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**Growth of sugarcane production: A zone wise
analysis in eastern Uttar Pradesh**

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Abstract

The paper attempts to study the growth and instability of sugarcane production in Eastern Uttar Pradesh. The time series data on area, production and productivity of sugarcane 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 sugarcane has registered positive growth rate in North Eastern Plain Zone. The gross cropped area of sugarcane is also increased in (2014-15) North Eastern Plain Zone is 8.27%. Percent change in 2014-15 over 1980-81 is 195.54%. After instability analysis it was observed that the higher instability of area, production and productivity is in Vindhyan Zone and the lower instability of area is found in Eastern Plain Zone and the production and productivity in North Eastern Plain Zone.

Keywords: Growth, trend, linear growth rate (LGR), compound growth rate (CGR), instability index

1. Introduction

Sugarcane or simply cane are several species of tall perennial true grasses of the genus Saccharum tribe used for sugarcane production. The plant is two to six metres tall. It has stout, jointed, fibrous stalks that are rich in sucrose, a simple sugar which accumulates in the stalk internodes. Sugarcane belongs to the grass family, an economically important seed plant family that includes maize, wheat, rice and sorghum and many forage crops. It is native to the warm temperate to tropical regions of South Asia, Southeast Asia and South America. Sugarcane is world's largest crop by production quantity. In 2012, the "Food and Agriculture Organization" estimated it was cultivated on about 26 million hectares in more than 90 countries. Sugarcane accounts for 79% of sugar produced; most of the rest is made from sugar beets.

2. Materials and Methods

2.1 Materials

The time series data on area, production and productivity of sugarcane 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.

2.2 Methods

2.2.1 Growth Models

The growth rate in area, production and productivity of rapeseed and mustard 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 $Y_t = a(1+r)^t$

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.

2.2.2 Measure of instability in rice production

High growth and low instability in production are prerequisites for sustainable agricultural performance. It has been a great concern that technological change in rice production has increased variability, which is considered to be one of the important facts. Since the magnitude of growth and instability in rice 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.

3. Results and Discussion**3.1 Trends in area, production and productivity of sugarcane**

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 sugarcane are depicted in the Table.

Table 1: Triennium averages ending at year shown of area (in '000' ha.), production (in '000' tones) and productivity (in kg/ha) of sugarcane 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	35.29	57.71	6.66	27.45	19.22
Production	72.85	7.20	14.16	39.70	19.54
Productivity	27.76	-10.06	7.03	9.60	34.81

Table 2: Triennium averages ending at year shown of area (in '000' ha.), production (in '000' tones) and productivity (in kg/ha) of sugarcane 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	3.89	-8.93	9.28	-25.14	-22.59
Production	5.94	7.37	21.77	-11.05	23.21
Productivity	1.97	17.91	11.42	18.81	59.17

Table 3: Triennium averages ending at year shown of area (in '000' ha.), production (in '000' tones) and productivity (in kg/ha) of sugarcane 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	10.7	3.13	-4.51	5.43	-5.51
Production	107.64	-0.61	-39.86	29.73	60.99
Productivity	54.12	-3.51	-6.85	22.96	70.33

The maximum contribution of area 35.29 per cent is found in North Eastern Plain zone and productivity 54.12 per cent in Vindhyan Zone during 1980-81 to 1990-91. In 1990-91 to 2000-01, the highest contribution of area 57.71 per cent in

North Eastern Plain zone and highest productivity 17.91 per cent is found in Eastern plain zone. In 2000-01 to 2010-11, the maximum contribution of area is 9.28 per cent and productivity 11.42 per cent in Eastern Plain zone respectively.

Table 4: Annual average simple and compound growth rate of area, production and productivity of Sugarcane during different periods in North Eastern Plain Zone

Period		Area	Production	Productivity
1980-81 to 1994-95	S.G.R	1.20	5.24	3.94
	C.G.R	1.18	5.57	4.25
1995-96 to 2004-05	S.G.R	5.56	4.51	-1.06
	C.G.R	5.61	4.49	-1.04
2005-06 to 2014-15	S.G.R	0.67	2.96	1.89
	C.G.R	0.65	2.90	1.88
1980-81 to 2014-15	S.G.R	2.36	2.98	0.69
	C.G.R	2.38	3.20	0.78

In North Eastern Plain Zone, the area under sugarcane has increased at the rate of about 2.38 per cent since 1980-81 to 2014-15. The growth is found more 5.61 per cent during second period than that of about 1.18 per cent in first period. The production of sugarcane has increased 3.20 per cent since 1980-81 to 2014-15. The maximum growth rate of 5.57 per cent is obtained during first period as against the 4.49 per cent and 2.90 per cent during second and third period. The productivity has nominal increase of growth 0.78 per cent during entire period. The highest growth rate of 4.25 per cent is found during first period.

Table 5: Annual average simple and compound growth rate of area, production and productivity of Sugarcane during different periods during Eastern Plain Zone

Period		Area	Production	Productivity
1980-81 to 1994-95	S.G.R	0.86	1.26	-0.48
	C.G.R	0.86	1.26	-0.60
1995-96 to 2004-05	S.G.R	-2.59	-3.11	-0.51
	C.G.R	-2.60	-3.10	-0.50
2005-06 to 2014-15	S.G.R	0.05	3.64	3.75
	C.G.R	0.03	3.74	3.76
1980-81 to 2014-15	S.G.R	-0.90	-0.00	1.06
	C.G.R	-0.92	-0.01	1.03

The area under sugarcane has declined at the rate of 0.92 per cent during entire period of study. This negative growth rate is prominent during second period 2.60 per cent. The production of sugarcane has declined 0.01 per cent since 1980-81 onwards. A high growth rate of about 3.74 per cent is found during third period against 1.26 per cent during first period. The growth of productivity of sugarcane has been obtained 1.03 per cent during 1980-81 onwards. A high growth rate of about 3.76 per cent is found during third period.

Table 6: Annual average simple and compound growth rate of area, production and productivity of Sugarcane during different periods during Vindhyan Zone

Period		Area	Production	Productivity
1980-81 to 1994-95	S.G.R	-1.10	0.77	1.82
	C.G.R	-1.09	1.04	2.15
1995-96 to 2004-05	S.G.R	-3.61	-1.43	2.26
	C.G.R	-3.73	-1.57	2.28
2005-06 to 2014-15	S.G.R	-2.79	0.43	3.31
	C.G.R	-2.79	0.44	3.39
1980-81 to 2014-15	S.G.R	-1.36	-1.26	0.21
	C.G.R	-1.47	-1.24	0.25

In Vindhyan Zone, the area has registered tremendous downfall at the rate of 1.47 per cent annually since 1980-81 to 2014-15. It can also be seen from the table that this decline is more prominent 3.73 per cent during third period as against 2.79 per cent during third period. The production of sugarcane is declined at the rate of 1.24 per cent annually since 1980-81 to 2014-15. The positive growth rate of production is found 1.04 and 0.44 per cent during first and third period, while the production has decline at the rate of 1.57 per cent annually during second period. The productivity of sugarcane has also increased at the rate of about 0.25 per cent since 1980-81 to 2014-15. Third period witnessed high growth rate of 3.39 per cent as against 2.15 and 2.28 per cent during first and second period, respectively.

3.3 Measures of instability in area, production, and productivity of wheat crop Instability index (in %) of Sugarcane during 1980-81 to 2014-15

Zone	Area	Production	Productivity
North Eastern Plain Zone	12.28	8.42	6.89
Eastern Plain Zone	7.06	8.87	10.05
Vindhyan Zone	16.85	23.60	20.61

In the above table the higher instability of area, production and productivity in Vindhyan Zone. It may be observed from the table that the lower instability of area is found in Eastern Plain Zone, production and productivity in North Eastern Plain Zone.

4. Discussion and Conclusion

Area, production and productivity of mustard increased during last thirty- five years in North Eastern Plain Zone. Instability for the production of sugarcane is also good in North Eastern Plain Zone. Literate the farmers for the proper uses of fertilizers, pesticides and make proper irrigation facilities for the production of mustard crop and make soil more fertile. There is a need of launching mission and the policy at the state and national level.

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