

Value Chain Analysis of the Sugar Industry

(With a focus on South Gujarat)



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Foreword

The study undertakes a value chain analysis of the sugar industry in India with a focus on the industry in South Gujarat. CLRA has had a long engagement with sugarcane harvesting workers of South Gujarat. It has mapped the workers and documented their work conditions. The South Gujarat sugar factories are organized along the lines of the cooperative sugar factories of Maharashtra. A special feature of the pattern is that harvesting of sugarcane is managed by the Factory management. In North India, the farmers are responsible for bringing the produce to the factory gate.

The sugarcane harvesting workers are paid piece rate wages. The level of piece rate wages has been a matter of contention between the workers and the factory management. The workers have claimed that is very low and does not ensure a living wage for them. Any demand for wage hike has to be located in the context of the overall profitability of the industry. It was therefore decided to sponsor a value chain study of the sugar industry. This helps in knowing the industry profitability. This will lead to better articulation of demands by the workers.

The current study meets this requirement. It provides an overview of the sugar industry in India, the various processes involved, and market trends. There is one chapter focusing on the industry in Gujarat. The last chain provides the value chain analysis with estimates of profitability. Hopefully the study will play a useful role in meeting the aspirations of workers for a decent living wage.

February 2022

Sudhir Katiyar

Secretary CLRA

Executive Summary

Centre for Labour Research and Action (CLRA) has been working with the rights and welfare of sugarcane harvesting labour, mainly in the state of Gujarat. It has sought to build capacity of the workers engaged in sugarcane harvesting so that they can improve their wages and work conditions. Over the years, the workers have been able to negotiate with the cooperative sugar industry of Gujarat to raise the wage rates under the aegis of their organization. However, it is still not adequate. CLRA, in order to better equip them to negotiate with the industry players instituted this study to understand the sugar value chain and its profitability. This study aimed to map the value chain of sugar, factors affecting production and costing and profitability of sugar production.

This value chain assessment is based mainly on Michael Porter's value chain model. This model suggest that value is added through a set of two types of activities: primary activities such as inbound logistics, operation, outbound logistics, marketing and sales and after services; and support activities such as firm infrastructure, human resource management, technology development and procurement. For the purpose of this study secondary literature have been reviewed, primary visit to one cooperative dairy sugar mill was conducted, discussions with sector expert, harvesting machine operators and other relevant stakeholders were also conducted to assess the sugar value chain. Findings presented in this report is solely based on findings from above information and interpretation of the consultant.

Sugar industry is the second largest agro based industry in India. It encompasses sugarcane production of 5 crore farmer and their employees, operates through 400 to 500 processing units, employs around 5 lakh labour and produce around 29 million metric ton of sugar (second largest producer in the world). Total output generated by Indian sugar industry is approximately Rs 80,000 crore.

Sugar in India is produced predominantly from sugarcane and only a small quantity is produced from sugar beets. In the last 5 years sugarcane acreage in India varied between 4,900 to 5,500 thousand hectares. Sugarcane production during this period varied between 3,000 to 4,100 lakh ton. Among the states, Uttar Pradesh lead both in acreage and production of sugarcane followed by Maharashtra, Karnataka, Bihar, Tamil Nadu in that order. These states together command 83 percent of total acreage in the country and 85 percentage of total production in the country. Gujarat accounts for 3.86 percent of total acreage in India and 3.23 percent of total production.

Indian Sugar Manufacturers Association's data shows that almost 80 percent of the sugarcane is used for production of sugar, 11.5 percent is used for seed, feed, etc. and rest is used for producing *gur* and *khandsari*. Sugarcane FRP, ex-mill gate, varied between Rs

2200 per ton to Rs 3160 per ton during 2015-16 to 2019-20. Highest sugarcane price is being paid by UP followed by Maharashtra, Karnataka and Gujarat.

Sugar Production Infrastructure

There are around 450-500 sugar operational factories operate in India. Installed capacities of these sugar factories used every year is in between 338 to 347 lakh ton per season. In 2019-20, as shown in Figure 2, 461 sugar factories were operational with an installed capacity of 347.1 lakh ton. Maharashtra has the highest number of factories as well as highest installed capacity. Sugar factories in India are in three sectors joint stock (private) sector, public sector and cooperative sector. Sugar production in Gujarat is undertaken by 22 cooperative sugar factories, installed capacity 79,000 TCD, located mostly in south Gujarat district which is the production belt of sugarcane in the state accounting for approximately 90 percent acreage and production.

Sugar Production

Total production of sugar in India in the year 2015-16, 2016-17, 2017-18, 2018-29 and 2019-20 were 25.13, 20.29, 32.48, 33.16, 27.14 million ton respectively. During this period the recovery percentage varied between 10.44 percent to 11.01 percent. Apart from sugarcane, this industry produces molasses, bagasse and press mud as by products. Molasses is used for spirit/ethanol production, bagasse for steam and power generation and press mud as fertilizer. Gujarat produces around 3.5 percent of total sugar production in India at around 1 lakh metric ton of sugar per year. Recovery percentage of sugar from sugar hovered around 10.5% during the last 5-6 years.

Harvesting of sugarcane is one of the key challenges faced by the sugarcane farmers as well as sugar factories. As of now, sugarcane is mostly harvested manually either by daily wage labour or contract labour. Cost of sugarcane harvesting, when done manually, comes to around Rs 300-350 per ton. Due to constraints in labour availability recently mechanical harvesters is being used by some farmers and mills. Cost of sugarcane harvesting through mechanical harvesting comes to around Rs 130 per ton. However, mechanical harvesting has not gained much ground as it has a number of problems such as constraints in use during rainy season, damaging the possibility of ratoon crop, decrease in sugar recovery percentage, etc.

Sugar Revenue

Revenue of sugar sector comes mainly from sale of sugar and molasses/rectified sprit/ethanol. A small percentage of revenue comes from sale of bagasse and press mud. Also, the mills are supported by government through various subsidies and incentives from time to time such as interest subsidy, export incentive, etc. which also contributes to their profitability.

Sugar Value Chain

Sugar in India is produced mainly from sugarcane which is produced mainly by 6 states of North and South India. Sugarcane production is, to certain extent, dependent on weather condition and varies with variation in rainfall, cold wave, etc. Pricing of sugarcane is controlled mainly by central and state government. Currently Fair and Remunerative Price for sugarcane is Rs 2,900 per ton. However, it was observed that sugar mills across India pay 7 to 11 percent more than the FRP, though delays and overdue can be observed in payment in some states. It was also observed that the payment system for sugarcane is better by cooperative mills than private sector mills.

Another key aspect of sugar production system is planning of production in procurement system. In case of private sector, mills do not play any role in production planning and procurement system is done mainly through ticketing system whereas cooperative mills play central role in production and procurement of sugarcane by farmers and largely controls the quality, quantity and timing of sugarcane production and procurement.

Processing technology consists of harvesting and transportation of sugarcane to mill; cane preparation; juice extraction; juice clarification; juice evaporation; syrup clarification; crystallization; centrifugation; sugar drying and packaging; and sales and marketing. In the last three to four decades there are many developments in sugar production technology starting from enhancement in factory capacity to automation of sub-processes.

Export sales and ethanol sales are two main contributors in enhancing the profitability of the sugar mills in recent times.

Sugar industry is largely controlled by central and state government. Most aspects of sugar production such as Minimum Sales Price for sugar, FRP for sugarcane, setting up of a sugar mill, deciding monthly sales and levy quota, allotting Maximum Admissible Export Quota, etc. are controlled by central and state governments. In addition to these regulatory control government also formed a number of committees for overall development of sugar industry and incentivise sugar production through various schemes/incentives.

Sugar mills operate for around 150 days a year and distillery operate for 250 days a year. Human resource management for operation and management of sugar mills and distillery is another key challenge faced by sugar mills. A typical 5,000 TCD sugar mill with 30,000 lpcd distillery require around 1,100 employees. Out of these 30 percent remain idle for 6-7 months a year. Retaining trained employees during dry season is a tricky subject for sugar mills. There are many sugar institutes in India which produces trained manpower for the industry.

Cost-Benefit of Sugar production

Installing a 5000 TCD sugar mill along with a cogent power plant and distillery requires around Rs 275 to Rs 325 Cr. A sugar mill with such capacity can generate a gross profit of around Rs 18.47 per kg of sugar produced and around Rs 10 per kg of net profit after deducting legal and financial cost. Ideal payback period of such a plant is 4-7 years.

Going forward, some of the threats and opportunities faced by Indian sugar industry are:

Threats

- Sugar production is dependent on high water requirement;
- Sugar sector is vulnerable to political interest;
- Competition among cooperative mills in Gujarat as same farmer may be member of more than one cooperative; etc.

Opportunities

- Ongoing technical innovation;
- Strong and ongoing government support;
- Ethanol Blending Programme and government support;
- Increasing international sugar prices; etc.

This report is organized into there chapters, Chapter 1 give a brief background of the study, Chapter 2 gives an overview of Indian and Gujarat sugar industry and Chapter 3 discuss the value chain of sugar in detail.

Chapter 1: Background and Approach

Background

Sugar industry is the second largest agro based industry in India after textile industry. During the year 2019-20 India produced almost 29 million metric ton of sugar which is roughly 17 percent of global production. India is the second largest producers of sugar in the world after Brazil. Also, India is the largest consumer of sugar with 25 million metric ton of consumption. Indian sugar industry is a major employment creating sector with more than 5 lakh jobs for skilled and semi-skilled labour in sugar and allied industry. It is estimated that this industry support around 50 million sugarcane farmers and their families. Indian sugar industry is estimated to generate annual output worth Rs 80,000 Cr. Sugarcane production is concentrated mainly in 6 states, namely Uttar Pradesh, Maharashtra, Karnataka, Tamil Nadu, Bihar and Gujarat. These states produce almost 88 percent of total sugarcane production of India. Sugar production is also concentrated around these states. Uttar Pradesh leads India in both sugarcane and sugar production. However, some estimates suggest that this year Maharashtra may overtake Uttar Pradesh in sugar production¹.



¹ <https://www.hindustantimes.com/cities/mumbai-news/maharashtra-may-become-largest-sugar-production-state-in-india-in-ensuing-season-101632842219342.html>

Centre for Labour Research and Action (CLRA) works with labour involved in sugarcane harvesting. CLRA has been working with the rights and welfare of these labour mainly in the state of Gujarat. It has sought to build capacity of the workers engaged in sugarcane harvesting so that they can improve their wages and work conditions. Over the years, the workers have been able to negotiate with the cooperative sugar industry of Gujarat to raise the wage rates under the aegis of their organization. However, it is still not adequate. CLRA, in order to better equip them to negotiate with the industry players instituted this study to understand the sugar value chain and its profitability. This study aimed to map the value chain of sugar, factors affecting production and costing and profitability of sugar production.

Approach and Methodology

It is to be noted here that sugar production in India is undertaken by both private and cooperative sector. Private sector sugar processing units are based mainly in Uttar Pradesh, Karnataka and Tamil Nadu whereas cooperative units are based mainly in Maharashtra, Karnataka, and Gujarat. As PCLRA is working mostly with labour in Gujarat, this study attempted to assess the sugar value chain in India with specific focus on South Gujarat.

This value chain assessment is based mainly on Michael Porter's value chain model. This model suggest that value is added through a set of two types of activities: primary activities such as inbound logistics, operation, outbound logistics, marketing and sales and after services; and support activities such as firm infrastructure, human resource management, technology development and procurement.

Methodology adopted to assess the sugar value chain involved review of secondary documents, discussion with relevant stakeholders and visit to a cooperative sugar mill in south Gujarat.

Figure 1: Value chain Assessment Framework



Chapter 2: Overview of Sugar Industry

Indian Sugar Industry

Sugar production in modern India started in the 1920s. During early 1930s there were 29 sugar mills in India producing around 1 lakh ton of sugar. This industry was facing competition from imported sugar and sought tariff protection. As a result, the *Sugar Industry Protection Act was passed in 1932* and India became self-sufficient by 1935. Since then, the Indian sugar industry is highly regulated. Central and state governments have varying degree of control over licensing, capacity, cane area, procurement, pricing (both sugarcane and sugar), sales and export.

Sugar industry is the second largest agro based industry in India. It encompasses sugarcane production of 5 crore farmer and their employees, operates through 400 to 500 processing units, employs around 5 lakh labour and produce around 29 million metric ton of sugar (second largest producer in the world). Total output generated by Indian sugar industry is approximately Rs 80,000 crore².

Sugarcane – The Raw Material

Sugar in India is produced predominantly from sugarcane and only a small quantity is produced from sugar beets. In the last 5 years sugarcane acreage in India varied between 4,900 to 5,500 thousand hectares. Sugarcane production during this period varied between 3,000 to 4,100 lakh ton. Figure 1 shows the sugarcane production scenario in India in the last 5 years. Among the states, Uttar Pradesh lead both in acreage and production of sugarcane followed by Maharashtra, Karnataka, Bihar, Tamil Nadu in that order. However, productivity of sugarcane is highest with around 90 ton/ha in Karnataka. These states together command 83 percent of total acreage in the country and 85 percentage of

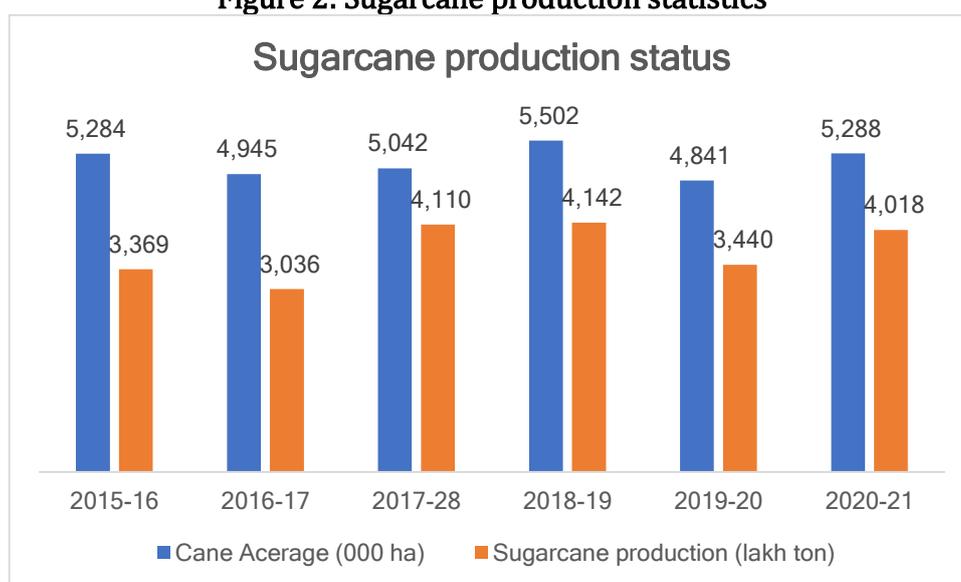


²

<https://dfpd.gov.in/sugar.htm#:~:text=Today%20Indian%20sugar%20industry's%20annual,339%20lakh%20MT%20of%20sugar.>

total production in the country. As per Indian Sugar Mills Association (ISMA) data shows that almost 80 percent of the sugarcane is used for production of sugar, 11.5 percent is used for seed, feed, etc. and rest is used for producing *gur* and *khandsari*. The Sugarcane (Control) order, 1966 was amended in 2009 and since then the Statutory Minimum Price (SMP) was replaced with Fair and Remunerative Price (FRP) system. Sugarcane FRP, ex-mill gate, varied between Rs 2,200 per ton to Rs 3160 per ton during 2015-16 to 2019-20. Highest sugarcane price is being paid by UP followed by Maharashtra, Karnataka and Gujarat.

Figure 2: Sugarcane production statistics



Source: <https://www.indiansugar.com/Statics.aspx>

Sugar Production Infrastructure

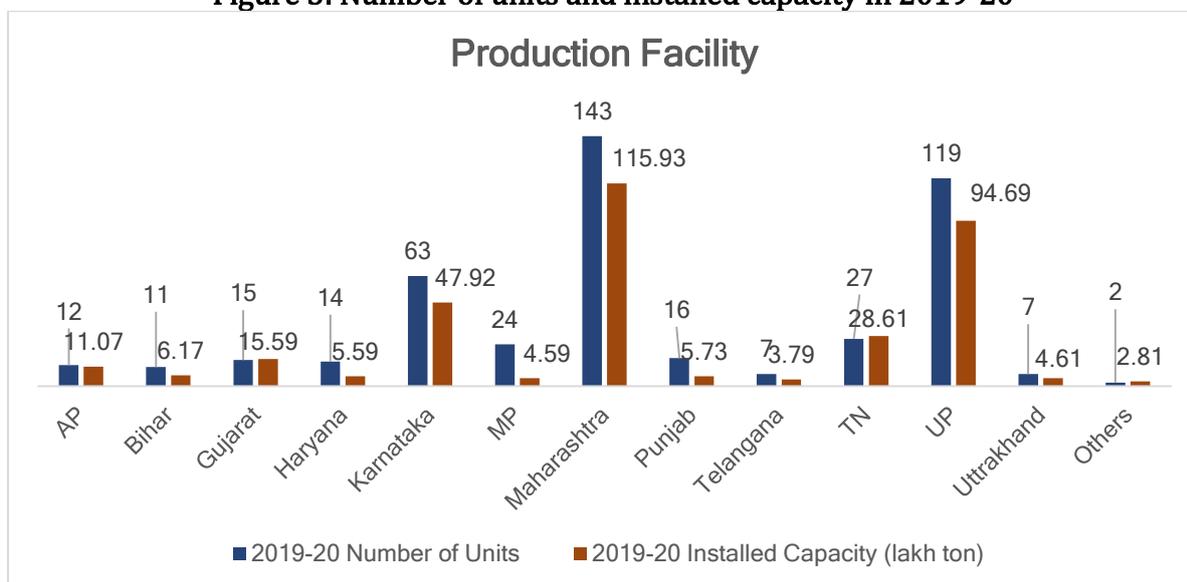
There are around 450-500 operational sugar mills in India. Every year 338 to 347 lakh TCD³ capacity is used for production of sugar. In 2019-20, as shown in Figure 3, 461 sugar mills were operational with an installed capacity of 347.1 lakh TCD. Maharashtra has the highest number of factories as well as highest installed capacity.

Sugar factories in India are in three sectors joint stock sector, public sector and cooperative sector. In 2019-20 out of the 461 operational units 280 were in the joint stock (private) sector, 8 were in public sector and remaining 173 were in cooperative sector. In UP, Karnataka and Bihar most of the units are in joint stock sector whereas in Tamil Nadu and Maharashtra this is evenly distributed among joint stock and cooperative sector and in Gujarat all of them are in cooperative sector.

³ Ton of sugarcane crushed per day



Figure 3: Number of units and installed capacity in 2019-20



Source: <https://www.chinimandi.com>

Sugar Production

As outlined in other part of the report, India is the second largest producer of sugar in the world. Total production of sugar in India in the year 2015-16, 2016-17, 2017-18, 2018-19 and 2019-20 were 25.13, 20.29, 32.48, 33.16, 27.14 million ton respectively⁴. Uttar Pradesh produced the largest percentage of sugar during this period followed by Maharashtra and Karnataka. During this period the recovery percentage varied between 10.44 percent to 11.01 percent. As far as state wise recovery percentage is considered Uttar Pradesh and Maharashtra alternates the top two positions. Table 1 shows the sugar production, consumption and import/export status in India during last 5 years.

Table 1: Sugar Production, Consumption, Import and Export in India

Season	Opening Stock	Production	Imports	Total Availability	Internal Consumption	Exports	Closing Stock
2015-16	90.8	251.25	-	342.05	247.97	16.56	77.52
2016-17	77.52	202.85	4.46	284.83	245.61	0.46	38.76
2017-18	38.8	324.79	2.15	365.74	253.9	4.64	107.2
2018-19	107.2	331.62	-	438.82	255	38	145.82
2019-20	145.79	274.11	0	419.9	257.09	56.5	106.31

Source: www.chinimandi.com

Sugar production in India generally follows a 3-5 years cycle, i.e., sugar production peaks and troughs in a 3-5 year cycle. Various factors affecting the sugar cycle are:

- Weather condition resulting in a 20-30% variation in sugarcane production;
- Changes in global and domestic consumptions of sugar resulting in changes in production/sales volume of sugar;
- Changes in by product usage strategy, e.g.; current ethanol blending strategy of government of India has helped sugar industries to divert part of molasses use to produce ethanol in place of alcohol/rectified spirit;
- Government subsidies from time to time for export, setting up ethanol processing units, interest subsidy, etc. changes the strategy of individual sugar mills altering the production and sales of sugar.

The main by-products of sugar processing are bagasse, molasses and press mud. Bagasse is mostly consumed by the sugar units in generating steam which runs the turbine and

⁴ www.chinimandi.com

generate electricity. The generated electricity is consumed for operating machineries within the processing unit. Press mud is sold back to farmers to be used as fertilizer. Molasses is used in distillery to produce alcohol/ rectified spirit and more recently ethanol. Recovery percentage of molasses is around 4.5 percent of sugarcane crushed.

Harvesting of Sugarcane

Harvesting of sugarcane is one of the key challenges faced by the sugarcane farmers as well as sugar factories. There are a number of systems in which sugarcane is harvested across various sugarcane producing states. Some of the predominant systems are:

Manual harvesting by daily wage labour – This system is mostly prevalent in Bihar, Karnataka, Tamil Nadu, Telangana and Uttar Pradesh. Under this system the farmers hire labour to harvest their sugarcane field and pay them directly. Many studies reported that the male worker engaged in sugarcane harvesting earns between Rs 200-400 per day whereas female workers earn between Rs 80-200. In many of the states where private sugar factories operate, they use to follow a ticketing system. This system offers farmers a time window of 2-3 days to supply a fixed quantity of sugarcane to the factory. Due to time window constraint farmers faces challenges in arranging labour and hence many a time sale their produce to intermediaries. On the other hand labour face the issues of gender gap in wage rate, delayed payment, and safety issue at work place.

Manual harvesting by contract labour – Under this system contract labours are hired for harvesting sugarcane. There are a number of contracting systems are followed across Indian. In some states farmers hire contract labour for harvesting of the whole field and pays them directly. In states where cooperative mills operate, the mills hire contract labour on per ton rate. In this system mills directly pay to the labour and deducts the payment from farmers. The average rate received by labour under this system is around Rs 300 per ton. Challenges faced by cooperative mills/farmers in this system is shortage of labour. On the other hand, labour gets low rate under this system which sometime go as low as Rs 250 per ton, unfair wage deduction, unfair weight deduction, drudgery at work place, etc.

It is to be noted here that on an average 1 ton of sugarcane can be harvested by 2 labours in one day. Cooperative mills in Gujarat have recently increased the per ton rate to Rs 350.

Mechanical Harvesting – Mechanical harvesting has started in some the states during last 3-4 years due to shortage of harvesting labour. These machines are mostly being used in Karnataka, Maharashtra and Telangana. The two main types of harvesters used in India are chopper harvester and whole stalk cane harvester. Quoted capacity of the mechanical

sugarcane harvester varies between 30 to 120 ton per day. However, operating efficiency is around 70 percent of the quoted capacity. These machines cost between Rs 7-8 lakh to Rs 100-125 lakh. However, mechanical harvesting contributes to very low percentage of total harvesting. Some of the key challenges of harvesting by mechanical harvesters are:

- Require large field size;
- Proper distance between rows is required;
- Ratoon crop cannot grow;
- Difficult to operate during rainy season
- Sugar recovery percentage are lesser as the harvester damages part of the crop;
- Require skilled labour; etc.

Cost benefit of a small-scale tractor mounted sugarcane harvested used mostly in Maharashtra is presented below:

From the perspective of sugar mills⁵

Daily harvesting capacity – Up to 50 ton per day,

Operational days of harvester – Up to 100 days in one season

Operating cost per ton – Rs 90 (1 lt diesel is paid to the tractor owners who operates the machine)

Repair and maintenance cost – Rs 15 per ton

Interest cost of machines – Rs 25 per ton

Total cost – Rs 130 per ton as against Rs 300-350 per ton for manual harvesting

From the perspective of tractor owner

Income (per season):

Daily harvesting – Average 35 ton

Daily income – Rs 3150

Annual income – Rs 3,15,000

Expenses (per season):

Main operator cost – Rs 72,000

Labour cost (1 labour is required) – Rs 20,000

Diesel cost – Rs 1,57,500

⁵ Sugarcane harvesters in Maharashtra are mainly purchased by sugar mills and they hire tractor owners to operate the machine. In turn mills pay them 1 lt diesel per ton of sugar harvested

Repair and maintenance of tractor – Rs 10,000

Total Expense – Rs 2,59,500

Profit per season – 55,500

Sugar Revenue

Revenue of sugar industries are generated mainly from sale of sugar and molasses. Many of the sugar industries in India have installed inhouse distillery units producing alcohol/rectified spirit or ethanol from molasses further adding to their revenue. Bagasse produced by individual units are mostly utilized for power generation and only a small part of it is sold in open market to other units such as paper mills, industrial units using boilers, etc. Press mud is composted and sold as biofertilizer to sugarcane farmers.

MSP for sugar for the year 2019-20 was fixed at Rs 31 per kg by government of India. Government also allocates sales quota including export quota for individual units. As against the MSP of Rs 31 per kg, sugar mills have been able to sell their produce at an average price of Rs 32.39 kg during 2019-20. However, the sale price is volatile over the last few years, it reached a maximum of Rs 36.20 per kg in 2016-17 and minimum of Rs 31.20 per kg in 2017-18. Molasses price is currently very high due to governments focus to increase ethanol blending in petrol. Governments target for ethanol blending is 20 percent by the year 2023-24. This is seen as an opportunity by the sugar industry and many of the sugar mills are in the process of increasing their in-house ethanol production capacity.

Gujarat Sugar Industry

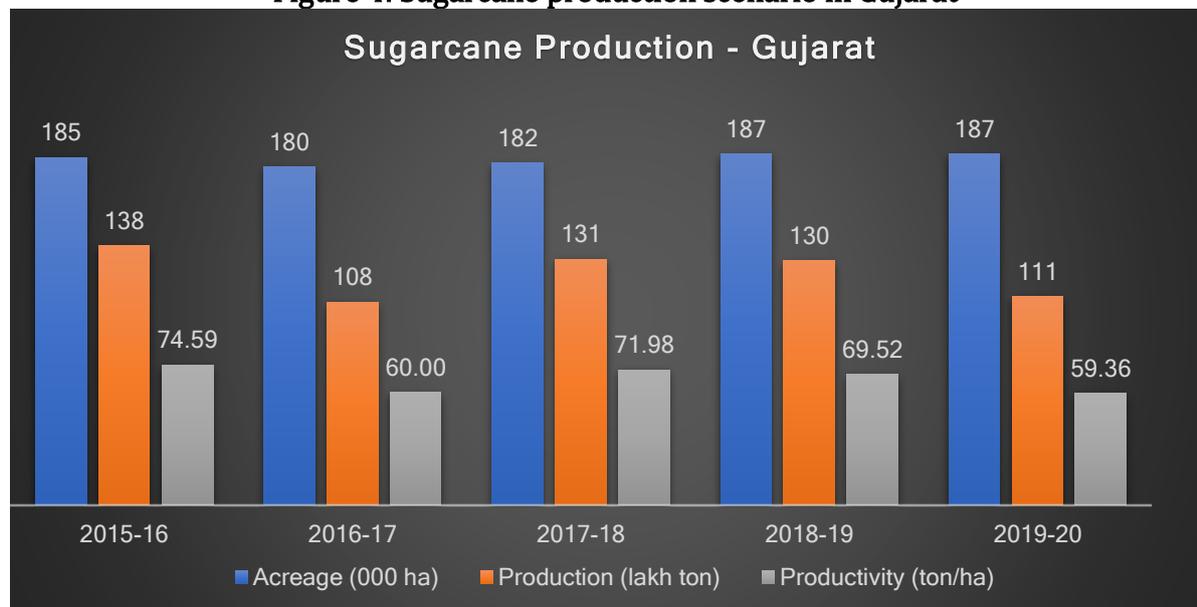
Sugar production in Gujarat is predominantly in southern part of the state and all sugar mills in the state are in cooperative sector. There are 22 cooperative sugar mills in Gujarat owned by approximately 5 lakh farmers. These sugar mills have an installed capacity of around 60,000 ton cane per day. In the year 2020-21 sugar mills in Gujarat crushed 97,99,980 ton of sugarcane and produced 1,00,633 ton of sugar with a recovery percentage of 10.269%. This section provides a brief overview of the sugar sector in Gujarat.

Sugarcane production – Gujarat

Total sugarcane acreage in Gujarat remained almost stagnant at around 1,85,000 ha in the last 5 years. However, production of sugarcane varied between 108 to 138 lakh ton in these 5 years due to the varying weather condition. Surat, Tapi, Bharuch and Navsari are the main sugarcane producing districts in Gujarat. Together they account for almost 90 percentage of acreage as well as production. Further, acreage and production in Tapi

district is decreasing whether the same are increasing in Bharuch district as per production data of directorate of agriculture, government of Gujarat. Productivity of sugarcane in these districts varies between 63 to 78 ton/ha. FRP for sugarcane in Gujarat was Rs 2,494 per ton in 2015-16, Rs 2,518 in 2016-17, Rs 2,845 in 2017-18, Rs 2,915 in 2018-19 and Rs 2,975 in 2019-20.

Figure 4: Sugarcane production scenario in Gujarat



Source: www.dac.net

Sugar Production Infrastructure

Sugar production in Gujarat is undertaken by 22 cooperative sugar mills located mostly in south Gujarat district which is the production belt of sugarcane in the state accounting for approximately 90 percent acreage and production. Out of these 22 mills, 13 are operational during last few years, 6 are non-operational and 3 are at various stages of planning or registration. Out of the 13 operational plants 9⁶ have their own inhouse distilleries to process molasses and produce rectified spirit. Total installed capacity of these 9 distilleries is 290 kilo litres per day. It is to be noted here that the sugar mills operate for 5-6 months in a year whereas the distilleries operate for 9-10 months.

Table 2: Installed capacity of sugar mills in Gujarat

Operational			Non-Operational		
Sl No	Name of Unit	Installed Capacity (TCD)	Sl No	Name of Unit	Installed Capacity (TCD)
1	Bardoli	10,000	1	Gandhar (Vadodara)	2,500
2	Gandevi	5,000	2	Maroli	2,500

⁶ Gandevi, Madhi, Chalthan, Sayan, Mahuva, Ganesh, Kamrej, Pandvai and Narmada Cooperatives have their own distillery as per gujsugarfed data

Operational			Non-Operational		
Sl No	Name of Unit	Installed Capacity (TCD)	Sl No	Name of Unit	Installed Capacity (TCD)
3	Madhi	7,000	3	Mandvi Vibhag	2,500
4	Chalthan	5,000	4	Ukai	2,500
5	Valsad	5,000	5	Bileshwar (Kodinar)	3,250
6	Sayan	5,000	6	Talala	1,250
7	Mahuva	3,500	Non-operational crushing capacity		14,500
8	Vataria (Ganesh)	4,000	New Sugar Mills (Being planned)		
9	Kamrej	2,500	1	Damangagnga	2,500
10	Virpor (Coper)	2,500	2	Kaveri	2,500
11	Kosamba (Pandvai)	2,500	3	Ukai Asargrast	2,500
12	Dharikheda (Narmada)	2,500	Planned crushing capacity		7,500
13	Kantha Vibhag	2,500			
Operational crushing capacity		57,000	Total Capacity		79,000

Source: www.gujsugarfed.com

Sugar Production

Gujarat produces around 3.5 percent of total sugar production in India at around 1 lakh metric ton of sugar per year. Contribution of Gujarat to total production of sugar in India declined from 4.65 percent in 2015-16 to 3.4 percent in 2019-20⁷. Recovery percentage of sugar from sugar hovered around 10.5% during the last 5-6 years.

Table 3: Sugar production in Gujarat

Season	Sugarcane crushed (metric ton)	Recovery percentage	Quantity of sugar produced (metric ton)
2015-16	1,08,45,967	10.44	1,13,220
2016-17	80,22,558	10.66	85,494
2017-18	1,00,79,330	10.60	1,06,833
2018-19	1,00,36,423	10.86	1,09,025
2019-20	83,51,581	10.80	90,190
2020-21	97,99,980	10.27	1,00,633

Source: www.gujsugarfed.com

Production of By-products

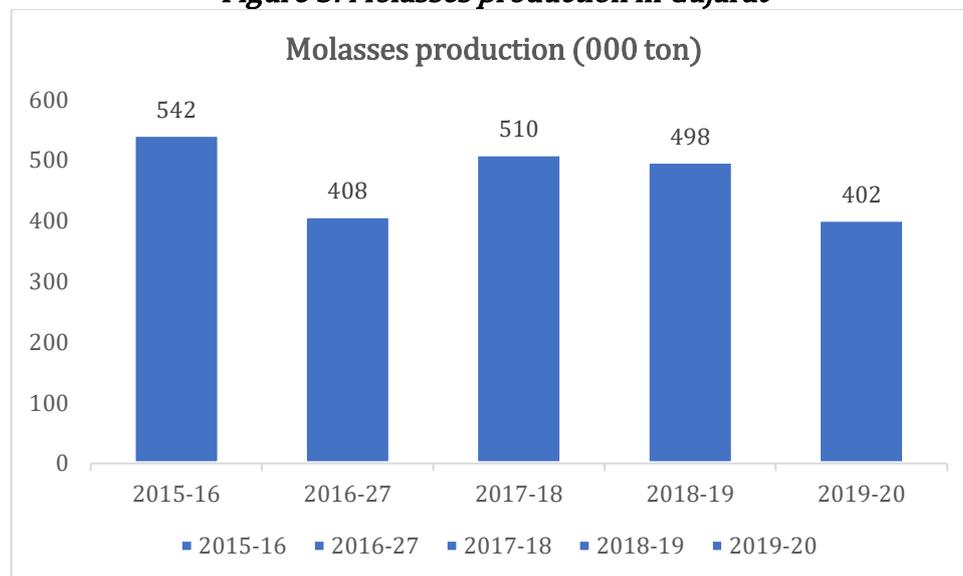
Molasses production in Gujarat varied between 400 to 540 thousand ton in last 5 years⁸ which is around 3.5 percent of total production in India. Molasses recovery percentage during this period was around 4.5 percent. It is to be noted that most of the molasses

⁷ As per chinimandi.com data

⁸ Indian Sugar Mills Association data

produced by sugar mills in Gujarat are used in their distillery for production of rectified spirit and/or ethanol.

Figure 5: Molasses production in Gujarat



There is no data related to quantity of bagasse produced by sugar mills of Gujarat. Only information available was that bagasse recovery percentage varied between 25 to 33 percent of sugarcane crushed during the last 2 years.

Chapter 3: Value Chain Analysis of Sugar

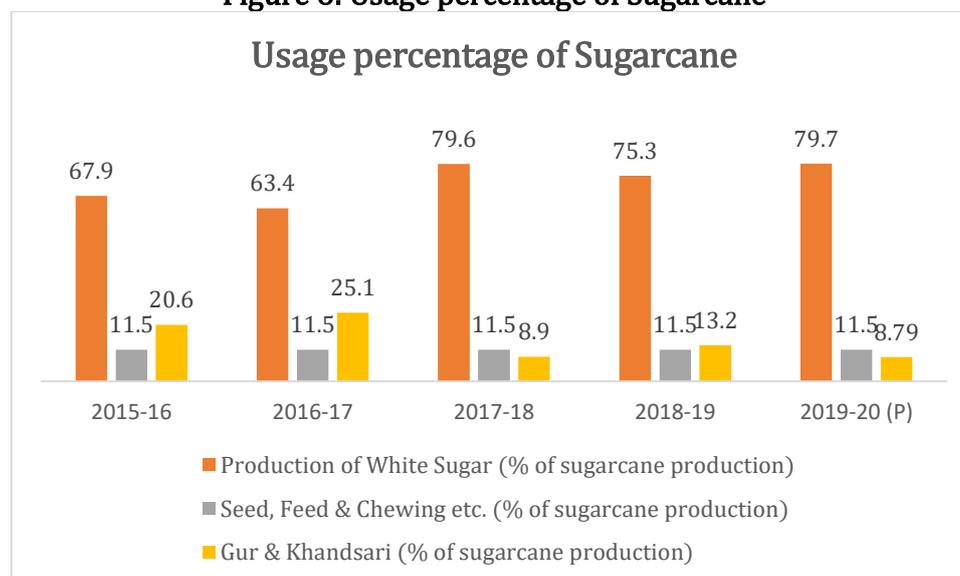
Primary Activities

Input - Sugarcane

Sugarcane is the main raw material used for producing sugar in India. A small portion of total sugar production in India is from sugar beets. Total production of sugar in around is between 4900 ton to 5500 ton. Sugarcane harvesting process for supply to mills vary from state to state. In states like UP farmers harvest and transport sugarcane to mills whereas in states like Gujarat cooperatives organize harvesting and transportation and adjust the cost in cane prices paid to the farmers.

Sugarcane is used for seed purpose, eating in raw form, and production of sugar, khandsari, gur. It is observed that more than 65% of sugarcane produced in India is used for production of sugar. Figure 5 shows the percentage utilization of sugar production across various use.

Figure 6: Usage percentage of Sugarcane

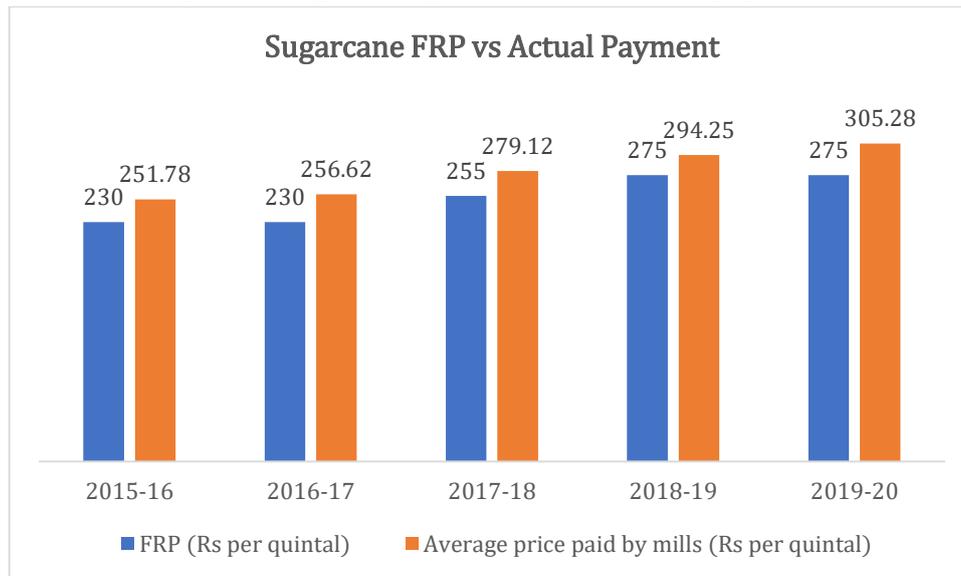


Source: ISMA data

Sugarcane Pricing

As far as sugarcane pricing is considered FRP is declared by central government on a year-to-year basis to be paid by sugar mills. However, actual payment by mills is 7 to 11.5 percent higher than the FRP.

Figure 7: Sugarcane price – FRP vs actual payment



Source: ISMA data

Input – Production and Procurement Planning

One of the important aspects for successful operation of sugar mills is their ability to ensure procurement of enough quantity of sugarcane in order to maximize capacity utilization. In order to achieve this target, the sugar mills have to be established in location with sufficient command area for production, have adequate arrangement of capital for payment of sugarcane price and good relationship with farmers. In this regard the cooperative sugar mills of Gujarat are better equipped. These mills have largely been able to control the sugarcane production and procurement process by engaging with the member farmers from the stage of production planning to harvesting and transportation to the mill. They have a dedicated estate department which provides support in allocating and scheduling sugarcane area and cultivation; support with variety selection and package of practice; provide technical inputs during cultivation period; procure and engage harvesting labour; and supports cane transportation.

Influence of Raw Material on Sugar Value Chain

Key influence of sugarcane production and planning are:

- Ensuring adequate quantity of sugarcane results in better capacity utilization;
- Ensuring that the mill has a command area of sugarcane production helps in managing adequate cane procurement;
- Varietal selection of sugarcane crops helps in controlling sugar extraction percentage;
- Pricing mechanism of sugarcane impacts profitability of sugar production.

Processing Technology

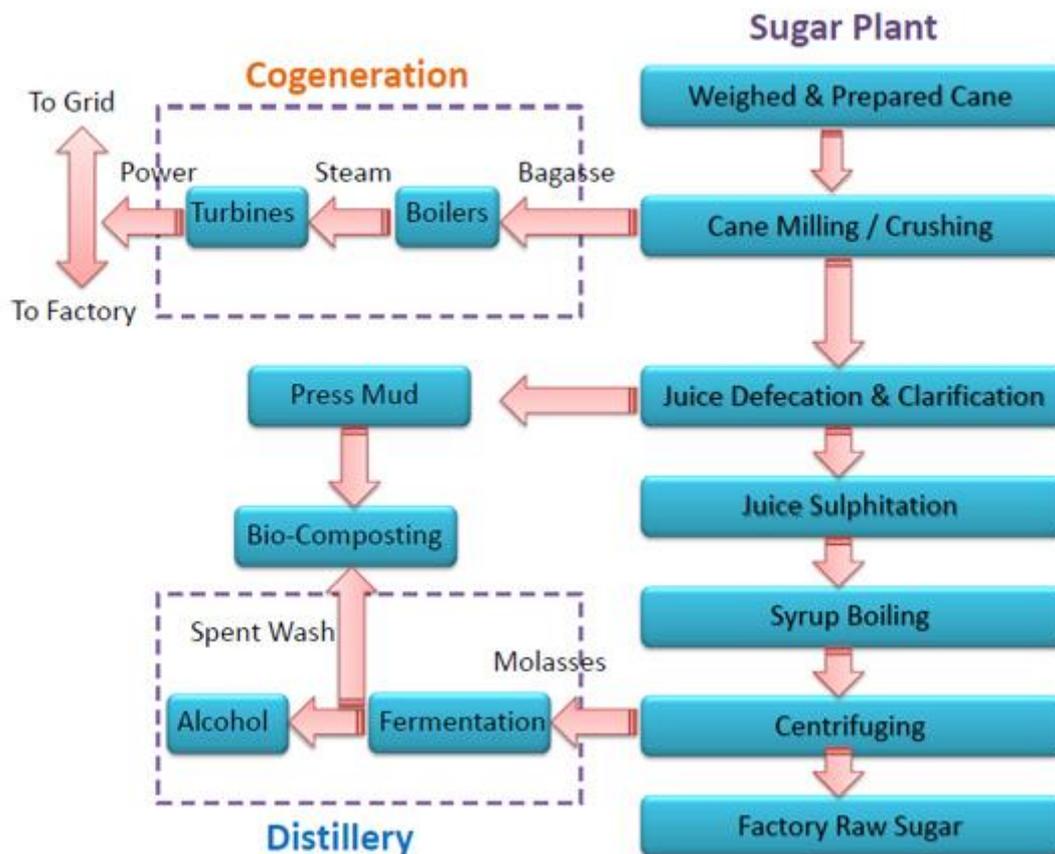
Sugar processing follows a series of steps which are outlined below. Total time requirement for processing cane to sugar varies between 48-72 hours. Technical implications and available technology options are discussed separately in support activities section.

Transportation to mill – Harvested sugarcane is transported to the mills through bullock cart, tractors, trucks, etc. and is unloaded directly to the milling assembly. Ideally received cane shall be washed and cleaned before loading into the milling assembly. However, sugarcane goes through some preliminary processing such as cutting of leaves, etc. at the farmgate itself.

Cane Preparation – Cane preparation process involves cutting and shredding the sugarcane into fibrous material sucrose bearing cells so that removal of sugarcane juice can be maximized. A variety of machineries are used in this step such as kicker, chopper, leveller, fiberizer, etc. These machineries are run by electrical power. Most of the sugar mills in India generate their own electricity by running turbines from steam generated by bagasse burning.

Juice Extraction – The next important process in sugar production is juice extraction from the prepared cane. Juice is extracted from the shredded/fiberized cane by crushing them at high pressure in grooved metal rollers. This process involves a set of mills, generally between 3 to 6, each set of which is called a tandem mill. To improve the milling extraction efficiency hot water is poured over the cane just before it enters the last mill in the milling train and is recirculated up to reach the first mill. Final dark green juice is then sent to a mixed juice tank for storage before clarification. The cane fibre (bagasse) is recycled as a fuel for the mill's boiler furnaces. Important consideration here is that milling must take place within 36 hours of the cane being cut else the juice percentage will reduce.

Figure 8: Sugar Processing Flowchart



Source: Indian Sugar Mills Association

Juice Clarification – Juice clarification process involves neutralizing acidity of cane juice whose pH value is around 4 to 4.5 and removing soluble and insoluble impurities such as sand, soil, etc. In order to achieve this objective cane juice is heated upto 130 degree Celsius. To this heated juice milk of lime (calcium hydroxide) is added to increase the pH value to 7, sulphur dioxide is added to bleach the sugar resulting in white coloured sugar, and calcium phosphite is added for clarification or sucrose solution and removal of finely soluble particles. This heated juice is then allowed to cool and precipitate. Clear juice flows out of the top of the heating tank. The muddy juice extracted from bottom of the tank is again mixed with fine bagasse and filtered to recover more sugar. The final recovered mud, called press mud is treated with spent wash⁹ to produce bio-compost which is sold to farmers.

Juice Evaporation – The clear juice is then concentrated to a syrup of 50-60 degree brix¹⁰ by boiling it under vacuum in evaporators.

⁹ The distillery generates a huge quantum of undesirable dark brown coloured wastewater called Spent Wash or Vinasse which has high COD and BOD.

¹⁰ **Degrees Brix** is the sugar content of solution, one degree Brix is 1 gram of sucrose in 100 grams of solution and represents the strength of the solution as percentage by mass.

Syrup Clarification – This syrup is then further clarified in syrup sulphiter by adding sulphur dioxide to heated syrup.

Crystallization - This syrup is further concentrated under vacuum in vacuum boiling pans till it becomes supersaturated. Finely grounded sugar crystals are added into the vacuum pans as seed crystals around which sucrose is deposited and these crystals then grow in size typically about 1 millimetre. This mixture of syrup and crystals, called massecuite, is then sent to the centrifuge. Most commonly used boiling scheme for crystallization is the three stage boiling scheme in which the sugar liquor is boiled in three stages, called A, B and C.

Centrifugation – The massecuite is then separated into sugar crystals and mother liquor (molasses) in high speed centrifuges.

Sugar Drying and Packaging – Rotary drums are most commonly used for drying sugar. Heated air moves along the long, cylindrical drum to dry sugar obtained from centrifugation. Heated air can be fed into the dryer through a centralized pipe to further control the drying effect. The dried sugar is then cooled, graded and packed into 50 kg bags.

Influence of Sugar Processing Operation on Sugar Value Chain

Key influence of sugar processing operations and related technologies are:

- Continuous research and development is essential for process upgradation and maintaining competitive advantage, however, level of R&D in this industry is low;
- Appropriate technology selection may result in better percentage of sugar recovery. However, many sugar mills still uses dated technology due to their inability to invest in upgradation of process and machinery;
- Appropriate technology may help in reducing power consumption which in turn may result in higher quantity of power sales and increasing revenue.

Sales and Marketing

Domestic Sales – Domestic sales of sugar is regulated in India by central government which releases monthly sales quota for each of the sugar mills in India. Briefly for a period between 2013 and 2017 this system was abolished based on the recommendation by C Rangarajan committee and sugar sales was decentralized in India. However, the quota system was reintroduced in June 2018 by the food ministry to regulate sugar sales. Sugar mills are required to submit information on sales in a particular month by 10th of next

month. Any violation in sales beyond allotted quota is punishable under the Essential Commodities Act, 1955. Further, minimum support price for sugar is determined by the government from time to time. Presently MSP for sugar is Rs 31 per kg. There is demand from the ISMA to raise the MSP for sugar from time to time. Currently ISMA is demanding to raise the MSP to Rs 34.50 citing increase in sugarcane FRP and production cost.

Ethanol Sales – Under the Ethanol Blending Programme (EBP) ethanol sales has become a major source of earning for the sugar industry. As on May, 2021 a total of 145.38 crore litres of ethanol has already been supplied by sugar mills to Oil Marketing Companies (OMC) as against Expression of Interest (EoI) quantity of 346.52 crore litres. Ethanol sales was merely 38 crore litres in 2013-14. OMCs buy ethanol from sugar mills at the price fixed by government. Currently, rate of ethanol extracted from pure sugarcane juice is Rs 63.45 per litre whereas the rate is Rs 59.08 and Rs 46.66 per litre for ethanol extracted from B-heavy molasses and C-heavy molasses respectively. Ethanol sales contribute to a good percentage of revenue for sugar mills and many of the sugar mills in India are in the process of augmenting or installing new plants to increase their ethanol production capacity.

Export Sales – International sugar prices in May 2021 has touched 4 year high as white sugar price in London and raw sugar price in New York averaged USD 461.8 ton¹¹. As a result, export from India has also increased. ISMA has reported, based on port information and market reports, that about 58 lakh ton of contracts for export of sugar against Maximum Admissible Export Quota (MAEQ) of 60 lakh ton for 2020-21, fixed by the government, have already been entered into so far. It is also estimated that almost 44 – 45 lakh ton of sugar has already got physically exported out of the country between January and May, 2021. Further, government gives an export subsidy to the sugar mills against quantity of sugar exported. Sugar subsidy was being given at the rate of Rs 6000 per ton till May, 2021 which subsequently been reduced to Rs 4000 per ton citing global market situation.

Influence of Sales and Marketing on Sugar Value Chain

- The quota system for sales of sugar produced is a restrictive process and impacts capital rotation capacity of mills;
- Sales of by-products contribute significantly to the profit margin;
- In recent years the Ethanol Blending Programme has become a saviour for the sugar industry by increasing demand for ethanol produced from raw sugar juice or molasses;

¹¹ https://www.careratings.com/uploads/newsfiles/21052021061220_Update_on_Sugar_Industry_-_May_2021.pdf

- Changes in international sugar prices impact the Indian sugar industry.

Support Activities

Regulatory environment

Sugar industry is largely controlled by central and state government. Every aspect of sugar processing such as MSP/FRP for sugarcane and sugar, setting up of a sugar mill, deciding monthly sales and levy¹² quota, allotting Maximum Admissible Export Quota, etc. are controlled by central and state governments. A list of various acts and rules guiding this sector are annexed to this report. Some of the key measures taken by government of India to help the sugar industry are:

- Molasses and industrial rectified spirit-based industries were decontrolled by central government in 1993 and are now being controlled by respective state government policies;
- Through an Ordinance, the Sugar Export Promotion Act, 1958, was repealed w.e.f. 15th January, 1997 and export of sugar was decanalised. Under the decanalised regime, export of sugar was being carried out through the Agricultural and processed Food Products Export Development Authority (APEDA). Sugar export was undertaken by various sugar mills/merchant exporters, after obtaining the export release orders from the Directorate of Sugar;
- Levy quota reduced from 40 percent to 10 percent between 2000 and 2002;
- Future trading allowed in sugar since 2001;
- Extended working capital loans with interest subvention under the Scheme for Extending Financial Assistance to Sugar Undertakings (SEFASU 2014) as well as the soft loan scheme;
- Provided incentive for exporting raw sugar in the sugar years 2013–14 and 2014–15;
- Facilitated sale of ethanol under Ethanol Blended Petrol (EBP) programme by fixing the remunerative price;
- Provided performance-based production subsidies at Rs 4.50 per quintal of cane crushed for sugar season 2015–16 payable to farmers against their cane dues contingent on mills undertaking export and supplying of ethanol;
- Aided sugar mills at Rs 5.50 per quintal of cane crushed for sugar season 2017–18 and Rs 13.88 per quintal in sugar season 2018-19 to offset the cost of cane;

¹² The government decides on the quantum of sugar to be sold by each mill every month to fair price shops, and the monthly quantum is usually referred to as the levy quota.

- Created buffer stock of 30 lakh ton in the 2017–18 sugar season for which the government will reimburse the carrying cost of Rs 1,175 crore towards maintenance of buffer stock which was increased 40 lakh ton in 2018-19 at a reimbursement cost of Rs 1,674 crore;
- Extended soft loans of Rs 6,139 crore in 2017–18 sugar season through banks to the mills for setting up new distilleries and installation of incineration boilers to augment ethanol production capacity for which the government will bear interest subvention of Rs 1,332 crore. A further extension of soft loans in 2018–19 sugar season of about Rs 10,540 crore was provided for which interest subvention was at 7% for one year, amounting to Rs 738 crore;
- To prevent cash loss and to facilitate sugar mills to clear cane dues of farmers in time, the government has fixed a minimum selling price of sugar at Rs 29 per kg for sale at factory gate in domestic market, below which no sugar mill can sell sugar which has been since raised to Rs 31 per kg;
- Notified the new National Policy on Biofuels, 2018, under which sugarcane juice has been allowed for the production of ethanol;
- Every year export targets were fixed by allocating mill-wise Minimum Indicative Export Quota (MIEQ);
- Assistance to sugar mills was extended for defraying expenditure towards internal transport, freight, and other charges to facilitate export of sugar at the rate of Rs 6,000 per ton till May 2021 and Rs 4,000 per ton since then;
- Increase in customs duty on import of sugar from 50% to 100%

Also, 7 committees¹³ were formed in the past to provide policy support to the sugar industry. These committees broadly recommended price determination and distribution mechanisms for sugar; setting up of new mills; amendments in various laws regulating sugar industry; increasing productivity of the sugar industry; issues with regard to cane-area reservation; decontrol of sugar; pollution mitigation; improving the efficiency of the industry in terms of power consumption; alternate uses of sugarcane for ethanol; improvement of exports; support needed for sugar mills to be more profitable, etc.

Technology Development

Some of the key technology related development in Indian sugar industry are listed below. It is to be noted that not all sugar mills use all technological development listed below.

¹³ BB Mahajan Committee in 1996, S K Tuteja committee in 2004, Y S P Thorat committee in 2007, Shivaji Rao G Patil committee in 2009, Nandkumar committee in 2010, C Rangarajan committee in 2012 and T Jacob committee in 2013

- Crushing capacity improvement – In the 1960s most of the sugar mills in India have a crushing capacity have 1,000 tons of cane per day (TCD) which has increased manifold since then. Minimum viable crushing capacity today is 5,000 TCD and even goes up to 10,000 TCD.
- In initial years lower steam pressure restricted power generation. However, with increase in steam pressure many new preparatory devices such as shredder, fibrizer, etc. are used in current times. Improvements in preparatory devices is also supported by number, weight, shape, material and design of knives and profile and design of hoods. Cane carrier automation with inter locking system has helped further improving the performance of fibrizer.
- With the advent of heavy duty cane preparatory devices chances of bagacillo (fine fraction of bagasse) particles getting into mixed juice and negatively impacting sugar quality was obvious. This problem was addressed by introducing rotary juice screen into processing assembly. The Rotary screen with continuous washing of screen offers complete drainage of juice and has helped minimising bagacillo particles coming into mixed juice. Juice recirculation is minimized, thereby avoiding additional load.
- One of the most important advancements in the milling station is the conversion of turbine drives into electrical drives for mills. The less efficient single stage turbines were replaced by electrical drives. The system involved generation of power centrally through more efficient multistage turbine and use of electric power for all other prime movers.
- Low Pressure Extraction System: Imbibition Oriented Extraction System - In the conventional milling there are three major functions contributing to extraction of juice from the cane: preparation of cane i.e., rupturing and opening of the cells, mechanical crushing through compressions by applying pressure and successive washing (imbibitions). This resulted in higher power consumption. As an alternative to this low pressure extraction system and compact multi roller mill system were developed which uses lixiviation process to extract juice which require almost one tenth of pressure required in conventional system thereby decreasing the power consumption significantly.
- Diffusion process is another alternative to milling process for extraction of juice from sugarcane. Supposedly it is more successful in sugar beet based sugar mills. However, it is presently being used successfully by one sugar mill in Andhra Pradesh. Key benefits of diffusion process over milling process are lesser power requirement, better percentage recovery, lower maintenance cost, lesser effluent, etc.
- Sugar Manufacturing Process can be controlled and automated using a Distributed Control System (DCS). Some of the automation used in varying degree are: bagasse belt conveyor speed control, mill drive speed control, boiler operation control, turbine operation control, raw juice flow control, juice flow stabilisation system,

process temperature control, juice pH control, chemical dosing system, vacuum pans feed control, pumps operation, etc. These automation results in higher productivity and lower manpower requirement.

Some of the key considerations for using technological advancement are continuous research and development process, perceived benefit, willingness and vision of management, investment requirements, etc.

Human Resource Management

Another important aspect of sugar value chain is human resource management. A typical sugar mill with installed capacity of around 5,000 TCD along with 20,000 to 40,000 lpcd distillery requires around 900-1,100 employees. However, the sugar crushing unit operates for only around 150-180 days in a year and the distillery operates for around 250-300 days. The key challenge here is how to retain the excess manpower during the period when the sugar crushing is closed. During the period when crushing unit is not operational manpower requirement reduces to approximately 60 percent of full capacity. Gujarat cooperative sugar mills retain their employees at 50% salary during the period when sugar crushing operation is closed. However, this adds to the overall cost of production.

Cost Benefit Analysis of Sugar Production

Factors affecting production cost – Some of the key factors that contribute towards cost of production of sugar are:

- Sugarcane pricing as determined by government
- Recovery percentage of sugar from cane
- Cost of manpower involved in sugar production
- Installed capacity and capacity utilization of sugar mills

Based on discussion with various stakeholders and review of literature a tentative cost benefit analysis is presented here which is presented based on the following assumptions:

- Sugarcane is procured @ Rs 3,050 per ton;
- Other cost is calculated based on the assumption that the installed capacity is 5000 TCD;
- Sugar mill operates for 150-160 days in a year;
- Sugar recovery percentage is 10.5%;
- Molasses recovery percentage is 4.5%;
- Bagasse recovery percentage is 25% of which is 15% is used internally and rest 10% is sold in market;

Cost		Revenue	
Sugarcane 1 ton @Rs 3050 per ton	3,050	Sale of sugar 105 kg @ Rs 31 per kg	3,255
Chemical	50	Sale of molasses 45 kg @ Rs 5 per kg	315
Packaging material	50	Sale of bagasse 100 kg @Rs 12 per kg	2,100
Sales and marketing cost	50		
Other cost (HR, electricity, repair & maintenance, etc.)	500		
Total Cost incurred for producing 105 kg sugar	3,700	Total Revenue earned from 105 kg sugar and by-products	5,670
Per kg cost	35.24	Per kg Revenue	54
Profit margin per kg of sugar			18.76

It is to be noted here that legal/taxation, offseason cost (such as staff retention cost, etc.) and financial cost (interest on working capital). On the revenue side, sugar mills get various incentive from time to time. Altogether these may result in another additional cost of Rs 7-8 per kg of sugar.

Further it is taken note of that the above calculation will vary based on the following changes:

- Changes in installed capacity;
- Changes in number of operational days of the plant;
- Changes in recovery percentage of main product and the by-products;
- Sales quota received and utilized (this impact fund rotation period);
- Legal cost; etc.

Setting up a 5,000 TCD sugar plant with cogen power plant and distillery will vary between 275 to 325 Cr Rs depending on combination of capacity (cogent power and distillery) and technology adopted. Out of this land cost will be 3-4%, civil works cost will be 12-15%, plant and machinery cost will be 70%, preliminary and preoperative cost will be 6-7% and rest will be other cost such as other fixed assets, contingency and working capital margin. Normally the payback period of a 5,000 TCD sugar plant is 4-7 years.

SWOT Analysis of Sugar Industry

Based on the discussion in above sections of the report the SWOT analysis of Indian sugar Industry is presented below:

<p>Strength</p> <p>Second Largest agro based industry in India World's second largest producer of sugar Provides direct benefit to 5 lakh skilled and semi-skilled labour Main source of income for 5 crore farmers and their families One of the key contributors to rural economy In house processing capacity for by-products</p>	<p>Weakness</p> <p>Inability to pay to the sugarcane farmers Most of the sugar mills are using 30-50 years old technology</p>
<p>Opportunity</p> <p>Ongoing technical innovation Strong and ongoing government support Ethanol Blending Programme and government support Increasing international sugar prices</p>	<p>Threat</p> <p>Sugar production is dependent on high water requirement Sugar sector is vulnerable to political interest Competition among cooperative mills in Gujarat as same farmer may be member of more than one cooperative</p>

Annexure 1: List of Acts and Rules guiding sugar industry

Essential Commodities Act, 1955
Sugar Development Fund Act, 1982
The Sugar Development Fund (amendment) Bill, 2008
The Sugar Development Fund Amendment, 2016
SDF (Amendment) Rules, 2015
Jute Packing Materials (Compulsory Use of Packing Commodities) Act, 1987
Food Safety and Standards Act, 2006
Food Safety and Standards (Packaging and Labelling) Regulations, 2011
Food Safety and Standards (Licensing and Registration of Food Business), Regulations 2011
Food Safety and Standards Rules, 2011
The Competition Act, 2002 and Amendment, 2008
Competition Commission of India (General) Regulations, 2009
Competition Commission of India (General) Amendments Regulations, 2013
Competition Commission of India (Lesser Penalty) Amendments Regulations, 2017
Electricity Act, 2003

Orders

Sugar (Control) Order, 1966
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