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Korem Sunitha
Department of Agricultural Statitics, Applied Mathamatics and Computer Science, College of Agriculture, University of Agricultural Science, Bangalore, Karnataka, India

DM Gowda
Department of Agricultural Statitics, Applied Mathamatics and Computer Science, College Of Agriculture, University of Agricultural Science, Bangalore, Karnataka, India

Rajashekar K
M.Sc(Agriculture) in Agricultural Economics, Department of Agriculture Economics, G. B. pant University of Agricultural and Technology, Uttarakhand, India

Correspondence
Korem Sunitha
Department of Agricultural Statitics, Applied Mathamatics and Computer Science, College Of Agriculture, University of Agricultural Science, Bangalore, Karnataka, India

Analysis of growth rates in area, production and productivity of rice crop in Telangana state

Korem Sunitha, DM Gowda and Rajashekar K

Abstract
The growth rates of rice for ten districts of Telangana State were studies using the time series data from 1986-87 to 2015-16. For this study whole 30 years data was divided into two periods, each period had fifteen years. The growth pattern was examined by compound growth rate (CGR) and linear growth rate (LGR). CGR fitted on exponential model $Y_t = \beta_0 \beta^t \varepsilon_t$ and LGR fitted on linear model $Y_t = \beta_0 + \beta_1 + \in$. The growth pattern in area, production and productivity of rice showed an upward trend at state as well as period-I and period-II. For rice crop area and production of Linear growth rate and compound growth rate were higher during the period II except in productivity was highest in period-I. As a whole state the growth rates of production were higher than the growth rates of area and productivity. Production showed highest growth rate during period-II compare to all periods of area and productivity. However growth rates were positive and significant at probability level 5 per cent and 1 per cent for production and productivity respectively in both periods for area growth rates were showed positive and non-significant in both periods

Keywords: Growth rate; rice; area, production, productivity

Introduction
Telangana State is youngest state in India and popularly known as granary of South India because of its abounding surpluses in the production of food crops. The economy of Telangana is mainly supported by agriculture. Telangana is developing into a seed hub in India, and was selects as a certifying agency as per OECD standards, for 10 states. The state cultivated seeds in 2,251 acres and exported 17,000 quintals to countries like Sudan, Egypt, and Philippines 2017-18, it expanded cultivation to 2,567 acre and was expecting yield of 26,000 quintals. In 2017-18 Telangana GDP rank was 8 and agriculture contribution in GDP was 18 per cent. Farmers in Telangana mainly depend on rain-fed water sources for irrigation. Rice is the major food crop and staple food of the state. Other important local crops are cotton, sugarcane, mango and tobacco. There are many multi-state irrigation projects in development, including Godavari River Basin Irrigation Projects.

Rice is the principal crop extensively cultivated inall the districts of the state both in karif and rabi seasons total cropped area and 47.99 percentunder food grain out of which paddy crop area accounted for 21.38 per cent of the of the total area during 2015-16. The area under during 2015-16 was 1046 lakh hectare the production of rice during 2015-16 was at 30.47 lakh hectare the productivity of rice is 2913 kgs/hectare hence selected for the growth rate study. Quantitativemeasurements of the growth of crop of the various factors to the growth of a crop output at the national, state or district levels is helpful in reorienting the programs and priorities of agricultural development so as to achieve higher rates of growth.

Yoginder and Sharma (1980) [10] were studied the growth rates of crops for the periods of green revolution (period I: 1960-61 to 1969-70) and post-green revolution (period II: 1970-71 to 1978-79). The study revealed that the estimated growth rates in sub-period II were higher than those for sub-period I and that the growth was more evenly spread in sub-period II.

Sharma and Joshi (1994) studied the compound growth rates of area, production and yield of rice in coastal districts of India by fitting an exponential function. They concluded that growth rate of area under rice is negative in majority of districts during *kharif* season. The production performance of rice in *kharif* season in the coastal districts is not very impressive except in coastal Andhra Pradesh. The growth rate of rice acreage during *rabi* season is significantly positive in majority of the districts. Therefore, an appreciable increase in rice acreage leads to comparatively higher growth in rice production during *rabi*season.

Shibu *et al*. (2004) [9] made an attempt to estimate the growth rates in area, production and productivity of cashew in Kerala during the period 1952-53 to 1999-2000. They divided the whole period into two sub-periods *viz.,* period I (1952-53 to 1975-76) and Period II (1976-77 to 1999-2000). They concluded that the growth rate in area were positive for the entire period with stagnant production and declining productivity.

Rao and Reddy (2005) [7] worked out the growth rates of area, production and productivity of groundnut for the period I (1988-89 to 2002-03) and period II (1953-56 to 2002-03) in the three geographical regions of Andhra Pradesh and also Andhra Pradesh state as a whole. Their study revealed that the compound growth rates of area, production for the period I, were negatively significant in coastal Andhra, Telangana and Andhra Pradesh state as a whole. However, in period-II, the compound growth rate of area is significant only in Rayalaseema, production is significant in all three regions and Andhra Pradesh state as a whole and productivity is significant in coastal Andhra and Andhra Pradesh state as a whole.

Rajendra Prasad *et al.* (2012) [6] studied the trends in area, production and productivity of maize crop in Andhra Pradesh during period 1969-2009 compound function is best fitted trend for area and production in case of productivity S-curve is best fitted trend function.

The factors responsible for the growth rate of rice crop output area sown, irrigated area under crop, rainfall, fertilizers, quality seeds, land development for cultivation crops, adopt soil conservations methods, improved implement, extent of mechanized cultivation etc. These factors influence growth in different degrees in different districts. As such a study of periods variations in area, production and productivity of rice crop would be importance to scientists, administrators and policymakers.

Methodology

The state of Telangana was broadly divided into ten districts. Data for the period 1986-87 to 2015-2016 at the district level and state level on area, production and productivity were collected from the Directorate of economics and statistics (DES) at Hyderabad by Government of India. Rice being major crop of the State was taken for this study. To assess the impact of new technological innovations the whole period was divided into two sub periods

Period I: 1986-87 to 2000-01

Period II: 2001-02 to 2015-16.

Estimation of growth rate

Compound Growth Rate (CGR) and Linear Growth Rate (LGR) for the crop characteristics i.e., area, production and productivity of rice crop in Telangana State were estimated by fitting the following functions through period-I, period-II and whole period.

Compound Growth Rate

Growth of any variable indicates its past performance. The analysis of growth is usually used in economic studies to find out the trend of a particular variable over a period of time. It clearly indicates the performance of the variable under consideration and hence it can be very well used for making policy decisions

Compound Growth Rate was computed based on the exponential model as given:

$$Y_t = \beta_0 \beta_1^t \ldots\ldots\ldots\ldots (1)$$

Where,

Y_t= variable for which growth rate was estimated (area, production and productivity of dependent variable)

t = the time in years, independent variable, 1, 2, …….n

β_0 = intercept

β_1= Regression coefficient and

ε_t= error term

Equation (1) can be transformed into log linear form as follows.

$$\ln Y_t = \ln \beta_0 + t \ln \beta + \ln \varepsilon_t \ldots\ldots (2)$$

This equation was estimated by using ordinary least square (OLS) technique. The compound growth rate percentage (CGR per cent) is computed from the relationship,

CGR per cent = [Antilog (ln β) -1)] x 100.

Linear Growth Rate

Linear growth rate was computed by fitting simple regression equation.

LGR equation given by

$$Y_t = \beta_0 + \beta_1 + \in \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where,

Y_t= the variable for which growth rate was estimated (area, production and productivity of dependent variable)

β_0 =is an Intercept

β_1= Linear Regression coefficient

t = is the time in years, independent variable and

ε_t = error term

The above equation is fitted by using the least squares method of estimation. The linear growth rate is calculated as follows:

Linear growth rate (LGR %) $= \frac{\beta_1}{\bar{Y}} \times 100$

Results and Discussion

For Period-I, Period-II and Combined Period Linear growth rate and Compound growth rate of area, production and productivity of rice crop was presented in Table 1.

For the area, period-I and period-II both linear growth rate and compound growth rate were non-significant. In combined period growth rates showed significant at 5 per cent level. Period-II was showing more growth rate than the period-I.

In production case Period-I, period-II and Combined Period of growth rates showed significantly at 5 per cent level. In these case also Period-II was more growth rate compare with the Period-I.

As well as in productivity case all periods were showing significant results at 1 per cent level. In these period-I growth rates were more than the period-II growth rates. Growth rates of all periods reveals positive growth.

Table 1: Growth Rates in Area, Production and Productivity of rice Crop in Telangana

		LGR	CGR
Area	Period-I	1.37^{NS}	1.37^{NS}
	Period-II	2.48^{NS}	2.56^{NS}
	Combined	1.10*	1.03*
Production	Period-I	3.19*	3.32*
	Period-II	4.09*	4.53*
	Combined	2.62**	2.59**
Productivity	Period-I	1.86**	1.93**
	Period-II	1.80**	1.92**
	Combined	1.52**	1.55**

NS Non-Significant.
** Significance at 1% level.
*Significance at 5% level.
LGR- Linear Growth Rate.
CGR- Compound Growth Rate.

As a whole, the growth rates of production were higher than growth rates of area and productivity. This implies relatively slow growth in area, moderately growth in productivity and high growth rate were observed in production.

The results were agreed with the work has done by other places on the same line. Ahmad *et.al* (2015) [1] examined on the trend of area, production and productivity of major cereals: India and Nigeria scenario from period1982-2012. Compound growth rate for cereals in India was negative and significant for area. Production and productivity compound growth rate was positive and significant. However from Nigeria compound growth rate were positive and significant at probabilities levels 1%, 1% and 5% for area, production and productivity respectively. Higher productivity were recorded India for rice, wheat and maize.

Mathur (2005) [4] computed the compound growth rates of area, production and productivity of rice, during the high yielding variety period (1966-67 to 2000-01) in India by the least square technique of fitting of exponential function $y=ab^t$. He concluded that the average yield is low in the regions comprising Uttar Pradesh, Bihar, Assam, West Bengal, Orissa, Madhya Pradesh and Maharashtra when compared with other regions and production in general, has grown at a much faster rate than area in all states.

Prabakaran and Sivapragasam (2013) [5] were studied on analysis of growth rates of Rice and Soghum in Andra Pradesh. Examined on the three distinct administrative regions namely Telangana, Rayalaseema and Coastal by using the time series data from 1970-71 to 1999-2000. Growth pattern was examined by fitting the exponential function. Results reveled that area, production andyield of rice showed an upward trend at state and regional level except in Rayalaseema region which showed a decline in area and production. In case of sorghum growth rate of area and production showed a downward trend in all the regions and state as whole.

Jaypatre *et. al.* (2010) [3] studied on estimated trends in area, production and productivity performance of mango in South Gujarat region. The entire period was split into two sub periods i.e period I (1990-91 to 1997-98) and period-II (1998-99 to 2007-08). The results reveled that linear growth rate of mango was non-significant in both the periods, but compound growth rate for mango was highly significant in both periods and the instability index for area, production and productivity were found higher in period II as compare to period I.

Conclusion

For estimating the growth pattern an exponential function and linear model was fitted to the area, production and productivity of the selected rice crop and LGR, CGR were obtained for the period 1986-87 to 2015-16. Following conclusions was made:

LGR and CGR of rice crop in the respect of area, production and productivity were positive at the all the periods and total period.

The growth of area, production were found to be highest in period -II. Growth rate of rice productivity were found to be highest in period-I. The productivity growth declined in the period-II

Growth rates of area, production and productivity of total period of LGR was higher than the CGR.

Hence it could be concluded that the general increasing productivity growth of rice complemented by positive growth in rice area resulted in overall increase in the rice production across in study sub periods. The seed-fertilizer-irrigation technologies introduced for increasing support on both input as well as output fronts in the form of subsidies and price support measures would be few factors involved for leading to the rice crop production.

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