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Trends in area, production and productivity of Wheat in India with special reference to Karnataka

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Abstract

The present study was conducted to analyze the growth in area, production and productivity of wheat crop in India and Karnataka. The study was based on purely secondary data related to area, production and productivity of wheat crop, collected from various public sources especially; INDIASTAT website and Karnataka State Department of Agriculture for a period of 20 years, which was divided into two periods (10 years each); Period-I (2001-02 to 2010-11) and period-II (2011-12 to 2020-21). The Compound Annual Growth Rate (CAGR) technique was employed to evaluate trends in area, production and productivity. The results obtained from analysis indicated that, the CAGR for area, production and productivity of wheat crop in India during period-I was reported to be 1.34 percent, 2.55 percent and 1.20 percent, respectively and during period-II the corresponding figures were 0.20 percent, 1.74 percent and 1.55 percent. The growth rates were positively significant in both the periods. The study concluded with positive trend in all cases.

Keywords: Area, compound annual growth rate, production, trends, wheat crop

Introduction

World population, particularly the population of developing countries is increasing at an alarming rate. To feed the ever-increasing population remains a challenging task to the planners of developing countries and also the world bodies. Agriculture plays a vital role in the Indian economy. Indian agricultural sector has undergone enormous transformation over the years from a state of severe food crisis to self-sufficiency in food grains production. Cereals are a rich source of vitamins, minerals, carbohydrates, fats, oils and protein. When refined by the removal of the bran and germ, the remaining endosperm is mostly carbohydrate. In some developing nations, grain in the form of rice, wheat, millet or maize constitutes a majority of daily sustenance. Wheat is a cereal grain that belongs to the grass family of the genus 'Triticum'. The origin of the durum wheat's was probably in the region of Abyssinia, whereas the whole group of soft wheat, which includes the bread wheat's, probably originated in the region of Pakistan, South Western and the Southern parts of mountainous Bokhara. It is cultivated mainly in the temperate and sub temperate regions of the world. Although a number of species of wheat are recognized in the world, only three species of wheat namely; *Triticum aestivum* (Bread wheat), *T. durum* (Macaroni wheat) and *T. dicoccum* (Emmer wheat) are commercially cultivated in India. Wheat is globally the leading source of carbohydrate in human food, with content of about 71 percent, apart from this, it also contains 13 percent proteins which is very high as considered to cereals and hence is also a major source of proteins around the world.

The health benefits of wheat greatly depend upon the form in which it is consumed. While whole wheat is extremely nutritious, the benefits of wheat are reduced if it is eaten as white flour which is obtained by processing after only 90 percent extraction from the grain in Indian condition. Various studies and researches show that wheat and wheat flour play an increasingly important role in the management of India's food economy. Being the second largest in population, it is also the second largest in wheat consumption after China, with a huge and growing wheat demand. Uttar Pradesh is the largest producer of wheat contributing for about 32 percent. Madhya Pradesh accounting for about 18 percent followed by Punjab for about 16 percent, Haryana for about 11 percent and Rajasthan for about 10 percent of the total wheat output in the country.

Karnataka stands twelfth position in overall wheat sowing area in India. Belagavi and Vijayapura were the leading districts in Karnataka with respect to both area and production of wheat. The total area of wheat in Belagavi and Vijayapura district was 49,886 hectares and 28,460 hectares respectively which accounted for nearly 32 percent and 18 percent, respectively. The total production of wheat in Belagavi and Vijayapura district was 69,239 tonnes and 21,305 tonnes which accounted for nearly 39 percent and 12 percent of wheat producing in Karnataka respectively, during 2020-21. Dharwad, Bagalkot, Gulburga, Gadag and Bidar were the other major wheat growing districts of Karnataka. With this backdrop, the present paper highlighted the trends in area, production and productivity of wheat crop in India and Karnataka.

Objective of the study

- To analyze the growth and instability in area, production and productivity of wheat in Karnataka and India.

Methodology

The secondary data pertaining to the study area was collected from INDIASTAT website and various published and unpublished reports from Department of Agriculture, Karnataka. The twenty years data is divided into two time periods (10 years each); Period-I (2001-2010) and period-II (2011-2020) to compare trends between two periods in India and Karnataka.

Compound Annual Growth Rate Analysis

For computing compound annual growth rates of wheat area, production and productivity in India and Karnataka, the exponential function of the following form was used.

$$Y_t = a b^t U_t \text{-----} (1)$$

Where,

Y = Dependent variable (area or production or productivity) in the year 't'

a = Intercept term indicating Y in the base period (t=0)

b = Regression coefficient

t = Time period

U^t = error term

The equation (1) was transformed into log linear form and written as;

$$\log Y = \log a + t \log b + U_t \text{-----} (2)$$

Equation (2) was estimated by using Ordinary Least Squares (OLS) technique.

Compound growth rate (g) was then computed

$$g = (b - 1) \times 100 \text{-----} (3)$$

Where,

g = Compound growth rate in percent per annum

b = Antilog of log b

The standard error of the growth rate was estimated and tested for its significance with 't' test statistic.

Instability analysis

In order to study stability of wheat crop with respect to area,

production and productivity instability techniques were employed.

Co-efficient of Variation (C.V.)

The co-efficient of variation was estimated using the expression given below.

$$C.V = \frac{\text{Standard Deviation}}{\text{Mean}} \times 100$$

Linear trend was fitted to the original data of production for the period of 20 years from 2001-02 to 2020-21. The trend coefficients were tested for their significance. Whenever, the trend of series found to be significant; the variation around the trend rather than the variation around mean was used as an index of instability.

Cuddy Della Valle Instability Index

The instability in area, production and yield of wheat crop were measured by using Cuddy-Della Valle Index. This method is being used by number of researchers as a measure of variability in time series data. CDI corrects the deficiencies of CV method. The districts were classified as low (< 15%), medium (15 to 20%) and high instability (> 20%) based on CDI values. CDI is expressed as follows

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

Where,

CV = Coefficient of variation (in percent)

Adj R² = Coefficient of determination from a time trend regression adjusted by the number of degrees of freedom

Results and Discussion

Trends in area, production and productivity of wheat crop in India during period-I and period-II

Growth rate of area, production and productivity of wheat crop in India during the period-I (2001- 2010) and period-II (2011-2020) is represented in the Table-1. The sowing area of wheat in India has been increased from 26,345 thousand hectares in 2001-02 to 29,069 thousand hectares in 2010-11 with an average of 27,231 thousand hectares. The production of wheat during the study period-I (2001- 2010) was increased from 72,766 thousand MT to 86,874 thousand MT with an average annual production of 75074.40 thousand MT. The productivity of wheat during the study period-I (2001-2010) was increased from 2,762 kg per hectare to 2,989 kg per hectare with an average annual productivity of 2,752 kg per hectare.

It is evident from the Table 1 that, the area, production and productivity of wheat crop showed significantly positive growth rate of 1.34 percent, 2.55 percent and 1.20 percent, respectively in the period-I (2001- 2010) and during period-II (2011-2020), production and productivity of wheat crop also showed significantly positive growth rate of 1.74 percent and 1.55 percent respectively concerned to India. During period-II, compound annual growth rate (CAGR) of area was found to be positively 0.20 percent which was found insignificant. The CAGR in area and production of wheat crop in India was recorded higher during period-I against period-II. The CAGR in productivity of wheat was higher in period-II as compared to period-I. It was mainly due to introduction of high yielding varieties during that period. It was observed that during

period- I, area and production showed rapid growth but which was slow down during period-II. The overall growth rate in area, production and productivity of wheat crop in India, showed increasing trend over the time period 2001-02 and 2020-21 which were positively significant. This area expansion might be due to the sharp rise in minimum support price and government's procurement during the study period. The major source of this increase in production was mainly attributed to increase in productivity followed by marginal expansion in area. This rise in productivity was due to adoption of high yielding varieties coupled with other inputs. The Cuddy- Della Valle index to measure the degree of variation around the trend. The instability indices for area, production, productivity for wheat crop in India of the period-I were 1.76, 4.34 and 3.08 respectively. During period-II, the instability indices for area, production, productivity were 2.22, 2.65 and 3.20 respectively. It indicates less fluctuation during overall study period.

Trends in area, production and productivity of wheat crop in Karnataka during period-I and period-II

Trends in area, production and productivity of wheat crop in Karnataka during the period-I (2001-2010) and period-II (2011-2020) is illustrated in the Table-2. The area of wheat in Karnataka has been decreased from 260 thousand hectares in 2001-02 to 253 thousand hectares in 2010-11 with an average

of 258 thousand hectares. The production of wheat during the study period-I (2001- 2010) was increased from 199 thousand MT to 299 thousand MT with an average annual production of 219 thousand MT. The productivity of wheat during the study period-I (2001- 2010) was increased from 761 kg per hectare to 1,134 kg per hectare with an average annual productivity of 851 kg per hectare. It is evident from the Table 1 that, the area, production and productivity of wheat crop showed significantly positive growth rate of 1.15 percent, 8.56 percent and 6.65 percent, respectively in the period-I (2001- 2010) and during period-II (2011-2020), area and production of wheat crop also showed significantly negative growth rate of 4.57 percent and 4.15 percent respectively concerned to Karnataka. During period-II, compound annual growth rate (CAGR) of productivity was found to be positively 3.08 percent which was found significant. The CAGR in area and production of wheat crop in Karnataka was recorded positive growth rate during period-I whereas period-II showed negative growth rate. It was due to replacement of wheat cultivated area by other commercial crops like sugarcane and other crops such as vegetables and horticultural crops. Farmers believed that they can able to get higher returns as compare to wheat crop in the study area. The CAGR in productivity of wheat was higher in period-I as compared to period-II. It was mainly due to introduction of high yielding varieties during that period.

Table 1: Trends in area, production and productivity of wheat crop in India during period-I and period-II

Period I				Period II			
Year	Area (₹ 000 ha)	Production (₹ 000 Tonnes)	Productivity (Kg./Ha)	Year	Area (₹ 000 ha)	Production (₹ 000 Tonnes)	Productivity (Kg./Ha)
2001-02	26345	72766	2762	2011-12	29865	94882	3177
2002-03	25196	65096	2584	2012-13	29995	93506	3117
2003-04	26595	72156	2713	2013-14	30471	95850	3145
2004-05	26383	68637	2602	2014-15	31466	96527	3067
2005-06	26484	69355	2619	2015-16	30417	92288	3034
2006-07	27995	75807	2708	2016-17	30790	98510	3200
2007-08	28039	78570	2802	2017-18	29681	9870	3368
2008-09	27752	80679	2907	2018-19	29319	103596	3533
2009-10	28457	80804	2839	2019-20	31377	107861	3440
2010-11	29069	86874	2989	2020-21	31125	109586	3521
Mean	27231.50	75074.40	2752.50	Mean	30450.60	99247.60	3260.20
SD	1140.05	6354.46	127.36	SD	698.86	5659.67	178.66
CAGR	1.34**	2.55**	1.20*	CAGR	0.20	1.74*	1.54*
CV	4.18	8.46	4.62	CV	2.29	5.70	5.48
R2	0.82	0.73	0.56	R2	0.06	0.78	0.65
CDVI	1.76	4.34	3.08	CDVI	2.22	2.65	3.20

Source: INDIASTAT website

**significant at 1 percent level of significance

*significant at 5 percent level of significance

@significant at 10 percent level of significance

Table 2: Trends in area, production and productivity of wheat crop in Karnataka during period-I and period-II

Period I				Period II			
Year	Area (₹ 000 ha)	Production (₹ 000 Tonnes)	Productivity (Kg./Ha)	Year	Area (₹ 000 ha)	Production (₹ 000 Tonnes)	Productivity (Kg./Ha)
2001-02	260	199	761	2011-12	255	217	851
2002-03	247	148	572	2012-13	225	193	858
2003-04	232	96	516	2013-14	223	221	991
2004-05	242	206	882	2014-15	209	260	1244
2005-06	253	226	881	2015-16	197	158	802
2006-07	269	224	811	2016-17	179	184	1028
2007-08	276	280	1019	2017-18	198	236	1192
2008-09	269	257	1013	2018-19	193	180	933
2009-10	283	264	919	2019-20	170	197	1159

2010-11	253	299	1134	2020-21	150	181	1198
Mean	258.40	219.92	850.93	Mean	199.90	202.70	1025.60
SD	15.22	58.64	184.56	SD	28.57	28.97	155.32
CAGR	1.15 [@]	8.56 [*]	6.65 ^{**}	CAGR	-4.57 ^{**}	-4.15 [@]	3.08 [@]
CV	0.31	0.53	0.60	CV	0.87	0.34	0.32
R2	5.89	26.66	21.69	R2	14.29	14.29	15.14
CDVI	4.89	18.26	13.69	CDVI	5.24	11.62	12.46

Source: INDIASTAT website

**significant at 1 percent level of significance

*significant at 5 percent level of significance

@significant at 10 percent level of significance

The Cuddy-Della Valle index to measure the degree of variation around the trend. The instability indices for area, production, productivity for wheat crop in India of the period-I were 4.89, 18.26 and 13.69 respectively. During period-II, the instability indices for area, production, productivity were 5.24, 11.62 and 12.46 respectively. It indicates less fluctuation during overall study period.

Conclusions

This study has analyzed the trend in area, production and productivity of wheat in India and Karnataka with the instability by Cuddy Della Valle index during the period-I (2001-2010) and period-II (2011-2020). The growth rate of area, production, productivity of wheat crop in India showed positive trend in throughout period whereas the growth rate of area, production of wheat crop in Karnataka were showed negative trend during period-II (2011-2020). It was mainly due to farmers were shifting from cereals to commercial and horticultural crops. But growth rate of productivity in Karnataka were positive trend during both the periods. The instability indices for area, production and productivity for wheat crop in India and Karnataka were positive which indicates less risk in growing wheat in future.

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