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Growth Trends and Instability of Sunflower in Karnataka: An Inter-Districts and Inter-Divisional Analysis

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ABSTRACT

Background: Indian vegetable oil economy is world's fourth largest after USA, China and Brazil. India was a net exporter of oilseeds and edible oils till 1960s but with stagnation in production and increasing demand for edible oils, India became net importer of edible oils by late-1970s. The government decided to achieve self-sufficiency in edible oilseeds through various policy/schemes such as NODP (1984-85), TMO (1986), OPDP (1991-92) was launched under the TMOP and ISOPOM (2004-05). Karnataka is the sixth largest state in area and production of oilseeds crops in India. Among the oilseed crops, sunflower accounts highest in area (36.71%) and production in state. Hence, the study was undertaken in Karnataka state with the objectives of assessing the growth and instability of sunflower production.

Methods: The growth trends and instability analysis of sunflower was corrie out in Karnataka. The four divisions of the states *viz*., Bangalore, Mysore, Belgaum and Gulbarga with 30 districts were selected for the study. The data pertaining to area, production and yield of sunflower were collected from many secondary sources and analysed for the period I: 1975-1995 (Pre-WTO), Period II: 1995-2015 (Post-WTO) and whole period: 1975-2015 by using CAGR and CDI Index.

Result: The growth pattern of sunflower showed a downward trend with respect of area, production and yield in all the four regions of the state during the period II than compared to period I. It might reflect the adverse effect of modern technology on production of sunflower in Karnataka state. The study indicated that the fluctuation in area, production and yield of sunflower were higher during post-WTO period when compared to pre-WTO period in across the districts and divisions. The mixed trend was observed during whole period with respect to growth and instability of sunflower production.

Key words: CAGR, CDI, Cuddy della vella index, WTO, Sunflower.

JEL Codes: C32, Q10, Q18

INTRODUCTION

Indian vegetable oil economy is world's fourth largest after USA, China and Brazil. Oilseed cultivation is undertaken across the country in about 260 lakh ha, largely under rainfed areas (72%) with risk in investment (Anonymous, 2014). As per the annual report (2013-14) of Ministry of Agriculture, India accounts for 12-15 per cent of oilseeds area, 7-8 per cent of oilseeds production in the world (Anonymous, 2014). The oilseeds account for 13 per cent of the gross cropped area, 3 percent of the gross national product and 10 percent value of all the agricultural commodities (Anonymous, 2014).

Scenario of Sunflower in World and India

Sunflower is grown over an area of more than 25 million ha in 70 countries with a world average yield of 1611 kg/ha (Anonymous, 2014). Russian Federation, Ukraine, Argentina, Romania, China, Kazakistan, Spain, Tanjania, Bulgaria, France, India, Turkey, South Africa, USA and Myanmar are the major sunflower growing countries. Russia (67.96 lakh ha) and Ukraine (50.92 lakh ha) have largest share (50%) in total sunflower production in the world (Anonymous, 2014). The sunflower is cultivating in an area 255.90 lakh ha in the world with total production 447.53 lakh tonnes (Anonymous, 2014). The commercial cultivation of sunflower as an oilseed crops was started during late 70s with an area of 12,000 ha mainly in Karnataka (Anonymous, 2014). National Average Yield (NAY) of sunflower was around 666 kg/ha as against the World Average of 1749 kg/ha and highest yield of 2559 kg/ha of China during 2013-14 as per oilseed status report 2014.

Karnataka is the sixth largest state in area and production of oilseeds crops in India. Among the oilseed crops, sunflower accounts highest in area (36.71%) and production in Karnataka state (GOK, 2013). According to ministry of agricultural and cooperation, status paper of oilseeds 2014, in area, production and productivity for sunflower in Karnataka state was 4.43 lakh ha, 2.97 lakh tonnes and 670 kg per hectare, respectively during 2013-14.

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Programmes and schemes governing edible oilseeds and oils in India

India was a net exporter of oilseeds and edible oils till 1960s but with stagnation in production and increasing demand for edible oils, India became net importer of edible oils by late-1970s (Anonymous, 2014). The government decided to achieve self-sufficiency in edible oilseeds through various policy/schemes and technological interventions by 1990s. The initial strategy to overcome stagnant oilseed production was to promote new technologies in oilseed production and processing through centrally sponsored schemes like National Oilseed Development Project (1984-85), TMO (1986), Oil Palm Development Programme (1991-92) was launched under the "Technology Mission on Oilseeds and Pulses" with a focus on area expansion many states, ISOPOM (2004-05) was implemented in the country (Anonymous, 2014).

Many scholars are having said that growth and instability are directly linked. Accordingly, Chattapadhyay (2001) and Paltasingh and Goyari (2013) said that relationship between growth and instability have two broadways, first, a direct or positive relationship where higher instability co exists with low growth or vice versa. The groundnut shows that high degree of instability in production (Rao and Raju, 2005). Pandey *et al* (2005) reported that the groundnut yield instability showed a mixed response. Ramesh and Raju (2009) said that oilseed production is found more risky as compared to cereals and pulses. Jainuddin *et al* (2019) reported that the growth pattern of groundnut indicated a downward trend especially during period II in Karnataka state. The high degree of instability in oilseeds production leads to large gap between consumption and production of edible oils in our country. This gap is being met through imports. The cost of import of edible oil is approximately Rs 60,000 crores during 2012-13 (Anonymous 2014).

Hence, based on above background, the present study were undertaken in Karnataka state with the overall objectives of assessing the growth and instability of sunflower production in the state. The results of this study would help in suggesting suitable policy options and regional level planning to increase oilseed productivity which in turn helps for the development of agricultural sector in general and oilseed sector in particular in the states.

MATERIALS AND METHODS

The proposed study was conducted in Karnataka state which has the highest area and production of edible oilseed crops in India. Karnataka is the sixth largest state in area and production of oilseeds crops in India. The oilseed crops grown in Karnataka are groundnut, sunflower, safflower, castor, sesamum, linseed soyabean, nigerseed, rape and mustard. Among these oilseed crops, Karnataka state has the largest area under sunflower (36.71%) crop (GOK, 2012-13). Hence, sunflower crop is selected for the present study.

Divisions and districts selected for study

The Karnataka state was formed in the year 1973. The old name of the state was Mysore which was formed on November 1, 1956. The Karnataka state has 30 districts at present which was divided in to four administrative (revenue) divisions which are head quartered by following districts *viz*., Bangalore, Mysore, Belgaum and Gulbarga. These divisions (30 districts) of the state were selected for the study. Since the policy implication, if any from the study would help in regional planning. Hence, this district-wise study would help in district level planning in agricultural sector in general and oilseed sector in particular in the state.

Data period and its source

The data relating to area, production, yield at the district and state levels for the period 1975-76 to 2015-16 will be obtained from various secondary sources like DES, Bangalore DAC, Indiastat.com, *etc*. The district-wise data on area, production and yield of sunflower were collected from DSO of the respective districts. The whole period (1975-76 to 2015-16) were divided into two sub period's; period-I (1975-76 to 1995-96) and period-II (1995-96 to 2015-16) to assess the impact of new technological innovations evolved before and after World Trade Organisation respectively and also assess the impact of trade linearization policy on area, production and productivity of sunflower in Karnataka.

Tools Used for Analysis
Compound growth rate (CAGR) analysis

The CAGR were used to analyse the growth in area, production and productivity of sunflower. The compound growth rates were computed by using the exponential function of the form.

$$Y = AB^t \quad \ldots\ldots\ldots\ldots \quad (3.1)$$

after substitution of log to equation

$$\log y = \log A + t \log B$$

Where,
Y = area, production, productivity of sunflower in the year 't'
A = constant,
B = regression coefficient and
t = time in years starting from base year 1974-75.

$$\text{Compound growth rate} = [\text{Antilog } B\text{-}1] \times 100$$

To test the significance of growth rates, correlation coefficients will be estimated by the following formula,

$$r = \{\text{Cov.}(Y.\ t) / \sqrt{\text{Var}(t).(\text{Var } Y)}\}$$

Where,
r = correlation coefficient,
Y = area/production/yield and
T = time

Cuddy-sella valle index (CDI)

In this study the instability in area, production and productivity of sunflower crop was measured in relative terms by the CDI index which is used in recent years by a number of researchers as a measure of variability in time series

data. The simple coefficient of variation over estimates the level of variability in time-series data characterized by long-term trends whereas the CDI index corrects the coefficient of variation.

The instability index of Cuddy-Della Valle index is given by the expression;

$$CDI=CV\sqrt{1-R^2}$$

Where

CV=Coefficient of variation (in percent)

R^2=Coefficient of determination from a time trend regression adjusted by the number of degrees of freedom.

RESULTS AND DISCUSSION

Growth Performance of Sunflower in Karnataka State

The growth pattern in terms of area, production and yield of sunflower for division-wise, district-wise and for the state as a whole pertaining to the period I (1975 to 1995), period II (1996 to 2016) and whole period were computed by using the CAGR analysis.

Table 1: Inter-districts and inter-divisional growth rates of sunflower area in Karnataka state.

Districts /Divisions	(Per cent)		
	Period I (1975 to 1995)	Period II (1996 to 2016)	Whole Period (1975 to 2016)
Bangalore	7.99	-9.47**	-3.01***
Kolar	46.47*	-13.40*	9.74**
Tumkur	29.43*	-7.29**	7.90*
Chitradurga	29.56*	-4.68**	4.82**
Shivamoga	23.87*	-0.09	-1.52
Bangalore Division	**27.03***	**-5.14****	**4.33****
Mysore	26.63*	-1.05	2.25
Mandya	16.10**	-15.05*	-9.85*
Hassan	38.76*	-9.63**	4.87**
Chickmagalur	45.60*	-6.17**	7.12**
Mysore Division	**31.22***	**-3.98****	**3.88****
Dharwad	31.68*	0.9	8.34*
Belgaum	26.32*	-1.76	7.24*
Bijapur	36.75*	-4.65**	5.69**
Belgaum Division	**34.00***	**-3.19*****	**6.08****
Bellary	23.96*	-7.54**	2.31
Bidar	13.66*	-7.34*	-1.64
Raichur	37.29*	-1.57	9.08*
Gulbarga	28.14*	-2.58	4.36**
Gulbarga Division	**26.23***	**-3.13*****	**4.90****
Karnataka State	**27.17***	**-3.71****	**5.06****

*Significant at 1% level ** Significant at 5% level, *** Significant at 10% level.

Data source: Directorate of Economics and Statistics, Bangalore.

Growth performance of sunflower area

The growth rates of area, production and yield of sunflower is presented in the Table 1. It is observed that the area under sunflower in the state exhibited a significantly very high positive growth rate during the period I (27.10%) as compared to the period II (-3.71%). The growth rate of sunflower in area during the period I exhibited a positive trend and the same was very high in Kolar (46.47%) district followed by Chickmangalur, Hassa and Bijapur districts. It is observed that all the districts in the state have witnessed a significantly positive and high growth rate during the period I than compared to period II. Table 1 clearly indicates that all the division's *viz*., Bangalore, Mysore, Belgaum and Gulbarga divisions witnessed a significantly positive growth (27.03%, 31.22%, 34% and 26.23%, respectively) in sunflower area during period I than compared to period II. The mixed trend was observed in whole period. The results are in line with the findings of Singh and Dhaliwal (1993) at all India level; Addisu (2000) and Nethrayini (2013) at state level. The rapid expansion of crop area under this crop during 1975's or pre-WTO might be due to its important features like short duration, photo insensitiveness and adoption to a wide range of soils and climatic condition (Netrayini, 2013). In Karnataka, sunflower area expanded during 1900's and 2000's by replacing crops peal millet and cotton and partly from increase in cropping intensity as stated (Girish *et al.*, 2012).

Growth performance of sunflower production

The state level production (Table 2) of sunflower witnessed a significantly positive and very high growth rate during the period I (22.89%) than compared to the period II (-2.39%). Table 2 indicated that all the districts significantly witnessed a negative growth in production of sunflower except Shivamogga (12.34%), Belgaum (0.72%) and Raichur (0.68%) districts during the period II as compared to the period I. Table 2 clearly indicates that all the divisions *viz*., Bangalore, Mysore, Belgaum and Gulbarga witnessed a significantly positive growth (21.73%, 27.77%, 26.65% and 22.89%, respectively) in production of the sunflower during period II than compared to period I. The study showed that all the districts and divisions are exhibited significantly positive growth in sunflower production during the period I than compared to the period II. The results are in line with Pradeep Kumar (2015).

Growth performance of sunflower yield

Table 3 indicated that the state level yield of the sunflower witnessed a significantly positive and very high growth rate during the period II (53.46%) and whole period (26.81%) than compared to the period I (-3.64%). Table 3 indicates that all the districts witnessed a significantly positive and very high growth rate in the yield of sunflower during the period II than compared to period I and whole period. Table 3 clearly indicates that in the divisions *viz*., Bangalore, Belgaum and Gulbarga witnessed a significantly positive and very high growth rate (60.86%, 55.36% and 52.95%,

respectively) in the yield of the sunflower during period II, while during the same period, the Mysore division witnessed a very high growth rate but non-significant in nature. During period II, the annual growth rate of sunflower yield was found to be higher than compared area and production. The higher growth in sunflower yield during period II may be due to lower instability in yield of sunflower and also better technological performance emerged from the TMO during post-WTO period.

The high growth rate in yield is due to change in mean yield of the crop than compared to change in mean area and interaction effect. The growth trends of sunflower (Fig 1) indicate that growth rate of area and production of sunflower were found to be decreased but yield of sunflower drastically increased during period II. This confirmed from the instability analysis of the study. The study concludes that positive trend in growth rates of area, production sunflower during period I across the districts and divisions could be due to government initiatives in the form of TMO as well as price and marketing support for oilseed growers (Girish *et al.,* 2012).

Table 2: Inter-districts and inter-divisional growth rates of sunflower production in Karnataka state.

Districts	(Per cent)		
	Period I (1975 to 1995)	Period II (1996 to 2016)	Whole Period (1975 to 2016)
Bangalore	3.31	-7.67**	-3.09**
Kolar	42.03*	-2.02	14.12*
Tumkur	23.75*	-4.11	8.16*
Chitradurga	23.95*	-5.13**	3.22**
Shivamoga	19.11*	12.34**	2.17
Bangalore Division	**21.73***	**-3.92****	**3.59****
Mysore	21.06*	-5.17	-0.83
Mandya	11.14	-11.51**	-9.82*
Hassan	36.41*	-7.68**	4.53**
Chickmagalur	43.16*	-8.83**	4.91**
Mysore Division	**27.77***	**-6.62****	**1.82**
Dharwad	28.56*	-2.82	7.02*
Belgaum	25.86*	0.72	8.94*
Bijapur	28.04*	-6.40**	4.90**
Belgaum Division	**26.65***	**-4.46****	**5.58****
Bellary	17.46**	-2.63***	2.71**
Bidar	6.84**	-2.65***	-0.63
Raichur	31.57*	0.68	8.01*
Gulbarga	24.48*	-5.08	3.59**
Gulbarga Division	**21.58***	**-1.29**	**4.21****
Karnataka State	**22.89***	**-2.39**	**4.50****

*Significant at 1% level ** Significant at 5% level, *** Significant at 10% level.

Data source: Directorate of Economics and Statistics, Bangalore.

Table 3: Inter-districts and inter-divisional growth rates of sunflower yield in Karnataka state.

Districts	(Per cent)		
	Period I (1975 to 1995)	Period II (1996 to 2016)	Whole Period (1975 to 2016)
Bangalore	-4.58**	58.66***	28.99
Kolar	-3.72**	59.04	29.3
Tumkur	-5.07**	57.53	28.73
Chitradurga	-4.19**	53.53	27.38*
Shivamoga	-3.91**	67.37*	31.48*
Bangalore Division	**-4.38****	**60.86***	**29.60*****
Mysore	-4.58***	54.18	27.35***
Mandya	-4.33**	55.87	28.01
Hassan	-1.66	58.04	29
Chickmangalur	-1.74	53.04**	27.55*
Mysore Division	**-2.92**	**55.08**	**27.92****
Dharwad	-2.6	52.05	26.3
Belgaum	-0.97	57.29*	28.14*
Bijapur	-3.36***	50.78	25.68
Belgaum Division	**-2.43**	**55.36***	**27.32****
Bellary	-3.74**	53.81**	27.01***
Bidar	-3.89***	52.95**	26.41
Raichur	-4.07**	51.6	26.20**
Gulbarga	-3.79***	53.94**	26.54***
Gulbarga Division	**-3.73****	**52.95****	**26.58**
Karnataka State	**-3.64****	**53.46****	**26.81**

*Significant at 1% level ** Significant at 5% level, *** Significant at 10% level.

Instability of sunflower in Karnataka state

Instability is one of the important decision tools that capture the degree of uncertainty and risks involved in farm production and adversely affect farmer's decisions to adopt modern technologies and investment in farming. Ramesh Chand and Raju (2009) opined that instability in production also affects price stability and can cause consumers and low income earners become vulnerable to market situations. Growth and instability of area and yield have a direct effect on growth and instability of production. Therefore instability of the sunflower was analysed during the study periods by using CDI Index which takes in to account coefficient of variation and adjusted R Squire.

Inter-districts instability in area, production and yield of sunflower

The instability of area, production and yield of sunflower were presented in Table 4. The results witnessed that the magnitude of instability at state level in sunflower area was marginally increased during period II (41.66%) when compared to the period I (34.53%). The degree of instability

marginally declined in sunflower area in all the districts of the state except Shivamogga, Mysore, Mandya, Hassan and Chickmangalur districts during the period II. Table 4 showed that the production of sunflower in Karnataka has witnessed a higher instability during the period II (43.43%) than compared to the period I (31.46%). The instability of sunflower production in Tumkur, Chitradurga, Shivamogga, Mysore, Mandya, Hassan, Chickmangalore, Dharwad and Belgaum districts were found to be higher during the period II. The degree of instability in yield of sunflower

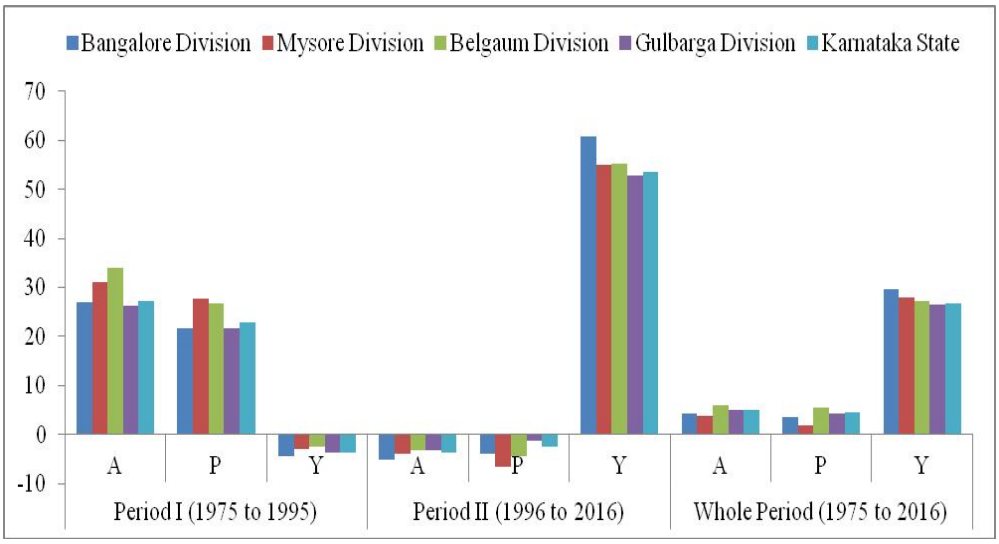


Fig 1: Growth trends in area (A), production (P) and yield (Y) of sunflower in Karnataka state.
Data source: Directorate of Economics and Statistics, Bangalore.

Table 4: Cuddy Della instability of area, production and yield of sunflower.

Districts	(Percent)								
	Period I (1975 to 1995)			Period II (1996 to 2016)			Whole Period (1975 to 2016)		
	A	P	Y	A	P	Y	A	P	Y
Bangalore	96.99	101.70	31.11	75.18	81.81	25.25	100.50	100.26	33.63
Kolar	96.86	117.72	32.94	58.67	98.92	48.45	95.91	116.33	44.27
Tumkur	65.45	56.14	35.29	65.01	90.00	39.99	83.79	102.49	41.34
Chitradurga	43.74	37.54	33.21	38.45	41.48	31.09	60.27	59.00	35.19
Shivamogga	26.71	20.12	31.72	105.38	73.89	29.03	94.63	68.80	49.68
Bangalore Division	**40.05**	**32.86**	**32.69**	**39.40**	**48.68**	**14.17**	**60.26**	**57.97**	**33.34**
Mysore	27.71	46.61	48.86	51.58	74.07	33.16	65.10	80.95	47.44
Mandya	105.19	113.78	44.92	137.52	125.46	38.77	143.80	156.82	45.92
Hassan	33.58	53.00	42.72	63.99	64.15	33.98	71.83	77.39	40.04
Chickmangalur	25.29	50.12	48.62	50.43	69.81	31.61	72.90	92.89	43.13
Mysore Division	**21.94**	**40.33**	**44.25**	**49.88**	**58.70**	**21.97**	**64.01**	**76.20**	**38.66**
Dharwad	41.72	48.54	47.32	39.25	52.54	28.87	46.31	58.81	39.62
Belgaum	31.77	41.68	45.45	50.79	52.30	15.60	57.13	57.83	30.74
Bijapur	124.71	49.85	48.34	45.50	55.56	25.64	117.89	65.20	41.96
Belgaum Division	**103.23**	**43.44**	**47.11**	**42.65**	**51.06**	**14.13**	**94.56**	**59.29**	**34.02**
Bellary	40.90	56.93	21.32	43.94	38.83	17.74	60.68	57.95	27.21
Bidar	15.51	44.87	41.43	33.00	37.14	15.46	59.50	52.85	35.41
Raichur	46.09	60.57	31.12	47.08	46.09	22.15	55.34	54.80	31.49
Gulbarga	48.57	66.19	47.82	49.43	65.19	25.03	73.83	85.31	41.30
Gulbarga Division	**35.46**	**35.71**	**26.17**	**43.59**	**43.76**	**15.12**	**57.21**	**53.68**	**28.17**
State Total	**34.53**	**31.46**	**27.15**	**41.66**	**43.43**	**16.47**	**55.82**	**52.32**	**27.73**

Data source: Directorate of Economics and Statistics, Bangalore.
Note: A-Area, P-Production, Y-Yield.

was reduced (16.47%) during the period II when compared to the period I. The magnitude of the instability was declined in all districts in state except Kolar and Tumkur districts were witnessed a marginally higher instability during the period II than compared to the period I. During period II, the level of instability in some districts of state in area, production and yield of sunflower was higher than compared to the period I. The results are in line with Pradeep Kumar (2015) who observed that the level of instability higher in area in Salem, Dharmapuri, Coimbatore, Periyar, Madurai, Nilgiris and Kanniyakumari districts during post reform period than compared to pre reform period.

Inter-divisional instability in area, production and yield of sunflower

Table 4 also indicated the division-wise instability of sunflower area, production and yield. The result showed that the degree of instability in area was reduced in Bangalore (39.40%) and Belgaum (42.65%) divisions during the period II when compared to period I, while in the same period instability was increased in Mysore and Gulbarga division. The level of instability was increased in sunflower production, whereas declined trend for sunflower yield in all four divisions of state during period II when compared to the period I. The results are in corroboration with the studies conducted by Pradeep Kumar (2015). The degree of instability was higher in area and production of sunflower during period II. The results are in corroboration with the studies conducted by Ramarao (2003).

CONCLUSION AND POLICY SUGGESTIONS

The study concluded that the growth pattern of sunflower showed a downward trend with respect of area, production and yield in all the four regions of the state during the period II when compared to period I. The mixed trend was observed during whole period. The decline in growth of the sunflower especially during second period of the study it might reflecting the adverse effect of modern technology on production of sunflower in Karnataka state. The study also concluded that the fluctuation in area, production and yield of sunflower were noticed during second period across the districts and divisions. Hence, the policy option here is that the research efforts should be concentrate on evolving suitable yield increasing technology like HYV, expansion of area under irrigation and large scale promotion of stabilization measures like crop insurance which can enhance the per unit production as well as stabilize the area and yield of these crops.

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