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Jyoti S Atla
MPKV, Rahuri, Maharashtra, India

VG Pokharkar
Assistant Professor, Department of Agricultural Economics, MPKV, Rahuri, Maharashtra, India

DB Yadav
Head, Department of Agricultural Economics, MPKV, Rahuri, Maharashtra, India

Corresponding Author:
Jyoti S Atla
MPKV, Rahuri, Maharashtra, India

Trend analysis of area, production and productivity of paddy in India

Jyoti S Atla, VG Pokharkar and DB Yadav

Abstract
The present study was conducted to estimate state wise annual compound growth rate of area, production and productivity of paddy in India by the way of using exponential growth function during pre-WTO period (1970-71 to 1994-95), post-WTO period (1995-96 to 2017-18) and overall period (1970-71 to 2017-18). In India, the growth rates of area, production and productivity were positive and significant in Uttar Pradesh, West Bengal, Karnataka, Maharashtra, Punjab and Assam and the growth rate in area was negatively significant while, the production and productivity was positively significant in Andhra Pradesh and Tamil Nadu for entire period.

Keywords: growth rates, paddy, area, production and productivity

Introduction
Paddy is the most widely grown cereal in the World and is staple food for more than 60 per cent of World's population. China is the largest producer of paddy contributing for over 30 per cent of the World's paddy output. India occupies the second position accounting for about 22 per cent followed by Indonesia with 8 per cent, Bangladesh with 7 per cent and Vietnam with 6 per cent of total paddy production in the World.
India is the second largest producer as well as consumer of paddy in the World. Similar to the trends in world production, paddy production in India has also increased at a slow pace 109,000 thousand tonnes in the year 2018-19 primarily due to rise in yields.
West Bengal has been the largest producing state accounting for about 14 per cent of total paddy output in the country followed by Uttar Pradesh and Andhra Pradesh competing for the second position with about 12-13 per cent share in production. Tamil Nadu, Bihar and Orissa are the other major paddy producing states contributing together for 20 per cent of country's rice output.

Methodology
The study period
The study period was divided into two periods based on the policy of the government on WTO of trade at different periods. However, for better understanding of growth rates in area, production and productivity were compared for the period from 1970-71 to 2017-18 which was further divided into two sub periods.
Period-I: Pre-WTO Period (1970-71 to 1994-95)
Period-II: Post-WTO Period (1995-96 to 2017-18)
Overall Period: (1970-71 to 2017-18)

Compound growth rate analysis
Compound growth rates in area, production and productivity of paddy in the country as a whole were estimated by using the exponential growth function of the form,

$Y = ab^t$

Where,
Y = Area, production, productivity and export
t = Time period
b = Regression coefficient
a = Intercept
CGR (%) = (Antilog b – 1) × 100

Results and Discussion

The state wise growth rates in area, production and productivity of paddy were studied by estimating compound growth rates for sub-periods as Pre-WTO period (1970-71 to 1994-95), Post-WTO period (1995-96 to 2017-18) and Overall period (1970-71 to 2017-18).

It is revealed from the Table 1 that, the growth rates of area, production and productivity of paddy at National level were observed to be positive and highly significant at one per cent level for the overall period (1970-71 to 2017-18). The area, production and productivity of paddy increased at the rate of 0.33, 2.22 and 1.88 per cent per annum, respectively, during the entire period. It indicates that the production of paddy at National level was increased by both area expansion and productivity improvement. The same trend was observed in Pre-WTO period (1970-71 to 1994-95) at National level where the growth rate of area, production and productivity was positive and highly significant which increased at the rate of 0.54, 3.05 and 2.50 per cent per annum, respectively. However, in Post-WTO period (1995-96 to 2017-18) the production and productivity of paddy was highly significant and increased at the rate of 1.53 and 1.55 per cent per annum, respectively. Whereas, the area under paddy was declined by 0.02 per cent per annum. It indicates that, the production of paddy in Post-WTO period (1995-96 to 2017-18) was mainly increased by productivity improvement.

In major states of India, the growth rates of area, production and productivity of paddy were positive and significant in Uttar Pradesh, West Bengal, Karnataka, Maharashtra, Punjab and Assam for overall period (1970-71 to 2017-18) indicating that, the production of paddy was influenced by both area expansion and productivity improvement in these states. The growth rate in area was negatively significant while, the production and productivity was positively significant in Andhra Pradesh and Tamil Nadu for overall period, indicating that the production of paddy was increased only due to productivity improvement in these two states. However, in Madhya Pradesh and Kerala, the growth rates of area and production of paddy was negatively significant and the growth rates of productivity were positively significant at overall period. The rate of growth decline in area was higher than the positive growth rate of productivity of paddy in Madhya Pradesh and Kerala, that's why the production of paddy was decline in these states, even though, there was a improvement in productivity.

Among the two periods *i.e.* Pre-WTO and Post-WTO period, the growth rates of area, production and productivity was more satisfactory in Pre-WTO period (1970-71 to 1994-95) than Post-WTO period (1995-96 to 2017-18) in all the states under study. In Post-WTO period (1995-96 to 2017-18) the production of paddy was increased due to new hybrid varieties in West Bengal, Uttar Pradesh, Maharashtra and Assam. Whereas, the production of paddy increased by both area expansion and productivity improvement in Punjab states. However, the production of paddy was declined only due to decreased in area in Andhra Pradesh, Karnataka, Madhya Pradesh, Tamil Nadu and Kerala. It is due to the diversification in cropping pattern and different competing crops for paddy in above mentioned states.

In Pre-WTO period (1970-71 to 1994-95), the production of paddy was significantly increased at the rate of 5.28, 3.31, 3.18, 2.22, 10.34 and 2.75 per cent per annum due to both productivity improvement and area expansion in Uttar Pradesh, West Bengal, Andhra Pradesh, Maharashtra, Punjab and Madhya Pradesh. Whereas, the production of paddy was significantly increased due to only yield improvement in Tamil Nadu and Assam.

Table 1: Annual compound growth rates of area, production and productivity of paddy in major states of India

Sr. No.	State	ACGR %								
		Pre-WTO (1970-71 to 1994-95)			Post WTO (1995-96 to 2017-18)			Overall Period (1970-71 to 2017-18)		
		Area	Production	Productivity	Area	Production	Productivity	Area	Production	Productivity
1.	Uttar Pradesh	0.92***	5.28***	4.32***	1.1 NS	1.24 NS	0.6**	0.54**	2.97***	2.53***
2.	West Bengal	0.61***	3.31***	2.69***	-0.69 NS	0.81***	1.52***	0.29**	2.45***	2.16***
3.	Andhra Pradesh	0.52**	3.18***	2.64***	-2.96***	-1.64**	1.36***	-0.68***	1.16***	1.85***
4.	Karnataka	1.05**	1.84***	0.78 NS	-0.81*	-0.47 NS	0.55 NS	0.36**	1.41***	0.82**
5.	Punjab	8.97***	10.34***	2.34***	1.22***	2.28***	1.05***	3.85***	5.23***	1.33***
6.	Maharashtra	0.64***	2.22***	1.56***	0.1 NS	0.96**	0.87**	0.2***	1.25***	1.05***
7.	Madhya Pradesh	0.67***	2.75***	2.06***	-4.18***	-0.89 NS	3.43***	-2.73***	-1.28**	1.49***
8.	Tamil Nadu	-1.61***	1.29***	2.96***	-1.18***	-1.05 NS	0.13 NS	-1.03***	0.15 NS	1.19***
9.	Assam	0.46 NS	2.08***	1.61***	-0.27 NS	2.11***	2.43***	0.48***	2.1***	1.62***
10.	Kerala	-2.57***	-1.31***	1.29***	-4.55***	-2.75***	1.89***	-3.84***	-2.53***	1.37***
11.	India	0.54***	3.05***	2.5***	-0.02 NS	1.53***	1.55***	0.33***	2.22***	1.88***

Note: ***, **, * indicates level of significance at 1%, 5% and 10% respectively. NS-Non significant

Conclusion

1. The growth rates of area, production and productivity of paddy at National level were observed to be positive and highly significant at one per cent level for the overall period. It indicates that the production of paddy at national level was increased by both area expansion and productivity improvement.
2. At overall period, in major states of India, the growth rates of area, production and productivity were positive and significant in Uttar Pradesh, West Bengal, Karnataka, Maharashtra, Punjab and Assam. It indicating that, the production of paddy is influenced by both area expansion and productivity improvement in these states.

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