An analysis of growth and variability in area, production and yield of groundnut in Punjab

SURBHI BANSAL and LOVEPREET SINGH

Department of Economics and Sociology, Punjab Agricultural University
Ludhiana 141004 Punjab, India
Email for correspondence: surbhi.bansal1993@gmail.com

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ABSTRACT

The study was conducted to examine the trends and variability in the growth of groundnut as oilseed crop in Punjab state. For the analysis purpose, the relevant secondary data from 1975-76 to 2014-15 were examined. The study was based upon secondary time series data collected from issues of various statistical abstracts of Punjab, published by Government of India or Economic and Statistical Organisation. The compound growth rates were estimated with the help of exponential function and variability by using Cuddy-Della Vella test for the convenience of comparison over the period. Therefore it was subdivided into three periods [Period-I: 1975-1995 (pre-WTO), Period-II: 1996-2015 (post-WTO) and whole period: 1975-2015]. The study concluded that area and yield had declined but reciprocated in terms of production in the whole 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.

Keywords: Area; production; yield; groundnut; variability

INTRODUCTION

Punjab has been named as the food bowl of India and it has earned its name by its marvelous performance in production of cereals during last five decades. But this humungous increase in cereal production has turned the tables of agricultural balance in the state. Diversification scenario of the state has turned into monoculture of wheat and paddy. As response to this monoculture several crops were got affected and cropping pattern of the state changed (Singh et al 2017). India became self-sufficient in food grains with the introduction of green revolution but Punjab being an early adopter of this revolution became a victim of it. This change lead to decline in production and area of oilseeds in the state. The area under oilseeds which was about 4 per cent of the total cropped area in 1961 came down to 0.53 per cent in 2017 (Sekhon 2014) and there was about 82.27 per cent decline in area under oilseeds observed during the last five decades.

This decline in area and production of oilseeds at the national as well as at the state level became a matter of concern for the governments because gap between demand and supply of oilseeds had been expanding year by year and to cover-up this gap government was paying huge amount for import bills of the edible oils and oilseeds (Grover and Singh 2007). This gap was widened up in 2016 when demand for oilseeds was 24 million tonnes but only 9 million tonnes was met from domestic production and this excess demand was fulfilled by paying around Rs 65,000 crore constituting around 2.5 per cent of India's total import bill (Ghosal 2017). In order to improve the production of oilseed Government of India launched various policy and technology interventions in Punjab like NMOOP (National Mission on Oilseeds and Oil Palm) in 2014-15.

Growth and instability are directly linked to each other (Jainudin et al 2019). According to Chattopadhyay (2001) and Paltasingh and Goyari (2013) the relationship between growth and instability

have a direct or positive relationship where higher instability coexists with lower growth or vice versa. The broad relationship was further expanded as higher instability with higher growth, low instability with low growth, high instability with low growth and low instability with high growth. The groundnut showed a high degree of instability in production (Rama Rao and Raju 2005). Pandey et al (2005) reported that the groundnut yield instability showed a mixed response.

However the government spent huge amount annually on programmes and policies to increase the production of oilseeds and also to increase the per capita availability of vegetable oil in our country but the performance of the oilseed sector in agriculture was not impressive. It still depended on imports of oilseeds to meet domestic demand. Hence the present study was aimed at to examine growth pattern and instability in the area, production and yield of groundnut in Punjab state.

METHODOLOGY

Data period and its source: The present study was based upon secondary time series data collected from various statistical abstracts of Punjab issues, published by the Government of India or Economic and Statistical Organisation. The whole data period for the analysis (1975-76 to 2014-15) was divided into two sub-periods, Period-I (1975-76 to 1994-95) and Period-II (1995-96 to 2014-15) to assess the impact of new technological innovations evolved before and after WTO. The study was conducted in Punjab state selecting 10 districts (Bathinda, Faridkot, Firozpur, hoshiarpur, Jalandar, Kapurthala, Ludhiana, Patiala, Rupnagar and Sangrur) out of 22 districts because of the higher area, production and yield in these districts (Statistical Abstract of Punjab, 2016).

Tools used for analysis

The compound growth rate analysis: The compound growth rate (CAGR) analysis was used to analyse the growth in the area, production and yield of groundnut. The compound growth rates were computed by using the exponential function of the form:

$$Y=AB^{t}$$

After substitution of log to equation:

$$LogY= LogA + tLogB$$

where Y= Area, production, productivity of oilseeds in the year 't', A= Constant, B= Regression coefficient, t= Time in years starting from base year 1975-76

Compound growth rate= [AntilogB × 1] x 100

To test the significance of growth rate, correlation coefficients were estimated by the following formula:

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

where r= Correlation coefficient, Y= Area/production/yield, T= Time

Cuddy-Della Valle index (CDI)

In this study the instability in the area, production and yield of groundnut crop was measured in relative terms by the Cuddy-Della Valle index which was 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 Cuddy-Della Valle 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 %), R^2= Coefficient of determination from a time trend regression adjusted by the number of degrees of freedom

RESULTS and DISCUSSION

Growth performance of groundnut in Punjab state

The growth pattern in terms of area, production and yield of groundnut for district-wise and for the state as a whole pertaining to the Period- I (1975 to 1995) and II (1996 to 2015) was computed and is presented in Table 1.

The data reveal that the area under groundnut in the state exhibited a significantly negative growth rate during the Period-I (-15.88% per annum) and Period-II (-8.09% per annum). The growth rate of groundnut in the area during the Period-I exhibited a positive trend in Hoshiarpur district. It was observed that all other districts showed a significantly negative growth in the area during the Period-I. It might be due to the introduction of green revolution. The area under

Table 1. Inter-district growth rate (% per annum) of groundnut area, production and yield in Punjab state

District	Area			Production			Yield		
	Period-I (1975-95)	Period-II (1996-2015)	Whole period (1975-2015)	Period-I (1975-95)	Period-II (1996-2015)	Whole period (1975-2015)	Period-I (1975-95)	Period-II (1996-2015)	Whole period (1975-2015)
Bathinda	-7.99*	2.53	-3.55*	-12.57**	3.49	-3.44**	-1.93**	-27.73*	-9.39*
Faridkot	-4.27	-2.08	-5.61*	-7.39	-1.75	-4.57***	-0.29	-16.74***	-4.28**
Firozpur	-2.28	4.26	-1.96	-1.07	6.64	-2.05	0.15	-26.45*	-9.17*
Hoshiapur	2.03*	-4.80	-0.35	1.73	-0.41	0.977***	-0.35	4.87*	1.37*
Jalandar	-17.86*	7.20	-12.45*	-18.83***	9.91**	-11.8***	-1.42	-26.67*	-8.62
Kapurthala	-17.44*	15.57*	-11.38*	-20.54***	15.53***	-11.89***	-4.47*	-35.40*	-12.83
Ludhiana	-23.51*	-0.04	-15.21*	-23.64***	-3.35	-14.69***	-0.17	-29.04*	-8.58
Patiala	-22.98*	7.71	-14.93*	-23.37***	14.28*	-16.09***	-1.01	-23.90*	-16.17
Rupnagar	-25.15*	10.71**	-10.55*	-24.46***	13.18***	-9.76***	-0.23	-26.66*	-7.89
Sangrur	-13.54*	-3.90	-14.01*	-12.47***	-4.69	-14.14***	1.01***	-28.34*	-9.14
Punjab	-15.88*	-8.09*	-11.62*	1.86*	-4.66*	2.73*	-1.29**	-6.19*	-2.03

*, ** and ***Significant at 10, 5 and 1 per cent level of significance respectively

Source: Statistical Abstract of Punjab

oilseeds, pulses, cotton, sugarcane, maize etc was shifted to wheat-rice monoculture. In order to overcome this situation and become self-sufficient in oilseeds, government of India launched a programme to change the technology mission on oilseeds in 1986 and to make country self-sufficient in edible oilseeds by 1990s. Further in Period-II positive growth was observed in Bathinda, Firozpur, Jalanadar and Patiala whereas significantly positive growth was witnessed in Kapurthala and Rupnagar districts. The whole period analysis showed negative and significant growth of area in all major oilseed growing districts as well as in overall Punjab state.

At state level production of groundnut witnessed a significantly positive growth rate during Period-I (1.86% per annum) whereas it was -4.66 per cent per annum in Period-II and 2.73 per cent per annum in overall period. It was observed that all the districts witnessed negative growth in production except Hoshiarpur district (1.73% per annum) during Period-I. In case of Period-II, Jalandar, Kapurthala and Rupnagar had positive and significant growth performance whereas Bathinda and Firozpur showed positive trend. The results further showed that all the districts witnessed significantly negative growth in production of groundnut during the whole period but the positive growth was witnessed in Hoshiarpur (0.977% per annum) and overall Punjab state (2.73% per annum).

At state level groundnut yield witnessed a significantly negative growth rate during Period-I (-1.29% per annum) and Overall Period (-2.03% per annum) as compared to Period-II (-6.19% per annum). All the districts witnessed a significantly negative growth in groundnut yield except Sangrur and Firozpur districts during Period-I while during the Period-II all districts exhibited a significantly negative growth except Hoshiarpur district. The results are in line with the findings of Kumar (2015) who observed significantly negative as well as positive growth rate in yield of paddy during the post-reform as compared to pre-reform period. The positive trend in growth rate of area, production and yield of groundnut during Period-I across the districts could be due to government initiatives in the form of technological marketing support for oilseed growers. The declining trend in growth rate during Period-II across the districts could be due to decrease in area under cultivation which could be attributed to imports of edible oils and relatively stagnant real prices of groundnut in the market. The government price

support mechanism continuously favoured wheat and rice crops and not the oilseed crops which led to lower oilseed cultivation (Jha et al 2012).

Instability of area, production and yield of groundnut in Punjab 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. Chand and Raju (2009) opined that instability in production also affected price stability and caused consumers and low-income earners to 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 groundnut was analyzed during the study periods: Period-I (1975 to 1995), Period-II (1996 to 2015) and the Whole Period (1975 to 2015) at districts as well as at state level using Cuddy-Della instability index (CDI) which takes into account coefficient of variation and adjusted R^2.

The results given in Table 2 show that the magnitude of instability at the district level in the area of groundnut was marginally increased during Period-II (14.28%) as compared to Period-I (13.60%). The district level instability analysis revealed lower instability for area in Hoshiarpur district (16.84%) followed by Jalandar (17.99%) and Ludhiana (19.01%) districts during Period-I whereas the highest instability was witnessed in Bathinda (82.64%) followed by Faridkot (72.19) and Firozpur (61.28) during Period-I. Bathinda and Hoshiarpur witnessed a decline in instability during Period-II than Period-I. During Period-II, Ludhiana, Patiala, Sangrur, Kapurthala and Faridkot districts showed higher instability.

The results are in line with the work of Kumar (2015) who observed increased instability in the area in Salem, Dharmapuri, Coimbatore, Periyar, Madurai, Nilgiris and Kanniyakumari districts during post-reform period as compared to pre-reform period. Moreover in production, the higher instability was observed in Faridkot, Patiala and Sangrur during Period-II as compared to Period-I. As per Jainuddin et al (2019) the higher instability in groundnut production was observed in Kolar, Tumkur, Shivamogga, Mysore, Mandya, Hassan, Dharwad, Belgaum, Uttar Kannada and Bellary districts of Karnataka whereas remaining districts showed lower instability in groundnut production. In case of yield of groundnut, the higher instability was observed for the state as a whole during Period-II as compared to Period-I. During Period-II the higher yield instability was found in Jalandhar, Firozpur, Patiala, Rupngar and Sangrur districts as compared to Period-I. At the same time the remaining districts showed lower instability during the same period. The results are in line with those of Kumar (2015) who observed higher instability in production and yield of paddy in some districts of Tamil Nadu during the post-reform as compared to pre-reform period. The results of inter-period comparison of instability indicate that Period-II and Whole Period witnessed higher instability in the area, production and yield as compared to Period-I. The results are in line with the findings of Rama Rao (2003) who reported that inter-period comparison of groundnut instability was higher during Period-II as compared to Period-I.

CONCLUSION

Punjab agriculture has made considerable progress particularly in respect of food crops such as wheat and rice with the introduction of green revolution however the performance has not been so good in case of other crops particularly oilseeds, pulses and coarse cereals. Therefore after achieving self-sufficiency in food grains the government is focusing attention on improving the production of these crops. The growth trends and instability analysis of groundnut were carried out for the Period-I: 1975-1995 (pre-WTO), Period-II: 1996-2015 (post-WTO) and Overall Period: 1975-2015. In the growth pattern of groundnut a downward trend was observed in terms of area and yield whereas in case of production growth rate was positive.

CDI showed that the fluctuation in area, production and yield of groundnut was lower in Hoshiarpur district as compared to other districts. The fluctuation in area, production and yield of groundnut was found to be higher in almost all the districts and Punjab state. The results showed that growth rate and variation in area, production and yield of groundnut were higher in Period-II (post-WTO) as compared to Period-I (pre-WTO). Thus there is need that the research efforts should concentrate on evolving suitable yield increasing technologies (eg high yielding varieties) and convincing the farmers to grow these crops in irrigated conditions through extension activities which can enhance the per unit area production of these crops.

Table 2. Cuddy-Della instability index (%) of area, production and yield of groundnut

District	Period-I (1975-95)			Period-II (1996-2015)			Whole period (1975-2015)		
	A	P	Y	A	P	Y	A	P	Y
Bathinda	82.64	116.23	22.33	77.03	70.97	38.61	117.92	165.03	34.29
Faridkot	72.19	88.01	35.83	93.18	102.38	35.33	88.71	118.08	35.40
Firozpur	61.28	87.13	18.54	92.93	97.23	45.35	89.44	119.01	35.21
Hoshiapur	16.84	32.15	30.26	13.89	14.96	22.33	24.96	23.36	32.76
Jalandar	17.99	25.20	26.76	81.01	56.32	46.63	100.29	116.06	38.78
Kapurthala	26.48	30.47	22.23	92.56	98.21	41.63	102.44	110.75	39.75
Ludhiana	19.01	21.34	18.82	140.32	152.61	38.50	90.80	94.08	33.61
Patiala	25.53	29.96	22.41	107.02	143.17	69.84	101.05	122.28	45.20
Rupnagar	21.59	26.54	34.21	77.21	60.42	44.94	135.53	153.02	41.30
Sangrur	23.41	23.86	15.95	117.67	137.49	45.03	63.06	62.36	35.81
Punjab	13.60	33.96	15.47	14.28	20.05	28.02	67.68	64.46	23.87

A= Area, P= Production, Y= Yield

Source: Statistical Abstract of Punjab

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