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Growth and Instability Analysis of Cauliflower Crop in Punjab

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ABSTRACT

The present study was conducted to show the statistical investigation of growth and instability in area, production and productivity of cauliflower in Punjab. The study was based on the data collected from the secondary sources like www.indiastat.com. The results revealed that area as well as production of cauliflower in Punjab and India had increased over the last 27 years but the yield of the crop was found to be decreased over the year in Punjab while in India it had increased over the year. The instability index of productivity was very low and stable in Punjab as compared to the whole over India. This was happening due to higher amount of assured irrigation facilities available in Punjab. Proper concentration should be paid on the improvement on production as well as marketing also.

Keywords: Cauliflower, Trend, CAGR, Growth rate, Instability index

Cauliflower (*Brassica oleracea*) is one of the important cruciferous vegetable crops of India. It is widely cultivated throughout the sub-tropical parts of north India. In India, the area under cauliflower was 430.20 thousand hectares with a production of 8234.30 thousand tones (Anonymous, 2017). Cauliflower is one of the major vegetables produced in Punjab and during 2016-17 area, production and productivity of cauliflower was 14.97 thousand ha, 279.67 thousand tonnes and 18560 kg/ha respectively (Anonymous, 2017). Cauliflower is the 3rd major producing vegetable contributing 6.73 per cent in total area and 6.04 per cent in total vegetable production of Punjab.

Growing demand for vegetables induced by rising incomes and changing consumption patterns coupled with declining farm incomes due to rising costs and stagnating food grain productivity has necessitated diversification towards high-value crops in recent times. Apart from income enhancement, these high-value crops have potential to generate additional employment opportunities in farming due to their labour- intensive character (Weinberger and Lumpkin, 2006).

During the past thirty years total production of cauliflower registered many fold increase in the country which is attributed to the well targeted research on various aspects like agro techniques, crop production, marketing, processing etc. The changing consumption pattern of the people, massive increase in the management and handling techniques in the countries and the emergence of the processing industry as an important sector have also contributed to the growth of cauliflower in India.

Therefore, an attempt has been made in the present study to investigate growth and instability in area production and productivity of cauliflower, one of the important vegetables being produced in Punjab state. Cauliflower cultivation is a profitable agricultural enterprise in the vegetable segment. The specific objectives of the study are (1) to analyze the trend in area, production and productivity of cauliflower in Punjab, (2) to analyze the growth and instability in area, production and productivity of cauliflower in Punjab.

Database and Methodology

In perspective of specific objectives of the present study, the time series data from 1990-91 to 2016-17 (27 years) regarding the area, production and

productivity of cauliflower was collected from the secondary source i.e. www. Indiastat.com.

The measurement of trends and fluctuations should be of great interest for both the researchers and planners (Rao *et al*. 1980).The linear trends (per year contribution) of area, production and productivity of cauliflower were observed through fitting the linear trend equations in the form of linear regression as under

$$Y_t = a + bt$$

Where,

Y$_t$ = Area/ production/ productivity of cauliflower for the year 't'.

a = Constant

t = Time variable

b = Regression coefficient

The trends in area, production and productivity were studied through Compound Growth Rate (CGR) following Hemant Kumar and Purushottam (2009), Sonia and Sexana (2009) and Mohammad Taher and Ahmadi Shadmeri (2008).

The growth rates refer to the percentage change of a specific variable within a specific period of time, given a certain context. The compound annual growth rates (CAGR's) of area, production and productivity of cauliflower were estimated for Punjab from 1990-91 to 2015-16. The growth model used is as under:

$$Y_t = AB^t$$

Where,

Y$_t$ = Area/ production/ productivity of cauliflower for the year 't'.

t = Time variable (1, 2…... n) for each period.

A = Constant

B = Growth coefficient

Log transformation of above function is:

$$ln\ Y_t = ln\ A + t\ (ln\ B)$$

Where,

ln B = ln (1+ r), and

t = [antilog (ln B) – 1]

CAGR's (%) = [antilog (ln B) – 1] × 100

Student's t- test was used to test the significance CAGR.

Wiktor and Travis (1985) have described that growth rates are measures of past performance of economic variables which are not developed to predict the trend in a variable over time.

Generally it was seen that the simple coefficient of variation overestimated the level of instability in time series data due to the presence of long-term trend, hence, there was a need of the index to correct the coefficient of variation. Cuddy Della Valle Index was used to estimate variability in area, production and productivity of cauliflower. The variability coefficient has been computed using the following formula:

$$\text{Coefficient of Variation (CV \%)} = \frac{\text{Standard Deviation}}{\text{Mean}} \times 100$$

The value of Cuddy Della Valle Index (CV*) was calculated by using the formula as:

$$CV^* = CV \times (1–R^2)^{0.5}$$

where R^2 is the estimated R-Square (Coefficient of multiple determination) from the growth analysis.

RESULTS AND DISCUSSION

The data on area, production and productivity in Punjab and India has been presented in Table- 1. The CAGR with respect to these variables are given in Table 2. The area under cauliflower in Punjab has increased significantly from 2.10 thousand ha in 1990-91 to 3.87 thousand ha in 1998-99 then it declined to 2.75 thousand ha in 1999-2000 and after that it had consistently increased to 14.97 thousand ha in 2016-17. During the overall study period, CAGR of area under cauliflower in the state was estimated at 8.49 per cent. During the same time period in India the area under cauliflower had increased from 201.34 thousand ha to 430.20 thousand ha. Share of Punjab in total area of cauliflower in India had increased from 1.04 per cent in 1990-91 to 3.48 per cent in 2016-17.

The data revealed that productivity of cauliflower in Punjab had decreased with CAGR of 1.25 per cent from 24033 kg/ha in 1990-91 to 18560 kg/ha in 2016-17. The rapid changes in the climatic conditions i.e. the mean annual rise in temperature might be the reason for this. In addition, continuous repetition of same crop in the field year after year in some districts was also a reason for such decrease in

Table 1: Area, production and productivity of cauliflower in Punjab and India, 1990-91 to 2016-17

Year	Area(000 ha)			Production (000 tonnes)			Productivity (kg/ha)	
	Punjab	India	% share of Punjab	Punjab	India	% share of Punjab	Punjab	India
1990-91	2.10	201.34	1.04	50.47	2987.65	1.69	24033	14839
1991-92	2.09	202.80	1.03	50.45	2998.10	1.68	24139	14784
1992-93	2.12	230.70	0.92	51.00	3612.20	1.41	24057	15658
1993-94	2.15	188.50	1.14	51.73	2872.90	1.80	24060	15241
1994-95	2.16	216.10	1.00	51.97	3244.10	1.60	24060	15012
1995-96	2.31	220.00	1.05	56.87	2474.00	2.30	24619	11245
1996-97	2.89	233.90	1.24	71.33	3419.00	2.09	24682	14617
1997-98	3.54	248.20	1.43	84.98	4471.00	1.90	24006	18014
1998-99	3.87	255.40	1.52	95.33	4690.60	2.03	24633	18366
1999-00	2.75	248.30	1.11	66.46	4717.80	1.41	24167	19000
2000-01	3.24	256.30	1.26	78.04	4695.80	1.66	24086	18321
2001-02	3.66	269.90	1.36	84.95	4890.50	1.74	23210	18120
2002-03	4.66	254.60	1.83	107.08	4444.10	2.41	22979	17455
2003-04	5.20	267.90	1.94	121.90	4940.20	2.47	23442	18440
2004-05	5.50	238.50	2.31	128.10	4514.80	2.84	23291	18930
2005-06	5.60	288.60	1.94	131.40	5323.10	2.47	23464	18445
2006-07	6.00	302.00	1.99	138.30	5538.00	2.50	23050	18338
2007-08	6.44	312.00	2.06	148.10	5777.00	2.56	22997	18516
2008-09	7.90	349.00	2.26	181.70	6532.00	2.78	23000	18716
2009-10	8.05	347.90	2.31	191.20	6569.00	2.91	23752	18882
2010-11	8.65	369.00	2.34	154.65	6745.00	2.29	17879	18279
2011-12	8.86	390.80	2.27	158.50	7348.90	2.16	17889	18805
2012-13	10.10	402.20	2.51	180.70	7886.70	2.29	17891	19609
2013-14	12.20	433.90	2.81	219.20	8573.30	2.56	17967	19759
2014-15	13.82	411.00	3.36	248.50	7926.00	3.14	17981	19285
2015-16	14.85	426.00	3.49	273.51	8199.00	3.34	18418	19246
2016-17	14.97	430.20	3.48	279.67	8234.30	3.39	18560	19785

Table 2: Compound annual growth rate of area, production and productivity of cauliflower in Punjab and India, 1990-91 to 2016-17

Year	Area		Production		Productivity	
	Punjab	India	Punjab	India	Punjab	India
1990-2000	6.41***	27.28**	6.59***	30.16**	0.17*	2.19**
2000-2010	9.94***	3.78***	9.79***	4.25***	-0.14	0.46**
2010-17	12.83***	2.74***	13.37***	3.74**	0.49**	0.94**
1990-2017	8.49***	6.74***	7.13***	8.07***	-1.25	1.24**

*** , ** and * significant at 1, 5 and 10 per cent level of significance.

productivity. In India the productivity of cauliflower had increased with significant with CAGR of 1.24 per cent from 14839 kg/ha in 1990-91 to 19785 kg/ha in 2016-17.

The data presented in the Table 1 portrayed that the production of cauliflower in Punjab had increased with CAGR of 7.13 per cent from 50.47 thousand tonnes in 1990-91to 279.67 thousand tonnes in 2016-17. During the same time period in India the production of cauliflower had increased with CAGR of 8.07 per cent from 2987.65 thousand tonnes to 8234.00 thousand tonnes. Share of Punjab in total

Table 3: Variability of area, production and productivity of cauliflower in Punjab and India 1990-91 to 2016-17

Year	Area		Production		Productivity	
	Punjab	India	Punjab	India	Punjab	India
1990-2000	7.83	63.78	5.41	63.34	1.86	24.83
2000-2010	13.88	4.96	13.97	12.92	1.46	10.41
2010-17	8.48	3.22	12.21	4.33	7.36	1.71
1990-2017	32.47	19.27	23.12	15.93	6.77	16.60

production of cauliflower in India had increased from 1.69 per cent in 1990-91 to 3.39 per cent in 2016-17.

The results of analysis of variability of area, production and productivity are presented in Table 2. In Punjab, variability in area and production of cauliflower was the highest in 2000s with the values 13.88 and 13.97 per cent respectively. In case of cauliflower productivity the incidence of variability was the highest (7.36%) in 2010s. The lowest variability index of area, production and productivity in state was found in 1990s at 7.83, 5.41 and 1.86 per cent respectively. The overall variability in area, production and productivity of cauliflower in Punjab was 32.47, 23.12 and 6.77 per cent respectively.

In India the variability in area, production and productivity was the highest in 1990s with the indices of 63.78, 63.34 and 24.83 per cent respectively. The lowest variability in area, production and productivity of cauliflower was observed during 2010s. The overall variability in area, production and productivity of cauliflower in India was 19.27, 15.93 and 16.60 per cent respectively.

The results indicated that the overall variability in area and production of cauliflower in Punjab was higher than the variability indices in India but the instability index of productivity of cauliflower in Punjab was seen lower than productivity instability index in India. Assured irrigation facilities being available in Punjab might be the reason for the lower productivity instability index of Punjab. In both cases the variability in cauliflower production was mainly due to the variability in area.

CONCLUSION

The present study has analyzed the growth and instability of area, production and productivity of cauliflower. The results concluded that area as well as production of cauliflower in Punjab and

India had increased over the last 27 years but the yield of the crop was found to be decreased over the year in Punjab while in India it had increased over the year. The instability index of productivity of cauliflower in Punjab was seen lower than productivity instability index in India. Adoption of improved technology and higher amount of assured irrigation facilities available in Punjab was the reason for this. Cauliflower is shown to have gradual decrement in yield over the period of time. The reason behind the decrement was rapid changes in the climatic conditions i.e. the mean annual rise in temperature. In addition, continuous repetition of same crop in the field year after year in some districts was also a reason for such decrease in productivity. Hence the cauliflower grower in Punjab should concentrate on the improvement on productivity as well as marketing also. There should be creation and strengthening of proper cropping pattern and suitable infrastructure for avoiding the risks attached with the crop safety. If this could happen then in Punjab also the yield could increase by many folds.

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