RESEARCH PAPER

Sugarcane Cultivation In Haryana: A Spatio-Temporal Analysis (1966-2022)

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Abstract

Sugarcane is one of the most important cash crops in india and this crop has a significant role in agrarian economy and the crucial in industry as a raw material. India has occupied second place in terms of sugarcane production in the world. In this paper, an attempt has been made to study the cropped area under sugarcane production and reveal the trends of sugarcane production in the state of haryana from the formation of the state to the year 2022. The pattern of sugarcane cultivation in haryana is very dynamic. There are several geographical factors that affect the distribution of sugarcane production in the state such factors as rainfall, temperature, soil, and transportation facilities, irrigation, and the location of sugar mills from the farm. To examine the trend in the area and production of sugarcane in the state, the triennium averages have been computed for the period 1966-69, 1990-93, and 2019-22. The total production under sugarcane has substantially increased during the period of 1966-67 to 2021-22. It has increased from 550 thousand tonnes in 1966-67 to 835 thousand tonnes in 2021-22 which is a total increment of 65 percent whereas, the total cropped area under sugarcane decreased from 3.19 percent in 1966-67 to 1.53 percent in 2021-22.

Keywords: Cropped Area, Cagr, Cash Crop, Sugarcane Cultivation, Spatio-Temporal.

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INTRIDUCTION

Agriculture is the world's oldest economic practice. Agriculture not only provides food and raw materials, but it also provides job opportunities (Rani, 2019). Haryana is one of the agriculturally developed states in India. Approximately 65% of the population is directly engaged in agricultural activities, representing around 16.2% of the state's GSDP (Haryana Economic Survey 2023-24).

Sugarcane (Saccharum officinarum L.) is a major cash crop in India (Singh et. al., 2021; Nisha et. al., 2020). Sugarcane and sugar beet are used for large-scale production of sugar (Manohar, 2023). Sugarcane was first domesticated as a crop in New Guinea around 6000 BC (Nisha et. al., 2020). It is a perennial grass of the family that is grown primarily for its sugar content. It is indigenous to the tropical region of South and Southeast Asia. Different species of sugar cane have different origins, with Saccharum barberi originating in India while Saccharum edule and Saccharum officinarum are indigenous to New Guinea. Sugarcane grows best in warm, sunny, frost-free climate conditions. It requires a tropical or subtropical climate with a minimum of 600 mm of annual rainfall. It grows well at 20 to 35 ° C temperature. It requires extended periods of sunlight (about 12 to 14 hours) with high humidity (80-85%), for fast sugarcane growth (Tarimo and Takamura, 1998). Sugarcane plants become ready for harvesting in 10-12 months in north India and 12-16 months in south India, depending on the variety and local climate conditions. Harvesting is usually done manually with machetes or automated means. The harvested cane is then taken to sugar mills for processing, where it is crushed to extract juice, which is then processed into sugar and other by-products like molasses and bagasse (Upreti and Singh, 2017).

India is the world's second-highest sugarcane producer after Brazil, accounting for 20% of the total production. The cultivation of sugarcane provides the primary income for about fifty million farmers in India (Balasaheb, 2013).

The sugar industry is India's second largest agro-based industry, after the cotton textile industry, and it depends on a large number of rural people (Kour, 2018).

India's top 10 sugarcane-producing states are Uttar Pradesh, Maharashtra, Karnataka, Gujarat, Tamil Nadu, Bihar, Haryana, Punjab, Madhya Pradesh, and Andhra Pradesh (Ministry of Agriculture, Government of India, 2023). Sugarcane cultivation is the primary influencer of the sugar production in the world.

Haryana is the 7th highest sugarcane producer in the country, accounting for 2.11% of total production (Ministry of Agriculture, Government of India, 2023). Sugarcane is one of Haryana's most important cash crop, with a considerable impact on the state's economy. Sugarcane agriculture in Haryana has a long history, with farmers using modern techniques to increase quality and yield. There are presently 14 sugar mills in Haryana, with the Saraswati Sugar Mill in Yamuna Nagar which has the highest sugarcane Crushed capacity, 10000 tons per day (haryanasugarfed, 2024).

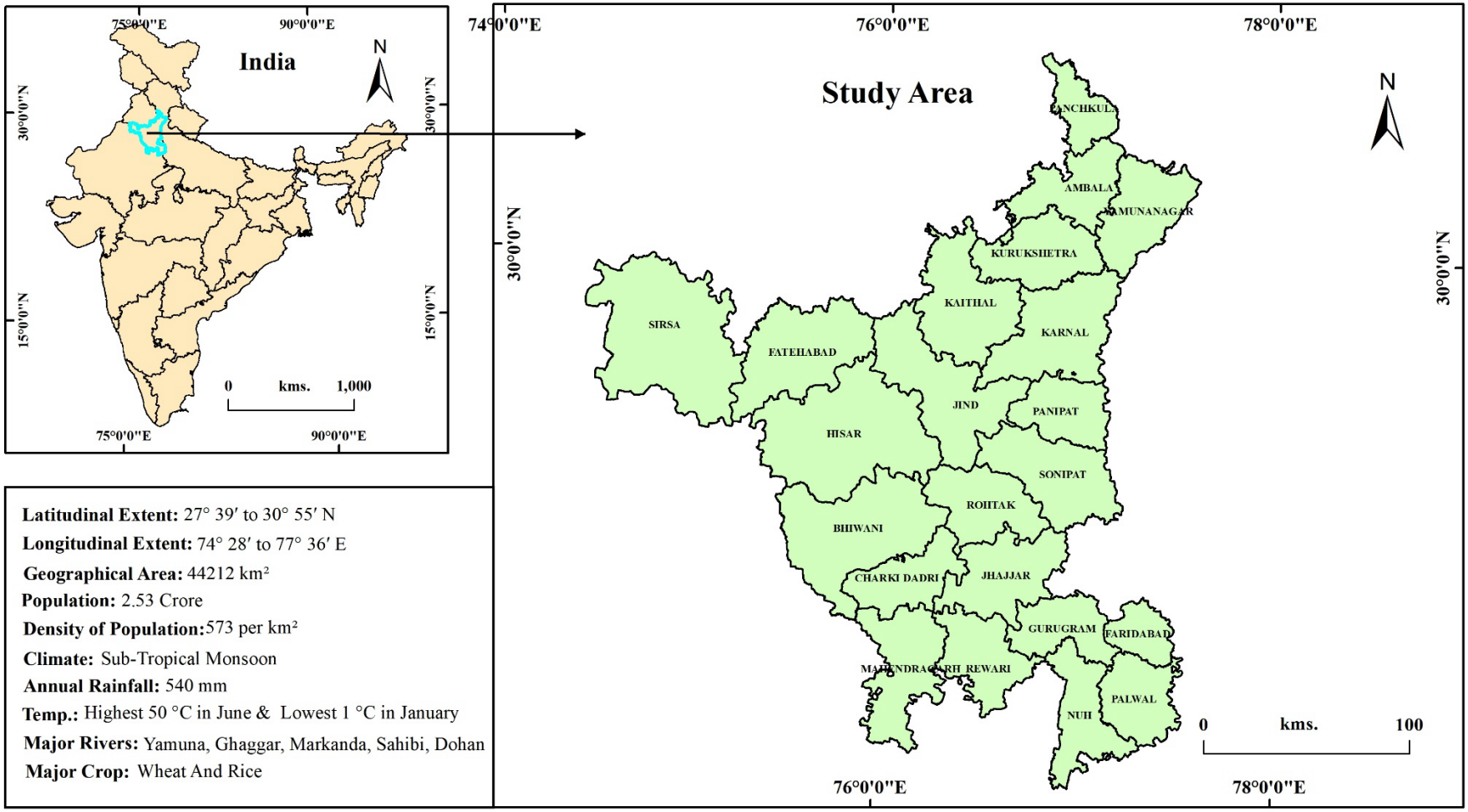
The objective of the Study:

The present study is aimed at the following objectives:

1. To examine the temporal change of area and production of sugarcane cultivation from 1966 to 2022 in Haryana.
2. To examine the spatial pattern of area and production of sugarcane in the study region.

STUDY AREA

The state of Haryana is located in the north-western part of India. It extends between 27° 39′ to 30° 55′ N latitude and 74° 28′ to 77° 36′ E longitude (Singh and Jaglan, 2021). (Fig. 1) The state's total geographical area is 44212 km², which is only 1.4 percent of the total area of India. It is one of the landlocked states of the country. The total population is 2.53 crore with a population density of 573 persons per km² according to the 2011 census (Statistical Abstract of Haryana, 2022). There are at present twenty-two districts in the state. The capital of Haryana is Chandigarh which is also the capital of its neighbouring state Punjab. It shares boundaries with Punjab on the Northern side, Himachal Pradesh on the North-West side, Uttar Pradesh on the East and Rajasthan on the South West side. The North-Eastern part of the state is bordered by the Aravalli ranges (Singh and Jaglan, 2021). The state has a sub-tropical monsoon climate with irregular rains, and hot summers about 540 mm rainfall which differs from 1100 mm in the north foothills north foothills of Siwalik Himalaya to 250–380 mm in the southwestern plains. About 80% of the total annual rainfall occurs during the monsoon season (July–September), and the rest of the rain falls during the winter season (December–February) owing to western disturbances (Sharma and Singh, 2023). The average slope of its surface is from northeast to southwest, the slope of the northern part is towards the south and slope of the southern part is towards north (Singh and Amrita, 2015). Almost all rivers of the state follow this direction. The major rivers of the state are Yamuna, Ghaggar, Tangri, Sahibi, Dohan, and Markanda.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AMBALA
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KURUKSHETRA
KAITHAL
KARNAL
SIRSA
FATEHABAD
JIND
PANIPAT
HISAR
SONIPAT
ROHTAK
BHIWANI
CHARKI DADRI
JHAJJAR
GURUGRAM
FARIDABAD
MAHENDRAGARH
REWARI
PALWAL
NUH
0 kms. 100
Latitudinal Extent: 27° 39′ to 30° 55′ N
Longitudinal Extent: 74° 28′ to 77° 36′ E
Geographical Area: 44212 km²
Population: 2.53 Crore
Density of Population: 573 per km²
Climate: Sub-Tropical Monsoon
Annual Rainfall: 540 mm
Temp.: Highest 50 °C in June & Lowest 1 °C in January
Major Rivers: Yamuna, Ghaggar, Markanda, Sahibi, Dohan
Major Crop: Wheat And Rice

Fig. 1

DATABASE AND METHODOLOGY

This analytical study is based on secondary data, The districts-wise data related to production, and cropped area of sugarcane from 1966 to 2022 has been collected from 'Statistical Abstract Haryana' (1966-2022) published by the Department of Economic and Statistical Analysis, Haryana (https://esaharyana.gov.in). After the collection of secondary data, the analysis was done by using suitable statistical methods such as average, percentage, Compound Annual Growth Rate (CAGR), and different GIS software (Arc-Map 10.8 and QGIS 3.34), etc. were calculated to draw valid inferences from the study, following formulas have been used in the present study**: -**

Average of triennium of area and production is used for the study

$$\text{Area and Production} = \frac{\text{Sum of the value of three year}}{3} \quad (1)$$

Proportion of Area under Sugarcane

$$\text{Cropped Area} = \frac{\text{Area Under Sugarcane}}{\text{Total Cropped Area}} \times 100 \quad (2)$$

Compound Annual Growth Rate

$$\text{CAGR of Area and Production} = \left(\frac{\text{End Value}}{\text{Start Value}}\right)^{1/n} - 1) \times 100 \quad (3)$$

Where **N** is the number of years

RESULT AND DISCUSSION:

Trends in area under sugarcane

The trend of the area under sugarcane in Haryana from 1966-1967 to 2021-22 exhibits significant fluctuations (Fig. 2) The graph shows so much fluctuation. in the trend of the area under sugarcane over the time period 1966-67 to 2021-22. Analyzing the data reveals that the area under sugarcane cultivation has both increased and decreased over this time period in Haryana. Sugarcane is cultivated on 150 thousand hectare area in the year 1966-67and 106.7 thousand-hectare area in the year 2021-22. The graph shows that the highest area under sugarcane was 168.5 thousand hectares in the year of 1976-77 while the lowest 94.8 thousand hectares in the year of 2011-12.

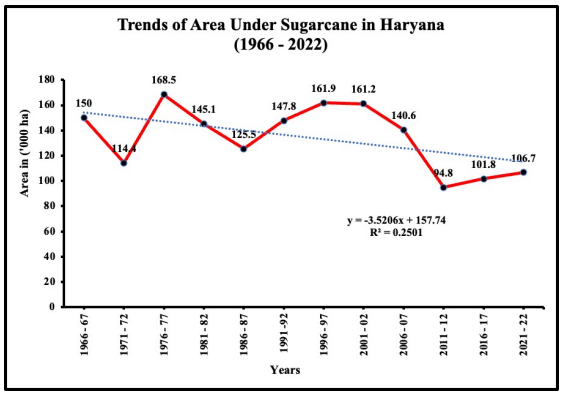

Fig. 2: Trends of area under sugarcane in Haryana (1966 - 2022)

The decrease in the area under sugarcane cultivation can be due to increase in the area under wheat and paddy crop cultivation. Rice and wheat were the crops that got enthusiastic success after the Green Revolution. Due to that farmers sugarcane adopted cultivation of these crops mainly in state. Increase in sugarcane yield and production can also be a reason behind the decrease in the area under its cultivation in the state. Generally, sugar mills decide the amount of sugarcane for purchase from the farmers according to their daily crushing capacity and the duration of the crushing season. If sugarcane farmers have more production from the purchase demand of the sugar mills, then the mills estimate the average of the last two or three-year record of the sugarcane provided by an individual farmer that he sold in the last two or three years to that mill and purchase the sugarcane from the farmer equal to that past year's average. sugarcane farmers estimate the probability of production and then decide on the area, under its cultivation from above mentioned procedure. Sometimes sugar mills also decrease their daily crushing capacity and duration of crushing season due to some reason like prices of sugar in the market etc. This situation adversely affects the sugarcane farmers.

District-wise Spatial Pattern of Area Under Sugarcane Cultivation

Table 1 and Fig. 3 also show the district-wise pattern of the total cropped area under sugarcane cultivation in Haryana during 1966-69, 1990-1993 and 2019-22 time periods. It is evident that sugarcane was grown almost in Haryana at the time of the foundation of the state.

Table 1 and Fig. 3 also show that the proportion of area under sugarcane was very low in the west and southwestern regions and highest in the north and northeastern regions from 1966 and 1969.

The proportion of area under sugarcane was highest in the Rohtak district with 6.74 percent and was lowest was in Mahendergarh district with 0.63 percent.

During the time period of 1990-93, the total area under sugarcane got broadened. On the basis of Table 1 and Fig. 3 it can be interpreted that the highest proportion of area under sugarcane was in the North and Northeastern regions and the lowest was in the West and southwester regions. Yamuna Nagar district has an high proportion area under sugarcane which is 22.81 percent and the lowest in the Sirsa district with 0.02 percent in the state.

Table 1. District-wise pattern of area under sugarcane in Haryana

Sr.	**Districts**	**1966-67** (Percent)	**1990-93** (Percent)	**2019-22** (Percent)
	Ambala	6.70	4.60	4.65
	Karnal	4.24	2.58	2.93
	Rohtak	6.74	5.05	4.12
	Gurgaon	1.69	0.16	0
	Mehanderg arh	0.63	0	0
	Jind	4.26	2.83	1.05
	Hisar	1.18	0.47	0.24
	Sonipat	DNA	4.83	2.66
	Bhiwani	DNA	0.16	0.53
	Kurukshetra	DNA	4.63	4.04
	Sirsa	DNA	0	0.01
	Faridabad	DNA	4.05	0.35
	Yamunanga r	DNA	22.81	9.00
	Kaithal	DNA	1.42	1.16
	Panipat	DNA	3.83	3.32
	Rewari	DNA	0	0
	Panchkula	DNA	DNA	1.46
	Jhajjar	DNA	DNA	1.03
	Fatehabad	DNA	DNA	0.29
	Mewat	DNA	DNA	0.25
	Palwal	DNA	DNA	1.95
	Charkhi Dadri	DNA	DNA	0.75
Haryana		**3.19**	**2.60**	**1.53**

Source: Statistical Abstract Haryana (1966-2022). **DNA** – Districts not available.

In the time period of 2019-22, By observing Table. 1 and Fig. 4 we interpret that the maximum proportion of total cropped area under sugarcane was in the Yamuna Nagar district with 9.00 percent and the minimum in the Sirsa district with 0.01 percent. When we compare it with 1966-69 the proportion of total cropped area under sugarcane decreased from 3.19% to 1.53%. The total cropped area under sugarcane declined due to many reasons but one of the foremost reasons is that the farmers moved on to other crops like paddy, wheat, and vegetables.

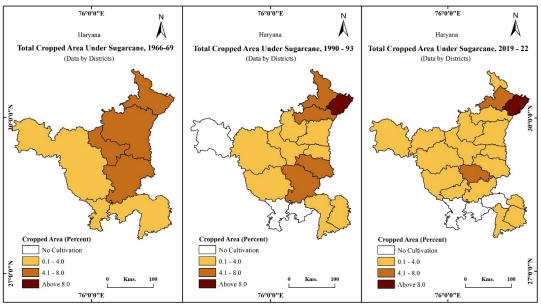

Fig. 3

Trends in the Production of Sugarcane:

Fig.4 presents data on sugarcane production in Haryana from 1966 to 2022, measured in thousand tons. Initially, from 1966-67 to 1971-72, sugarcane production remained relatively stable, with a slight increase from 510 thousand tons to 514 thousand tons. A significant growth period followed, with production rising to 728 thousand tons by 1976-77, indicating improvements in agricultural practices, expansion of cultivated areas, or favorable weather conditions. Between 1976-77 and 1986-87, production fluctuated, dropping to 576 thousand tons in 1981-82 and then increasing to 684 thousand tons in 1986-87.

The period from 1986-87 to 2006-07 saw a general trend of increasing production, peaking at 965 thousand tons in 2006-07. This peak likely

resulted from advancements in agricultural technology, better irrigation facilities, and supportive government policies. However, production significantly declined to 695 thousand tons by 2011-12, possibly due to adverse weather conditions, pest attacks, or economic factors affecting sugarcane farming. Following this decline, a gradual recovery ensued, with production reaching 822 thousand tons in 2016-17 and further increasing to 874 thousand tons by 2021-22. This recovery could indicate improvements in sugarcane farming practices, better crop varieties, or more favourable economic conditions.

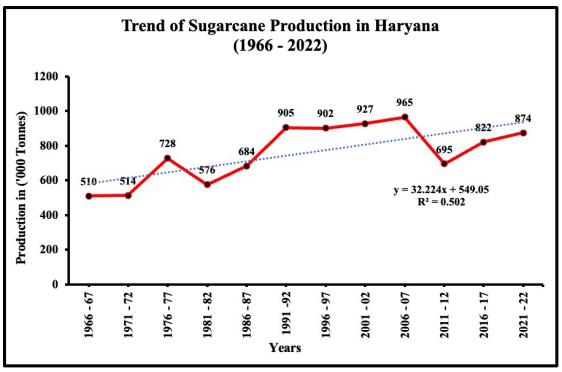

Fig. 4: Trend of sugarcane production in Haryana (1966 - 2022)

Overall, the fluctuations in sugarcane production highlight the impact of economic conditions, government policies, technological advancements, and environmental factors on sugarcane farming. Understanding these historical trends is valuable for informing future agricultural planning and policy-making in Haryana.

District-wise Spatial Pattern of Sugarcane Production

The spatial pattern of sugarcane production in the state has been analysed with respect to three trienniums 1966-69, 1990-93, and 2019-22. In 1966-69, Rohtak district recorded the highest production 170.0 thousand tonnes in the state. Mahendergarh was placed at the last rank with production of 9.7 thousand tonnes of sugarcane.

Table 2. District-wise pattern of Sugarcane Production in Haryana

Sr.	Districts	1966-67 ('000 tons)	1990-93 ('000 tons)	2019-22 ('000 tons)
1.	Ambala	65.3	54.7	84.0
2.	Karnal	140.0	45.0	107.7
3.	Rohtak	170.0	115.3	63.3
4.	Gurgaon	28.3	3.3	0
5.	Mehandergarh	9.3	0	0
6.	Jind	56.0	67.0	37.0
7.	Hisar	81.0	25.0	12.7
8.	Sonipat	DNA	55.7	70.7
9.	Bhiwani	DNA	4.3	20.0
10.	Kurukshetra	DNA	71.0	100.3
11.	Sirsa	DNA	0	0
12.	Faridabad	DNA	40.3	2.0
13.	Yumnangar	DNA	257.0	162.7
14.	Kaithal	DNA	26.7	44.3
15.	Panipat	DNA	41.7	57.3
16.	Rewari	DNA	0	0
17.	Panchkula	DNA	DNA	6.0
18.	Jhajjar	DNA	DNA	18.7
19.	Fatehabad	DNA	DNA	10.0
20.	Mewat	DNA	DNA	3.7
21.	Palwal	DNA	DNA	22.0
22.	Charkhi Dadri	DNA	DNA	12.7
Haryana		**550**	**807.0**	**835.0**

Source: Statistical Abstract Haryana (1966-2022) **DNA** – Districts not available.

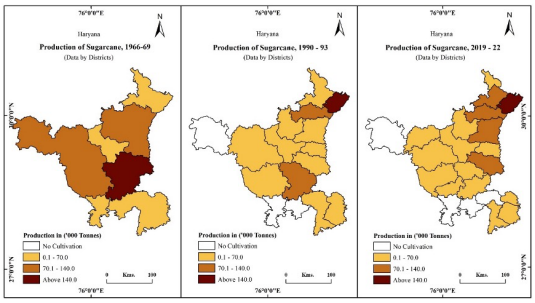

Fig. 5

During the period of 1990-93, by present Table. 2 and Fig. 5 we can see that the maximum production was found in the newly emerged Yamuna Nagar district with 257 thousand tonnes, and the minimum production belonging to Gurgaon district with 3.3 thousand tonnes. Up to 1990-93, Jind was the only district that made the increment in the total production of sugarcane from 56 thousand tonnes in 1966-67 to 67 thousand tonnes in 1990-93 and the rest of the district's production substantially declined due to many new districts were come out during the time period of 1990-93.

In the time period of 2019-22, the overall production of sugarcane increased by 835 thousand tonnes from the previous 1966-67 with 550 thousand tonnes. The maximum production has occurred in the Yamuna Nagar district with 162.7 thousand tonnes and the minimum was occupied by the Faridabad district with 2.0 thousand tonnes.

Growth of Area and Production of Sugarcane

Fig. 6 presents the percentage growth rates of the area under sugarcane cultivation and sugarcane production in Haryana across five distinct periods from 1966 to 2022, as well as the overall period. In the first period 1966-75, the area under sugarcane cultivation grew by 0.51%, and production increased significantly by 3.02%, indicating an expansion phase for sugarcane farming. The second period 1976-85 saw a substantial decrease in both area -4.69% and production -3.67%, reflecting significant challenges, possibly due to economic, environmental, or policy-related issues. The third period 1986-95 experienced a moderate increase in area 1.36% and production 1.69%, suggesting improvements or adaptations in agricultural practices. In the fourth period 1996-05, the area decreased by -2.23%, while production declined by a smaller margin of -0.82%, indicating that productivity might have been relatively maintained despite reduced land use. The fifth period 2006-22 showed continued declines in both area -1.71% and production -0.62%, highlighting ongoing challenges or shifts away from sugarcane cultivation. The overall period from 1966 to 2022 area of sugarcane has a negative growth rate with -0.61 and production a positive growth rate with 0.96 percent growth rate.

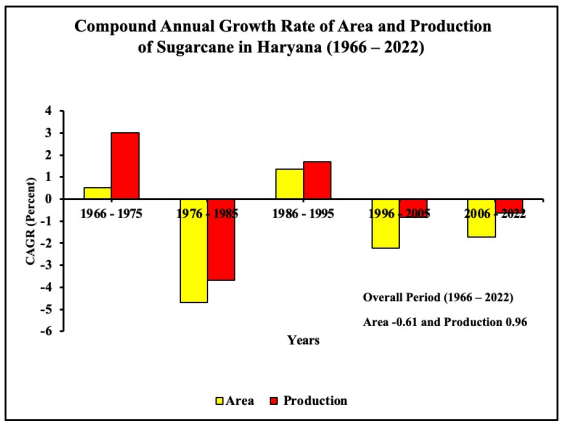

Fig. 6: CAGR of Area and Production of sugarcane in Haryana (1966-2022)

CONCLUSION

The present analysis of sugarcane cultivation in Haryana shows that it covers 1.53% of the total cropped area in that state. This share of the cultivated area is relatively low compared to other cash crop in the state. District-wise distribution study suggested concentration of sugarcane cultivation is high in the northeastern districts of Yamuna Nagar, Ambala, Kurukshetra along with the central district Rohtak. The prime reasons behind this proportion of sugarcane in the region could be attributed to irrigation facilities provided by Yamuna River, advanced agricultural practices infrastructure and mill facilities low proportion of sugarcane cultivation in north-western & southern Haryana can be due to non-suitable climate conditions, scarcity of labour during harvesting season, poor irrigation and mill facilities. The temporal and spatial trend shows that before the year 2001-2002, the area under sugarcane was high but the production was much less, after 2001-02 the area declined but the production substantially increased due to the use of the high quantity of fertilizers, advanced technological techniques and more verities of sugarcane seeds. In the end, we can say that the overall production is increasing and a gentle increment is also showing in the area under sugarcane. In the overall time period from 1966 to 2022, the CAGR of the area under sugarcane has a negative growth rate of -0.61, and production has a

positive growth rate of 0.96 percent growth rate. There are presently 14 sugar mills in Haryana, with the Saraswati Sugar Mill in Yamuna Nagar which has the highest sugarcane Crushed capacity, 10000 tons per day. which are mostly located in the north-eastern region, but some are also located in the central part.

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