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Research paper

Performance of chickpea in Maharashtra: an analysis of growth and instability

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ABSTRACT

Chickpea is one of the major pulses cultivated and consumed worldwide. Region wise performance of chickpea was judged based on two important parameters i.e., growth and instability, in Maharashtra state. Compound growth rates was estimated by fitting non-linear model to the area, production and productivity data for the period from 1960-61 to 2019-20. Instability was assessed by employing Cuddy-Della Valle instability index. The results showed that the production of chickpea increased in the state during the entire study period. Growth in area was the main reason for significant growth in production up to 1990, but thereafter, increase in chickpea production was due to area expansion coupled with improvement in the yield. As against expansion in area and production, rise in yield level of chickpea was slower in the state. High growth in area and production of chickpea was associated with high level of instability. Area variability in chickpea was more as compared to yield variability at overall level. Therefore, attempt should be made to stabilize the yield level in chickpea.

***Key words*:** Chickpea, Cuddy-Della Valle Index, Compound growth rate, Growth, Instability index

INTRODUCTION

India is the largest producer, importer and consumer of pulses in the world which nearly accounts for 30% of the global pulses production. The production of pulses in India has remarkably increased to 26.96 mt during 2021-22. Chickpea is most important pulse crop of India contributing about 30% of total pulses acreage and about 48% of total pulses production of the nation. Chickpea is widely consumed in the country as it is the most affordable source of nutritional protein for vegetarians (Kaur and Prasad, 2021). Demand for chickpea is increasing globally due to changing lifestyles, increasing household incomes and changing consumer tastes and preferences for products with high protein content. Chickpea is gaining popularity in the form of ready-to-eat meals, salads and snacks. Thus, it is expected to fuel the demand growth over the period of time.

The area and production under chickpea cultivation in the country has witnessed significant increase over recent years due to the policy and research supports. The chickpea production rose to 11.9 mt with an area of 10.9 m ha in India during 2021-22. Chickpea is grown in various states *viz*; Madhya Pradesh, Rajasthan, Maharashtra, Uttar Pradesh, Andhra Pradesh, Karnataka and Gujarat. A good price in the market and conductive soil moisture in Maharashtra state led to 3.10 mt production from an area of 2.70 m ha with productivity of 1145 kg ha^{-1} during 2021-22.

Analyzing the performance of chickpea at state level, in terms of growth will helps us to suggest research strategies for research, policy measures and plans to ensure availability and sustain production. However, estimates on variability help us to know the extent of instability and risk in the production process. In addition to this, performance of crop sector is needed to study to find out whether the growth or variation in output is due to area expansion or yield improvement.

The growth and instability pattern of agricultural sector is mostly studied at the national and state level by previous researchers but there are wide regional variations, in terms of resource endowments and climatic conditions within the state (Sonawane, 2022). Thus, present study aimed to analyze the region wise performance of chickpea in Maharashtra state. The regional study is necessary for understanding the pattern of agricultural growth and instability at more disaggregated level in the state. Analyzing performance of chickpea in terms of growth helps us to suggest research strategies for crop improvement, undertake policy measures

and develop plans to ensure availability and sustain production. However, estimates on variability help us to know the extent of instability and risk in the production process.

MATERIALS AND METHODS

The present study is based on secondary data collected from various issues of Statistical Abstracts of Maharashtra State published by Directorate of Economics and Statistics (DES), Maharashtra. Data was collected for the period of 1960-1961 to 2019-2020 i.e., sixty years which was categorized into two sub-periods as following;

Period I (Pre -liberalization period): 1960-61 to 1989-90

Period II (Post-liberalization period): 1990-91 to 2019-20

The growth performance of chickpea was estimated with the help of exponential model (compund growth rates) assuming additive error terms:

Y_t = constant *$(1+CGR)^t$ +e_t

Where,

Y_t is the time series data for area / production / yield for year t,

t is the time trends for years of interest,

e_t is the error term and

CGR is the compound growth rate for the period under consideration.

The data were smoothened with the help of three-year central moving average techniques to remove bias from the data induced by the outliers (Sawant, 1983).

Instability

Growth is mostly accompanied with instability in crop production. It is very important to estimate the magnitude of instability to identify the risk in the production process. Instability in area, production and productivty of the chickpea was studied by estimating Cuddy Della Valle Index. It is a modification of the coefficient of variation and found superior over other methods (Cuddy and Valle, 1978). It is calculated with the given formula:

$$I_x = CV\sqrt{(1 - \overline{R}^2)}$$

Where,

Coefficient of Variation (CV)= SD/Mean*100

$$\text{Standard Deviation (SD)} = \sqrt{\frac{(x_i - x)^2}{n}}$$

$\overline{R}^2$ = Adjusted coefficient of multiple determination

Whereever trend in the time series data was non-significant, instability of that particular series was analysed with the help of conventional statistical tool of instability i.e., coefficient of variation.

The growth and instability in area, production and productivty of the chickpea was estimated by using Statistical Analysis System (SAS) software.

RESULTS AND DISCUSSION

Region wise performance of chickpea was judged based on two important parameters i.e. growth and instability in Maharashtra state.

Growth performance

The compound growth rates (CGR) of area, production and yield of chickpea were estimated at region as well as for Maharashtra state. The compound growth rates were estimated for three time periods; Period I (1960-61 to 1989-90), Period II (1990-91 to 2019-20) and overall period (2019-2020). The mean values and CGR of area, production and yield of chickpea are represented in table 1.

Table 1. Growth rates of area, production and productivity of chickpea in Maharashtra state (per cent)

Chick-pea		Konkan			Western Maharashtra			Marathwada			Vidarbha			Maharashtra		
		Peri-od I	Period II	Over-all	Peri-od I	Period II	Over-all	Peri-od I	Period II	Over-all	Peri-od I	Period II	Over-all	Peri-od I	Period II	Over-all
Mean	A	2.09	5.14	3.61	131.21	356.23	243.72	175.59	367.84	271.72	83.12	363.92	223.52	392.01	1093.13	742.57
	P	0.72	3.56	2.14	59.98	272.53	166.26	57.29	259.79	158.54	30.16	290.05	160.11	148.16	825.94	487.05
	Y	333.20	705.32	519.26	434.09	732.96	583.53	321.54	629.72	475.63	348.21	719.92	534.06	364.9	698.3	531.6
CGR	A	2.13**	-1.07**	1.83**	2.36**	3.09**	3.27**	0.26**	5.79**	3.50**	2.47**	5.44**	5.32**	1.35**	4.74**	3.98**
	P	4.42**	0.31^{NS}	3.12**	4.42**	5.07**	5.16**	1.21**	8.97**	7.95**	3.73**	7.57**	7.70**	2.86**	7.13**	6.80**
	Y	1.69**	1.82**	2.33**	1.15**	1.36**	1.64**	0.89**	2.37**	2.24**	0.49*	2.23**	2.32**	1.01**	1.91**	2.07**

Note: Period I: 1960-61 to 1989-90, Period II: 1990-91 to 2019-20, Overall period: 1960-61 to 2019-20; Area in '000'ha, production in '000' tonns and productivity in kg ha^{-1}; * Significant at 5% and ** significant at 1%

The results showed that chickpea crop have shown sharp increase in area, production and yield in Maharashtra. An area under chickpea was increased to 742.57 thousand hectares @ 3.98 per cent per annum in overall period. The area of chickpea was increased @ 1.35 and 4.74 per cent per annum in two sub-periods. It was noticed that, area expansion was more in second period compared to first period. The production of chickpea has shown positive trend in two sub-periods and overall period. The estimates of compound growth rate (CGR) in production of chickpea were 2.86, 7.13 and 6.80 per cent per annum, respectively. The high level of positive and highly significant trend was observed in second period and overall period as the magnitude of CGR was more than 3 per cent.

It was observed that growth in area (1.35%) to be the main driver of growth in chickpea production during first sub-period. However, area expansion (4.74%) along with yield improvement of chickpea (1.91%) was responsible for increased level of chickpea production in the state during second sub-period. Positive trend in area (3.98%) and yield (2.07%) during overall period leads to positive and highly significant trend (p=0.01) in production of chickpea at state level.

Yield was increased @ 1.01 and 1.91% per annum in first and second sub-period at state level. As against expansion in area and production, rise in yield level of chickpea was slower and it was increased from 364.90 to 698.30 kg/ha. Thus, area, production and yield of chickpea were positive and highly significant (p=0.05) at state level. The enhanced growth in production of pulses after 1990s was observed in the state due to government's initiatives such as National Pulse Development Programme, Technology Mission on Oilseeds and Pilot Project on Oilseeds and Pulses crops as reported by More *et al*. (2018).

Across regions, high growth in area expansion of chickpea was observed in Vidarbha region. The annual CGR in area of chickpea was 2.47, 5.44 and 5.32 per cent per annum during two sub-periods and overall period, respectively. This showed that, maximum growth in area of chickpea has been occurred during second period. Yield of chickpea has shown positive and significant trend in all 3 periods of study but maximum growth was observed during second period. The CGR of yield during two sub-periods and overall period was 0.49, 2.23 and 2.32 per cent, respectively. The positive growth in area and yield during second period leads to highly significant growth in production of chickpea i.e., 7.57% per annum. Positive and significant trend in production of chickpea was also seen in overall period. During this period, CGR of production was highest (7.70%). Thus, area, production and yield of chickpea revealed highly significant growth (p=0.01) during overall period in Vidarbha region.

Marathwada region was next to reveal area expansion in chickpea crop. In this region, extent of CGR in area of chickpea was 0.26, 5.79 and 3.50 per cent in two sub-periods and overall period, respectively. The area expansion was high during second period compared to first sub-period. The production of chickpea was increased significantly from 57.29 thousand tonnes to 259.79 thousand tonnes @ 1.21 and 8.97 per cent per annum from first to second period. Thus, overall the annual production of chickpea was increased by 7.9%. Thus, highly positive and significant growth (p=0.01) in the area, production and yield of chickpea was noticed during overall period in Marathwada region. The degree of CGR in yield of chickpea was high (2.37%) in second period which revealed that yield improvement was predominantly occurred during second sub-period. Chickpea has registered significant growth in yield by 2.24 per cent in overall period. Dhokar *et al*. (2018) reported that growth in area, production and productivity of chickpea was positive and significant in Marathwada region due to consistent improvement in the yield of pulses.

In case of Western Maharashtra, the production of chickpea has shown significantly positive trend in two sub-periods and overall period (p=0.01). The estimates of compound growth rate (CGR) in production of chickpea were 4.42, 5.07 and 5.16 per cent per annum, respectively. The high level of growth was observed in entire study period as the magnitude of CGR was more than 3%. In overall period, growth in area (3.27%) and improvement in yield of chickpea (1.64%), both factors resulted in enhanced level of chickpea production. Yield of chickpea enhanced over the years as extent of CGR was positive and significantly increased from 434.09 kg/ha to 732.96 kg/ha by 1.15 and 1.36 per cent per annum in both sub-periods. Thus, maximum growth in area, production and yield of chickpea observed during second period.

In Konkan region, the maximum area expansion and high production growth of chickpea was observed in first sub-period. The area expansion by 2.13% and improvement in yield by 1.69% showed significant increase in chickpea production by 4.42%

Table 2. Instability in area, production and productivity of chickpea in Maharashtra state (per cent)

Chickpea		Konkan			Western Maharashtra			Marathwada			Vidarbha			Maharashtra		
		Period I	Period II	Overall	Period I	Period II	Overall	Period I	Period II	Overall	Period I	Period II	Overall	Period I	Period II	Overall
Mean	A	2.09	5.14	3.61	131.21	356.23	243.72	175.59	367.84	271.72	83.12	363.92	223.52	392.01	1093.13	742.57
	P	0.72	3.56	2.14	59.98	272.53	166.26	57.29	259.79	158.54	30.16	290.05	160.11	148.16	825.94	487.05
	Y	333.20	705.32	519.26	434.09	732.96	583.53	321.54	629.72	475.63	348.21	719.92	534.06	364.9	698.3	531.6
Instability	A	29.55	19.72	37.02	23.32	18.50	24.53	12.06	26.80	40.50	23.98	20.24	40.72	15.83	18.01	31.83
	P	42.47	26.51	44.48	45.32	33.28	47.06	29.13	52.23	80.59	50.70	34.88	70.30	37.70	35.76	61.37
	Y	27.36	17.21	21.59	19.82	14.88	16.92	23.62	24.20	27.14	19.97	19.89	24.02	20.44	16.86	19.83

Note: Period I: 1960-61 to 1989-90, Period II: 1990-91 to 2019-20, Overall period: 1960-61 to 2019-20
Area in '000'ha, production in '000' tonns and productivity in kg/ha.

during first period. The production of chickpea was not significantly changed during second period even though yield level was improved in this region. Area under chickpea showed negative growth (p=0.01) during second period. However, Konkan region showed positive and significant trend in area, production and yield of chickpea at overall period due to significant performance in first period.

Thus, encouraging performance of chickpea production was revealed due to area expansion and productivity improvement in all regions and state as a whole during entire study period.

Instability analysis

The pattern of instability in crop production across different regions was examined and reported in Table 2. A significant growth in chickpea production was accompanied with instability as the state registered high degree of variation in production (61.37%) during overall level. The magnitude of area and yield instability was 31.83 and 19.83 per cent during same period. It connotes that area variability in chickpea was more as compared to yield variability at overall level. However, the production and yield variability was higher (37.70 and 20.44 per cent) in first period and it was declined (35.76 and 16.86 per cent) in second period. The similar findings were reported by Salunkhe *et al*. (2021) that production and yield instability of chickpea was higher in Maharashtra state.

In Marathawada region, due to increased variation in chickpea area from 12.06 to 26.80 per cent and yield variability from 23.62 to 24.20 per cent, the magnitude of production variability showed steep rise from 29.13 to 52.23 per cent during consecutive study periods. Instability in production and yield of chickpea in Vidarbha region was reduced from 50.70 and 19.97 per cent in first period to 34.88 and 19.89 per cent in second period, whereas the variability in area of chickpea was slightly reduced from 23.98 per cent to 20.24 per cent during same period. At overall level, the production instability was too high (70.30%) indicated the unstable nature of chickpea production. Similar results were reported by Gajbhiye *et al*. (2010) in which researcher stated that production of chickpea was highly unstable compared to area in Vidarbha region. Western Maharashtra region revealed decrease in magnitude of instability in chickpea area (23.32 per cent to 18.50 per cent), production (45.32 per cent to 33.28 per cent) and productivity (19.82 per cent to 14.88 per cent) during sub-sequent periods, which is good sign. Still, the region recorded moderate instability in chickpea area and yield of chickpea i.e. 24.53 and 16.92 per cent and high instability in production (47.06 per cent) at overall level. In a similar way, Konkan region also registered declining trend in magnitude of instability in chickpea area (29.55 per cent to 19.72 per cent), production (42.47 per cent to 26.51 per cent) and productivity (27.36 per cent to 17.21 per cent) during both the sub-periods of study.

To sum up, area instability of chickpea was increased while yield instability was decreased at state level. All regions showed declined variations in chickpea production except Marathwada region in which tremendous growth in production was accompanied with high instability.

CONCLUSION

The significant area expansion and the yield improvement due to adoption of high yielding varieties have led to enhanced production of chickpea in Maharashtra state. However, a significant growth in chickpea production was accompanied with moderate level of instability. The varying performance of chickpea at regional and state level has indicated that there is the need for evolving specific strategies for ensuring sustainable and inclusive agricultural growth as well as to stabilize

the yield level in chickpea in Maharashtra state. To mitigate the consequences of persisting instability, large-scale promotion of stabilization measures like insurance should be pursued vigorously in the state. In addition to this, expansion of production to meet expanding demand is expected to continue**.**

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