Sugarcane is an important commercial crop of India. It plays a crucial role for overall socio-economic development of farming community. India ranks second in production of sugarcane after Brazil. In India about 4.73-millionhectare land is occupied by sugarcane crop. Based on the importance of sugarcane crop, present study was conducted to know growth rate of area, production and yield of sugarcane in India and performance of sugarcane crop in major sugarcane producing states of India.

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. India is the largest producer and consumer of sugar in the World. About 45 million sugarcane farmers, their dependents and a large agricultural force, constituting 7.5 percent of the rural population, are involved in sugarcane cultivation, harvesting and ancillary activities. This enabled India to become the largest producer of sugarcane and sugar in the world leaving the other major producers Brazil and Cuba. The major sugarcane crop growing states in India are Uttar Pradesh, Bihar, Assam, Haryana, Gujarat, Maharashtra, Karnataka and Tamil Nadu.

**Key words:** Sugar cane Production, Employment opportunities, Economic development.

I. INTRODUCTION

Sugarcane is the main source of sweeteners globally and holds a prominent position as a cash crop. India occupies second position in Sugarcane cultivation after Brazil. Climatic condition of India is favorable for sugarcane cultivation hence the production of Sugarcane spread across the country. There are two different agro-climatic regions of sugarcane cultivation in India namely tropical and sub-tropical. The tropical regions include the states of Maharashtra, Gujrat, Tamil Nadu, Andhra Pradesh and Karnataka, Madhya Pradesh, Goa, Kerala. Tropical region records the high sugar recovery due to the long sunshine hours, cool nights with clear sky and the latitudinal position of the area favorable for sugar accumulation. The sub-tropical region includes the states namely Uttar Pradesh, Bihar and Haryana and Punjab. Climatic conditions are generally variable depending upon the season and sometimes within the seasons also.

Sugarcane crop faces all the season in a year. Uttar Pradesh is having largest area under sugarcane crop. However, the highest sugar recovery can be obtained in the Maharashtra. It is a major source of raw material not only sugar industry but other allied group of industries. Sugarcane and its by products provide employment opportunities to large number of people and responsible for socio-economic transformation of farming community. Sugar industry has been instrumental in resource mobilization, employment generation, income generation and creating social infrastructure in rural areas, in other words sugar industry has facilitated and accelerated pace of rural industrialization. Production of Sugarcane in India is not uniform, fluctuating trend of production has been found. This is due to the several problems faced by sugarcane industry, such as Low yield of Sugarcane, Prices fixed by government, delay in payments, unpredictable monsoon condition etc. (Gaikwad, C. 2017). Water scarcity is the major problem faced by sugarcane farmers in India, the major reason for low production and low productivity is the unpredictable monsoon condition. So, the present study will examine the
growth of area, production and productivity of sugarcane crop in India and to analyze the performance of major sugarcane producing states in India.

India has been known as the original home of sugarcane and sugar. India is the second largest producer of sugar in the World after Brazil and produces more of cane sugar and not beet sugar. Sugarcane is the important commercial crop of the country. Sugarcane is a major cash crop in India responsible for the overall socio-economic development of the farming community. Molasses, sugar and khandsari etc, are produced from the juice of sugarcane. Production of the crop is mainly located in the states of Uttar Pradesh, Maharashtra, Tamil Nadu, Karnataka and Gujarat. Sugarcane cultivation needs temperature of 15 degree to 40 degree and rainfall of 100 to 150 centimeters and fertile loamy soil or hard soil. Sugarcane is a long duration crop which produces huge amounts of biomass, requiring large quantities of water, which typically are supplied through 25-30 irrigation cycles per crop season sugarcane is cultivated from Kanyakumari (southern Part) to Punjab (north – west) but it is more cultivated in Uttar Pradesh, except these States, sugarcane is an important crop in Maharashtra, Tamil Nadu, Andhra Pradesh, Karnataka, Punjab, Haryana, and Bihar etc. In India, the sugar industry is the second largest agriculture based industry after textile fibers. It arises over INR 225 billion in taxes for the common wealth and state governments.

Study Problem

India is the fourth major producer country in the world and in India Sugar Industry is the second industry after textile industry. Sugar Industry, one of the major agro industries in India, has been instrumental in resource mobilization, employment generation, income generation and creating social infrastructure in rural and urban areas. Indeed Sugar Industry has facilitated and accelerated pace or rural industrialization. In present time there are 615 sugar mills (Public, Private and cooperative sector) producing 25 million tons sugar. Indian Sugar Industry is providing employment to more than 6 lakh people in rural area and more than 5-40 crores farmers are engaged in sugar-cane cultivation. Sugar Industry has brought socioeconomic changes in rural India by way of facilitating entrepreneurial activities such as dairies, poultries, fruits and vegetable processing and providing educational health and credit facilities. The sugar industry was granted protection till 1950. Since independence there have been on overall increasing trend in sugar production in India. Production of sugar has increased by leaps bounds in the planning period.

II. LITERATURE REVIEW

Murty et al. analyzed the impact of environmental regulation on productive efficiency and cost of pollution abatement for the sugar industry of India. The average environmental efficiency has been observed to be 0.85, which implied that the industry had to incur an input cost of 15% more to reduce pollution for a given level of production of good output.

Sarbapriya Ray et al. economic analysis on “Performance of Indian Sugar Industry: An Economic Analysis” result showed that there has been diminishing capacity utilization growth rate in the industry during post reform period. The impact of liberalization on economic capacity utilization of Indian sugar industry is noticed to have significant negative impact.

Adya Prasad Pandey et al., conclude that the main concern of sugar industry in India is fluctuations in sugarcane production due to inadequate irrigation facilities, lower sugarcane yield, and frequent droughts in tropical and sub-tropical areas where sugarcane is grown on a large scale. Sugar recovery is also lower in comparison with other sugar manufacturing countries. This leads to escalation of production costs and weakness competitive edge of the industry. Sugarcane production in India has decelerated to a great extent due to water and power shortage, in recent years. Special attention is needed to be given on water resource management.

Deshmukh et al. developed a systematic approach for analysing in-bound logistics (the interfaces between the sugar industry and the farmers). In his methodology an attempt was be made to minimize harvesting to crushing time to obtain the maximum possible sugar recovery for enhancing the profitability. To accomplish this, farmers and millers should be treated as an inter-dependent enterprise.

Objectives of the Study

The main objective of the present study is to determine the growth and development of sugar production in India.
Methodology

The Study is based on secondary source of data which is collected from various reports. The compound annual growth rate, percentage change or annual growth rate was calculated. Compound annual growth rates (CAGR) was worked out to study about the changes in area, production and yield of sugarcane over a period. The compound annual growth rate was calculated by fitting the following equation in the time series data area, production and yield.

\[ Y_t = Y_0 \left(1 + r\right)^t \]

Taking log on both side we will get

\[ \ln Y_t = \ln Y_0 + t \ln (1 + r) \]

\[ \ln Y_t = a + bt \]

Where,

- \(a = \ln Y_0\)
- \(b = \ln (1 + r)\)

\(Y_t\) = area/ production/ yield

\(Y_0\) = constant

\(t\) = time period in years and

\(b\) = regression coefficient

\(\% \) compound growth rate\(=\left(\text{Anti log } b - 1\right) \times 100\)

Percentage change in yield is given by:

\(\% \text{ change in yield } = \left(\text{Current year yield } - \text{Previous year yield}\right) \times 100\)

Previous year yield

Analysis of Sugarcane in India

As already discussed, India is the second largest producer of sugarcane in the world and it has enormous influence on economy of the country. So, it is important to study the area, production and yield of Sugarcane in the country. During, 1995-96 area under sugarcane crop was 4147 thousand hectares. The area increased to 4737 thousand hectares in 2017-18. As shown in the table1 over the years area, production and yield has increased from 1995-96 to 2017-18. The area under sugarcane has sharply increased in 2006-07 i.e. 5151 thousand hectares. It is clear from the table that area, production and yield is fluctuating in the study period. Production of sugarcane in 2017-18 was increased as compare to 2006-07, but area in 2006-07 was more, this is due to the various incentives, high yielding verities etc. It is clear from the study that the trend of sugarcane cultivation in India is uneven.

### TABLE 1 SUGARCANE CROP IN INDIA (1995-96 TO 2017-18)

<table>
<thead>
<tr>
<th>Year</th>
<th>Area (000 Hectare)</th>
<th>Production (000 Tonne)</th>
<th>Yield (in K.G/ Hect.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010-11</td>
<td>4885</td>
<td>342382</td>
<td>70091</td>
</tr>
<tr>
<td>2011-12</td>
<td>5038</td>
<td>361037</td>
<td>71668</td>
</tr>
<tr>
<td>2012-13</td>
<td>4999</td>
<td>341200</td>
<td>68254</td>
</tr>
<tr>
<td>2013-14</td>
<td>4993</td>
<td>352142</td>
<td>70522</td>
</tr>
<tr>
<td>2014-15</td>
<td>5067</td>
<td>362333</td>
<td>71511</td>
</tr>
<tr>
<td>2015-16</td>
<td>4927</td>
<td>348448</td>
<td>71511</td>
</tr>
<tr>
<td>2016-17</td>
<td>4436</td>
<td>306069</td>
<td>69001</td>
</tr>
<tr>
<td>2017-18</td>
<td>4737</td>
<td>376905</td>
<td>79650</td>
</tr>
</tbody>
</table>

Source: Indian Sugar Mills Association. & Ministry of Agriculture & Farmers Welfare, Govt. of India
TABLE 2 Annual growth rate of area, Production of Sugarcane

<table>
<thead>
<tr>
<th>Year</th>
<th>Area (000 Hectare)</th>
<th>Production (000 Tonne)</th>
<th>Yield (in K.G/ Hect.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010-11</td>
<td>17.01</td>
<td>17.13</td>
<td>0.10</td>
</tr>
<tr>
<td>2011-12</td>
<td>3.13</td>
<td>5.45</td>
<td>2.25</td>
</tr>
<tr>
<td>2012-13</td>
<td>-0.77</td>
<td>-5.49</td>
<td>-4.76</td>
</tr>
<tr>
<td>2013-14</td>
<td>-0.12</td>
<td>3.21</td>
<td>3.32</td>
</tr>
<tr>
<td>2014-15</td>
<td>1.48</td>
<td>2.89</td>
<td>1.40</td>
</tr>
<tr>
<td>2015-16</td>
<td>-2.67</td>
<td>-3.83</td>
<td>-1.11</td>
</tr>
<tr>
<td>2016-17</td>
<td>-9.97</td>
<td>-12.16</td>
<td>-2.43</td>
</tr>
<tr>
<td>2017-18</td>
<td>6.79</td>
<td>24.12</td>
<td>16.23</td>
</tr>
</tbody>
</table>

Source: Indian Sugar Mills Association. & Ministry of Agriculture & Farmers Welfare, Govt. of India

Compound annual growth rate was calculated on area, production and yield of sugarcane in India to know about the growth rate over a period of time. It is clear from the table that annual growth rate in area, production and yield is not even. The growth in terms of area has increased rapidly between 2005-06 and 2006-07. The highest annual growth in terms of area is found in 2006-07 i.e. 22.58 percent. The highest negative annual growth rate in area is found in 2003-04. The periods in which the area has increased; production has also increased in those periods. Compound annual growth for production is highest in 2006-07. Yield is showing better growth in 2017-18, which indicates that farmers can take up this crop in better way.

TABLE 3 COMPOUND ANNUAL GROWTH RATES OF SUGARCANE

<table>
<thead>
<tr>
<th>Year</th>
<th>Area (in Percent)</th>
<th>Production (in Percent)</th>
<th>Yield (in Percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995-2005</td>
<td>0.13</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>2005-2015</td>
<td>1.60</td>
<td>2.17</td>
<td>0.55</td>
</tr>
<tr>
<td>1985-2015</td>
<td>5.63</td>
<td>7.40</td>
<td>1.68</td>
</tr>
</tbody>
</table>

Source: Calculated by authors, data obtained from Ministry of Agriculture & Farmers Welfare, Govt. of India

It is clear from the table and figure that CAGR in area, production and yield is increasing between 1985-1995. But between 1995-2005 the production and yield are not increasing. After the 2005 the rate of area, production and yield started to increase but the rate of increment was very slow. The overall Compound annual growth rate of 30 years (1985-2015) for area under sugarcane crop in India is 5.63 percent. Compound Annual growth rate for production in 30 years is 7.40 percent, and for yield is only 1.68 percent.

III. CONCLUSION

The analysis of the secondary data on production of sugarcane in India has revealed that there were variations in production. It was evident from the trend equations that there were fluctuations in the production of sugarcane in India, no uniform pattern of growth was observed. It is hereby to conclude that the major reason for low production and low productivity is the unpredictable monsoon conditions. Thus initiatives on proper irrigation management would enable the scope and increase the production of sugarcane in India.

From the above discussion it was found that the area under sugarcane was found to be increased by 5.63 percent over thirty years (1995 to 2015), whereas production and yield increased at 7.40 percent and 1.68 percent. It is clear from the study that trend of sugarcane cultivation in India is fluctuating, no uniform pattern of growth has observed. This is due to many problems faced by sugarcane farmers includes the problem of scarcity of water,
sugarcane pricing problems etc. Sugarcane crop requires regular supply of larger quantity of water for its growth. Availability of sufficient water mainly depends on rainfall. Fluctuation in seasonal rainfall in India adversely affects the production of sugarcane. Sugarcane being a long duration crop which requires more irrigation. Poor water availability leads to drying of crop and yield loss. The lack of usage of mechanization in India is due to the small size of land holding, improper crop spacing, and lack of finance. Some machines are worthy, and these are not affordable to farmers but introduction of costly machines through custom hiring centers can help the farmers to get the benefits of machinery.

REFERENCES