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## Growth of wheat production: A zone wise analysis in Eastern Uttar Pradesh

**Ekta Pandey and VN Rai**

### Abstract

The paper attempts to study the growth and instability of wheat production in Eastern Uttar Pradesh. The time series data on area, production and productivity of wheat pertaining to the period 1980-81 to 2014-15 were used for the study. The study relates to 1980-81 to 2014-15 which is further divided into four sub- periods. The production under wheat has registered positive growth rate in all three zones viz. North Eastern Plain Zone, Eastern Plain Zone and Vindhyan Zone. The area, production and productivity of wheat are found to be highest in North Eastern Plain Zone. After instability analysis it was observed that there is high instability in area, production and productivity in Vindhyan Zone.

**Keywords:** Growth functions, growth rate, instability index, trend analysis

### Introduction

Wheat is a grass widely cultivated for its seed, a cereal grain which is a worldwide staple food. The many species of wheat together make up the genus *Triticum*; the most widely grown is common wheat (*T. aestivum*). The archaeological record suggests that wheat was first cultivated in the regions of the Fertile Crescent around 9600BCE. Botanically, the wheat kernel is a type of fruit called a caryopsis. Wheat is grown on more land area than any other food crop (220.4 million hectares, 2014). World trade in wheat is greater than for all other crops combined. Wheat is an important source of carbohydrates. When eaten as the whole grain, wheat is a source of multiple nutrients and dietary fiber. Globally, wheat is the leading source of vegetable protein in human food. It has high protein content than other major cereals such as maize (corn) or rice. It was one of the first crops that could be easily cultivated on a large scale and its seed could be stored for long periods in a dry climate. Wheat has a high demand for phosphorus and can grow well when phosphorus is not supplemented in the fertilizer schedule, may be due to the wheat's ability to mine phosphorus from the soil.

### Research Methodology

#### Materials

The time series data on area, production and productivity of wheat for 35 years from 1980-81 to 2014-15 has been collected from the Bulletins of Directorate of Agricultural Statistics & Krishi Bhawan Lucknow, Government of Uttar Pradesh.

#### Methods

##### Growth Models

The growth rate in area, production and productivity of wheat have been worked out by fitting the following three different functions:

- 1) Simple linear function  $Y_t = a + b_t$
- 2) Compound growth rate function  $Y_t = a(1+r)^t$
- 3) where,  $Y_t$  stands for area/ production/ productivity,  $t$  is time index,  $a$  and  $b$  are model parameters, and  $r$  is the compound growth rate.

##### Measure of instability in wheat production

High growth and low instability in production are prerequisites for sustainable agricultural performance. It has been a great concern that technological change in wheat production has increased variability, which is considered to be one of the important facts. Since the magnitude of growth and instability in wheat production has serious implications for policy makers, the level of instability in the area, production and productivity has been estimated by using Cuddy Della Valle Index, which corrects the coefficients of variations and it is given by

$$\text{Instability index} = cv \sqrt{1 - R^2}$$

where,  $R^2$  is the coefficient of determination from a time trend regression and  $cv$  is the coefficient of variation.

## Results and Discussion

### Trends in area, production and productivity of wheat

The triennium average of area (in thousand hectares), production (thousand tones) and productivity (kg/hectare) and its per cent change in different decadal periods for wheat are depicted in the Table 1.

Triennium averages ending at year shown of area (in '000' ha.), production (in '000' tones) and productivity (in kg/ha) of wheat and its changing pattern in North Eastern Plain Zone.

Crops	% change in 1990-91 over 1980-81	% change in 2000-01 over 1990-91	% change in 2010-11 over 2000-01	% change in 2014-15 over 2010-11	% change in 2014-15 over 1980-81
Area	6.79	5.52	5.11	2.30	21.17
Production	42.69	43.01	20.67	-23.20	89.11
Productivity	33.62	35.53	14.80	-24.93	56.06

Triennium averages ending at year shown of area (in '000' ha.), production (in '000' tones) and productivity (in kg/ha) of wheat and its changing pattern in Eastern Plain Zone.

Crops	% change in 1990-91 over 1980-81	% change in 2000-01 over 1990-91	% change in 2010-11 over 2000-01	% change in 2014-15 over 2010-11	% change in 2014-15 over 1980-81
Area	25.75	5.83	1.96	1.45	37.68
Production	64.39	22.85	22.09	-28.45	76.42
Productivity	30.73	16.08	19.73	-29.48	28.13

Triennium averages ending at year shown of area (in '000' ha.), production (in '000' tones) and productivity (in kg/ha) of wheat and its changing pattern in Vindhyan Zone.

Crops	% change in 1990-91 over 1980-81	% change in 2000-01 over 1990-91	% change in 2010-11 over 2000-01	% change in 2014-15 over 2010-11	% change in 2014-15 over 1980-81
Area	26.48	57.97	-10.18	2.80	85.50
Production	42.16	145.88	9.96	-19.34	210.03
Productivity	12.39	55.64	22.43	-21.55	68.03

### Area

The triennium average of area and its per cent change in different decadal period of wheat crop in all the three zones of Eastern Uttar Pradesh. In all the three zones the area of wheat decreased from 1980-81 to 2014-15. The area shows increased in first period 1980-81 to 1990-91.

### Production

The triennium average of production and its per cent change has increased in all zones of Eastern Uttar Pradesh. The production has increased from 1980-81 to 2014-15. The rainfall is heavy in 2014-15.

### Productivity

The triennium average of productivity of wheat crop has increased in all decades. The maximum increased has been found in the year 1980-81 to 2014-15. The production and productivity both are increased in all the zones of Eastern Uttar Pradesh in year 2014-15.

**Table 1:** Annual average simple and compound growth rate of area, production and productivity of wheat during different periods in North Eastern Plain Zone.

Period		Area	Production	Productivity
1980-81 to 1994-95	S.G.R	0.39	3.33	5.17
	C.G.R	0.39	3.45	3.07
1995-96 to 2004-05	S.G.R	1.21	1.62	0.43
	C.G.R	1.23	1.67	0.43
2005-06 to 2014-15	S.G.R	0.46	2.43	1.88
	C.G.R	0.46	2.48	1.92
1980-81 to 2014-15	S.G.R	0.55	2.46	1.93
	C.G.R	0.55	2.59	2.02

In North Eastern Plain Zone, the area under wheat has increased at the rate of 0.55 per cent annually since 1980-81 to 2014-15. This increase in growth rate is prominent during the second period about 1.23 per cent. The production of wheat has also registered growth rate of about 2.59 per cent annually during the entire period under study. This growth rate has been found more 3.45 per cent during first period.

Similar is the case with its productivity, where it has increased at the rate of about 2.02 per cent annually during the entire period under study. A high growth rate in the production of wheat has been found 3.07 per cent during first period.

**Table 2:** Annual average simple and compound growth rate of area, production and productivity of wheat during different periods during Eastern Plain Zone

Period		Area	Production	Productivity
1980-81 to 1994-95	S.G.R	2.93	5.44	2.53
	C.G.R	3.05	5.73	2.57
1995-96 to 2004-05	S.G.R	0.78	-0.30	-1.08
	C.G.R	0.79	-0.30	-1.08
2005-06 to 2014-15	S.G.R	-0.06	1.31	1.37
	C.G.R	-0.05	1.31	1.37
1980-81 to 2014-15	S.G.R	0.99	2.35	1.46
	C.G.R	1.06	2.59	1.50

The area under wheat has decrease at the rate of about 1.06 per cent in the state since 1981-2015 onwards. The growth rate has been more 3.05 per cent during first period. The production of wheat has also increased in the state at the annual growth rate of about 2.59 per cent since 1980-81 to 2014-15. First period witnessed high growth rate of 5.73 per cent against 1.31 per cent during the third period.

The productivity of wheat has registered nominal -1.08 per cent during the second period. On the other hand, productivity has increased at the rate of 2.57 and 1.37 per cent during first and third period, respectively. However, the overall growth rate of productivity has been increased to the tune of 1.50 per cent.

**Table 3:** Annual average simple and compound growth rate of area, production and productivity of wheat during different periods during Vindhyan Zone

Period		Area	Production	Productivity
1980-81 to 1994-95	S.G.R	1.90	3.55	2.95
	C.G.R	1.94	3.32	2.87
1995-96 to 2004-05	S.G.R	2.31	2.89	0.63
	C.G.R	2.44	3.12	0.63
2005-06 to 2014-15	S.G.R	0.04	4.09	4.09
	C.G.R	0.08	4.33	4.24
1980-81 to 2014-15	S.G.R	2.20	4.14	2.15
	C.G.R	2.34	4.64	2.21

In Vindhyan Zone, the area under wheat has increased at the rate of about 2.34 per cent annually since 1980-81 to 2014-15. The growth has been found to be more 2.44 per cent second period as compared to that of 1.94 and 0.08 per cent during first and third period, respectively. The production of wheat has also registered growth rate of about 4.64 per cent annually during the entire period of study. The growth rate has found to be more 4.33 per cent during third period than that of about 3.32 and 3.12 per cent during first and second period.

The productivity of wheat has also increased at the rate of about 2.21 per cent annually since 1980-81 to 2014-15. A high growth rate of about 4.24 per cent is observed during third period as compared to 2.87 and 0.63 per cent during first and second period.

**Table 4:** Measures of instability in area, production, and productivity of wheat crop. Instability index (in %) of Wheat during 1980-81 to 2014-15

Zone	Area	Production	Productivity
North Eastern Plain Zone	1.76	4.38	4.94
Eastern Plain Zone	5.87	7.20	5.39
Vindhyan Zone	12.25	17.77	12.70

From above table, the highest instability has been found in case of area, production and productivity in Vindhyan Zone and low instability has been found in North Eastern Plain Zone.

### Discussion and conclusion

It can be observed from the results the productivity of wheat has increased annually 2.15 per cent in Vindhyan Zone. The per cent change has increased in North Eastern Plain Zone in area, production and productivity. The high growth rate has been found in second period of all zones in Eastern Uttar Pradesh. Also the highest instability has been found in Vindhyan Zone. Therefore, there is need of launching another mission- mode approach by the policy makers at the state and national level to enhance the production of wheat. The farmers are also required to be given facilities and incentives for cereals production in general and wheat in particular. It was apparent that the soil management practices might have some contribution towards the performances of the given tillage operations.

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