

## Original Research Article

# Growth and Decomposition Analysis of Sugarcane Production in India

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## A B S T R A C T

Sugarcane is an important commercial crop grown all over the world. It is the raw material for the production of white sugar, jaggery (gur) and khandsari. It is also used for chewing and extraction of juice for beverage purposes. The sugarcane cultivation and sugar industry in India plays a vital role towards socio-economic development in the rural areas by mobilizing rural resources and generating higher income and employment opportunities. The sugarcane production in the country has gone up from 57.05 to 379.9 million tons between 1950-51 and 2017-18, registering a modest growth. During the period while the area has also gone up from 1.71 to 4.74 million ha, the yield has steadily increased from 33422 to 80198 kg/ha. In the present study data were broadly partitioned into seven decades in order to demonstrate the trend of sugarcane production in a more convincing way and simple manner. The compound growth rates of area , production and yield of sugarcane was found positive for each decades of the study period. Overall there was positive growth rate of area, production and yield. The area effect has a greater say in sugarcane each decade except seventies. The area and yield instability were of medium order and production instability is of high order. Overall the change in production is due to all the three component yield, area and interaction effect.

## Keywords

Sugarcane,  
Instability, Growth  
rate, Coefficient of  
variance,  
Decomposition  
analysis

## Introduction

There are a number of crops grown by farmers. These include different food crops, commercial crops, oil seeds crops etc., sugarcane is one of the important commercial crops grown in India and is the main source of sugar in Asia and Europe. It is the raw material for the production of white sugar, jaggery (gur) and khandsari. It is also used for chewing and extraction of juice for beverage purposes. The sugarcane cultivation and sugar industry in India plays a vital role towards socio-economic development in the

rural areas by mobilizing rural resources and generating higher income and employment opportunities.

The Indian states Uttar Pradesh, Maharastra, Karnataka, Tamilnadu, Gujrat, Bihar, Andhra Pradesh, Punjab, Haryana, Madhya Pradesh, Uttrakhand, and Telangana where sugarcane is grown on a large extent of area and production. There are a number of varieties that are grown in India depending on the suitability of the soil. The area, production and yield and sugarcane cultivation is subjected to fluctuate in

response to policies of the government and also conditions of cultivation.

The sugarcane production in the country has gone up from 57.05 to 379.9 million tons between 1950-51 and 2017-18, registering a modest growth. During the period of study the area has increased from 1.71 to 4.74 million ha, while the yield has steadily increased from 33422 kg/ha to 80198 kg/ha.

In this article an attempt has been made to assess the growth of sugarcane in India and study the contribution of area, yield and interaction of yield and area to the total production during the last 67 years (i.e. 1950-51 to 2017-18).

### Materials and Methods

The time series secondary data on area, production and yield of sugarcane during the period 1950-51 to 2017-18 were collected from “Agricultural Statistics at a Glance”, a publication of the government of India. The present data were broadly partitioned into six decades in order to demonstrate the trend of sugarcane production in more convincing and simple manner. The partition of the data in decade's terms could clearly show the sugarcane production status and growth pattern in the country.

The compound growth rate has been determined by using the following exponential function adopted by Naidu (2015) and Devraj (2019).

$$Y = ab^t$$

Where

Y = the variable for which growth rate is calculated

t= time variable

b= the regression coefficient

a= intercept

The log form of the above exponential equation is expressed as

$$\log(Y) = \log(a) + t \log(b)$$

The compound growth rate percentage (r %) can be expressed as

$$r \% = (\text{Antilog}(\log(b)) - 1) \times 100$$

The coefficients of variation in percent (CV %) were computed using the formula  
 $CV (\%) = (\text{Standard deviation} / \text{Mean}) \times 100$   
[Moorti (1991) and Hasija (2003)].

To study the contribution of area, yield and the interaction of area and yield towards increasing the sugarcane production in India, a decomposition analysis has been performed and is expressed as

Production in the base year is given by

$$P_o = A_o \times Y_o$$

Similarly, the production in the n<sup>th</sup> year is given by

$$P_n = A_n \times Y_n$$

Also  $P_n = P_o + \Delta P$ ,  $A_n = A_o + \Delta A$  and  $Y_n = Y_o + \Delta Y$

Therefore,

$$\begin{aligned} P_n &= A_n \times Y_n \\ &= (A_o + \Delta A)(Y_o + \Delta Y) \\ &= A_o Y_o + A_o \Delta Y + \Delta A Y_o + \Delta A \Delta Y \\ &= P_o + A_o \Delta Y + \Delta A Y_o + \Delta A \Delta Y \\ \text{or } \Delta P &= P_n - P_o = A_o \Delta Y + Y_o \Delta A + \Delta A \Delta Y \end{aligned}$$

The first term on the right hand side can be considered as the yield effect, the second term as the area effect and the third term as the interaction effect.

Where,

$A_o$  = area in the base year

$A_n$  = area in  $n^{\text{th}}$  year

$P_o$  = yield in base year

$P_n$  = yield in  $n^{\text{th}}$  year

$Y_o$  = yield in base year

$Y_n$  = yield in  $n^{\text{th}}$  year

$\Delta A$  = Change in area ( $A_n - A_o$ )

$\Delta P$  = Change in production ( $P_n - P_o$ )

$\Delta Y$  = Change in yield ( $Y_n - Y_o$ )

## Results and Discussions

Decade wise area, production and yield of sugarcane has been given in table 1. The area under sugarcane in 1950-51 was 1.71 million ha which showed an increasing trend and recorded acreage of 3.2 million ha in 2017-18. It was highest (5.15 million ha) in 2005-06. The production and yield of the crop also witnessed an increasing trend. The production of sugarcane was 379.9 million tons in 2017-18 and its production was 57.05 million tons in the base year 1950-51. Similarly, the yield of sugarcane showed an increasing trend and recorded 80198 kg/ha in 2017-18 as against 33422 kg/ha in 1950-51. The farmer could achieve this increasing trend in production and yield mainly due to introduction of resistant varieties against different diseases and insects and pests, better management and matching improved production and protection technologies.

Table 2 presents the percentage contribution of area, yield and their interaction in changing (increase or decrease) of the production of sugarcane for each decades from 1950-51 to 2017-18 and the overall period. Response to change in production was due to acreage affect during all the decades except seventies of last century. There were negative effect of area and yield in the seventies of last century and first decades of this century respectively. The interaction of area and yield is not much. Overall the production is increased due to all three factor i.e. yield, area and interaction effect.

The compound growth rate and coefficient of variation in area, production and yield of sugarcane in different decades and for the whole period are given in table 3. It indicates that the compound growth rates of area and production of sugarcane were found positive in each decade of the study period. Overall there were positive growth rate of area, production and yield. The coefficient of variation of the detrained data was used as a measure of instability in the production of sugarcane in the country. The instability of area, production and yield for each decade are of low order and Table 3 revealed that for the overall period 1950-51 to 2017-18 the area and yield instability were of medium order and production instability was of high order.

**Table.1** Area, production and yield of sugarcane during 1950-51 to 2013-14

Year	Area (m.ha.)	Production (m.tons)	Yield (kg/ha)
1950-51	1.71	57.05	33422
1960-61	2.42	110.00	42349
1970-71	2.62	126.37	48322
1980-81	2.67	154.25	57844
1990-91	3.69	241.05	65395
2000-01	4.32	295.96	68578
2010-11	4.88	342.38	70091
2017-18	4.74	379.90	80198

**Table.2** Percentage contribution of yield, area and their interaction in production of sugarcane

Period	Yield	Area	Interaction
1950-51 to 1959-60	24.6	69.2	6.2
1960-61 to 1969-70	34.5	60.0	4.5
1970-71 to 1979-80	122.3	-21.8	-0.5
1980-81 to 1989-90	29.1	62.5	8.4
1990-91 to 99-2000	35.1	59.5	5.4
99-2000 to 2009-10	-145.5	240.3	5.2
1950-51 to 2017-18	24.8	31.4	43.8

**Table.3** coefficient of variation (CV %) and compound growth rate (r%) of sugarcane in different decades

Period	Area		Production		yield	
	CV	r	CV	r	CV	r
1950-51 to 1959-60	11.75	2.58	15.83	4.35	7.10	1.72
1960-61 to 1969-70	9.5	0.64	13.06	1.82	7.22	0.73
1970-71 to 1979-80	8.6	1.90	12.21	2.56	4.76	0.64
1980-81 to 1989-90	7.44	1.46	10.24	2.71	4.45	1.23
1990-91 to 99-2000	6.54	1.67	9.06	2.73	3.88	1.05
2001-02 to 2009-10	9.88	0.74	12.76	1.21	4.66	0.47
1950-51 to 2017-18	31.29	1.62	49.55	2.87	23.45	1.23

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