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Growth Trends Of Oilseed Production, Area, And Yield In India: An Estimation Through The Structural Stability Regression Model

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ABSTRACT

The production, area and the yield of agricultural output of oilseeds, as well as the growth, trend, and structural stability of agricultural production (oilseeds), represent an economy's contribution and stability. The goal of this study is to assess the growth, trend, and structural stability of oilseed output, area under cultivation, and yield per hectare in India before and after the new agricultural policy (1980-2000). (2001–2020). Secondary data from the Reserve Bank of India's handbook of statistics on the Indian economy (2020–21) to meet the objectives. The structural stability regression model, t test, and trend line were used for estimation. The growth rate of the average production and yield of oilseeds were 59.4% and 42%, respectively, from 1980 to 2000 to 2001-2020, despite only a 13.7 percent in area under cultivation of oilseeds. The compound annual growth rates for production, area, and yield are -26.1 percent, -45.6 percent, and -12.7 percent, respectively, oilseed production and yield are increasing and the structure of oilseed production and area in India has changed throughout time. The focus should be on increasing yield through technical innovation, improve the cultivation, agricultural research, and training, as well as improving policy implementation in India.

Keywords: Oilseed, Yield, Structural Stability, Regression, Correlation.

INTRODUCTION

For almost 58 percent of India's population, agriculture is their primary source of income. Agriculture and related sectors account for 20.19 percent of GDP when broken down by sector. The agricultural sector ensures food security and nutrition for India's enormous population, as well as a significant supply of raw materials for the country's industrial foundation and export surpluses. Better irrigation systems, pre-monsoon rainfall, new technology introductions, investment, mechanisation, seeds, pricing policies, and other factors all led to the tremendous increase in food grain and commercial crop production. Oil seeds are a major commercial crop in India, and they are the country's second-largest agricultural export after food grains. Vegetable oils, which are increasingly being selected over animal fats as people grow more health-conscious, are produced by oil-seeds. India produces a lot of oilseeds and imports a lot of edible oils. India's vegetable oil economy is the world's fourth largest after the United States, China, and Brazil. According to recent estimates, oilseeds now account for 13% of gross cultivated area, 3% of GDP, and 10% of the total value of all agricultural products. According to the crops division, total oilseed production increased by 254.5 percent from 93.7 million tonnes in 1980–81 to 332.2 million tonnes in 2019–20.

During the same time period, the area under cultivation of oilseeds (in lakh hectares) and yield (kg per hectare) increased by 54.2 percent and 130.1 percent, respectively, to 176 to 271.4 lakh hectares and 532 to 1224 kg per hectare. National Food Security Mission is being implemented in all states to boost food and non-food grain production and productivity. Groundnut, rapeseed, mustard, and soyabean are the most common oilseeds. The most important oil seed in India is groundnut, which accounts for more than half of the country's major oilseed production. Groundnut is mostly grown in Kharif, but it is also grown in Rabi. Groundnut output, area, and yield were 50.1, 68, and 736, respectively, in 1980–81; in 2019–20, they were 99.5, 48.3, and 2063, with 98.6%, -29, and 180 percent growth rates. Similarly, rapeseed and mustard are India's most important oilseeds. Oil from these seeds is used as a cooking medium, a pickle preserver, a lubricant, and in cosmetics. Oil cake is a common cattle feed that may be used as manure as well. Thus, rapeseed and mustard area and yield were 23, 41.1, and 560, respectively, in 1980–81; in 2019–20, they were 91.2, 68.6, and 1331, with growth rates of 296.5 percent, 66.9%, and 137.7%, respectively. most extensively produced oilseed in the country. Production, area, and yield were 4.4, 6.1, and 728 in 1980–81, and 112.3, 121.9, and 921 in 2019–20, with growth rates of 2452.3, 41.1%, and 137.7%, respectively. As a result, total oilseed output, area, and yield per hectare of oilseeds have increased by 254.5%, 54.2%, and 130.1%, respectively, from 93.7, 176, and 532 in 1980–81 to 332.2, 271.4, and 1224 in 2019–20. In July 2000, the Indian government presented the New Agricultural Policy. This programme was designed by the government with the intent of promoting the growth and development of agricultural production and productivity, consequently improving income, employment, and living standards. The goal of this policy was to support the overall development of the agriculture industry. The policy's purpose was to encourage the agriculture industry to grow at a rate of more than 4% per year. Boosting input productivity, increasing value added per hectare, protecting the interests of poor farmers, modernising agricultural sectors, preventing environmental degradation, agricultural research and training, and removing bureaucratic bottlenecks are among the other objectives. The new agricultural policy intends to enhance agricultural sustainability by promoting economically viable, technically sound, environmentally non-degrading, non-hazardous, and socially acceptable uses of the country's natural resources. With the new agricultural strategy, groundnut output, area, and yield increased by 55.2 percent, 26.4 percent, and 111.2 percent, respectively, from 64.1, 65.6, and 977 in 2000–01 to 99.5, 48.3, and 2063 in 2019–20. Rapeseed and mustard output, area, and yield increased by 117.7%, 53.1 percent, and 42.4 percent, respectively, from 41.9, 44.8, and 935 in 2000-01 to 91.2, 68.6, and 1331 in 2001-02. Soybean output increased by 112.7, 88.9, and 12 percent from 52.8, 64.2, and 822 acres in 2000-01 to 112.3, 121.9, and 921 acres in 2019–20. Total oilseed production (in lakh tonnes), area under cultivation (in lakh hectares), and yield (kg per hectare) have changed as a result of the new agricultural policy (2000), from 184.4, 227.7, and 810 in 2000-01 to 332.2, 271.4, and 1224 in 2019-20; and the growth rates of production, area, and yield per hectare of oilseed have been 80.2, 19.2, and 51.1 percent, respectively. Soybean output increased by 112.7, 88.9, and 12 percent from 52.8, 64.2, and 822 acres in 2000-01 to 112.3, 121.9, and 921 acres in 2019–20. Total oilseed production (in lakh tonnes), area under cultivation (in lakh hectares), and yield (kg per hectare) have changed as a result of the new agricultural policy (2000), from 184.4, 227.7, and 810 in 2000-01 to 332.2, 271.4, and 1224 in 2019-20; and the growth rates of production, area, and yield per hectare of oilseed have been 80.2, 19.2, and 51.1 percent, respectively.

OBJECTIVE

To examine the growth and trends in oilseed production, area, and yield before and after the new agricultural policy was instituted.

To evaluate the structural stability of agricultural production as well as the area under oilseed cultivation.

HYPOTHESIS

There is no structural change in the agricultural production and area under cultivation of oilseeds before and after the new agricultural policy in India.

There is no difference in the average production, area, or yield of oilseed before and after India's new agricultural strategy.

METHODOLOGY

To carry out the study's objectives of production, area under cultivation, and yield per hectare of commercial oilseed crops in India, we employed secondary data. The Reserve Bank of India's handbook of statistics on the Indian economy—2020—21 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: 1980 to 2000 (Period I) and 2001 to 2020 (Period II), which corresponded to the period before and after the country's new agriculture policy. Both periods, such as 1980 to 2020 in India, necessitate a thorough investigation. The Chou test (Gregory Chou) is a structural stability regression model that is used to quantify the structural stability of agricultural production. 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 commercial oilseed crops.

Structural Stability Regression Model

Before and after the new agricultural policy, the structural stability regression model was employed to analyse the stability of the growth parameter

$.Y_t = Z_1 + Z_2 X_t + E_t$

Where.
Y_t, $Y_{t(1)}$ and $Y_{t(2)}$ = Production oilseed in pooled, period I and II.
X_t, $X_{t(1)}$ and $X_{t(2)}$ = Area oilseed in pooled, period I and II.
T = time period,
Z_1 and Z_2, V_1 and V_2, U_1 and U_2 = intercept and the growth parameter in pooled, period I & II.
Et, $E_{t\,(1)}$ and $E_{t\,(2)}$ = Stochastic ingredient in the pooled, Period I & II.
S_1, S_2, S_3 = Residual sum of squares in pooled, period I & II.
$S_4 = S_2 + S_3$.
$S_5 = S_1 – S_4$.
k= Number of parameters.

$$F = \frac{S5/k}{S4/(n1+n2-2k)}$$

LITERATURE REVIEW

Efficiency in the Indian Edible Oilseed Sector: Analysis and Implications, Mruthyunjaya et al., 2005. The study found that oilseed production has 1/4 to 1/3 technical inefficiencies on average, and even more at the farm/processing unit level, as well as allocative and scale inefficiencies. The aggregate technological inefficiencies in the oilseed sector have been estimated to be half to two-thirds, which is massive. Technical efficiency in oilseed production is determined by soil quality, seed replacement, and education. Technical efficiency in oil production is determined by the availability of adequate raw materials and higher oil recovery. The oilseed industry's poor performance can be attributed to a lack of a reliable market for oilseeds as well as a timely and reliable supply of quality seeds and raw materials for processing. Oilseeds must be considered for growing on irrigated land if they are to compete with other crops for profitability. According to Krishna Teja et al. (2017), "Performance of oilseeds in India-a temporal analysis". The total oilseed items are groundnut, rapeseed-mustard, soybean, sunflower, sesame, safflower, and niger, and two non-edible crops, namely castor and linseed, which are farmed throughout the country. After analyzing the performance of oilseeds, it was determined that the yield aspect of total oilseeds had a notable performance at the national level. Over the study period, there was slow growth in terms of area, production, and yield of total oilseeds, despite a strong upward and significant rise in terms of area, production, and yield. There is a disparity between domestic demand for oilseeds and supply, forcing us to import edible oils. To close the gap between oil seed production and consumption, the government must invest in technological advances and increase oil seed yield. In (2017) Prem Narayan An Analytical Approach to the Recent Demand-Supply and Growth of Oilseeds and Edible Oil in India Oilseeds are an important part of a nutritionally balanced diet. In Indian diets, these are the primary sources of edible oil and protein. After cereals, oilseeds are the second most important source of protein in the Indian diet. India is a net importer of edible oil and a net user of it. India contributes 13–15 percent of oilseed area, 7-8 percent of oilseed yield, 4-6 percent of edible oil production, 12–14 percent of vegetable oil imports, and 10–12 percent of edible oil consumption. Indian agriculture has been considered in the perspective of available supplies of oil from oilseed and non-oilseed origins to meet the vegetable oil needs of the Indian population. To meet the nutritional fat demands of India's anticipated population of 168.5 million people by 2050, the country will need to produce 17.84 million tonnes of vegetable oil. The Current Trends in Oilseed Crop Production: An Overview, Sharma, Amod (2018) Oilseed crop cultivation was moderately riskier, as seen by the lower CV. Oilseed crops had a CV of less than 43.68 percent in terms of acreage, production, and productivity. The oilseed crop instability indexes for area, production, and productivity were all positive, indicating a lower danger of producing oilseed crops in the future. During the study period, the rise in output was attributed to an increase in area as well as the interplay between area and productivity of oilseed crops. Dr. C. P. Verma and Dr. Kalpana Singh (2020). Study on Edible Oil Consumers and Their Interaction with the Category Sunflower oil is popular because it is perceived to be good for the heart and cholesterol; similarly, soybean oil is popular because it is perceived to be low in calories and is frequently recommended by doctors and retailers. Apart from pricing and package size, groundnut and cotton seed oils are popular for their aroma and colour. Cottonseed and palmolein oil are commonly purchased by low-income individuals, whereas mustard oil is purchased

because of its flavour and pungency, as well as the fact that it is frequently suggested by shopkeepers. Suresh A. Kurup et.al. (2015) Technical and efficiency changes in India's oilseed sector: Policy Implications. The study found that groundnut, rapeseed/mustard, and soybean productivity growth slowed over period II (1996–2010) compared to period I (1996–2010). (1985-1995). The TFP change was positive for peanuts and rapeseed/mustard over the entire time period, but negative for soybeans. Groundnut and rapeseed/mustard TFP alterations have increased in two out of three states during Period II. The TFP change in soybeans was favourable in only one of the three major states. Technical changes accounted for the whole change in TFP in all crops, with no contribution from efficiency changes. Radika Kumar and Monica Bhati (2020). A Study of Rapeseed and Mustard Prices in India After Trade Liberalization: A Study of Rapeseed and Mustard Prices According to the findings, India is a net exporter of rapeseed and mustard oilseeds, with lower price volatility for these crops. India, on the other hand, has been a net importer of processed rapeseed and mustard oil. The study looked into these topics in greater depth following trade liberalisation and India's admission to the World Trade Organization, as well as commitments under the Agriculture Agreement. The purpose of this study was to look at how fluctuations in international and domestic prices of rapeseed and mustard crops affected crop competitiveness after trade liberalisation. Padmavathi.A and N. Peddobilesu (2019). Oilseed Productivity Analysis in Andhra Pradesh Oilseed production plays a significant role in India's agricultural economy. The country has the world's longest oilseed production and produces 7% of global vegetable oil production, with a 14 percent share of the area. Since the implementation of the Technology Mission Oilseeds (TMO) in 1986, the oil seed situation in the country has changed dramatically. As a result, in light of the increasing relevance of oilseed production for assuring inclusive growth and the necessity to attain self-sufficiency, the current study aims to investigate the trend of area, production, and productivity of oilseeds in the state of Andhra Pradesh (United). (2017) Prem Narayan Analysis of soybean's impact on India's edible oil supply India is the world's largest consumer and importer of edible oils. Soybeans are important; their area is 11.16 million hectares. TE 2015 contributed 42 percent of total production (12.30 million tonnes) and 41 percent of total oilseed crops. The annual compound growth rate of soybean area was 14 percent, production was 15.5 percent, and yield was 1.34 percent over 4.5 decades (1970–71 to 2014–15), while total oilseed area was 1.33 percent, production was 3.31 percent, and yield was 1.96 percent. Palm oil, soybean oil, and sunflower oil account for roughly 54%, 21%, and 11% of the 89 percent of imported crude edible oil, respectively.

RESULTS AND DISCUSSION

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

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
1980-81	93.7		176		532	
1981-82	120.8	28.9	189.1	7.44	639	20.1
1982-83	100	-17.2	177.6	-6.08	563	-11.9

1983-84	126.9	26.9	186.9	5.24	679	20.6
1984-85	129.5	2.0	189.2	1.23	684	0.7
1985-86	108.3	-16.4	190.2	0.53	570	-16.7
1986-87	112.7	4.1	186.3	-2.05	605	6.1
1987-88	126.5	12.2	201.3	8.05	629	4.0
1988-89	180.3	42.5	219	8.79	824	31.0
1989-90	169.2	-6.2	228	4.11	742	-10.0
1990-91	186.1	10.0	241.4	5.88	771	3.9
1991-92	186	-0.1	258.9	7.25	719	-6.7
1992-93	201.1	8.1	252.4	-2.51	797	10.8
1993-94	215	6.9	269	6.58	799	0.3
1994-95	213.4	-0.7	253	-5.95	843	5.5
1995-96	221.1	3.6	259.6	2.61	851	0.9
1996-97	243.8	10.3	263.4	1.46	926	8.8
1997-98	213.2	-12.6	261.2	-0.84	816	-11.9
1998-99	247.5	16.1	262.3	0.42	944	15.7
1999-00	207.1	-16.3	242.8	-7.43	853	-9.6

Source: RBI – Handbook of statistics on the Indian Economy – 2020-21.

Table 1 depicts the growth rates of oilseed production, area, and yield in India prior to the new agricultural policy; the highest rate of output growth was found and it was 42.5 percent in 1988-89, followed by 28.9 percent in 1981-82 and 26.9 percent in 1983-84. In 1982-83, 1985-86, and 1999-2000, the lowest growth rates were 17.2 percent, 16.4 percent, and 16.3 percent, respectively. Oilseed cultivation increased at an annual rate of 8.79 percent in 1988-1989, 8.05 percent in 1987-1988, and 7.44 percent in 1999-2000. In the same way, the area of oilseeds decreased by -7.43 percent in 1999-2000, -6.08 percent in 1982-83, and -5.95 percent in 1994-95. Prior to the new agricultural strategy, the growth rate of oilseed yield per hectare was 31% in 1988-89, 20.6 percent in 1983-84, and 20.1 percent in 1980-81, with a decreasing rate of -16.7 percent in 1985-86, -11.9 percent in 1982-83, and 1997-98, and -10 percent in 1989-90. In the years 1988–89, there is general tendency in the growth rate of output, area, and yield per hectare of oilseed.

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	12.0	226.4	-0.6	913	12.7
2002-03	148.4	-28.2	214.9	-5.1	691	-24.3
2003-04	251.9	69.7	236.6	10.1	1064	54.0
2004-05	243.5	-3.3	275.2	16.3	885	-16.8
2005-06	279.8	14.9	278.6	1.2	1004	13.4

2006-07	242.9	-13.2	265.1	-4.8	916	-8.8
2007-08	297.6	22.5	266.9	0.7	1115	21.7
2008-09	277.2	-6.9	275.6	3.3	1006	-9.8
2009-10	248.8	-10.2	259.6	-5.8	958	-4.8
2010-11	324.8	30.5	272.2	4.9	1193	24.5
2011-12	298	-8.3	263.1	-3.3	1133	-5.0
2012-13	309.4	3.8	264.8	0.6	1169	3.2
2013-14	327.5	5.9	285.3	7.7	1153	-1.4
2014-15	275.1	-16.0	257.3	-9.8	1037	-10.1
2015-16	220.9	-19.7	219.3	-14.8	968	-6.7
2016-17	312.8	41.6	261.8	19.4	1195	23.5
2017-18	314.6	0.6	245	-6.4	1284	7.4
2018-19	315.2	0.2	247.9	1.2	1271	-1.0
2019-20	332.2	5.4	271.4	9.5	1224	-3.7

Source: RBI – Handbook of statistics on the Indian Economy – 2020-21.

Table 2 shows the growth rates of production, area, and yield of oilseed after the new agricultural policy were calculated and it was with the highest growth rate of production at 69.7% in 2003-04, 41.6 percent in 2016-17, and 30.5 percent in 2010-11, and the lowest growth rate at -28.2 percent in 2002-03, -19.7% in 2015-17, and -16 percent in 2014-15. Similarly, the growth rate of area under cultivation of oilseeds was 19.4% in 2016-17, 16.3% in 2004-05, and 10.1 percent in 2003-04, with the negative growth rates of -14.8 percent in 2015-16, -9.8% in 2014-15, and -6.4 percent in 2017-18. After the new agricultural policy, the highest growth rates for oilseed yield per hectare were 54 percent in 2003-04 followed by the 24.5 percent in 2010-11, and 23.5 percent in 2016-17, while the highest negative growth rates were -24.3 percent in 2002-03, -16.8% in 2004-05, and -10.1 percent in 2014-15, respectively.

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

Year	Production of Total Oilseeds	3 yearly moving average	Total Area of Oilseeds	3 yearly moving average	Total Yield of Oilseeds	3 yearly moving average
1980-81	93.7		176		532	
1981-82	120.8	104.8	189.1	180.9	639	578.0
1982-83	100	115.9	177.6	184.5	563	627.0
1983-84	126.9	118.8	186.9	184.6	679	642.0
1984-85	129.5	121.6	189.2	188.8	684	644.3
1985-86	108.3	116.8	190.2	188.6	570	619.7
1986-87	112.7	115.8	186.3	192.6	605	601.3
1987-88	126.5	139.8	201.3	202.2	629	686.0
1988-89	180.3	158.7	219	216.1	824	731.7
1989-90	169.2	178.5	228	229.5	742	779.0
1990-91	186.1	180.4	241.4	242.8	771	744.0

1991-92	186	191.1	258.9	250.9	719	762.3
1992-93	201.1	200.7	252.4	260.1	797	771.7
1993-94	215	209.8	269	258.1	799	813.0
1994-95	213.4	216.5	253	260.5	843	831.0
1995-96	221.1	226.1	259.6	258.7	851	873.3
1996-97	243.8	226.0	263.4	261.4	926	864.3
1997-98	213.2	234.8	261.2	262.3	816	895.3
1998-99	247.5	222.6	262.3	255.4	944	871.0
1999-00	207.1		242.8		853	

Source: RBI – Handbook of statistics on the Indian Economy – 2020-21.

Before the new agricultural policy, the three-year moving average for the reduction in the variability of production, area, and yield per hectare of oilseed in India was highlighted in Table 3. Oilseed production increased from 93.7 lakh tonnes in 1980-81 to 207.1 lakh tonnes in 1999-2000, with a moving average of 104.8 lakh tonnes to 222.6 lakh tonnes over the same period; oilseed cultivation area increased from 176 lakh hectares to 242.8 lakh hectares, with a moving average of 180.9 to 255.4. Oilseed yields ranged from 532 to 853 kg per hectare throughout the same time period, with a moving average of 578 to 871 kg per hectare.

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

Year	Production of Total Oilseeds	3 yearly moving average	Total Area of Oilseeds	3 yearly moving average	Total Yield of Oilseeds	3 yearly moving average
2000-01	184.4		227.7		810	
2001-02	206.6	179.8	226.4	223.0	913	804.7
2002-03	148.4	202.3	214.9	226.0	691	889.3
2003-04	251.9	214.6	236.6	242.2	1064	880.0
2004-05	243.5	258.4	275.2	263.5	885	984.3
2005-06	279.8	255.4	278.6	273.0	1004	935.0
2006-07	242.9	273.4	265.1	270.2	916	1011.7
2007-08	297.6	272.6	266.9	269.2	1115	1012.3
2008-09	277.2	274.5	275.6	267.4	1006	1026.3
2009-10	248.8	283.6	259.6	269.1	958	1052.3
2010-11	324.8	290.5	272.2	265.0	1193	1094.7
2011-12	298	310.7	263.1	266.7	1133	1165.0
2012-13	309.4	311.6	264.8	271.1	1169	1151.7
2013-14	327.5	304.0	285.3	269.1	1153	1119.7
2014-15	275.1	274.5	257.3	254.0	1037	1052.7
2015-16	220.9	269.6	219.3	246.1	968	1066.7
2016-17	312.8	282.8	261.8	242.0	1195	1149.0

2017-18	314.6	314.2	245	251.6	1284	1250.0
2018-19	315.2	320.7	247.9	254.8	1271	1259.7
2019-20	332.2		271.4		1224	

Source: RBI – Handbook of statistics on the Indian Economy – 2020-21.

The three-year moving average for the reduction in the variability of oilseed production, area, and yield per hectare in India was highlighted in Table 4 following after the new agricultural policy. The oilseed production increased from 184.4 million tonnes in 1980-81 to 332.2 million tonnes in 1999-2000, with a moving average of 179.8 million tonnes to 320.7 million tonnes over the same period; oilseed cultivation area increased from 227.7 million hectares to 271.4 million hectares, with a moving average of 223 to 254.8, respectively. During the same time period, oilseed yields ranged from 810 to 1224 kg per hectare, with an 804.7 to 1259.7 kg per hectare moving average.

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

Average Production of Oilseeds (Lakh Tonnes)				
	Oilseeds			Total Oilseeds
	Groundnut	Rapeseed & Mustard	Soyabean	
Average (Period I)	72.26	42.8	28.62	170.11
Average (Period II)	72.13	70.4	98.8	271.2
Grand Average	71.69	56.6	63.7	220.3
t – test	0.177	9.06	14.1	11.07
P- value	0.861	2.32	1.63	9.94
Pearson “r”	-0.046	0.58	0.64	0.682
Average Area Under Cultivation of Oilseeds (Lakh Hectares)				
Average (Period I)	76.07	52.91	29.87	225.4
Average (Period II)	56.1	60.5	93.7	256.2
Grand Average	66.07	56.7	61.8	240.6
t – test	-8.49	2.58	29.53	3.84
P-value	6.85	0.018	2.44	0.001
Pearson “r”	-0.231	0.146	0.89	0.260
Average Yield Per Hectare of Oilseeds (Kg per Hectare)				
Average (Period I)	932.95	789.6	861	739.3
Average (Period II)	1298.1	1155.6	1049	1049.5
Grand Average	1115.5	972.6	955.1	894.4
t – test	4.76	11.17	3.49	12.47
P -value	0.0001	8.66	0.002	1.35
Pearson “r”	0.204	0.53	0.062	0.717

Source: RBI – Handbook of statistics on the Indian Economy – 2020-21.

In the period I to II, the rate of growth of the average production of groundnut, rapeseed & mustard, soyabean, and total oilseeds were the -0.18 percent, 64.5 percent, 245.2 percent, and 245.2 percent, respectively, as shown in Table 5. For periods I and II, the rate of growth of area under cultivation of oilseeds was -26.3 percent, 14 percent, 214 percent, and 14 percent, respectively. Similarly, the rate of growth of the average yield per hectare of oilseeds changed by 42% during the two eras, with groundnut accounting for 39%, rapeseeds and mustard for 46%, soyabean for 22%, and total oilseeds accounting for 42%. The Pearson coefficient of association is negative for groundnut output (-0.046) and area (-0.231), but there is a very low positive relationship in yield per hectare in periods I and II. The correlation coefficient is positive for groundnut, rapeseed, mustard, soyabean, and total oilseed production, area, and the yield. The null hypothesis is kept since the p-value is greater than 0.05 for the average production of groundnut, rapeseed, and mustard, soyabean, and total oilseeds of commercial crops. For instance, there is no statistically significant difference in groundnut, rapeseed, mustard, soyabean, and overall oilseed production. The null hypothesis is rejected for rapeseed, mustard, and total oilseeds, as it was for area under cultivation of oilseeds, because the p-value is less than 0.05. Because the p-value for groundnut and soyabean is greater than 0.05, the null hypothesis is accepted. Similarly, the null hypothesis is rejected when the average yield per hectare of groundnut and soyabean, because the p-value is less than 0.05. The null hypothesis was retained in rapeseed and mustard, as well as total oilseeds, because the p-value was greater than 0.05.

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)	0.247	4.98	15.7	4.26
CAGR (Period II)	2.34	4.18	4.05	3.15
Overall CAGR	3.68	7.52	18.59	6.89
CAGR of Area Under Cultivation of Oilseeds (Lakh Hectares)				
CAGR (Period I)	0.054	2.04	13.0	1.71
CAGR (Period II)	-1.60	2.27	3.43	0.93
Overall CAGR	-1.78	2.73	17.07	2.31
CAGR of Yield Per Hectare of Oilseeds (Kg per Hectare)				
CAGR (Period I)	0.210	2.90	2.90	2.52
CAGR (Period II)	4.01	1.88	0.60	2.20
Overall CAGR	5.57	4.66	1.25	4.48

Source: RBI – Handbook of statistics on the Indian Economy – 2020-21.

Table 6 shows that the compound annual growth rate for which the groundnut and soyabean is higher in periods I to II, but it is lower for rapeseed & mustard, and the total oilseeds in the production of oilseed items. From period I to period II, the compound annual growth rate of the area for groundnut is negative, while it is positive for rapeseed and mustard, during same periods, the CAGR of soyabean and total oilseed

areas dropped. When comparing period, I and II, the CAGR of yield per hectare increased for groundnut but declined for rapeseed, mustard, soyabean, and total oilseeds.

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	0.69	0.92	0.99	0.96
Period II	-0.004	0.82	0.80	0.73
Pooled	0.14	0.83	0.96	0.86

Source: RBI – Handbook of statistics on the Indian Economy – 2020-21.

The correlation coefficient between the production and the area of oilseeds like the groundnut, rapeseed & mustard, soyabean and the total oilseeds were examined in the table 7, which indicates that there is positive relationship between the production and area under cultivation of groundnut in before, it was negative for the period II and is very low positive for the pooled period. Similarly, there is a positive relationship between the production and the area under the cultivation of rapeseed & mustard, soyabean and the total oilseeds from period I, II and in the pooled.

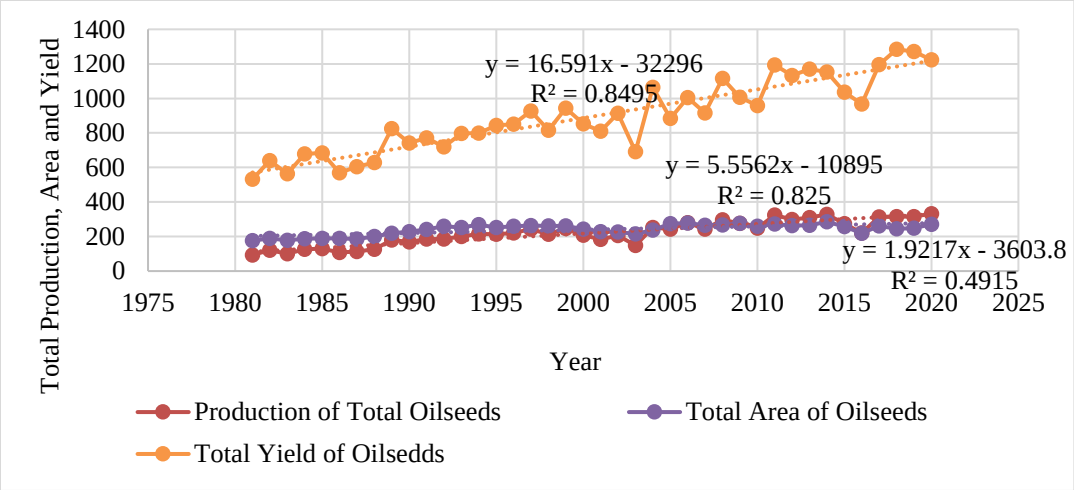
Table 8 Coefficient of Variation Between Production, Area and Yield in Period I & II

Coefficient of Variation Between Production, Area and Yield					
	Period	Groundnut	Rapeseed & Mustard	Soyabean	Total Oilseeds
Production	Period I	18.8	33.9	80.5	29.3
	Period II	22.01	20.5	27.67	18.5
Area	Period I	8.15	21.3	67.02	14.9
	Period II	12.3	12.9	21.04	7.95
Yield	Period I	14.86	17.59	19.75	16.12
	Period II	25.7	13.27	16.27	14.8

Source: RBI – Handbook of statistics on the Indian Economy – 2020-21.

In the table 8, shows that the coefficient of variation is less, is considered to be more consistent for the groundnut in period I for the production, area and the yield. As in the case of rapeseed & mustard, soyabean and the total oilseeds that the coefficient of variation is for the period II, and is considered as 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 – 2020-21.

Figure 1 shows that, compared to production, area and the yield of oilseed, the growth rate is very low for the area under cultivation and highest in the yield per hectares of oilseeds. The total production of oilseeds from the entire periods, the growth rate is only for 5.6, its for 1.9 to area and 16.6 for the yield per hectares of oilseeds. The intercept is also very low for the area under cultivation of oilseeds from the period 1980-81 to 2019-20.

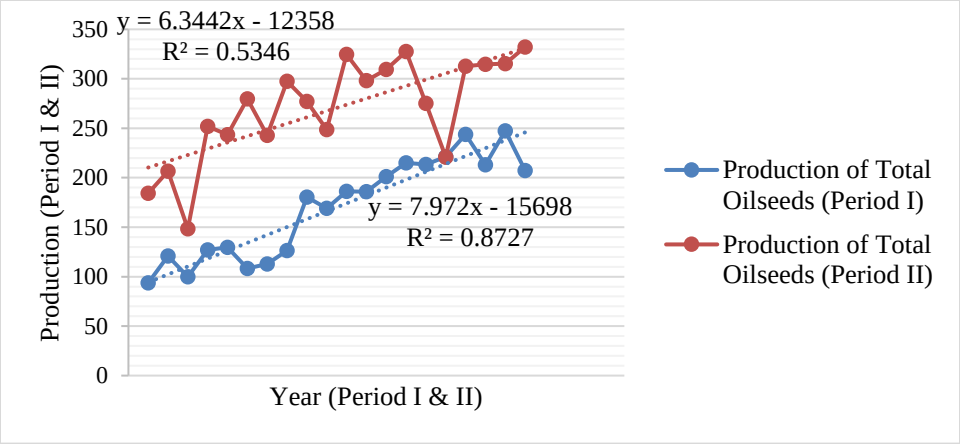
Table 9 Trend in the Total Production, Area and Yield of Oilseeds Items in Pooled Period

	Production	Area	Yield
Total Oilseeds	Y =5.6X-10895 R^2 = 0.83	Y = 1.92X-3604 R^2 = 0.49	Y = 16.6X-32296 R^2 = 0.85
Groundnut	Y = 0.30X-523 R^2 = 0.9559	Y = -0.85X+1770.4 R^2 = 0.68	Y = 20.5X-39863 R^2 = 0.57
Rapeseed & Mustard	Y = 1.55X-3037 R^2 = 0.80	Y = 0.56X+1068 R^2 = 0.39	Y = 18.8X-36637 $9R^2$ = 0.8976
Soyabean	Y = 3.6X-7071 R^2 = 0.91	Y = 3.2X-6379 R^2 = 0.98	Y = 10.9X-20754 R^2 = 0.42

Source: RBI – Handbook of statistics on the Indian Economy – 2020-21.

Compared to the growth rate of production, area and the yield of oilseeds, there is a negative growth rate in the area of groundnut for the entire period and very low in the case of production, but the corelation coefficient was positive but less. During in the pooled period, the growth rate is high for the yield of groundnut and followed by the total oilseeds.

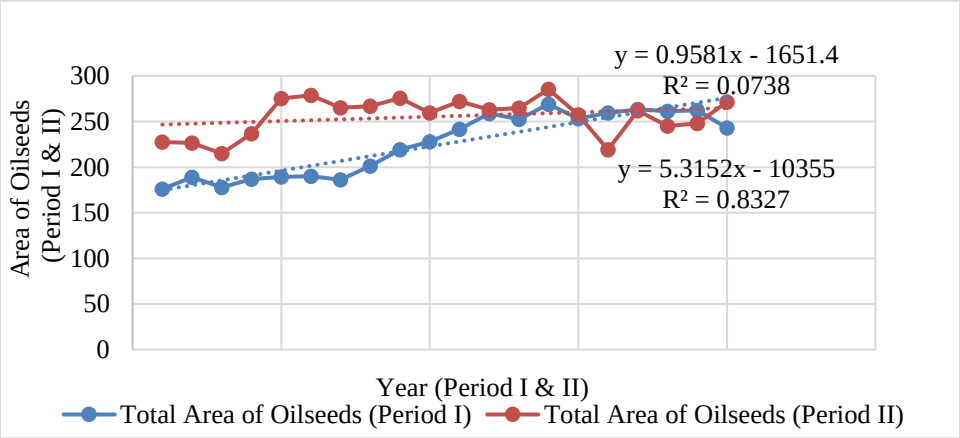
Figure 2 Production of Total Oilseeds in the Period I and II



Source: RBI – Handbook of statistics on the Indian Economy – 2020-21.

The total production of oilseeds in the period I and II, indicates in the figure 2 shows that the growth rate for the period I were 7.972 and 6.3442 for the period II -20.4 percent variation take place compared to period I & II. Similarly, the intercept for the period I is 15698 and 12358 for the period II. The variation between period I and II were -21.3.

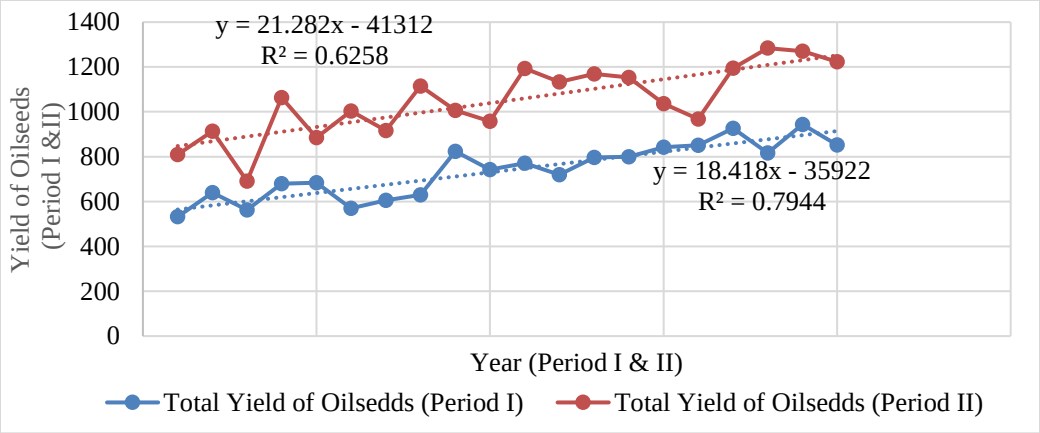
Figure 3. Total Area of Oilseeds in the Periods I and II



Source: RBI – Handbook of statistics on the Indian Economy – 2020-21.

Figure 3 indicates the total area under cultivation of oilseeds from period I and II, which indicates the growth rate for the period I and II were 5.3152 and 0.9581, -82 percent variation take place in the period I to period II. As in the intercept, 10355 and 1651.4 for the period I and II, -84.1 percent variation take place during these periods.

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



Source: RBI – Handbook of statistics on the Indian Economy – 2020-21.

Figure 4 shows that the growth rate of the yield per hectares of oilseeds form period I & II were 18.418 and 21.282; 15.6 Percent variation occurred in period I to period II. During the same period the intercept were 35922 and 41312 and the percent variation is 15.

Table 10 Trend line of Total Production, Area and Yield of Oilseeds items in Period I and II

		Production	Area	Yield
Groundnut	Period I	Y = 1.082X-2082 R^2 = 0.220	Y = 0.20X-3151 R^2 = 0.033	Y = 12.4X-23838 R^2 = 0.271
	Period II	Y = 1.042X-2020 R^2 = 0.143	Y = -1.008X+2083 R^2 = 0.714	Y = 41.9X-82980 R^2 = 0.532
Rapeseed & Mustard	Period I	Y = 2.321X-4498 R^2 = 0.822	Y = 1.76X-3443 R^2 = 0.810	Y = 18.3X-35687 R^2 = 0.581
	Period II	Y = 1.824X-3597 R^2 = 0.532	Y = 0.473X-903.1 R^2 = 0.125	Y = 22.32X-43654 R^2 = 0.701
Soyabean	Period I	Y = 3.82X-7571 R^2 = 0.913	Y = 3.42X-6726 R^2 = 0.9551	Y = 24.64X-48173 R^2 = 0.696
	Period II	Y = 3.671X-7271 R^2 = 0.598	Y = 3.21X+6365 R^2 = 0.883	Y = 6.21X-11441 R^2 = 0.044
Total Oilseeds	Period I	Y = 7.93X-15698 R^2 = 0.873	Y = 5.32X-10361 R^2 = 0.833	Y = 18.42X-35922 R^2 = 0.794
	Period II	Y = 6.344X-12484 R^2 = 0.535	Y = 0.9581X+1671 R^2 = 0.074	Y = 21.37X-41738 R^2 = 0.626

Source: RBI – Handbook of statistics on the Indian Economy – 2020-21.

Table 10 indicates the methods of least square for the trend curve, the percentage changes in the rate of growth from period I to period I for the production, area and the yield per hectare of groundnut is -3.7%, -60.4% and 237.9%, rapeseed & mustard is -21.4%, -5.4% and -76.3%, soyabean -4.2%, -6.1% and -74.8% and the total oilseeds were -20%, -82% and the 16% respectively. Similarly, the intercept for the

production, area and the yield per hectares of groundnut were -3%, -33% and 248.1%, rapeseed & mustard is -20%, -73.8% and 22.3%, the soyabean -4%, -5% and -76.3% and the total oilseeds were -20.5%, -83% and 16.2% respectively.

Table 11 The Structural Stability of Regression Model - Production and Area of Oilseeds

	Pooled Sample	Period I	Period II
Groundnut	$\hat{Y}_t = 58.08 + 0.11X_t$ $r^2 = 0.019$ $S_1 = 5610.5$ D f = 38	$\hat{Y}_t = 53.4 + 0.318X_t$ $r^2 = 0.473$ $S_2 = 404.7$ D f = 18	$\hat{Y}_t = 56.18 - 0.002X_t$ $r^2 = 0.0001$ $S_3 = 947.4$ D f = 18
	$S_4 = 1352$	$S_5 = 4258.4$ F = 56.68	P-value = 0.002
Rapeseed & Mustard	$\hat{Y}_t = 32.15 + 0.43X_t$ $r^2 = 0.69$ $S_1 = 1328.9$ D f = 38	$\hat{Y}_t = 22.4 + 0.713X_t$ $r^2 = 0.84$ $S_2 = 398.8$ D f = 18	$\hat{Y}_t = 29.34 + 0.442X_t$ $r^2 = 0.67$ $S_3 = 407.8$ D f = 18
	$S_4 = 806.6$	$S_5 = 522.3$ F = 11.65	P-value = 0.002
Soyabean	$\hat{Y}_t = 8.49 + 0.84X_t$ $r^2 = 0.93$ $S_1 = 4178.8$ D f = 38	$\hat{Y}_t = 5.23 + 0.86X_t$ $r^2 = 0.98$ $S_2 = 149.7$ D f = 18	$\hat{Y}_t = 36.5 + 0.58X_t$ $r^2 = 0.64$ $S_3 = 2767.2$ D f = 18
	$S_4 = 2916.9$	$S_5 = 1411.6$ F = 8.71	P-value = 0.002
Total Oilseeds	$\hat{Y}_t = 155.5 + 0.39X_t$ $r^2 = 0.744$ $S_1 = 10264.6$ D f = 38	$\hat{Y}_t = 113.6 + 0.66X_t$ $r^2 = 0.93$ $S_2 = 1658.2$ D f = 18	$\hat{Y}_t = 176 + 0.29X_t$ $r^2 = 0.53$ $S_3 = 3923.4$ D f = 18
	$S_4 = 5581.6$	$S_5 = 4683$ F = 15.1	P-value = 0.002

Source: RBI – Handbook of statistics on the Indian Economy – 2020-21.

Table 11 shows the structural stability of the regression equation used to estimate agricultural production and the area under the cultivation of oilseeds such as groundnut, rapeseed & mustard, soyabean and total oilseeds. The calculated values for the oilseed's items like groundnut (56.68), rapeseed & mustard (11.65), soyabean (8.71) and the total oilseeds (15.1) respectively. When the level of significance is set to 5%, the crucial $F_{2,38}$ is computed to be 0.002, which is less than 0.05. 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, indicating structural stability. As a result of the new agricultural strategy, there has been a structural change in the production of oilseeds and the area under cultivation in India. **CONCLUSION**

Within the section of field crops, oilseed crops are the second most important determinant of the agricultural economy, trailing only cereals. Oilseed crops are planted largely for the purpose of extracting vegetable oils. Oilseeds play a significant role in the Indian agricultural economy. The country is the world's largest producer of oilseeds, accounting for 7% of global vegetable oil production and holding a 14% share

of the market. The average production of groundnut, rapeseed, mustard, soyabean, and total oilseeds grew at a rate of -0.18 percent, 64.5 percent, 245.2 percent, and 245.2 percent, respectively, from I to II in this study. Groundnut output (-0.046) and area (-0.231) have negative Pearson coefficients of correlation, whereas yield per hectare has a very low positive correlation in periods I and II. Groundnut, rapeseed, mustard, soyabean, and total oilseed production, area, and yield all have a positive association coefficient. Before, there was a positive association between groundnut production and area under cultivation, but it was negative after that, and it is now extremely low for the pooling era. Similarly, from period I to II, and in the pooling, there is a positive link between production and the area under cultivation of rapeseed, mustard, soyabean, and total oilseeds. Because the coefficient of variation for the groundnut in period I is lower, it is thought to be more constant in terms of production, area, and yield. As with rapeseed and mustard, the coefficient of variation for soyabean and total oilseeds is for period II, and it is believed to be more efficient. As a result of the new agricultural policy, there has been a structural change in the production of oilseeds and the area under cultivation in India.

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