

# A Study on Trends and Growth Rates in Area, Production and Productivity of Sugarcane in Kushinagar District of Uttar Pradesh, India

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**Abstract**— The study was conducted to know trends in growth rate of area, production and productivity of sugarcane in India and performance of sugarcane crop production of Kushinagar, Uttar Pradesh. The study was based on secondary source of data. Simple statistical tools like compound annual growth rate, percentage methods were used in this study. The study reveals that compound annual growth rate in case of area, production and Productivity showing a positive sign. The compound annual growth rate in area, production and productivity in India is reported an increase of 0.80 percent, 1.73 percent, and 0.92 percent. The compound annual growth rate in area, production and productivity in Uttar Pradesh is reported an increase of 0.43 percent, 1.51 percent, and 1.06 percent, respectively. The compound annual growth rate in area, production and productivity in Kushinagar district is reported that -0.15 percent, 2.72 percent, and 2.87 percent, respectively. The area and production of crop is showing a fluctuating trend because there are many factors which is responsible sugarcane cultivation like monsoon conditions, government price polices etc.

**Keywords**— Trends, Compound annual growth rate, Production, Productivity, Sugarcane.

## I. INTRODUCTION

Sugarcane is important cash crop grown in India. Sugarcane is one of the most important commercial crops of the country and the sugar industry occupies an important place in the economy of our country. Sugarcane crop provides raw material to over 25 other industries and sugar industry is one of the largest agro based processing industry responsible for socio-economic development of rural masses and national economy of our country. In the current day rural economy set up sugarcane cultivation and sugar industry has been focal point for socio-economic development in rural areas by mobilizing rural resources, generating employment and higher income, transport and communication facilities.

India is 2<sup>nd</sup> largest sugarcane producer in the world with the production of 494.22 million metric tons the area of 5.88 million hectare Presently sugarcane is grown in an area of 2.73 million hectare (45.12 percent) and production 225.22 MT (44.78 percent) among the sugarcane growing countries of the world Uttar Pradesh has 1<sup>st</sup> position in sugarcane area 45.12 percent in the country, followed by Maharashtra, Karnataka, Bihar, Gujarat, Tamil Nadu, Madhya Pradesh, Haryana, Punjab, Uttarakhand, Andhra Pradesh. (<https://sugarcane.dac.gov.in/> 2022-23). Uttar Pradesh is the largest production of sugarcane in India. The climatic condition of Uttar Pradesh is ideal for sugarcane cultivation. Sugarcane industry is an important industry of Uttar Pradesh and is the main source of almost 35 lakhs farming families of the province. The province has a total of 157 established sugar mills from where at present season 2023-24 total 118 sugar mills are operational. Total sugarcane area of province is 2.73 million hectare and sugarcane productivity is 104.78 tonne per hectare.

The compound growth rate of area, production and productivity of sugarcane in Orissa during the period 1995-96 to 2005-06 for the state were -1.43(NS) per cent, 0.06 (NS) per cent, 1.86 (MS) per cent. (Rout *et al.* 2016). The trend in growth models on area, production and productivity of sugarcane crops in coastal Andhra region of Andhra Pradesh state for the period of 1973-74 to 2012-13. They observed that quadratic function was the best fitted model for area and production where as linear

function for productivity. And the results revealed that area, production and productivity of sugarcane crop would be increased during their study period (**Greeshma et al. 2017**). A time series data from 1970-1971 to 2014-15 (45 year) of major sugarcane producing states Uttar Pradesh and Maharashtra in India was used. It is revealed from the results that area, production and productivity of sugarcane is increasing at the rate of 1.20 per cent, 2.27 per cent and 1.20 per cent respectively in Uttar Pradesh and 4.10 per cent, 3.80 per cent and 0.2 per cent respectively in Maharashtra. At India level area, production and productivity grew at the rate of 1.6 per cent, 2.5 per cent and 0.9 per cent respectively in India, (**Kumar and Singh 2018**). Analyzed sugarcane cultivation trends in India and Haryana from 1971 to 2018. It finds an overall increasing trend in India, with Compound Annual Growth Rates (CAGRs) of 1.52 percent, 0.84 percent and 2.37 percent, for area, production, and productivity respectively. In Haryana, the trend is decreasing, but production and productivity are increasing, (**Nisha et al. (2020)**). The trend of sugarcane productivity in Maharashtra was found to be stagnant between 1.0 to 3.0 percent. The result of decomposition analysis indicates a relatively more important contribution of area rather than increase in the production. The result of the Instability analysis revealed that the level of instability in the area, production and productivity of sugarcane increased drastically in Maharashtra. (**Gupta and Badal (2021)**).

## II. MATERIALS AND METHOD

### 2.1 Compound growth rate analysis:

In order to access growth in credit to different purposes compound growth rates will be worked out. Compound growth rates will be computed by using exponential function of the form.

$$Y_t = A B^t e^{u_t} \quad (1)$$

Where,

$Y_t$  = Credit dispersed during time  $t$

$A$  =  $Y$  in the base year

$T$  = Time period

$u_t$  = Error term

$B = 1 + g$

$g$  = Growth rate.

By taking the logarithm, equation (1) was reduced to the following form

$$\text{Log } Y_t = \text{Log } A + (\text{Log } B)t + u_t \quad (2)$$

Where  $\text{Log } A$  and  $\text{Log } B$  were the parameters of the function obtained by ordinary least square method (OLS).

Defining,  $Q_t = \log Y_t$

$t$  = time period

$a = \log A$  and  $b = \log B$

Equation (2) can be written as follows

$$Q_t = a + bt + u_t \quad (3)$$

Once the above equation is estimated,  $g$  can be computed as:

$$g = (\text{Antilog } (b) - 1) \times 100 \quad (4)$$

## III. RESULT AND DISCUSSION

### 3.1 Compound annual growth rate (CAGR) of sugarcane in India:

Table 1 indicates the compound annual growth rates for area, production, and productivity for all sugarcane in India.

**TABLE 1**  
**YEAR WISE AREA, PRODUCTION AND PRODUCTIVITY OF SUGARCANE IN INDIA (2001 TO 2022)**

Year	Area (in 000 ha)	Production (in 000 tonne)	Productivity (in 000 tonne/ha)
2001	4.32	295.96	68.50
2002	4.41	297.21	67.37
2003	4.52	287.38	63.58
2004	3.93	233.86	59.38
2005	3.66	237.09	64.75
2006	4.20	281.17	66.93
2007	5.15	355.52	69.03
2008	5.06	348.19	68.88
2009	4.42	285.03	64.55
2010	4.17	292.30	70.02
2011	4.88	342.38	69.25
2012	5.04	361.04	71.63
2013	5.00	341.20	68.24
2014	4.99	352.14	70.57
2015	5.07	362.33	71.47
2016	4.93	348.45	70.39
2017	4.44	306.07	69.00
2018	4.74	379.90	80.20
2019	5.06	405.42	80.10
2020	4.60	370.50	80.54
2021	4.85	405.40	83.59
2022	5.15	431.81	83.85
Total	102.59	7320.35	1563.07
CGAR %	0.80	1.73	0.92

*Sources: dacnet.nic.in*

It shows that the respective rates for area, production, and productivity were 0.80 percent, 1.73 percent, and 0.92 percent. The chart indicates that in 2007 and 2022, the largest area was 5150.00 thousand hectares, and in 2015, it was 5070.00 thousand hectares. 405.42 MT in 2019 and 83.85 MT in 2022 were the highest production and productivity, respectively, while 83.59 MT in 2021 and 431.81 MT in 2022 were the highest productivity.

### 3.2 Compound annual growth rate (CAGR) of sugarcane in Uttar Pradesh:

Table 2 indicates the compound annual growth rate for the area, productivity, and production of all sugarcane in Uttar Pradesh.

**TABLE 2**  
**YEAR WISE AREA, PRODUCTION AND PRODUCTIVITY OF SUGARCANE OF UTTAR PRADESH (2001 TO 2019)**

Year	Area (in 000 ha)	Production (in 000 tonne)	Productivity (in 000 tonne/ha)
2001	1.99	129266.70	65.12
2002	1.97	116483.40	58.99
2003	2.01	115418.90	57.39
2004	1.94	106067.50	54.72
2005	2.04	117982.00	57.98
2006	2.15	120948.00	56.28
2007	2.03	112754.00	55.54
2008	1.95	118715.60	60.73
2009	2.16	125469.90	58.20
2010	2.25	133949.40	59.63
2011	2.18	124665.30	57.21
2012	2.08	109048.00	52.33
2013	1.98	117140.00	59.25
2014	2.13	120545.00	56.73
2015	2.16	128819.00	59.58
2016	2.21	132427.68	59.87
2017	2.23	134688.62	60.45
2018	2.14	133061.42	62.15
2019	2.17	145385.00	67.03
2020	2.18	178342.00	81.80
2021	2.18	177438.42	81.38
Total	44.13	2698615.84	1282.36
CGAR %	0.43	1.51	1.06

*Sources: dacnet.nic.in*

It shows that the area, productivity, and production all had compound annual growth rates of 0.43 percent, 1.51 percent, and 1.06 percent, respectively. According to the table, the largest area was 2.25 thousand hectares in 2010 and 2.23 thousand hectares in 2017. 2020 and 2021 show the highest output and productivity levels, respectively, of 178.34 MT and 177.43 MT. In 2020, 81.80 MT and 81.38 MT were the highest productivity levels.

### 3.3 Compound annual growth rate (CAGR) of sugarcane in Kushinagar:

Table 3 provides an examination of the compound annual growth rate for the acreage, productivity, and production of all sugarcane in Kushinagar.

**TABLE 3**  
**YEAR WISE AREA, PRODUCTION AND PRODUCTIVITY OF SUGARCANE OF DISTRICT IN KUSHINAGAR (2010 TO 2021)**

Year	Area (in 000 ha)	Production (in 000 Tons)	Productivity (in 000 tons/ha)
2010-11	73.13	3763.65	5.15
2011-12	72.23	3758.61	5.20
2012-13	70.22	3998.09	5.68
2013-14	99.10	5923.25	5.98
2014-15	70.10	4217.90	6.02
2015-16	71.89	4251.06	5.91
2016-17	71.89	4689.97	6.52
2017-18	71.89	5164.49	7.18
2018-19	70.89	5450.09	7.69
2019-20	71.89	5445.76	7.58
2020-21	71.89	4923.26	6.84
Total	815.12	51586.94	69.75
CAGR %	-0.15	2.72	2.87

*Source: dacnet.nic.in*

It shows that the area, productivity, and production all had compound annual growth rates of -0.15 percent, 2.72 percent, and 2.87 percent, respectively. The chart indicates that in 2013–14, the highest area was 99.10 thousand hectares, followed in 2010–11 by 73.13 thousand hectares. 2013–14 saw the highest output of 5923.25 MT, which was followed by 2018–19's 5450.09 MT. Similarly, 2018–19 saw the highest productivity of 7.69 MT, which was followed by 2019–20's 7.58 MT.

#### IV. CONCLUSION

The growth rate of area, production and productivity of sugarcane in India and Uttar Pradesh for the last 22 years were witnessed to be positive, significant and showing an increasing trend over time. It revealed that the production of sugarcane increases mainly due to expansion of the area under sugarcane cultivation and slight improvement of productivity by the adoption of advanced cultivation practices and diversification of cultivated variety. In case of Kushinagar district, the compound annual growth rate in area was negative trend but production and productivity was positive. It implies that farmers should need to pay adequate attention to adopt improved production technologies and advanced management to address the problems of fluctuation in sugarcane production.

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