263.14 | 278.6 | 264.48 | 1004 | 996.8 |
| 2006-07 | 242.9 | 268.2 | 265.1 | 272.28 | 916 | 985.2 |
| 2007-08 | 297.6 | 269.26 | 266.9 | 269.16 | 1115 | 999.8 |
| 2008-09 | 277.2 | 278.26 | 275.6 | 267.88 | 1006 | 1037.6 |
| 2009-10 | 248.8 | 289.28 | 259.6 | 267.48 | 958 | 1081 |
| 2010-11 | 324.8 | 291.64 | 272.2 | 267.06 | 1193 | 1091.8 |
| 2011-12 | 298 | 301.7 | 263.1 | 269 | 1133 | 1121.2 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2012-13 | 309.4 | 306.96 | 264.8 | 268.54 | 1169 | 1137 |
| 2013-14 | 327.5 | 286.18 | 285.3 | 257.96 | 1153 | 1092 |
| 2014-15 | 275.1 | 289.14 | 257.3 | 257.7 | 1037 | 1104.4 |
| 2015-16 | 220.9 | 290.18 | 219.3 | 253.74 | 968 | 1127.4 |
| 2016-17 | 312.8 | 287.72 | 261.8 | 246.26 | 1195 | 1151 |
| 2017-18 | 314.6 | 299.14 | 245 | 249.08 | 1284 | 1188.4 |
| 2018-19 | 315.2 | 326.76 | 247.9 | 262.82 | 1271 | 1244.2 |
| 2019-20 | 332.2 | 340.2 | 271.4 | 268.26 | 1224 | 1267.6 |
| 2020-21 | 359 | - | 288 | - | 1247 | - |
| 2021-22 | 380 | - | 289 | - | 1312 | - |

Source: RBI – Handbook of statistics on the Indian Economy – 2021-22.

Table 4 presents the five-year moving average of oilseed output variability, area variability, and yield per hectare in India after the implementation of the new agricultural policy. With a moving average of 206.96 million metric tonnes to 340.2 million metric tonnes during the same period, oilseed production increased from 184.4 million metric tonnes in 2000–01 to 380 million metric tonnes in 2021–2022. During the same period, oilseed cultivation area increased from 227.7 million hectares to 289 million hectares, with a moving average of 236.16 to 268.26, respectively. Oilseed yields fluctuated between 810 and 1312 kg/hectare throughout the same period, with a moving average between 872.6 and 1267.6 kg/hectare.

**Table 5** Average Production, Area and Yield of Oilseeds: Period I, Period II, and Pooled

| Average Production of Oilseeds (Lakh Tonnes) | | | | |
|---|---|---|---|---|
| Measures | Oilseeds | | | Total Oilseeds |
| | Groundnut | Rapeseed & Mustard | Soyabean | |
| Average (Period I) | 70.24 | 40.41 | 26.29 | 221.38 |
| Average (Period II) | 74.80 | 74.06 | 101.44 | 163.19 |
| Grand Average | 72.52 | 57.23 | 63.87 | 279.57 |
| t – test | 0.110 | 6.32 | 12.3 | 9.01 |
| P- value | 0.724 | 5.01 | 2.31 | 5.31 |
| Pearson "r" | -0.024 | 0.62 | 0.52 | 0.53 |
| Average Area Under Cultivation of Oilseeds (Lakh Hectares) | | | | |
| Average (Period I) | 75.59 | 51.28 | 27.52 | 239.67 |
| Average (Period II) | 56.29 | 61.65 | 96.55 | 220.62 |
| Grand Average | 66.04 | 56.47 | 62.03 | 258.71 |
| t – test | -6.23 | 3.21 | 21.03 | 4.25 |
| P-value | 4.01 | 0.016 | 3.24 | 0.002 |
| Pearson "r" | -0.32 | 0.121 | 0.78 | 0.36 |
| Average Yield Per Hectare of Oilseeds (Kg per Hectare) | | | | |
| Average (Period I) | 922.68 | 760.32 | 853.59 | 895.05 |
| Average (Period II) | 1338.3 | 1187.8 | 1046.2 | 719.73 |
| Grand Average | 1130.5 | 974.07 | 949.84 | 1070.36 |
| t – test | 3.89 | 9.45 | 5.29 | 9.78 |
| P -value | 0.005 | 4.25 | 0.023 | 1.45 |
| Pearson "r" | 0.32 | 0.65 | 0.054 | 0.865 |

Source: RBI – Handbook of statistics on the Indian Economy – 2021-22.

As indicated in Table 5, the average production growth rates for groundnut, rapeseed & mustard, soyabean, and total oilseeds for periods I to II were 6.49 percent, 83.27 percent, 285.9 percent, and -26.3 percent, respectively. Oilseed cultivation area grew at a rate of -25.53 percent, 20.22 percent, 250.8 percent, and -7.94 percent during periods I and II, respectively. Comparably, during the two eras, the average yield per hectare of oilseeds varied in growth rate. Groundnuts accounted for 45.04 percent of this yield, followed by rapeseeds and mustard at 56.22 percent, soyabean at 22.56 percent, and total oilseeds at -19.58 percent. While there is a very weak positive correlation in yield per hectare in periods I and II, the Pearson coefficient of association for groundnut production (-0.024) and area (-0.32) is negative. For the production, area, and yield of groundnut, rapeseed, mustard, soyabean, and all oilseeds, the correlation coefficient is positive.

**Table 6** CAGR of Food Grains Production and Area – Period I, Period II, and Pooled

| CAGR of Food Grains Production (Million Tonnes) | | | | |
|---|---|---|---|---|
| | Oilseeds | | | Total Oilseeds |
| | Groundnut | Rapeseed & Mustard | Soyabean | |
| CAGR (Period I) | -0.008 | 0.054 | 0.162 | 0.035 |
| CAGR (Period II) | 0.007 | 0.027 | 0.032 | 0.028 |
| Overall CAGR | 0.011 | 0.044 | 0.092 | 0.031 |
| CAGR of Area Under Cultivation of Oilseeds (Lakh Hectares) | | | | |

| | | | | |
|---|---|---|---|---|
| CAGR (Period I) | -0.004 | 0.026 | 0.155 | 0.015 |
| CAGR (Period II) | -0.007 | 0.015 | 0.020 | 0.006 |
| Overall CAGR | -0.006 | 0.019 | 0.090 | 0.011 |
| CAGR of Yield Per Hectare of Oilseeds (Kg per Hectare) | | | | |
| CAGR (Period I) | 0.054 | 0.029 | 0.007 | 0.024 |
| CAGR (Period II) | 0.015 | 0.011 | 0.012 | 0.013 |
| Overall CAGR | 0.018 | 0.025 | 0.002 | 0.022 |

Source: RBI – Handbook of statistics on the Indian Economy – 2021-22.

Table 6 demonstrates that the CAGR for soyabean is higher in periods I through II, while for groundnut, rapeseed, mustard, and all oilseeds used in the manufacturing of oilseed goods, it is lower. The area's compound annual growth rate for groundnuts is negative from period I to period II, but it is positive for rapeseed, mustard, soybean, and all oilseeds throughout the same years. The CAGR of yield per hectare for groundnuts grew between periods I and II, but it decreased for oilseeds in general, rapeseed, mustard, and soyabean.

**Table 7** Correlation Coefficient Between Production and Area Period I, II & Pooled

| Correlation Coefficient Between Production and Area | | | | |
|---|---|---|---|---|
| Period | Groundnut | Rapeseed & Mustard | Soyabean | Total Oilseeds |
| Period I | 0.696 | 0.932 | 0.990 | 0.969 |
| Period II | 0.490 | 0.849 | 0.818 | 0.783 |
| Pooled | 0.045 | 0.868 | 0.968 | 0.890 |

Source: RBI – Handbook of statistics on the Indian Economy – 2021-22.

Table 7 shows the correlation coefficient between production and area under cultivation of oilseeds such as groundnut, rapeseed, mustard, soyabean, and total oilseeds before and after the two periods, with a very low positive correlation coefficient for the pooled period for groundnut. Similarly, there is a positive link between production and area under cultivation of rapeseed and mustard, soyabean, and total oilseeds from periods I, II, and the pooled data.

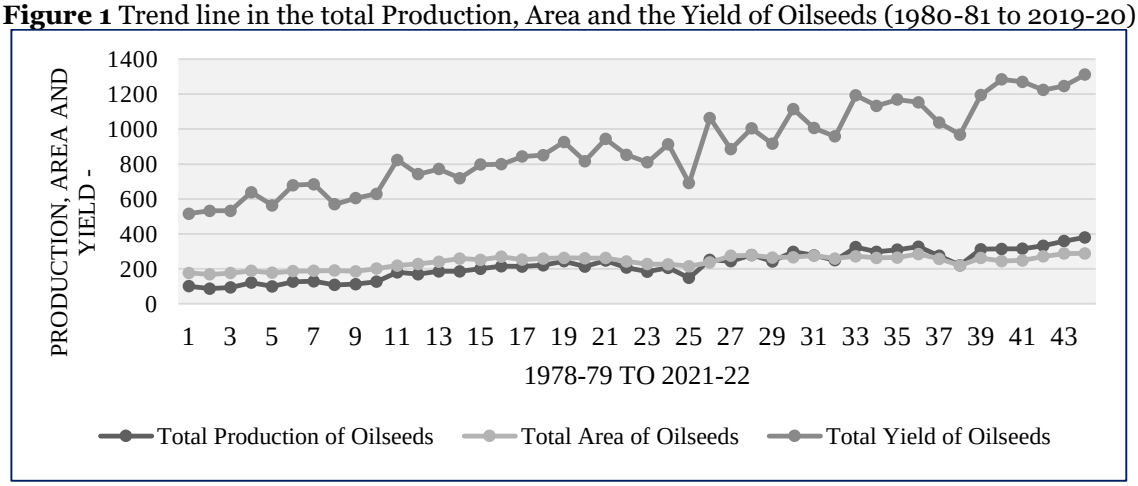
**Table 8** Coefficient of Variation Between Production, Area and Yield in Period I & II

| Coefficient of Variation Between Production and Area | | | | Coefficient of Variation Between Production and Yield | | |
|---|---|---|---|---|---|---|
| Period I | | | Period II | Period I | | Period II |
| Groundnut | Production | 174.6 | 300.5 | Production | 174.6 | 300.5 |
| | Area | 55.07 | 5.62 | Yield | 1661.2 | 5318.5 |
| Rapeseed & Mustard | Production | 249.2 | 332.9 | Production | 249.2 | 332.9 |
| | Area | 175.4 | 132.8 | Yield | 2353.6 | 2901.7 |
| Soyabean | Production | 536.7 | 750.3 | Production | 536.7 | 750.3 |
| | Area | 470.1 | 468.2 | Yield | 3388.2 | 3059.6 |
| Total Oilseeds | Production | 2684 | 3094.4 | Production | 2684 | 3094.4 |
| | Area | 1778.2 | 939.2 | Yield | 6521.5 | 8539.3 |

Source: RBI – Handbook of statistics on the Indian Economy – 2021-22.

Table 8 indicates a lower coefficient of variation, suggesting greater consistency in groundnut production, area, and yield over period I. Similar to mustard, soy, and all oilseeds, rapeseed and mustard have a coefficient of variation for period II, which is thought to be more efficient.

**Figure 1** Trend line in the total Production, Area and the Yield of Oilseeds (1980-81 to 2019-20)




Source: RBI – Handbook of statistics on the Indian Economy – 2021-22.

Figure 1 shows that, compared to production, area, and yield of oilseeds, the growth rate is very low for the area under cultivation and highest in the yield per hectare of oilseeds. The total production of oilseeds from the entire period.

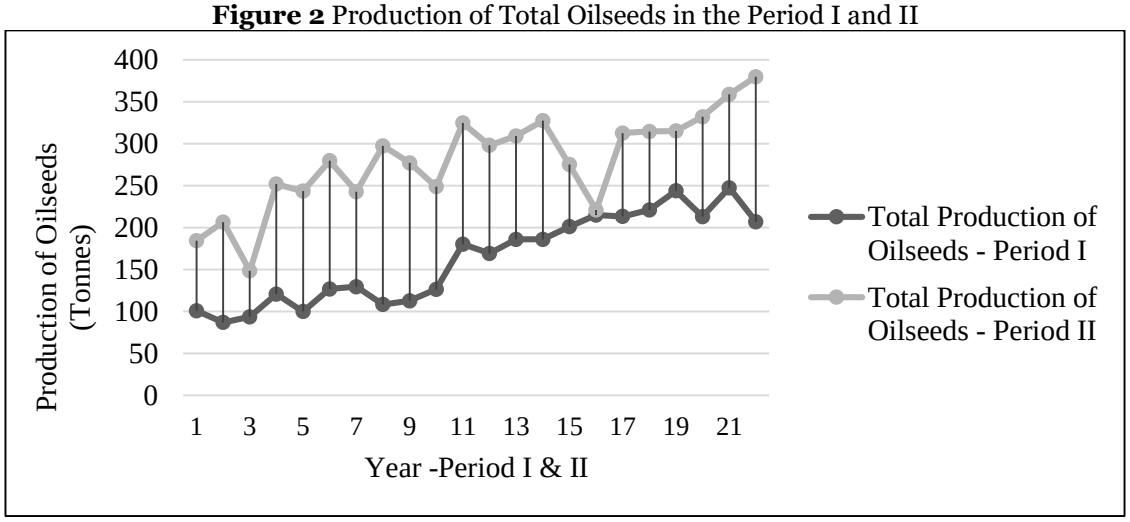
**Table 9** Trend in the Total Production, Area and Yield of Oilseeds Items in Pooled Period

| Total Oilseeds | Production | Area | Yield |
|---|---|---|---|
| | Y = 0.149X-10.53<br>$R^2$ = 0.865 | Y = 0.281X-44.76<br>$R^2$ = 0.596 | Y = 0.052X-24.27<br>$R^2$ = 0.885 |
| Groundnut | Y = 0.311X-0.076<br>$R^2$ = 0.146 | Y = -0.868X+79.83<br>$R^2$ = 0.631 | Y = 0.030X-11.66<br>$R^2$ = 0.629 |
| Rapeseed & Mustard | Y = 0.483X-5.181<br>$R^2$ = 0.833 | Y = 0.781X-21.57<br>$R^2$ = 0.39 | Y = 0.044X-20.12<br>9$R^2$ = 0.887 |
| Soyabean | Y = 0.268X+5.367<br>$R^2$ = 0.917 | Y = 0.312X-3.135<br>$R^2$ = 0.978 | Y = 0.041X-16.25<br>$R^2$ = 0.392 |

Source: RBI – Handbook of statistics on the Indian Economy – 2021-22.

The groundnut area has grown at a positive rate for the entire period, while the production growth rate has been relatively low. The correlation coefficient was positive, but it was less than the growth rates of oilseeds, area, and yield. Groundnut production grows at a fast pace during the pooling period, with total oilseeds growing at a lower rate.

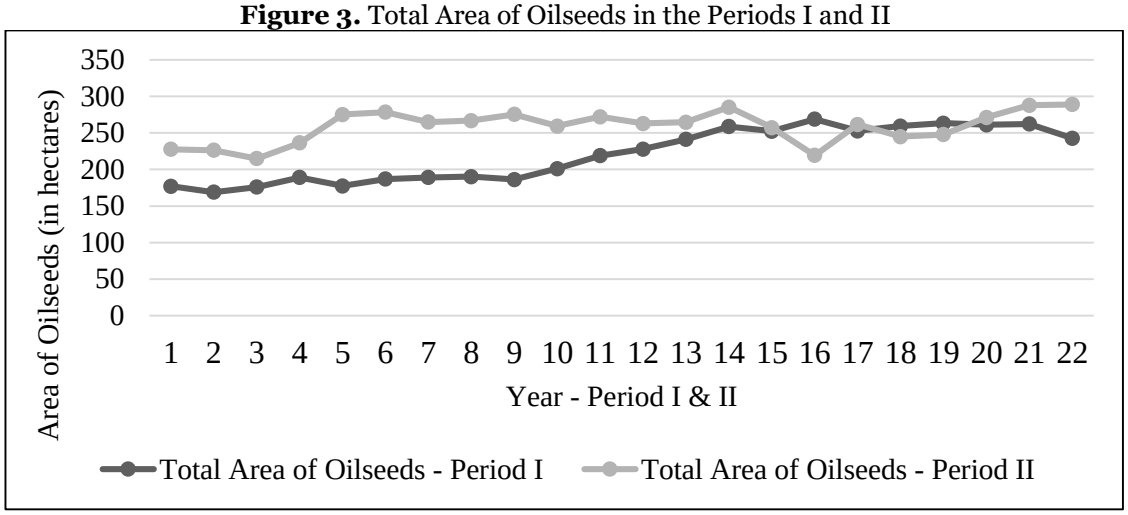
**Figure 2** Production of Total Oilseeds in the Period I and II




Source: RBI – Handbook of statistics on the Indian Economy – 2021-22.

Figure 2 depicts the total output of oilseeds in periods I and II, demonstrating that the growth rate for periods I and II was higher than that of period II.

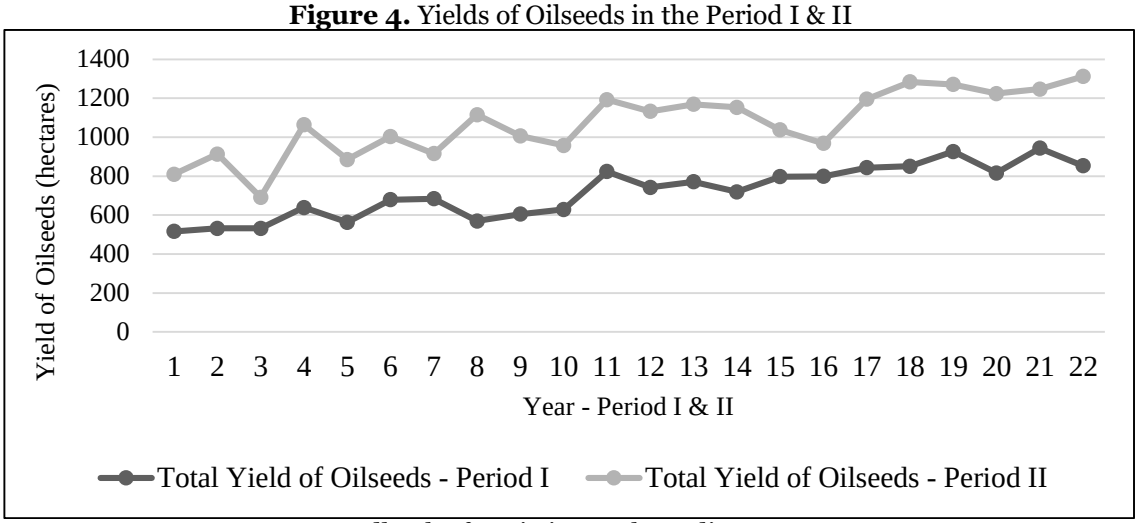
**Figure 3.** Total Area of Oilseeds in the Periods I and II




Source: RBI – Handbook of statistics on the Indian Economy – 2021-22.

The total area under oilseed cultivation from periods I and II is shown in Figure 3, along with the growth rates for each. Variations occur from periods I to II at specific times.

**Figure 4.** Yields of Oilseeds in the Period I & II




Source: RBI – Handbook of statistics on the Indian Economy – 2021-22.

Figure 4 shows that the growth rate of the yield per hectare of oilseeds in periods I and II varies from period I to period II in certain periods.

**Table 10** The Structural Stability of Regression Model - Production and Area of Oilseeds

| | Pooled Sample | Period I | Period II |
|---|---|---|---|
| Groundnut | $W_t = 68.541 + 0.06M_t$<br>$r^2 = 0.002$<br>$N_1 = 10658.6$<br>D f = 42 | $W_{t(1)} = -46.37 + 1.54M_t$<br>$r^2 = 0.485$<br>$N_2 = 1977.2$<br>D f = 21 | $W_{t(2)} = 67.56 + 0.13M_t$<br>$r^2 = 0.002$<br>$N_3 = 6594.2$<br>D f = 21 |
| | $N_4 = 8571.4$ $N_5 = 2087.2$ F = 4.87 P-value = 0.001 | | |
| Rapeseed & Mustard | $W_t = -44.03 + 1.793X_t$<br>$r^2 = 0.754$<br>$N_1 = 6222.04$<br>D f = 42 | $W_{t(1)} = -22.96 + 1.23M_t$<br>$r^2 = 0.869$<br>$N_2 = 712.8$<br>D f = 21 | $W_{t(2)} = -37.41 + 1.81M_t$<br>$r^2 = 0.721$<br>$N_3 = 2044.6$<br>D f = 21 |
| | $N_4 = 2757.4$ $N_5 = 3464.64$ F = 25.12 P-value = 0.002 | | |
| Soyabean | $W_t = -3.798 + 1.091X_t$<br>$r^2 = 0.937$<br>$N_1 = 5680.2$<br>D f = 42 | $W_{t(1)} = -4.53 + 1.12M_t$<br>$r^2 = 0.981$<br>$N_2 = 244.43$<br>D f = 21 | $W_{t(2)} = -2.25 + 1.074M_t$<br>$r^2 = 0.671$<br>$N_3 = 5444.9$<br>D f = 21 |
| | $N_4 = 5689.33$ $N_5 = 9.13$ F = 0.032 P-value = 0.000 | | |
| Total Oilseeds | $W_t = -269.44 + 2.018X_t$<br>$r^2 = 0.794$<br>$N_1 = 56985.8$<br>D f = 42 | $W_{t(1)} = -149.7 + 1.4M_t$<br>$r^2 = 0.939$<br>$N_2 = 3570.3$<br>D f = 21 | $W_{t(2)} = -243 + 2.02M_t$<br>$r^2 = 0.613$<br>$N_3 = 26329.9$<br>D f = 21 |
| | $N_4 = 29900.2$ $N_5 = 27085.6$ F = 18.12 P-value = 0.003 | | |

Source: RBI – Handbook of statistics on the Indian Economy – 2021-22.

The structural stability of the regression equation used to calculate agricultural production and the area planted to oilseeds, including groundnut, rapeseed, mustard, soyabean, and total oilseeds, is displayed in Table 10. These are the estimated values for the oilseed items: soyabean (0.032), groundnut (4.87), rapeseed and mustard (25.12), and the total oilseeds (18.12). The important F2,42 is calculated to be less than 0.05, specifically 0.001, 0.002, 0.000, and 0.003, when the level of significance is set to 5. Therefore, as the observed test values for soyabean, groundnut, rapeseed, mustard, and total oilseeds were all higher than the critical value, demonstrating structural stability, the null hypothesis should be rejected. The amount of land under cultivation and oilseed output in India have structurally changed as a result of the new agricultural policy.

## CONCLUSION

Only cereals rank higher among the field crops as significant determinants of the agricultural economy than oilseed crops. Vegetable oil extraction is the main reason oilseed crops are grown. In India's agricultural economy, oilseeds are quite important. With 14% of the worldwide oilseed market and 7% of the world's vegetable oil production, the nation is the world's largest oilseed producer. The percentage growth of total oilseed production, area under cultivation, and yield per hectare from 1978–1979 to 1999–2000 were 105.7 percent, 36.2 percent, and 65.3%, respectively. From 2000–01 to 2021–22, the percentage growth was 106.7 percent, 529 percent, and 61.9 percent. There is less fluctuation in the coefficient of variation between production, area, and yield of oilseeds in India among the areas with production and yield. For oilseeds such

as groundnut, rapeseed, mustard, soyabean, and total oilseeds, there is a positive correlation between production, area, and yield per hectare in periods I, II, and pooling periods. For the oilseeds in periods I, II, and the pooled periods, there is a smooth trend line. The structural stability of the regression equation that was used to calculate agricultural output and the area dedicated to oilseed cultivation, including total oilseeds, groundnut, rapeseed, and mustard, with a p-value of less than 0.05, the values for the oilseed items, such as groundnut (4.87), rapeseed and mustard (25.12), soyabean (0.032), and the total oilseeds (18.12), are computed as 0.001, 0.002, 0.000, and 0.003. As a result, the null hypothesis should be rejected because the observed test values for groundnut, rapeseed, mustard, soyabean, and the total oilseeds were all higher than the critical value, suggesting structural stability. The production of oilseeds and the area under cultivation in India have undergone a structural change as a result of the new agricultural policy. Due to the new agricultural strategy, India's oilseed production, cultivated area, and yield per hectare have all changed structurally.

## COMPETING INTERESTS

No conflicting interests are stated to exist by the author.

## ACKNOWLEDGMENT

No particular grant of any kind, whether public, private, or nonprofit, was given to this paper.

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