



Research Article

GROWTH AND INSTABILITY OF MAJOR OILSEED CROPS IN GUJARAT

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Abstract: Oilseed crops are the second most vital determinant in agricultural economy, next only to cereals in field crops. Gujarat plays a dominant role in oilseed production in India. The present study was conducted to estimate the growth and instability of major oilseed production from period 1990-91 to 2019-20 in India. Out of nine oilseed crops, major five oilseed crops have been selected as they shared more than 95 per cent of the area in Gujarat according to 2019-20 data. Statistical tools like compound rate of growth for calculating annual rate of growth and Cuddy-Della Valle Index for instability index were used. The period 1990-91 to 2019-20 has been further sub-divided into three sub-period, viz., period I (1990-91 to 1999-00), period II (2000-01 to 2009-10) and period III (2010-11 to 2019-20) to clearly bring out the trends in the more recent periods. The study reveals that groundnut was found positive growth with high instability in production in all three periods. Castor production was found positive growth with lower instability in period I & II while negative growth with lower instability in period III. Sesame production was found negative growth with high instability in period II whereas positive growth with high instability in period I & III. Soybean growth was found negative growth with medium instability in period I where as positive growth in period II & III in production. rapeseed and mustard growth were found irregular growth with medium instability in production from period I to period III.

Keywords: Oilseed crops, Cuddy-Della Valle Index, Instability index

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Introduction

Agriculture continues to be mainstay of life for majority of the Indian population. It contributes around 20.2 per cent of the GDP and employs 41.49 per cent of the workforce in the country [1]. Significant growth has been made in agriculture production since independence. The agriculture production of food grains was 51 million tonnes in 1950-51 i.e., before beginning of the 1st Five Year Plan to 285.21 million tonnes in 2018 -19 [2]. The output of oilseeds increased from 5.16 million tonnes to 33.22 million tonnes from 1950-51 to 2019-20 [2]. Oilseeds all over the world are known for being a rich source of food, feed, energy and employment. The oilseeds and their by- products also provide nutrition to the livestock and a good source of manures to the crop production.

Oilseed crops are the second most important determinant of agricultural economy, next only to cereals. Indian Vegetable oil economy is world's fourth largest after USA, China and Brazil. Oilseed cultivation is undertaken across the country in about 27 M ha, mainly on marginal lands, dependent on monsoon rains (un-irrigated) and with low levels of input usage [3]. Lack of technologies, cultivation with input-starved conditions, combating both the biotic and abiotic stresses are some of the major reasons for poor productivity of Oilseed crop.

The huge drain on the import bill with the above factors led to establishment of Technology Mission on Oilseeds (TMO) in 1986 for increasing the domestic production of edible Oils. Subsequently, pulses were also brought under the ambit of Technology Mission in 1990. Oil palm and Maize were also brought under the Technology Mission in 1992-93 and 1995-96 respectively. Consequent upon the setting up of Technology Mission on Oilseeds, a major breakthrough in increasing Oilseed's production was achieved through an integrated approach by introducing new crop production technologies, better supply of inputs and extension services support for marketing, post-harvest technologies and

excellent coordination/cooperation between various concerned organizations/ departments and Ministries [4]. As a result of concerted efforts by the different development programme, the production of Oilseeds increased from 10.83 million tonnes in 1985-86 to 33.22 million tonnes in 2019-20. This brought not only increase in area but also improvement in productivity from 570 kg/ha to 1224 kg/ha. The self-sufficiency in oilseeds attained through "Yellow Revolution" during early 1990's, could not be sustained beyond a short period. India is Despite being the fourth largest oilseed crop producing country in the world, even though India is also one of the largest importers of vegetable oils today. There is increasing trend in the vegetable oil consumption in recent years in respect of both edible as well as industrial usages. The demand-supply gap in the oilseed has necessitated huge imports accounting for 55.74 per cent of the country's requirement (2019-20: import 18.41 million tonnes). 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 increase per capita consumption (18 kg oil per annum) led by an increase in population and increased per capita income [5].

Demand projections of vegetable oils in India by the terminal year of XII Plan (2017) have been made by different agencies/researchers in the recent past, which is likely to be at least 16 kg/year/capita. For a projected population of 1276 million, the total vegetable oil needs will be 204 lakh tonnes. In terms of Oilseeds, it is nearly equivalent to 680 lakh tonnes provided that the proportion of different oilseeds remains constant in the coming years. If one assumes at least 20% of vegetable oils from crops other than annual oilseeds like rice bran, cottonseed, coconut, tree-borne oilseeds, Oil palm, etc then the country needs to produce about 544 lakh tonnes by the terminal year of XII plan to achieve near self-reliance in vegetable oils [6].

Table-1 Growth rate of area, production and productivity of major oilseed crops of Gujarat

Crops	Period 1 (1990-91 to 1999-00)			Period 2 (2000-01 to 2009-10)			Period 3 (2010-11 to 2019-20)		
	Area	Production	Productivity	Area	Production	Productivity	Area	Production	Productivity
Groundnut	-0.44	6.26	6.74	-0.29	8.63	7.50	-0.19	4.39	4.59
Castor	2.44	5.00	2.49	0.15	4.53	4.37	-0.99	-1.08	-0.09
Sesame	2.92	9.31	6.20	-4.64	-6.13	-1.55	-7.34	2.46	3.14
Soybean	-13.12	-13.81	-0.79	38.17	34.49	-2.66	11.48	18.27	7.77
Rapeseed and Mustard	-2.18	-1.16	1.04	3.04	5.50	2.39	-2.08	-0.37	1.75
Total Oilseed	0.02	4.90	4.89	-0.51	5.20	5.74	-1.08	1.44	2.55

Table-2 Instability of area, production and productivity of major oilseed crops of Gujarat

Crops	Period 1 (1990-91 to 1999-00)			Period 2 (2000-01 to 2009-10)			Period 3 (2010-11 to 2019-20)		
	Area	Production	Productivity	Area	Production	Productivity	Area	Production	Productivity
Groundnut	3.73	52.89	53.66	4.19	62.33	45.34	13.38	45.51	38.41
Castor	7.13	12.24	8.40	12.20	14.49	10.06	19.44	20.21	9.90
Sesame	9.04	44.37	39.25	11.80	34.31	28.47	24.70	147.32	15.01
Soybean	28.04	18.25	20.77	16.21	20.50	22.77	30.03	37.26	18.18
Rapeseed and Mustard	8.62	18.84	25.56	18.16	25.21	13.41	12.81	16.40	7.06
Total Oilseed	2.30	35.51	35.42	3.33	35.68	32.88	8.94	29.46	23.6

The diverse agro-ecological conditions and farmers experience in the country are favourable for growing 9 annual oilseed crops, which include 7 edible oilseeds (groundnut, rapeseed & mustard, soybean, sunflower, sesame, safflower and niger) and two non-edible oilseeds (castor and linseed) over an area of about 27 million ha. Among these, soybean (42%), groundnut (21%), rapeseed & mustard (30%) contributes to more than 90 per cent of total oilseeds production. Andhra Pradesh (groundnut) & Gujarat (groundnut), Haryana (Mustard), Karnataka (Groundnut), M.P (Soybean), Maharashtra (Soybean), Rajasthan (Mustard & Soybean), Tamil Nadu (Groundnut), U.P (Mustard), West Bengal (Mustard) contributing more than 95 per cent of total oilseed production in the country [7]. In India, the West zone region contributes highest production around 75 per cent followed by South zone (11%), North zone (8%) and East zone (6%). Gujarat and Rajasthan contribute highest oilseed production around 20 percent each followed by Madhya Pradesh (19%) and Maharashtra (16%).

The state of Gujarat plays a dominant role in oilseed production in India. The state contributes about 10 per cent and 11.5 per cent oilseed's area and production in India. The area under total oilseeds has been stagnated over the years. The area under total oilseed has declined from 2908.5 thousand Hectare in 1995-96 to 2867.69 thousand Hectare in 2019-20. Among all the nine oilseed crops Gujarat secures first rank for area and production of groundnut in India with 1.68-million-hectare area and 4.65 million tonnes production respectively. Gujarat state ranks first position in the country with respect to area (7.36 lakh hectare) and production (1.4 million tonnes) of castor. Gujarat also secures first position in India with respect to area and production of sesamum with 1.65 lakh hectare area and 1.07 lakh tonnes production. Gujarat ranks sixth position in India with respect to area (1.72 and 1.006) and production (3.33 and 1.32 lakh tonnes) of rapeseed-mustard and soybean respectively [8].

Gayatri, (2018) [9] found the growth rate of the area of groundnut was showing the negative trend, whereas production and yield shows a positive trend with one percent and 3.26 percent respectively. Reddy and Immanuelraj (2017) [10] studied on area, production and yield trend and pattern of oilseed growth in India and revealed that the oilseeds crops have registered the significant growth in area and production in last 30 years. However, compare to cereals like paddy and wheat, the growth rate of area and production of oilseeds is insignificant and there exists wide variability in their yield in different states of the country. Tambe *et al.* (2021) [11] study growth and instability in area, production and productivity of soybean in Maharashtra using CDCI. They concluded that for overall period (1987-2017) area under soybean is highly fluctuating and instable in all the districts of Maharashtra except Latur district. The production is mainly depending on area under soybean crop. However, the productivity is fluctuating in all the districts. Bansal and Singh (2020) [12] studied an analysis of growth and variability in area, production and yield of groundnut in Punjab. The study concluded that area and productivity had decreased but reciprocated in terms of production in the study period. In context with variability, the study concluded that there persisted wide fluctuations in the growth of area and production of groundnut over the study period.

Materials and Methods

Study area and crops

The present study was comprised of area, production and productivity of major oilseed crops of Gujarat state. Out of nine oilseed crops, major five oilseed crops have been selected as they shared more than 95 per cent of the area in Gujarat according to 2019-20 data.

Period and source of data

The present study is based on secondary data and the time series data of area, production and productivity of thirty years were collected from the Directorate of Agricultural, Gujarat. The period of the study is from the year 1990-91 to 2019-20. The period 1990-91 to 2019-20 has been further sub-divided into three sub-period, viz., period I (1990-91 to 1999-00), period II (2000-01 to 2009-10) and period III (2010-11 to 2019-20) to bring out the trends in the more recent periods.

Data Analysis

Statistical tools like compound growth rate and Cuddy-Della Valle Index were used to analyse growth rates and instability in area, production and productivity of major oilseeds in India respectively. Compound growth rate was calculated using the following formula.

$$C.G.R.(%) = (Antilog b-1) \times 100$$

where, b = regression coefficient

Cuddy Della Valle Instability index

Coefficient of Variation measures instability but it overestimates the level of it in time-series data. The Cuddy Della Valle index (CDVI) is calculated as follows:

$$\text{Cuddy - Della Valle Index } (\%) = cv \times \sqrt{(1-R^2)}$$

where,

C.V. = Coefficient of Variation

R² = Coefficient of multiple determination

The ranges of CDVI (Sihmar, 2014) are given as follows:

Low instability = between 0 and 15

Medium instability = greater than 15 and lower than 30

High instability = greater than 30

Result and Discussion

Before the 1970s there is no significant changes found in area and production of oilseeds in India. AICRP for oilseed was introduced in 1966 and concentrated for oilseed up to 1974. During this period production of oilseed rose 162.41 per cent and reached 63.95 lakh tonnes. In 1974, IODP was launched in 5th five-year plan. The acreage of oilseed changes 35.06 per cent which becomes 183.76 lakh ha. Production of oilseed rose 78.53 per cent (114.17 lakh tonnes) during 1974-1985. TMO was launched in 1986 to boost the production of oilseeds. Acreage of oilseed changes 41.20 per cent which becomes 259.47 lakh ha. Production of oilseed rose 91.69 per cent which becomes 218.86 lakh tonnes during 1985-1997. After that special focused plan was absent between 1997 to 2004.

In that period first time area and production was declined after 1st five-year plan. In 2019-20, the Production of oilseed becomes 332.10 lakh tonnes. Yield was constantly rising from 1951 for all oilseed.

The present study encloses the period from 1990-91 to 2019-20 of major oilseed crops in Gujarat state. The growth rate of area, production and productivity of major oilseed crops of Gujarat for periods I, II and III are presented in [Table-1]. In the period I, growth rate of area shows positive in the case of castor and sesame. Groundnut, soybean and rapeseed and mustard showed a negative growth rate in area. Groundnut, castor and sesame show positive growth of production. While soybean and rapeseed and mustard show negative growth of production in period I. In period I all the major oilseed crops show positive growth of productivity except soybean. From the table, it is observed that in period I, area under sesame shows the highest growth rate (2.91%) followed by castor (2.44%). In the case of production highest growth rate shown in sesame (9.31%) followed by groundnut (6.74%) while in productivity highest growth rate shown in groundnut (6.74%) followed by sesame (6.19%). Total oilseed area was not found significant growth whereas production and productivity growth rate increase with 4.90 and 4.89 per cent respectively. During this period TMO boosts the production as well as productivity of oilseeds. During this period yellow revolution plays a significant role in the self-sufficiency in the oilseed and lesser dependent on import of oilseed. Technology mission on oilseeds (TMO) made satisfactory progress and import of oilseeds almost on short term basis. However, the country again became a net importer due to static oilseed production and several unfriendly policy decisions.

In period 2 castor, soybean and rapeseed and mustard shows positive growth while groundnut and sesame show negative growth of area. In the case of production all the given crop shows positive growth except sesame while in the case of productivity groundnut, castor and rapeseed and mustard shows positive growth and sesame and soybean shows negative growth. In period 2, area under soybean shows the highest growth rate (38.16%) followed by rapeseed and mustard (3.03%). In the case of production highest growth rate shown in soybean (34.49%) followed by groundnut (8.62%) while in productivity highest growth rate shown in groundnut (7.49%) followed by castor (4.37%). Total oilseed area was found negative growth whereas production and productivity growth rate increase with 5.19 and 5.74 per cent respectively. During this period ISOPOM was launched to enhance oilseed production and productivity. As a result of this programme, various initiatives are taken by the government to increase production like seed village programme, crash programme for quality seed production, distribution of certified seed, distribution of mini kits, infrastructural development, transfer of technology etc.

In period 3 all the given crops show negative growth in area except soybean. In the case of production groundnut, sesame and soybean show positive growth whereas castor and rapeseed and mustard show negative growth. In last decade, productivity of all the given crops show positive growth except castor. In period 3, area under soybean shows highest growth rate (11.48%) followed by groundnut (-0.19%). In the case of production highest growth rate shown in soybean (18.27%) followed by groundnut (4.38%) and also soybean (7.77%) shows highest growth rate followed by groundnut (7.49%) in productivity. Total oilseed area was found negative growth whereas production and productivity growth rate increase with 1.44 and 2.55 per cent respectively. National Mission on Oilseeds and Oil Palm (NMOOP) launched during 2014-15 envisages increasing production and productivity of oilseeds crops and oil palm through bringing in fallow areas under oilseed crops and diversification of area from low yielding cereals. As a result of this mission significant increase in production and productivity in oilseed.

Instability

The agriculture sector, as it depends on climatic factors subjected to a large degree of uncertainty. Though it is said that growth with stability is good but growth with instability is a lot of usually the fact. Generally, a growth rate is not able to explain fluctuations or instability in the time series data, So the co-efficient of Variation (CV) was used as a measure of instability in area, production and productivity and results are presented in [Table-2]. In terms of area of oilseeds in the period I, Low Instability was found except soybean. Area of soybean was found medium instable as indicating 28.03 per cent.

In terms of production, High instability was found in groundnut and sesame. Castor production remained low instable during the period I. Soybean and rapeseed and mustard were moderately instable in the period I. Highest instability in production was found in groundnut during period I. Production and productivity were found in similar trend in terms of instability. Highest instability in productivity was found in groundnut during period I. Area of total oilseed was low instable whereas production and productivity were highly instable in period I.

In terms of area of oilseeds in period II, Low Instability was found in all major oilseed crops except soybean and rapeseed and mustard. Lowest instability was found in groundnut whereas the highest instability was found in rapeseed and mustard. Groundnut production was found highest instable with 62.33 per cent and castor production was found lowest instable with 14.49 per cent in period II. Groundnut and sesame production were highly instable. Soybean and rapeseed and mustard production were moderately instable and castor production was found low instable. Groundnut productivity was the highest instable (45.34) and castor productivity was lowest instable (10.06) in period II. Other oilseeds except for groundnut, lower instability was found in period II. Total oilseed area was found low instability whereas production and productivity were highly instable in period II. In terms of area of oilseeds in period III, Low Instability was found in groundnut and rapeseed and mustard. Lowest instability was found in rapeseed and mustard whereas the highest instability was found in soybean. Production of sesame was found highest instability with 147.31 per cent and rapeseed and mustard production found lowest instable with 16.39 per cent in period III. Production of groundnut, sesame and soybean was found highly instable while castor and rapeseed and mustard production was found moderately instable in period III. Groundnut productivity was found highest instable with 38.41 per cent and rapeseed and mustard was lowest instable with 7.05 per cent in period III. Soybean and sesame productivity was found moderately instable while castor and rapeseed and mustard were found low instable during period III. Total oilseed area was found low instable whereas production and productivity were moderately instable in period III.

Conclusion

Indian agriculture has made considerable progress and becomes self-sufficient, particularly in the food crops such as wheat and rice in irrigated areas. Therefore, after achieving self-sufficiency in food grains the government is focusing attention on oilseeds. The oilseed sector has been an important area of concern and intervention for Indian policymakers in the post-reforms period when India became one of the largest importers of edible oils in the world, importing about half of the domestic requirement in the 1990s. The study reveals that groundnut was found positive growth with high instability in production and productivity in all three periods. Castor production and productivity was found positive growth with lower instability in periods I & II while negative growth with lower instability in period III. Sesame production was found negative growth with high instability in period II whereas positive growth with high instability in period I & III. Soybean growth was found negative growth with medium instability in period I whereas positive growth in period II & III in production with medium and high instability respectively. Rapeseed and mustard growth were found irregular growth with medium instability in production from period I to period III. Total oilseed Growth in production and productivity was positive in all three period because of different development programmes implemented during this period like TMO, ISOPOM, NMOOP etc. which impact significantly in oilseed production and productivity.

Application of research: Agricultural growth and instability remained subject of debate in agriculture economics in India. Since agriculture is dependent on weather condition, sowing area, production and crop yield are subject to significant variation over time.

Research Category: Agribusiness Management

Abbreviations: TMO-Technology mission on oilseeds
ISOPOM-integrated scheme of oilseeds, pulses, oilpalm and maize
NMOOP-National Mission on Oilseeds and Oil Palm

AICRP-All India Coordinated Research Project
IODP-Oilseeds Development Programme

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Study area / Sample Collection: Gujarat

Cultivar / Variety / Breed name: Oilseeds

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Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

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