SUGAR AND ETHANOL INDUSTRY IN INDIA: CHANGING DYNAMICS

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Sugar and Ethanol Industry in India: Changing Dynamics

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Project Team:

Ms. Jahanwi Singh, Chief Manager

Mr. Ashok Singh, Officer

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EXECUTIVE SUMMARY

Sugar is among the most widely produced and traded commodities. It is also an essential source of employment and income for millions of people worldwide, particularly in developing countries. Given its importance for economic output and livelihood, the industry is also highly regulated and heavily subsidised across countries.

In recent years, the sugar sector has faced significant challenges, including volatile prices, shifting consumer preferences, environmental issues, and increasing competition from alternative sweeteners. These challenges have raised concerns about the sustainability of the sector, particularly in terms of economic viability, environmental impact, and social equity. At the same time, there has been a growing focus on ethanol globally, which is creating competing demand for sugar crops. Ethanol has emerged as a crucial alternative fuel source globally, owing to its environmental benefits and potential to reduce dependence on fossil fuels.

In India, the sugar industry is a major contributor to the agricultural production and employment generation. It is the second largest agro-based industry in India after textile. In India, ethanol has also been gaining significant traction in recent years, primarily due to the government's push towards cleaner and sustainable energy sources.

Given the significance of the sugar and ethanol sector for the Indian economy and the changing dynamics of the sector, this Study analyses the current scenario of the sector both globally and in India. The Study also assesses challenges faced by the industry in India, highlights the best practices and competitive environment globally, and identifies the strategies and policy interventions needed to support the growth of the sector.

GLOBAL SCENARIO

Sugarcane Production

Being the main sugar crop, sugarcane currently contributes to nearly 80% of the global sugar production[1]. The global production of sugarcane was estimated at 1859.4 million tonnes during 2021, witnessing a decline of (-) 0.3% during the year, as compared to the production in 2020.

Brazil was the largest sugarcane producing country during 2021, with an estimated production of 715.7 million tonnes, accounting for 38.5% of the global sugarcane production, and witnessing a y-o-y decline of (-) 5.5% during the year. India was the second largest producer of sugarcane during 2021 with an estimated production of 405.4 million tonnes, witnessing a y-o-y increase of 9.4% during the year. India accounted for 21.8% of the global sugarcane production during 2021. The favourable climatic conditions for sugarcane cultivation in India, along with strong government support has helped India in becoming one of the largest sugarcane producers. Other major producers of sugarcane in 2021 included China (a share of 5.7% in global sugarcane production), Pakistan (4.8%), Thailand (3.6%), and Mexico (3.0%).

Sugar Beet Production

Sugar beet is another important source of sugar, biofuels, and fodder. During 2021, sugar beet was cultivated in more than 50 countries, with estimated production of 270.2 million tonnes. Russia is the largest producer of sugar beet, accounting for 15.3% of the global sugar beet production, followed by France (12.7% of global production), the USA (12.3%), Germany (11.8%), Türkiye (6.8%), and Poland (5.7%). In 2021, the European Union produced a total of 113.3 million tonnes of sugar beet, accounting for 41.9% of the total sugar beet produced globally.

[1] International Sugar Organisation

Sugar Production

The global production of sugar was estimated at 181.2 million tonnes during Marketing Year (MY)[2] 2021-22. During MY 2020-21 and MY 2021-22, the global sugar production witnessed a consistent increase but remained below the record levels of production achieved during MY 2017-18.

Although sugar is produced in over one hundred countries, the world sugar market has long been dominated by a small group of major producers that are mainly located in the Asia-Pacific, and the Latin American region. India is the largest sugar producer with an estimated production of 36.9 million tonnes during MY 2021-22. India's sugar production was higher than Brazil, despite having much lower sugarcane production, because the sugarcane in Brazil is also being utilized for large-scale ethanol production. Brazil was the second largest producer of sugar in MY 2021-22, followed by the EU, Thailand, China, and the USA. The Study discusses the policies of some of the top sugar producers, which could inform policy making in India.

Sugar Trade

During MY 2021-22, 64.3 million tonnes of raw sugar were exported globally, representing 35.5% of the global sugar production[3]. Value of global sugar[4] exports has moderated since the peak levels of 2017, registering a CAGR of (-) 2.8% during 2017 to 2021. Global sugar exports was estimated at US$ 27.6 billion during 2021, witnessing a y-o-y increase of 7.0%. Brazil is the largest sugar exporter with a share of 33.3% in global sugar exports. Other major exporters included India (13.9%), Thailand (6.4%), France (4.3%), and Germany (3.6%).

China was the largest importer of sugar with estimated imports of US$ 2.6 billion during 2021, a share of 8.2% in the global sugar imports during

[2] Refers to Marketing Year as considered by the USDA Foreign Agricultural Services' Sugar World Markets and Trade Report. The reference period is May- April with some exceptions. In case of India, the reference period is October-September.

[3] Exim Bank calculation based on data from USDA.

[4] Includes HS 1701 and HS 170290 as per principal commodity classification of DGCIS

the year. Other major sugar importers in 2021 included Indonesia (7.9%), the USA (6.3%), Malaysia (3.1%), and South Korea (3.0%). Currently, raw sugar constitutes majority of the sugar imports and in the upcoming years, no major change is expected in the distribution of sugar imports between raw and refined sugar.

INDIAN SCENARIO OF SUGAR AND SUGARCANE

India's sugar sector supports over 7 million farmers[5], and also contributes significantly to the national GDP. India's sugar industry also holds immense significance for the global sugar market, as it accounts for nearly one-fifth of both global sugarcane production and global sugar production.

The production of sugarcane in India reached record level of 431.8 million tonnes during 2021-22[6], registering an increase of 6.5% as compared to the production in 2020-21. During the period from 2012-13 to 2021-22, sugarcane production in the country recorded a moderate CAGR of 2.7%. The production of sugarcane during this period witnessed intermittent periods of growth and decline, mainly due to the changes in weather conditions. Development and use of improved sugarcane varieties, application of new agricultural techniques, mechanisation, and modernisation of sugar mills have all contributed to the improvement in India's cane production and productivity[7]. With the strong support from government and increasing crop area, India is expected to witness a steady rise in its sugarcane production in the upcoming years.

During MY 2020-21, the sugar production in India increased by 16.8%, as compared to the previous year, which further increased by 9.2% y-o-y to reach 36.9 million tonnes during MY 2021-22. Over the years, sugar production in India has increased at a steady rate due to use of better crop varieties, better technology, increasing sugarcane acreage due to better returns, etc.

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[5] S. Solomon. M. Swapna, Indian Sugar Industry: Towards Self-reliance for Sustainability (2022)

[6] As per Third Advance Estimates, Ministry of Agriculture and Farmers' Welfare, GoI

[7] Solomon, S., Swapna, M. Indian Sugar Industry: Towards Self-reliance for Sustainability. Sugar Tech 24, 630–650 (2022)

Apart from climatic advantages that play a significant role in sugar production in India, government support also plays a major role in India's sugar production. Sugar is considered as an essential commodity under the Essential Commodities Act of 1955, which allows the Government of India to intervene and regulate the sugar sector[8]. The Government of India supports the domestic sugar industry primarily through three different ways— sugarcane subsidies, sugar supply regulations, and support for modernisation and diversification. The Government support for the sector in India are discussed in the Study.

Due to the frequent changes in trade policies adopted by the Government of India for sugar, international trade in sugar for India also varies from time to time. India's sugar[9] exports registered a CAGR of 43.5% during 2018-19 to 2022-23, to reach an estimated US$ 5.8 billion during 2022-23. During FY 2022-23, sugar exports from India witnessed a y-o-y increase of 25.4%. In 2021, due to production shock in Brazil and higher international prices compared to domestic prices, exports of Indian sugar were competitive in the international market, without any explicit export subsidies by the Government of India.

As per the data from DGCIS, India exported sugar to 160 countries across the globe during 2022-23. Sudan was the largest destination for India's exports of sugar during 2022-23, accounting for 13.6% of the overall exports of sugar from India during the year.

Going forward, heightened uncertainties due to the Russia-Ukraine conflict and an increased diversion of sugarcane towards ethanol blending in Brazil could disrupt international sugar supply and countries importing from Brazil would look beyond Brazil to other suppliers like India and Thailand. However, the Government of India's Ethanol Blending Programme, the dependence on monsoons for sugarcane cultivation in several states, and the recent

[8] Department of Food and Public Distribution (DFPD), Ministry of Agriculture and Farmers' Welfare, GOI

[9] Includes HS 1701 and HS 170290 as per principal commodity classification of DGCIS

quantitative restrictions on sugar exports, can impact India's ability to scale up sugar exports.

ETHANOL

Ethanol's clean, affordable, and low-carbon nature makes it the perfect substitute for petroleum, particularly for use as transportation fuel. Currently, sugar crops are among the major feedstocks for ethanol production, in addition to other starch-rich crops like corn, wheat, and cassava. Global increase in demand for biofuels, particularly ethanol, has led to substantial diversion of both sugar beet and sugar cane towards ethanol production.

The global production of ethanol during 2021 was estimated at 27.3 billion gallons, witnessing a y-o-y increase of 3.0%. The USA was the largest ethanol producing country during 2021, with estimated production of 15.0 billion gallons, a share of 55.1% in the global ethanol production during the year. Brazil was the second largest ethanol producer with estimated production of 7.4 billion gallons, a share of 27.2% in the global ethanol production. The EU is the third largest ethanol producing region with estimated share of 5.0% in the global ethanol production. Other major ethanol producing countries in 2021 included China (a share of 3.2% in the global ethanol production), India (3.2%), Canada (1.6%), Thailand (1.3%), and Argentina (1.0%). The trends in ethanol production across major ethanol producers and the policy support by the respective governments are discussed in the Study.

CHALLENGES AND STRATEGIES

Rationalising Pricing Policy

Large cane arrears to be paid by the sugar mills to farmers is one of the main issues faced by the Indian sugar industry. In India, the pricing of sugarcane is determined by the government through the Fair and Remunerative Price (FRP) policy wherein the farmers are guaranteed at least the FRP for their sugarcane produce. The farmers are also eligible for premium on higher sugar recovery rates as the FRP is linked to a certain sugar recovery rate. However,

due to lack of liquidity with sugar mills for upfront payments to the sugarcane farmers, there are cane price dues from time to time.

The Sugarcane (Control) Order, 1966 (as amended up to 7th January 2010) provides for payment of cane price within 14 days of the delivery of sugarcane either at the gate of the factory or at the cane collection centre and any failure in making payment attracts penal interest on the amount due at the rate of 15% per annum for the period of such delay beyond 14 days. This further increases the amount of cane price arrears. Further, the dual cane pricing of FRP and State Advised Prices in some states, which are usually higher than the FRP, distorts the economics of cane and sugar and leads to substantial cane price arrears.

In recent times, ethanol production has proved to be helpful in reduction of cane price arrears, but more systemic changes are required to alleviate the challenge. A three-pronged strategy can be adopted to resolve the issue of large cane price arrears –

Revenue Sharing Policy: The Rangarajan Committee recommended a Revenue Sharing Formula (RSF) in 2012, wherein cane price payable by the sugar mills could be fixed at 70% of the revenue of sugar mills from sugar and by-products, or at 75% of revenue from sugar alone. The Committee further recommended that the farmers could be guaranteed a minimum cane price at the level of FRP. In case the RSF price is lower than the FRP, the gap could be paid to the farmers by the government through a Price Stabilization Fund (PSF). As per the Rangarajan Committee, the PSF should be a self-financing mechanism, and possibility of dual pricing of sugar for bulk consumers and household sector, sugar tax on soft drinks/beverages, retention of part of surplus fund generated under RSF when sugar prices are high, contribution by sugar mills in lieu of discontinuation of levy sugar obligation on mills, etc., may be explored to create the PSF.

The revenue sharing system is also prevalent in several other sugar producing countries, such as Thailand. It helps reduce the risk of fluctuations in the price of sugarcane paid by mills and leads to stable gross profits for the millers. In

India as well, the RSF recommended by the Rangarajan Committee can be adopted for win-win outcomes for farmers and mills.

Staggering the Payment made to Farmers: Staggering the payment made to the sugarcane farmers could also be beneficial for alleviating the challenge of large cane price arrears. A revenue model where 60% of the payment can be made upfront, and the remaining 40% is paid in instalments depending on the sale of sugar, could be adopted. The balance 40% payment needs to be staggered in a way that it balances the interests of both farmers and sugar mills. Arrangements can also be made through the banking channels, which includes support from government through some specially curated fund, to make sure that the farmers are not inconvenienced by the staggered payment of remaining 40%.

Holding off Increase in FRP: To solve the liquidity crisis in the sugar industry, the Government of India introduced the concept of Minimum Selling Price (MSP) of sugar in 2018, to ensure that the industry gets the minimum cost of producing sugar and the interests of the farmers are protected. This policy was expected to allow the mills to clear the cane price due to the farmers, as it was expected to generate enough liquidity. As per industry bodies, the current MSP fails to cover the cost of manufacturing, given that the MSP is at the level of ₹ 31 per kilogram that was fixed in 2019, and the FRP has increased every year and is at a reasonably high rate of ₹ 305 per quintal for a basic recovery rate of 10.25% for the sugar season 2022-23.

Moreover, the high FRP has led to over-production of sugarcane and surplus sugar production as sugarcane is a more profitable crop than other crops/crop combination in India. Returns from sugarcane at all-India level in the triennium ending 2019-20 were about twice the returns from crop combinations of ‘cotton and wheat’ and ‘paddy plus wheat’, 2.6 times the crop combination of ‘soyabean plus wheat’, and 4.2 times the crop combination of ‘soyabean plus gram’. The overproduction is exerting pressure on mill profitability and leading to delays in making payments to farmers. Considering the adverse incentives due to high FRP, the Government could keep the FRP constant for a period of time till the monetary benefit to the sugarcane farmers is in comparable range to that of other food crops.

The rationalisation of sugarcane prices, and thus sugar prices, would also bode well for international competitiveness of Indian sugar. The cane price paid in India is much higher than the prices paid across countries such as Thailand, Brazil and Australia. Rationalisation of the cane pricing policies could bring the cane prices in India in tune with the global prices, thereby facilitating greater exports.

Reviewing Minimum Distance Criteria and Cane Reservation Area

Under the Sugarcane Control Order (1966), the central government has prescribed a minimum radial distance of 15 km between any two sugar mills. This regulation was introduced to ensure a minimum availability of cane for all mills so that the mills do not compete for the same resources. However, this criterion often causes distortion in the market. The virtual monopoly over a large area can give the mills disproportionate bargaining power compared to farmers, especially where landholdings are smaller. Moreover, in addition to restricting competition, the regulation inhibits entry and further investment by new entrepreneurs with better technologies.

Another policy that needs to be reviewed, which is complementary to the minimum distance criteria, is that of cane reservation area and bonding. Under this, every designated mill is obligated to purchase from cane farmers within the cane reservation area, and conversely, the farmers are bound to sell to the mill. The expected result of this policy is to ensure a minimum supply of cane to sugar mills, but it can also reduce the bargaining power of the farmers, particularly when they are forced to sell to the mill even when there are cane arrears.

Notwithstanding these disadvantages, these policies can have a positive impact in regions where sugar mills are underperforming due to the lack of raw materials. The policies would ensure a minimum supply of cane to the industries and ensure that the fixed capital is not left underutilised.

These policies need to be carefully reviewed, taking into consideration the capacity and efficiency level of sugar mills. The Economic Advisory Council

to the Prime Minister in its 'Report on the Regulation of Sugar Sector in India: The Way Forward' in 2012, had also recommended that the minimum distance criteria and cane reservation area and bonding are not in the interest of sugarcane farmers or the sugar sector and may be dispensed with[10]. None of the states have taken action on either of the policies so far[11]. Instead of having a state-wide mandate that may be difficult to implement given the varying scenario across the various regions of the state, the state governments can adopt a differential policy for each region depending on the capacity of mills, efficiency, and production levels.

Utilisation of By-products

The four main by-products of the sugarcane industry are cane tops, bagasse, press muds, and molasses. By-products from the industry are widely used in several industries such as chemical and pharmaceuticals. In India, processing 100 tonnes of sugarcane yields 10 tonnes of sugar, 30-34 tonnes of bagasse, around 4.45 tonnes of molasses, 3 tonnes of pressed mud, 120 tonnes of flue gases and 1500 kWh of surplus electricity[12]. There has been a growing interest in the by-products of sugarcane industry over the years, and its optimal use can lead to greater profits for the sugar industry.

Even though Indian sugar industry has been processing the by-products to generate bioethanol, bioelectricity, and many other value-added products, it is not developed up to its full potential. There is need for technology upgradation in the sugar industry for better utilisation of sugarcane, its co-products, and by-products, and production of value-added goods from the by-products.

Encouragement for Sugar Beet Production

Sugar beet has a growth span of 6-7 months, compared to 10-12 months taken by sugarcane. It also has a higher sugar content (15%-17%), higher

[10] Department of Food and Public Distribution, Government of India

[11] Department of Food and Public Distribution, Government of India

[12] Solomon, S. (2011). Sugarcane By-Products Based Industries in India. In Sugar Tech (Vol. 13, Issue 4, pp. 408–416)

sugar recovery rate (12%-14%), and higher purity (85%-90%). Sugar beet has the potential to produce yield comparable to sugarcane, in half the time with water saving of 30%-40%[13].

Sugar beet was first introduced in India in 1950[14], and exploratory trials for the crop were conducted by the Indian Institute of Sugarcane Research, Lucknow. The institute also identified suitable sites all over the country for the cultivation of sugar beet. Studies have found that sugar beet can be efficiently grown in the black cotton soil, in the deccan tract of Maharashtra, Karnataka, Andhra Pradesh and Tamil Nadu. It can also be grown in the plains of North India during the rabi season[15]. Presently, even though sugar beet is cultivated in isolated parts of the country, it is not grown on a commercial scale due to the lack of factories with capacity to process sugar beet.

A market for sugar beet needs to be developed for encouraging cultivation of sugar beet on a commercial scale. Incentives and subsidies, as available for sugarcane, are required for promoting large-scale production of sugar from sugar beet. The Government of India could announce funds for capacity development of sugar mills for processing of sugar beet for sugar and ethanol production. The Government could also establish partnerships with European countries for technology transfer for sugar production from sugar beet.

Product Diversification in Exports

Diversification towards exports of value-added sugarcane and sugar items can bode well for the industry. There are various products that can be made from sugarcane and in the subsequent sugar formation process, which can be marketed and sold in international markets. Some of these products includes sugarcane edible strips, sugarcane juice, sugarcane syrup, jaggery, confectionary and packaged sweets, among others.

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[13] Souvenir, IISR-Industry Interface on Research and Development Initiatives for Sugarbeet in India (2013)

[14] Pathak, A. D., Kapur, R., Solomon, S., Kumar, R., Srivastava, S., & Singh, P. R. (2014). Sugar Beet: A Historical Perspective in Indian Context. In Sugar Tech (Vol. 16, Issue 2, pp. 125–132).

[15] Sugar Beet: A Historical Perspective in Indian Context, Pathak et al. (2014)

Food promotion campaigns in international markets could also be sponsored by the Indian government for Indian sugar confectionery. Focus on quality and hygiene aspects in such initiatives could also help in dissipating the negative perception about Indian food being greasy and unhealthy.

Geographical Indication Tags for Niche Products

Geographical Indication (GI) tag is a form of intellectual property certification given to products with specific qualities or reputation due to their origin. Geographical Indication status for niche products in the sugar industry can function as product differentiators and serve as important tool for marketing. Variants of jaggery like Central Travancore Jaggery, Marayoor Jaggery/ Marayoor Sharkara and Kolhapur Jaggery have been granted GI for their distinct geographical identities. The logo and the GI brand name need to be developed and marketed, and mechanism needs to be devised for ensuring that all products marketed under the GI brand adhere to minimum specific standards. To ensure the quality and uniqueness of the products, the state governments could set up a certification body, that would provide certificate of authenticity to select sugar-based high-potential export items.

RoDTEP Incentives for Sugar Exports

Sugar exporters received benefit under the Remission of Duties and Taxes on Export Products Scheme (RoDTEP) of 0.5% on FOB value of exports, until the export of sugar was put in the restricted category. To regulate the domestic supply and prices of sugar, the Government of India placed restrictions on the exports of sugar during MY 2022-23, and extended the restriction on exports of sugar till 31 October 2023. Any commodity falling under the restricted category is not eligible for export benefits. The Government could consider reinstating the benefits of RoDTEP for the sugar sector, for improving the export competitiveness of sugar.

Removal of Non-tariff Quantitative Restrictions

Presently, the sugar sector has mill-wise export quotas and quantitative restrictions on exports. Alongside, India has also imposed 100% import

tariff on import of cane or beet sugar[16]. According to Gulati et. al (2013), the restrictive export policy indicates a "pro-consumer" and "antifarmer" bias, with export bans reflecting an "implicit taxation" of the producers and "cross-subsidization of consumers". Imposing export bans deprives farmers of getting the best prices for their produce. On the other hand, high import duties reflect "anti-consumer" and "pro-producer" bias[17]. Clearly, the motive of India's trade policy in sugar, with restrictions on both exports and imports, is unclear. Moreover, the policy is also not aligned with the Agriculture Export Policy (AEP) of India, which aims at providing assurance that processed agricultural products and all kinds of organic products will not be brought under the ambit of any kind of export restriction. The Rangarajan Committee had also recommended that trade policies related to sugar should be stable. The Committee also recommended that appropriate tariff instruments like export duty should be applied, as opposed to quantitative restrictions. The industry body, Indian Sugar Mills Association, has also requested the Government of India to consider allowing exports under open general licensing.

Against this backdrop, the government could consider shifting from quantitative restrictions to tariff-based restrictions that are less trade-distortive than export quotas. This move could also help India gain a reputation as a reliable supplier of sugar in the international market.

Promotion of Organic Sugar

Organic sugar is a healthier and more environmentally friendly alternative to traditional sugar. It is therefore becoming increasingly popular in the international markets. Globally, farmers and large-scale producers are also opting for no pesticides and no chemicals in the growing of sugar crops, in response to the growing demand for organic sugar. Given the health and environmental benefits of organic sugar, and its growing international demand, there is a need to promote the production of organic sugar in

[16] HS 1701

[17] Gulati A., Jain S. and Hoda A., 2013, "Farm trade: tapping the hidden potential", Discussion paper no: 3, Commission for Agricultural Costs and Prices, Department of Agriculture & Cooperation, Ministry of Agriculture, Government of India

India. The Government could provide WTO compliant incentives for the development of the organic sugar industry in the country.

Incentives for Flex-fuel Vehicles

The corrosive nature of ethanol requires fuel material compatibility countermeasures in existing vehicles. The countermeasures lead to significant reduction in fuel efficiency. For example, when using E20, there is an estimated loss of 6-7% in fuel efficiency for 4 wheelers which are originally designed for E0 and calibrated for E10, 3-4% for 2 wheelers designed for E0 and calibrated for E10, and 1-2% for 4 wheelers designed for E10 and calibrated for E20[18]. For a further increase in the blending rate target, such calibrations would not be sufficient, and there would be need for introduction of flex-fuel vehicles, which have entirely new engine architecture and engine management systems. Flex-fuel vehicles are capable of running on a combination of 100% petrol or 100% bio-ethanol and their blends. These vehicles are already prevalent in countries like the USA, Brazil, China, and the EU. The automobile companies have already been advised by the Government of India to start producing flex-fuel vehicles. The Production Linked Incentive scheme for automobile and auto components also incentivises flex-fuel vehicles as several components of flex-fuel engine are included in the list of eligible products.

Given the importance of flex-fuel vehicles in reducing carbon emission as well as saving import bill of crude oil, there is a need to further incentivise the production as well as usage of flex-fuel vehicles. In the case of Electric Vehicles, the Government is incentivising the manufacturers with schemes like Faster Adoption and Manufacturing of Electric Vehicles (FAME), where government provides subsidies to the manufacturers. The Government is also incentivising consumers by giving purchase incentives, interest subvention, registration fee exemption, income tax benefits, among others[19]. Similar incentives could be provided for the production and usage of flex-fuel vehicles.

[18] Roadmap for Ethanol Blending in India 2020-25, Niti Ayog

[19] Niti Ayog

Flexibility in Sugar and Ethanol Production in Sugar Mills

In Brazil majority of the sugar mills can produce both sugar and ethanol. Sugar processing facilities are considered biorefineries and can make sugar, bioethanol, and electricity from bagasse. These plants are flexible, producing more sugar or more ethanol depending on the price premium of one over another. This flexibility is a key reason for the Brazilian ethanol industry's success[20]. There is a need to replicate such production technologies in India, with the ability to switch between the production of sugar and ethanol. To incentivise investments in such production technologies, in the 'scheme for extending financial assistance to sugar mills for enhancement and augmentation of ethanol production capacity', the Government could consider providing marginally higher interest subvention for integrated plants with such flexibilities.

Focus on Use of Alternative Feedstock for Ethanol

Ethanol can be produced from sugarcane, sugar, molasses, maize, damaged food grains, and surplus rice with the Food Corporation of India. Production of sufficient feedstock for ethanol production, without compromising on the food security of India is a big challenge. Further, there is also need for feedstocks which are less water-intensive and therefore more environmentally sustainable.

The production of alternative raw materials like sugar beet, maize, sorghum could help in increasing the production of ethanol, while being environmentally more sustainable and without putting a dent in the food security objective of the Government.

Biofuel production from used cooking oil is another promising alternative. Utilising used cooking oil for biofuel production has dual advantage of greater production of biofuel and reduction in environmental problems due to the disposal of used cooking oil. The National Policy on Biofuels, released by the Government of India in 2018, envisages production of biofuel from Used Cooking Oil (UCO). Oil Marketing Companies (OMCs) are periodically floating

[20] Charting the future of India's sugar industry, IFPRI

Expression of Interest for procurement of Biodiesel produced from UCO. The Government also launched a 'Repurpose Used Cooking Oil (RUCO)' sticker and a phone app to enable the collection of used cooking oil. Restaurants and hotels interested in supplying used cooking oil can affix the sticker to show availability. Going forward, there is a need for effective implementation of the current initiatives and amplifying these efforts.

Cooperation with Brazil in areas of Bioenergy and Biofuels

There has been remarkable transformation of the transportation sector in Brazil on the back of increased ethanol production. The support by the Brazilian Government, the large sugarcane production, and the ability to easily switch between sugar and ethanol production, have been crucial factors for the transformation of the transportation sector in Brazil.

India and Brazil have undertaken several bilateral and international activities/ initiatives in the biofuels sectors in recent years, including the exchange of technical visits, the Brazil-India Ethanol Talks, Symposium on Aviation Biofuels, the Joint Working Group on Bioenergy Cooperation, Roundtable on India-Brazil Collaboration in Biofuels in the automobile sector etc. Being the two largest sugarcane producing countries, there is immense potential for further collaboration between India and Brazil to scale up production and use of sustainable bioenergy and biofuels. The two countries could work towards joint development of ethanol and biomethane fuel cell vehicles, leveraging Brazil's experience in flex-fuel vehicles and the advanced capabilities of India in the automotive sector. Also, given the significant dependence on sugarcane for ethanol production in the two countries, collaborative efforts need to be taken to develop less water intensive and higher yield sugar crops.

Easier, Sustainable and Cost-effective Transportation of Ethanol

India's ethanol procurement by Public Sector OMCs has soared from 38 crore litres in supply year 2013-14 to over 452 crore litres in 2021-22. The encouraging number comes with a logistical challenge of moving the fuel from distilleries to blending depots and retail points. There are some states that produce more ethanol than the blending requirements, while some states

have a deficit in production. The surplus production needs to be transported to other states with lower production capacity. Currently, majority of ethanol is transported through road by tankers. There is a need for alternate methods of transportation of ethanol which includes dedicated pipelines, use of railways and coastal ways. In Brazil, which is the second largest ethanol producing country, the movement of fuel and ethanol is entirely through pipelines, rail or coastal ships.

Along with a change in method of transportation of ethanol, there is also a need to implement the amendments made in the Industries (Development and Regulations) Act 1951, to vest exclusive control of denatured ethanol to the central government for smooth movement of ethanol across the country. The amendments have not been implemented by many states, which is restricting the movement of ethanol. There is a need for speedy implementation of the amendments for easier transportation of ethanol.

CONCLUSION

In conclusion, promoting sugar and ethanol production in India requires a multifaceted approach. Some long-pending, structural issues in the sugar sector that have been highlighted need to be resolved at the earliest. This includes rationalising pricing policies for cane and reviewing minimum distance criteria and cane reservation areas. Encouraging sugar beet production can also improve the economic viability and sustainability of sugar and ethanol production. Further, utilising by-products and diversification of exports towards value-added items can help create additional revenue streams. GI tags for niche products can also be leveraged for effective marketing for exports of these products. RoDTEP incentives for the sugar sector can also improve the export prospects for the industry.

In the ethanol segment, incentivising the use of flex-fuel vehicles, promoting flexibility in sugar and ethanol production through integrated mills, use of alternative feedstocks including waste for ethanol production, cooperation with Brazil in the areas of bioenergy and biofuels, and better transportation of ethanol, can help bolster the segment and ensure success of India's ethanol programme.

1. INTRODUCTION

BACKGROUND

Sugar is among the most widely produced and traded commodities. Food and beverage sector is a major driver of consumption of sugar, but sugar also finds numerous applications in other industries such as pharmaceutical and skincare industry. It is also an essential source of employment and income for millions of people worldwide, particularly in developing countries. Given its importance for economic output and livelihood, the industry is also highly regulated and heavily subsidised across countries.

In recent years, the global sugar sector has faced significant challenges, including volatile prices, shifting consumer preferences, environmental issues, and increasing competition from alternative sweeteners. These challenges have raised concerns about the sustainability of the sector, particularly in terms of economic viability, environmental impact, and social equity. At the same time, there has been a growing focus on ethanol globally, which is creating competing demand for sugar crops. Ethanol has emerged as a crucial alternative fuel source globally, owing to its environmental benefits and potential to reduce dependence on fossil fuels. As the industry continues to evolve, it would be essential for companies engaged in sugar and ethanol to remain innovative and responsive to changing consumer demands.

With around 550 operating sugar mills, 309 distilleries and 213 cogeneration plant[21], India is the largest producer of sugar in the world. The sugar industry in India is a major contributor to the agricultural production and employment

[21] Solomon, S., Rao, G.P. & Swapna, M. Impact of COVID-19 on Indian Sugar Industry. Sugar Tech (2020)

generation in the country. It is the second largest agro-based industry in India after textile. The sugar industry in India is majorly dependent on sugarcane as raw material.

In India, ethanol has also been gaining significant traction in recent years, primarily due to the government's push towards cleaner and sustainable energy sources. The country is one of the largest consumers of fuel in the world, and its dependence on crude oil imports has been a major concern. To address this issue, the Indian government has been promoting the use of ethanol as a blending component in petrol, with the aim of reducing the country's reliance on imported crude oil and cutting down emissions.

SCOPE OF THE STUDY

Given the significance of the sugar and ethanol sector for the Indian economy and the changing dynamics of the sector, this Study analyses the current scenario of the sector both globally and in India. The Study also assesses challenges faced by the industry in India, highlights the best practices and competitive environment globally, and identifies the strategies and policy interventions needed to support the growth of the sector. Through the assessment, the Study hopes to provide insights that can inform future policymaking and contribute to the development of a more robust and sustainable sugar and ethanol industry in India.

2. GLOBAL SCENARIO OF SUGAR AND SUGARCANE

Sugar is an integral part of the diets of people, globally. It is majorly produced from two crops namely sugarcane and sugar beet, which are grown in different climates across the globe. As per FAO estimates, more than 110 countries actively participated in the industrial production of either cane sugar or beet sugar during 2019.

GLOBAL SUGARCANE PRODUCTION

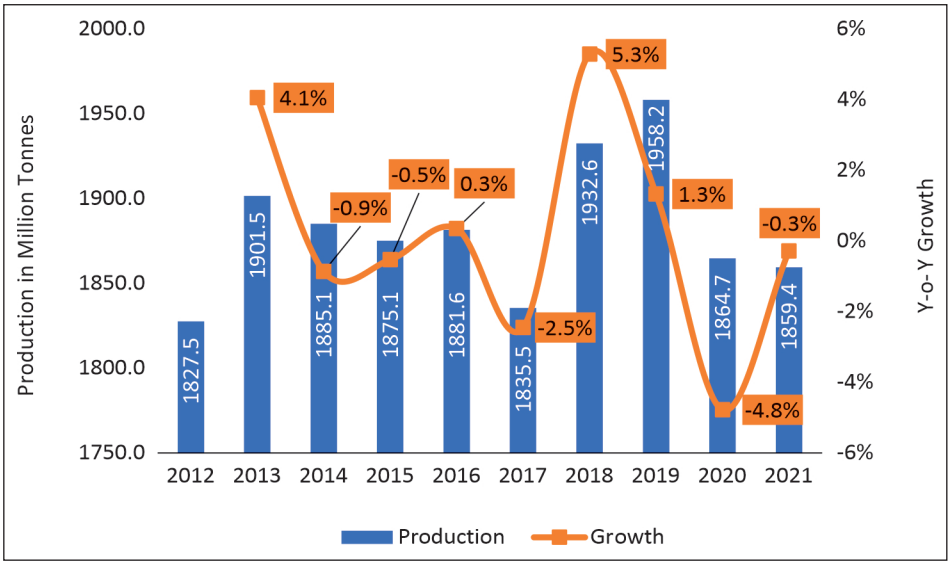
Sugarcane is an important commercial crop across many countries, and is the main source of sugar, ethanol and jaggery. It is also regarded as one of the most efficient sources of biomass and is used in biofuel production. Being the main sugar crop, sugarcane currently contributes to nearly 80% of the global sugar production[22]. It is mostly grown in countries with wholly or partly tropical climate, like Brazil, India, and Thailand. Nearly 26.3 million hectares of land was devoted to sugarcane cultivation worldwide during 2021. The global average yield of sugarcane in 2021 was 70.6 tonnes per hectare.

The global production of sugarcane was estimated at 1859.4 million tonnes during 2021, witnessing a decline of (-) 0.3% during the year, as compared to the production in 2020 (Exhibit 2.1). During the period from 2012 to 2021, sugarcane production recorded a nominal CAGR of 0.2%. The production of sugarcane during this period has witnessed intermittent periods of growth and decline, but has not witnessed any large volatility. Weather conditions are an important determinant of the levels of sugarcane production and unfavourable weather conditions in major sugarcane producing countries has been a key reason for the decline in sugarcane production during some of

[22] International Sugar Organisation

the years. For example, the sugarcane production witnessed a decline in 2020 due to unfavourable weather conditions in some major sugarcane producing countries like Thailand. The onset of COVID-19 also contributed to the decline in sugarcane production on account of lack of availability and access to labour and agriculture inputs due to lockdown in many sugarcane producing countries.

Exhibit 2.1: Global Sugarcane Production



Source: FAOSTAT, Exim Bank Research

Major Producers of Sugarcane

Sugarcane thrives in warm, tropical areas and these areas have dominated the sugar market for centuries. Brazil was the largest sugarcane producing country during 2021, with an estimated production of 715.7 million tonnes, witnessing a y-o-y decline of (-) 5.5% during the year. Brazil accounted for 38.5% of the global sugarcane production during 2021. The south-central region of Brazil contributes to more than 90% of the national production of sugarcane, making it the heart of the sugarcane production in the country. Production of sugarcane in Brazil has witnessed slight decline over the period 2017 to 2021, registering a CAGR of (-) 1.4% during this period.

Large-scale production of sugarcane in Brazil began in 1975, when soaring oil prices and a supply shortage in the international sugar market led the Brazilian Government to implement Proálcool (National Programme of Alcohol). This programme was designed to promote the use of alcohol from sugarcane (sugarcane ethanol) as an alternative fuel for motor vehicles. To encourage the production of ethanol, the government offered a range of subsidies to the industry. These included guaranteed purchases of ethanol by the state-owned oil company Petrobras, low-interest loans to agro-industrial ethanol firms, lower excise taxes on ethanol than on petrol and the fixing of hydrous ethanol prices at 59% of the government-set gasoline price at the pump[23].

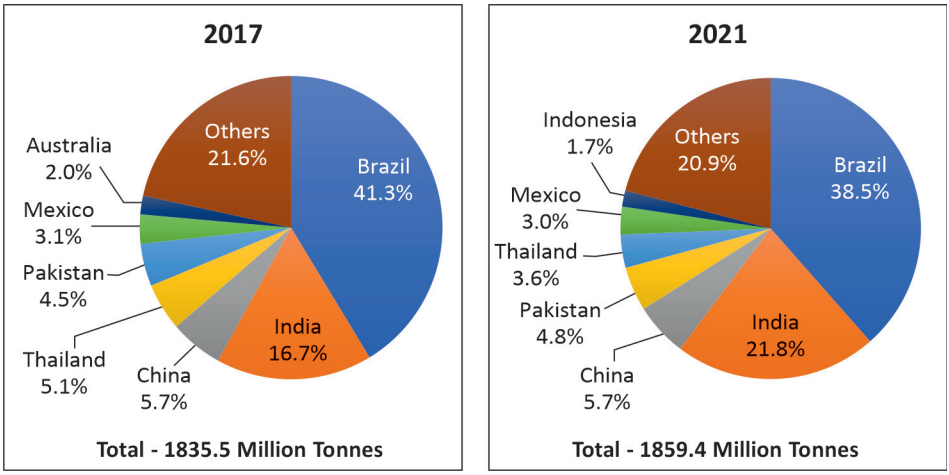
India was the second largest producer of sugarcane during 2021 with an estimated production of 405.4 million tonnes, witnessing a y-o-y increase of 9.4% during the year. India accounted for 21.8% of the global sugarcane production during 2021. There has been an increase in India's sugarcane production during the period 2017 to 2021, with a CAGR of 7.3% recorded during this period. The favourable climatic conditions for sugarcane cultivation in India, along with strong government support has helped India in becoming one of the largest sugarcane producers. Other major producers of sugarcane in 2021 included China (a share of 5.7% in global sugarcane production), Pakistan (4.8%), Thailand (3.6%), and Mexico (3.0%) (Exhibit 2.2). These six countries together accounted for more than three-fourth of the global sugarcane production during 2020.

Compared to 2017, there has not been major changes in the share of countries contributing to the global sugarcane production in 2021 (Exhibit 2.2). Brazil maintained its position as the world's largest sugarcane producer during 2021, with a minor decline in share. India increased its share in global sugarcane production by 5.1 percentage points during the period 2017 to 2021. Brazil and India together accounted for 60.3% of the total global sugarcane production in 2021, up from 58.0% in 2017. Thailand's share in the global sugarcane production declined from 5.1% in 2017 to 3.6% in

[23] The Brazilian Sugar Industry, Australian Bureau of Agricultural and Resource Economics and Sciences (June 2016)

2021, as relatively dry weather in the country during this period impacted the production.

Exhibit 2.2: Major Producers of Sugarcane in 2017 vs 2021



Source: FAOSTAT, Exim Bank Research

GLOBAL SUGAR BEET PRODUCTION

Sugar beet is another important source of sugar, biofuels, and fodder. It is a crop with almost zero-wastage as it is utilised for industrial purposes in different sectors. It represents around 20% of the world's total sugar production[24]. Commercially viable sugar beet crop can be produced in a growth span of 5-6 months. It is rich in sucrose and has greater resistance to water stress than sugarcane. Sugar beet is mainly cultivated and produced in the Eastern European countries. It thrives in cold, wet weather, making it an alternative to sugarcane in several parts of Europe and North America.

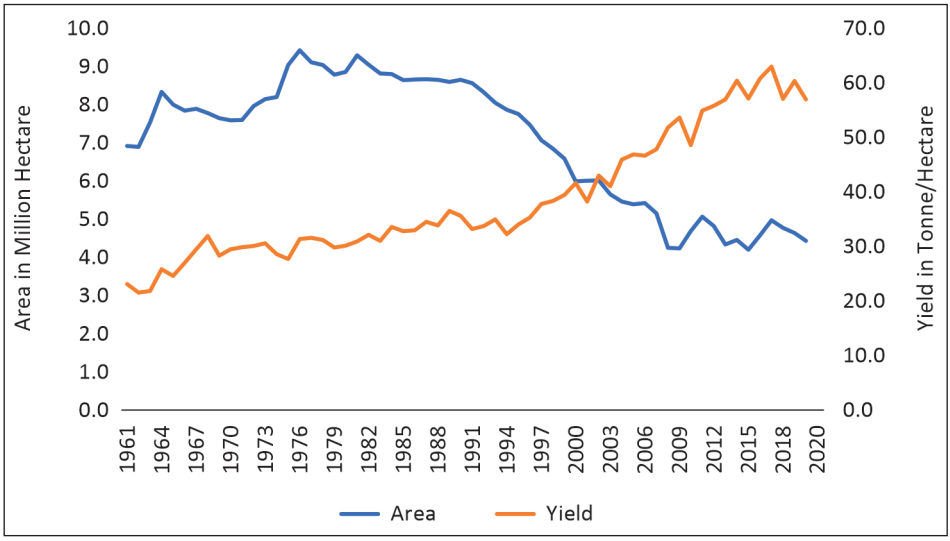
Sugar beet cultivation was initiated in the year 1747 when a German chemist discovered sugar in sugar beet varieties. However, sugar beet was not grown widely in Europe until the 19th century since its processing methods were not well developed. Since then, technical improvements in beet processing, quick development of plant breeding methods, agricultural mechanization,

[24] International Sugar Organisation

fertilizer application, as well as trade barriers in the sugarcane industry, led to substantial increases in sugar beet cultivation throughout the world[25].

The advancement in plant breeding methods, agricultural mechanization, and fertilizer application has resulted in increase in the yield of sugar beet. While there has been a continuous fall in the area under production of sugar beet, the yield has increased overtime (Exhibit 2.3).

Exhibit 2.3: Global Area under Harvest and Yield of Sugar Beet (1961-2020)

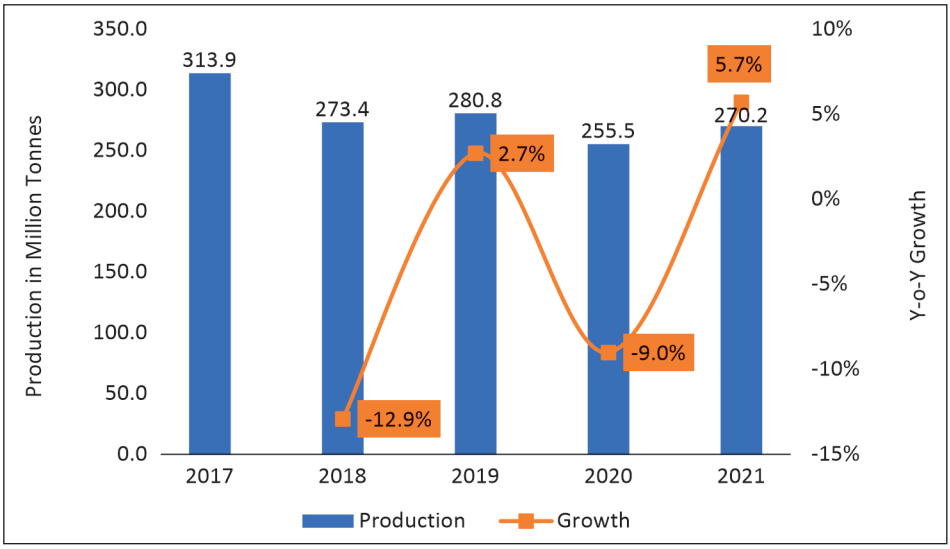


Source: FAOSTAT, Exim Bank Research

During 2021, sugar beet was cultivated in more than 50 countries, with around 4.4 million hectares of area under harvest and estimated production of 270.2 million tonnes (Exhibit 2.4). The production witnessed a y-o-y increase of 5.7% in 2021, majorly due to dry summers in the EU countries. The production of sugar beet has remained volatile during 2017-2021, witnessing intermittent period of growth and decline. The production of sugar beet registered a CAGR of (-) 3.7% during 2017 to 2021.

[25] Rajaeifar et al. (2019). A review on beet sugar industry with a focus on implementation of waste-to-energy strategy for power supply. Renewable and Sustainable Energy Reviews.

Exhibit 2.4: Global Sugar Beet Production



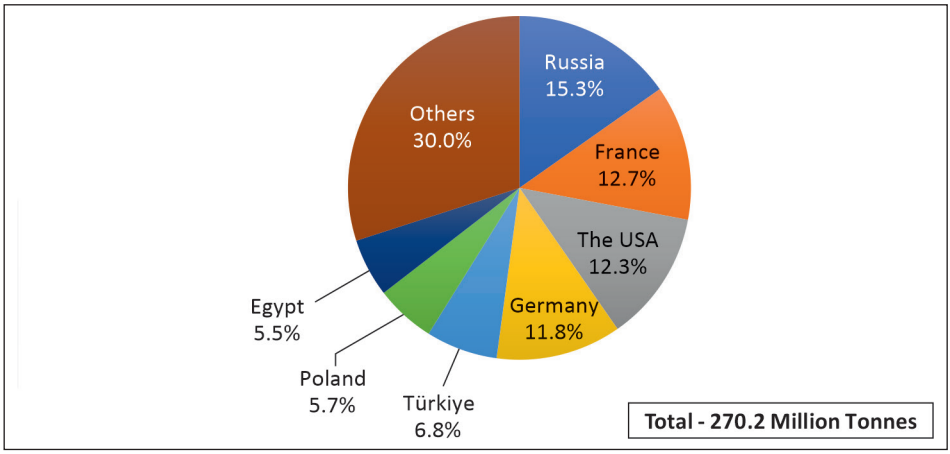
Source: FAOSTAT, Exim Bank Research

Major Sugar Beet Producers

Russia is the largest producer of sugar beet, accounting for 15.3% of the global sugar beet production during 2021. Russia had estimated sugar beet production of 41.2 million tonnes during 2021, witnessing a sizeable y-o-y decline of (-) 37.6%. Russia has more than doubled sugar output over the past decade (2010 to 2020) to end its reliance on imports. However, in 2020, farmers in Russia reduced their sugar beet sowing area by almost 19%, as profitability was impacted by weak domestic sugar prices due to sugar stockpile from five years of oversupply.

France is the second largest sugar beet producer with an estimated production of 34.4 million tonnes during 2021, and a share of 12.7% in the global sugar beet production. Production of sugar beet in France witnessed a y-o-y increase of 31.2% during 2021, after a decrease in production during the previous year. Other major sugar beet producers in 2021 included the USA (12.3%), Germany (11.8%), Türkiye (6.8%), and Poland (5.7%) (Exhibit 2.5).

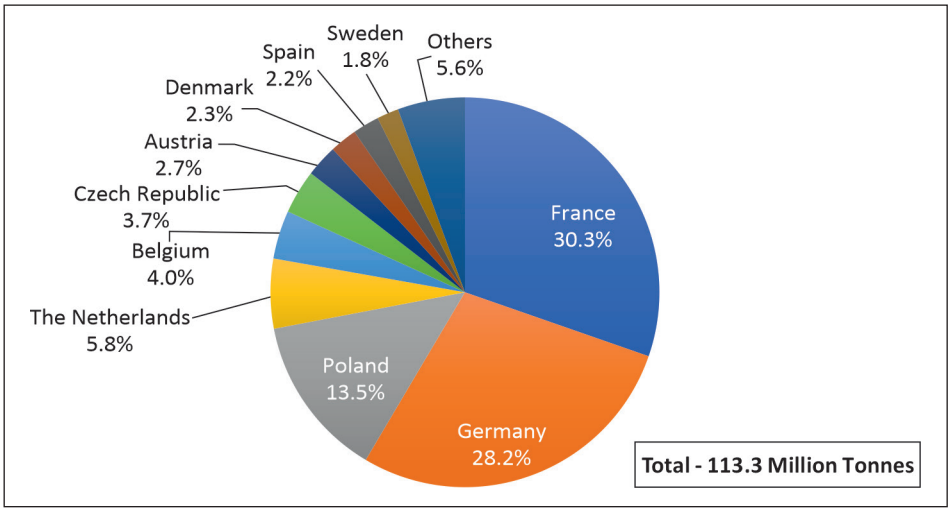
Exhibit 2.5: Major Producers of Sugar Beet (2021)



Source: FAOSTAT, Exim Bank Research

In 2021, the European Union produced a total of 113.3 million tonnes of sugar beet, accounting for 41.9% of the total sugar beet produced globally. Among the member states of the European Union, the major sugar beet producing countries in 2021, were France (30.3% of total EU's production), Germany (28.2%), Poland (13.5%), the Netherlands (5.8%), and Belgium (4.0%) (Exhibit 2.6). Out of the 27 EU member countries, 20 countries produce sugar beet.

Exhibit 2.6: Major Sugar Beet Producers in the EU (2021)



Source: FAOSTAT, Exim Bank Research

The production of sugar was subject to a quota system in Europe, as part of the Common Agricultural Policy (CAP) of 1968. Even though it was gradually liberalized over the years, CAP was abolished only in 2017. The European Union's sugar beet production in 2016 was 108.3 million tonnes; and with the removal of the quota system in 2017, production was expected to increase approximately 20% in the successive harvest due to expected increase in area, expectation of good climatic conditions and due to the unrestricted access to international markets. Even though the beet sugar production went up to 134.2 million tonnes in 2017, the production was much lower in 2018 (around 111.9 million tonnes) due to the dry summers of 2018. This further reduced during 2020 to 100.1 million tonnes due to a decline in area under harvest.

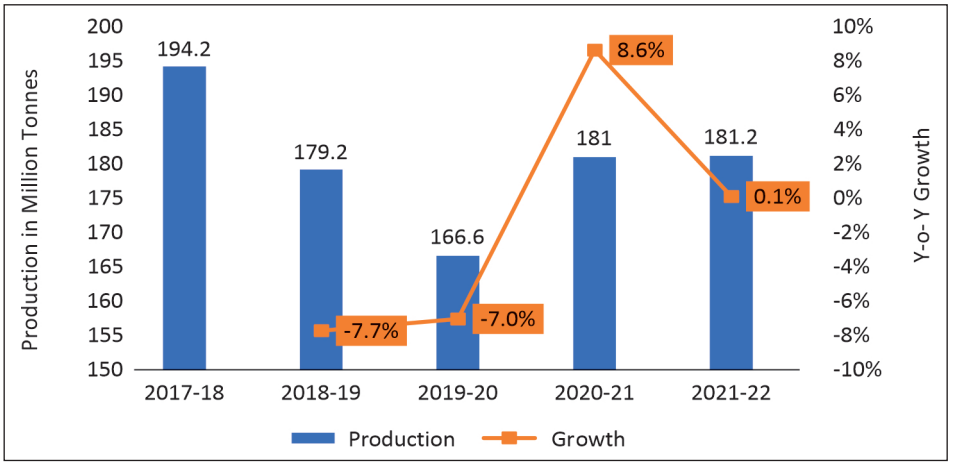
GLOBAL SUGAR PRODUCTION

According to the International Sugar Organization (ISO), sugar is one of the world's most produced and traded commodities. It is also one of the most government-regulated commodities. In MY[26] 2017-18, there was a record sugar production of 194.2 million tonnes. However, after MY 2017-18, there was a decline in global production of sugar in the following two years, which led to an upward pressure on prices. In MY 2018-19, the sugar production declined by (-) 7.9%, followed by a further decline of (-) 7.0% in production in the following year. In MY 2019-20, global production of sugar reached its lowest recorded level in recent years. The fall in global sugar production was majorly attributed to the decrease in sugar production in Thailand due to drought.

During MY 2020-21 and MY 2021-22, the global sugar production witnessed a consistent increase but remained below the record levels of production during MY 2017-18. The global production of sugar was estimated at 181.2 million tonnes during MY 2021-22 (Exhibit 2.7).

[26] Refers to Marketing Year as considered by the USDA Foreign Agricultural Services' Sugar World Markets and Trade Report. The reference period is May- April with some exceptions. In case of India, the reference period is October-September.

Exhibit 2.7: Global Sugar Production



Note: Time period is the respective marketing years.
Source: Foreign Agricultural Service, USDA, Exim Bank Research

Major Sugar Producers

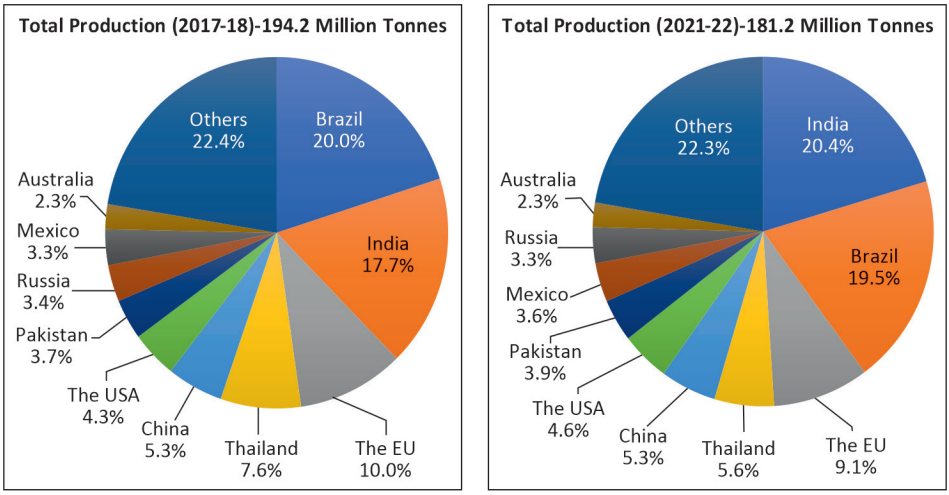
Although sugar is produced in over one hundred countries, the world sugar market has long been dominated by a small group of powerful producers that are mainly located in the Asia-Pacific, and the Latin American region.

India is the largest sugar producer with an estimated production of 36.9 million tonnes during 2021-22. India's sugar production was higher than Brazil, despite having much lower sugarcane production, because the sugarcane in Brazil is also being utilised for large-scale ethanol production. After 2017-18, out of the total sugarcane produced in Brazil, more than half is being used for ethanol production[27]. Despite the decline in use of sugarcane for sugar production, Brazil was the second largest producer of sugar in 2021-22. Brazil's production of sugar was estimated at 35.4 million tonnes during 2021-22, witnessing a y-o-y decline of (-) 15.9%. The Brazilian sugar industry is dynamic in nature on account of the flexibility of the mills to switch between production of sugar or ethanol, based on the returns offered by each product.

[27] Sugarcane Sector, Brazilian Confederation of Agriculture and Livestock (CNA).

The European Union is the world's third largest producer of sugar. While a large portion of the sugar is produced from sugar beet, in which Germany, France, Poland, and the Netherlands are the leading producers, the EU also refines imported raw sugar to a small degree[28]. The EU's sugar production was estimated at 16.5 million tonnes during 2021-22, a share of 9.1% in the global sugar production. Other major sugar producers in 2021-22 included Thailand (a share of 5.6% in global sugar production), China (5.3%), the USA (4.6%), and Pakistan (3.9%) (Exhibit 2.8).

Exhibit 2.8: Major Sugar Producing Countries



Note: Time period is the respective marketing years.
Source: Foreign Agricultural Service, USDA, Exim Bank Research

SUGAR MARKET PRICES

The demand-supply dynamics in the global sugar market is impacted by the production and policies adopted by the key producers, thus affecting the global sugar prices[29]. The price of sugar has been volatile, but in general, there has been a growing trend in the sugar prices in recent years. There are two major reasons for this growth in prices—firstly, the growing demand for sugar and secondly, increase in biofuel production resulting in a diversion of raw material i.e. sugarcane from sugar to the bio-fuel sector.

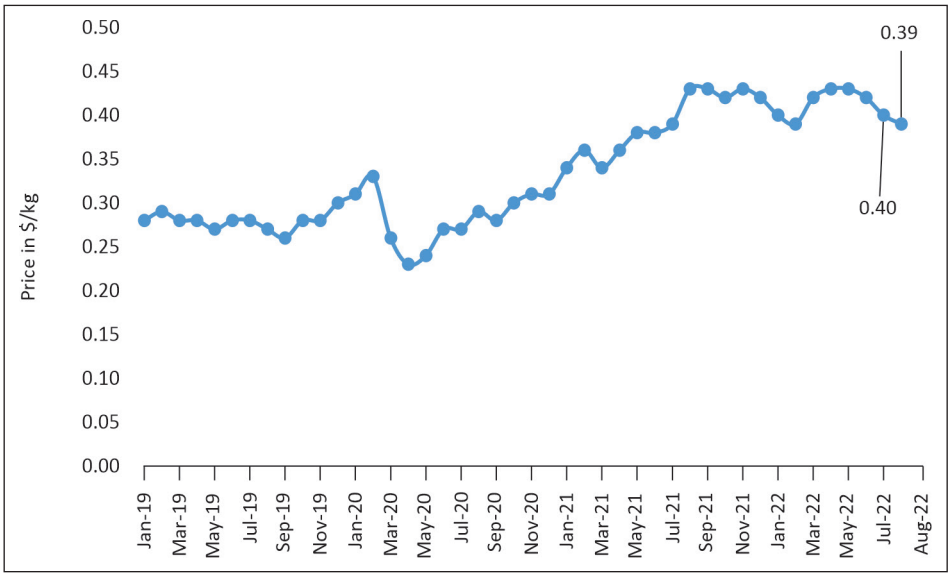
[28] Czarnikow (2021), The Sugar Series: The Top 10 Sugar Producing Countries in the World.

[29] Svatoš et al. (2013), World Sugar Market – Basic Development Trends and Tendencies, Papers in Economics and Informatics

It is noteworthy that even though sugar is a perfectly homogenous product, its price across the world is not uniform. Significant price differences are observed among different countries, based on the domestic policies of the countries. Also, different countries can produce sugar at different costs, due to their comparative advantage in production, creating differences in efficiency and profitability of sugar production across countries. Higher sugar prices are generally observed in the OECD countries, especially the European countries due to the large production cost. Environmental, social, labour, technical and other standards adopted by these countries also make the production expensive. Sugar prices are relatively lower in countries of Southeast Asia and Latin America.

As evinced by the International Sugar Agreement prices, world sugar prices witnessed decline in late 2021 and early 2022, but rebounded in March 2022 (Exhibit 2.9), mainly due to expectations of a higher diversion of sugarcane to ethanol in Brazil due to higher international crude oil prices. There has been slight moderation in the Sugar prices in the second quarter of 2022.

Exhibit 2.9: World Sugar Price (Jan-19 to Aug-22)



Note: The World Bank describes the sugar price data as sugar price from International Sugar Agreement (ISA) daily price, raw, f.o.b. and stowed at greater Caribbean ports.

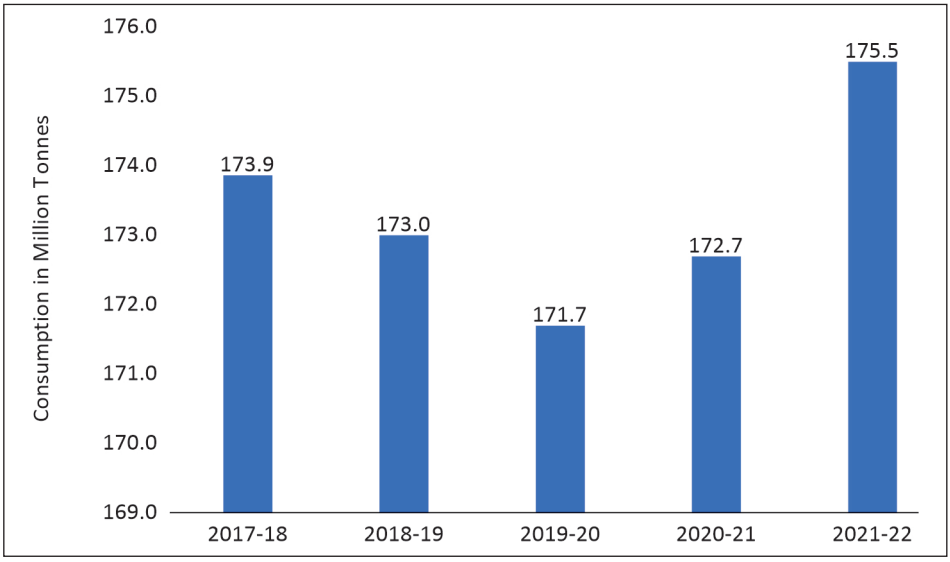
Source: World Bank, Exim Bank Research

As per the OECD-FAO Agricultural Outlook, the white and raw sugar prices are expected to remain stable over the upcoming years, with additional supplies of sugar foreseen to keep up with the growth in consumption in developing countries[30].

GLOBAL SUGAR CONSUMPTION

Global consumption of sugar registered two consecutive years of decline during MY 2018-19 and MY 2019-20. During MY 2019-20, the COVID-19 pandemic related lockdown caused a fall in sugar consumption around the world, with the global consumption of sugar declining to 171.7 million tonnes during the year. This was followed by a marginal recovery in sugar consumption during MY 2020-21. The recovery was even stronger in MY 2021-22, with the global sugar consumption increased by 1.6% to reach 175.5 million tonnes (Exhibit 2.10). Overall, global sugar consumption registered a CAGR of 0.2% during MY 2017-18 to MY 2021-22.

Exhibit 2.10: Global Sugar Consumption



Note: Time period is the respective marketing years.
Source: Foreign Agricultural Service, USDA, Exim Bank Research

[30] OECD-FAO Agricultural Outlook 2021-2030

According to the Commodity Coverage report by the International Institute for Sustainable Development, developing countries account for almost three-quarters of the global sugar consumption. They are also expected to drive future growth in demand for sugar. Geographically, the Asia-Pacific region is witnessing the highest growth rate for sugar consumption due to a rise in disposable income, rapid urbanisation of previously low-income sections, and improvements in the food and beverage industry in the region[31].

As per OECD-FAO estimates, the global sugar consumption is expected to continue growing at around 1.4% per annum, to reach almost 196 million tonnes by 2030. Growth in global population and income would be the main contributing factors for the increase in sugar consumption.

India is the largest sugar consuming country with estimated consumption of 29.0 million tonnes during MY 2021-22, accounting for a share of 16.8% in the global consumption during the year. India's consumption registered a CAGR of 2.3% during MY 2017-18 to MY 2021-22, higher than the CAGR for global sugar consumption during this period. India was followed by the European Union with estimated sugar consumption of 17.0 million tonnes during MY 2021-22, and a share of 9.7% in the global sugar consumption. Other major sugar consuming countries in MY 2021-22 included China (a share of 9.0% in global sugar consumption), the USA (6.4%), Brazil (5.6%), Indonesia (4.5%), and Russia (3.5%)[32] (Exhibit 2.11).

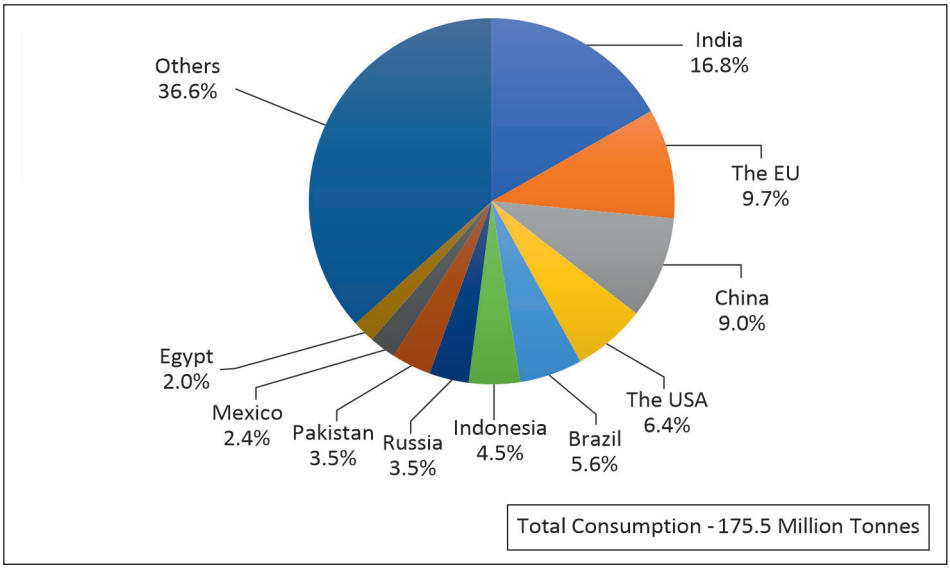
The average per capita consumption in developing countries is expected to increase over the upcoming years, due to the income growth and urbanization in these countries. The highest growth is expected in Asia, and the region is expected to represent more than half of the global consumption by 2030[33]. In Africa, population growth will be the main factor driving the consumption of sugar. Sugar consumption in developed countries is not expected to witness considerable growth in the next few years, on account of concerns about its negative effects on health.

[31] OECD-FAO Agricultural Outlook 2021-2030

[32] Sugar World Markets and Trade, USDA, May 2022 Issue

[33] OECD-FAO Agricultural Outlook 2021-2030

Exhibit 2.11: Major Sugar Consuming Countries (MY 2021-22)



Note: Time period is the respective marketing years.
Source: Foreign Agricultural Service, USDA, Exim Bank Research

GLOBAL SUGAR TRADE

The international sugar market is extremely volatile and is affected by the sugar policies adopted by the key producers, particularly Brazil, India, and Thailand. During MY 2021-22, 64.3 million tonnes of raw sugar was exported globally, representing 35.5% of the global sugar production[34]. As per OECD-FAO estimates, sugar will remain a highly traded product in the upcoming years due to the dominance of few countries in global production and a much wider consumption base.

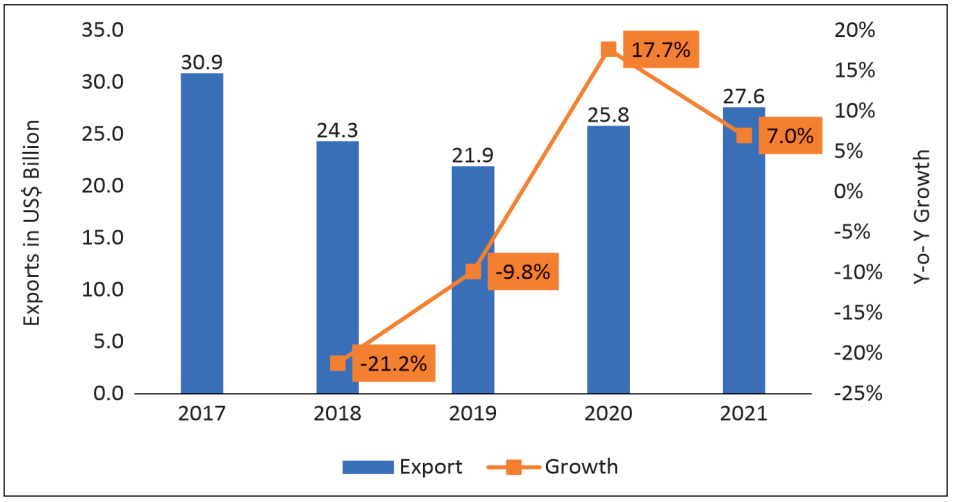
Global Sugar Exports

Global sugar exports registered a CAGR of (-) 2.8% during 2017 to 2021. Global sugar[35] exports were estimated at US$ 27.6 billion during 2021, witnessing a y-o-y increase of 7.0% (Exhibit 2.12). Despite the increase, global exports of

[34] Exim Bank calculation based on data from USDA.
[35] Includes HS 1701 and HS 170290 as per principal commodity classification of DGCIS

these products remained below the record levels of US$ 30.9 billion achieved during 2017. After the record-high in 2017, global sugar exports recorded two consecutive years of decline on account of reduction in sugar production and weak demand. Global sugar exports recovered thereafter in 2020, recording a y-o-y growth of 17.7% and the upward trajectory continued in 2021.

Exhibit 2.12: Global Exports of Sugar



Source: ITC Trademap, Exim Bank Research

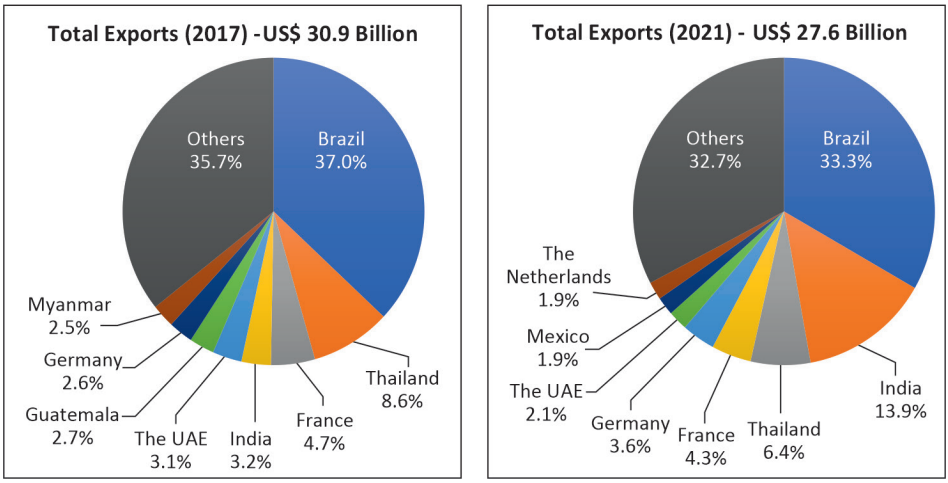
Major Sugar Exporters

Brazil, which is among the largest producers of sugar, is the largest sugar exporter, accounting for nearly one-third of the global sugar exports during 2021. India was the second largest exporter of sugar with estimated exports of US$ 3.8 billion during 2021, a share of 13.9% in the global sugar exports during the year. Other major sugar exporters in 2021 included Thailand (a share of 6.4% in global sugar exports), France (4.3%), Germany (3.6%), the UAE (2.1%), and Mexico (1.9%) (Exhibit 2.13). The top 3 sugar exporting countries accounted for more than 50% of the global sugar exports in 2021.

During 2017 to 2021, Brazil's share in global sugar exports moderated from 37.0% in 2017 to 33.3% in 2021. An increase in domestic ethanol production in Brazil has been a major reason for this shift. Thailand also witnessed a

decline in its share in global sugar exports during this period due to a fall in domestic production. India stepped up its supply of sugar during this period and the share of India in global sugar exports increased from 3.2% in 2017 to 13.9% in 2021. With the domestic production remaining above the consumption requirement and a supply void in the international market, India has been able to leverage the opportunity and increase its market share.

Exhibit 2.13: Major Sugar Exporters- 2017 and 2021



Source: ITC Trademap, Exim Bank Research

Major Sugar Importers

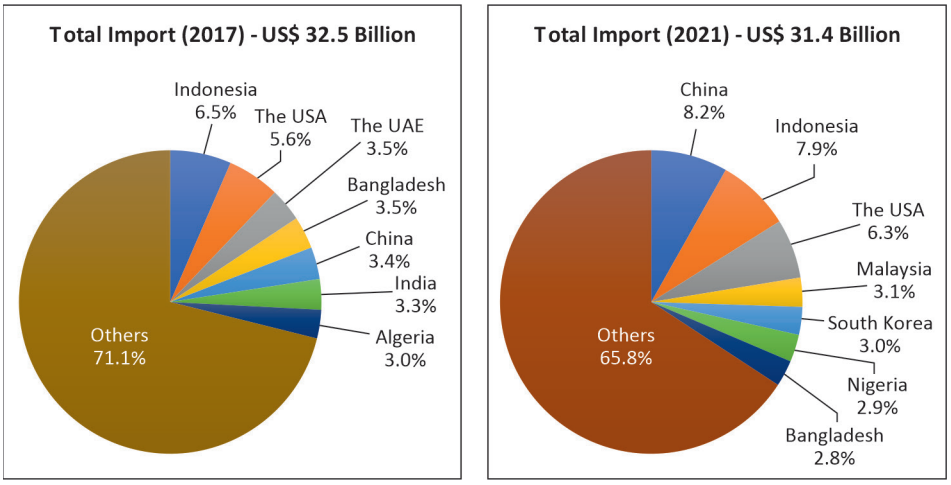
China is the largest importer of sugar with estimated imports of US$ 2.6 billion during 2021. China's share in global sugar imports has increased overtime, from 3.4% in 2017 to 8.2% in 2021. Increasing domestic consumption and unmet demand from domestic sources has led to the increase in sugar imports by China. Brazil is the largest supplier of sugar to China, accounting for almost 70% of the sugar imports by China during 2021.

Indonesia was the topmost sugar importing country in 2017 but became the second largest importer in 2021 due to the relatively larger growth in demand for sugar in China. Indonesia's sugar imports were estimated at US$ 2.5 billion during 2021, and its share in global sugar imports has

increased from 6.5% in 2017 to 7.9% in 2021. Indonesia's leading source for sugar imports is India, followed by Australia, Thailand, and Brazil. India's exports of sugar to Indonesia increased from mere US$ 90 thousand in 2017 to US$ 859.0 million in 2021. Earlier Thailand was the major source of imports for Indonesia, but with the drought situation in Thailand and subsequent reduction in sugar production, Indonesia eased its policy to allow imports from India. During 2020, Indonesia opened its sugar market for India by changing the colour specification for raw sugar imports to allow shipment from India. The Government of Indonesia halved the ICUMSA (International Commission for Uniform Methods of Sugar Analysis[36]) measure to 600 as most Indian mills were making raw sugar with an ICUMSA of as much as 800 and could not ship to Indonesia earlier, which had defined a level of 1200 for imported sugar.

Other major sugar importing countries in 2021 included the USA (share of 6.3% in global sugar imports), Malaysia (3.1%), South Korea (3.0%), and Nigeria (2.9%) (Exhibit 2.14).

Exhibit 2.14: Major Sugar Importers- 2017 and 2021



Source: ITC Trademap, Exim Bank Research

[36] ICUMSA is a regulatory organization which sets the global standard for quality control in sugar. The ICUMSA test evaluates the purity of sugar based on its colour.

Currently, raw sugar constitutes majority of the sugar imports and in the upcoming years, no major change is expected in the distribution of sugar imports between raw and refined sugar. Most of the sugar imports will continue to be of raw sugar, as per OECD-FAO analysis.

MAJOR SUGAR PRODUCERS

The five leading sugar producers in MY 2021-22 were India, Brazil, the European Union, Thailand, and China. The trends in production and trade of sugar in these countries, except India, is presented in this section to understand the competitive landscape for India's exports.

Brazil

Brazil is among the world's leading sugar producers and exporters. Brazilian sugar industry contributed nearly 19.5% to the global sugar production in MY 2021-22. Over the last few decades, Brazil's sugar and sugarcane sector has grown tremendously, owing to the technological progress, new varieties of crops, fertilizers, mechanization, different cropping practices, etc.

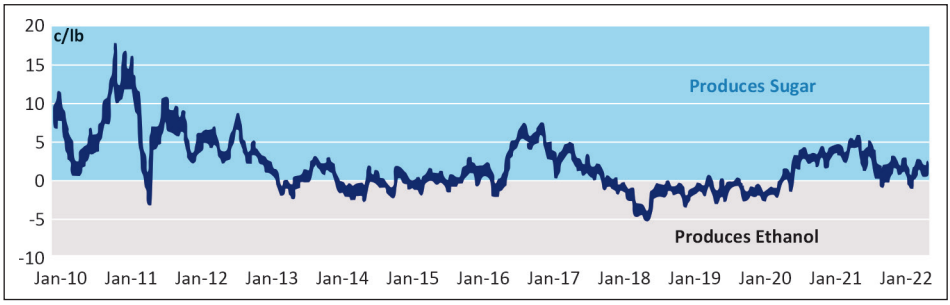
In Brazil, sugar is entirely derived from sugarcane. Cane production is highly concentrated in the southern parts of Brazil, where 60% of cane production is directly produced by the sugar factories that hold the land or rent it. The rest of the production is done by independent producers who engage in contracts[37]. State intervention has played a crucial role in development of the Brazilian sugar industry. Brazilian agriculture, including sugarcane, benefits from a reduced mandatory contribution to the government pension fund scheme. Farming activities have a special tax, informally called 'Funrural', which is much lower than the standard taxation applicable on non-agricultural activities.

Although Brazil is the largest sugarcane producer, less than 50% of the cane it grows is used to produce sugar, with the remaining utilised for ethanol

[37] Sant' Anna et al. (2016), Analysing sugarcane production contracts in Brazil.

production[38]. In Brazil, each mill has both sugar and ethanol producing capabilities. Mills decide ahead of time which commodity to produce based on the 'sugar and ethanol parity', which basically means the point at which sugar and ethanol prices are equal and therefore deliver the same return to the mill. During the COVID-19 period, oil prices were adversely impacted while raw sugar offered record returns, leading to an increase in the sugar and ethanol parity. Mills in Brazil therefore favoured sugar production. Recent trends indicate that mills are migrating even more towards sugar in the recent period due to a drop in the ethanol market[39] (Exhibit 2.15).

Exhibit 2.15: Sugar and Ethanol Parity



Source: CZAPP

The sugar production in Brazil during MY 2017-18 was estimated at 38.9 million tonnes which witnessed a sharp fall of 24.1% in the subsequent year due to below average crop management and slower stock development as a result of dry weather conditions[40]. Sugar production in Brazil witnessed marginal recovery in MY 2019-20, followed by a stronger recovery in MY 2020-21. Brazil's sugar production increased by 38.8% y-o-y to reach 42.1 million tonnes during MY 2020-21. Good rainfall and greater diversion of sugarcane towards sugar production due to a recovery in the sugar price during that period, were the main factors for the increase in production during MY 2020-21. But in the following year, drought conditions and fire outbreaks

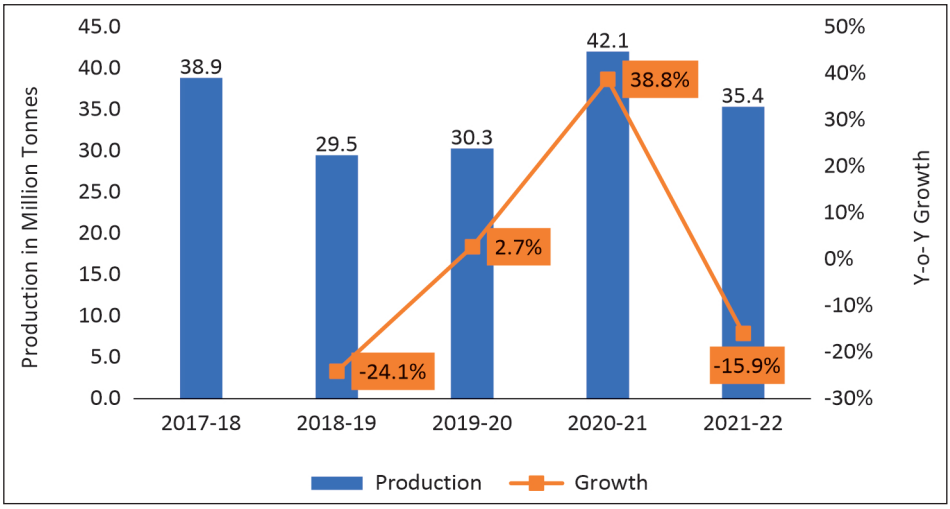
[38] How a change in Brazil's sugar policies would affect the world sugar market, Policy Research Working Paper, World Bank Group

[39] Biggest Sugar Mix since 2013 in CS Brazil, CZAPP, September 15,2022

[40] Brazil Sugar Annual, GAIN Report, USDA Foreign Agricultural Service (April 2018)

harmed the cane stocks, and a larger share of sugarcane was once again diverted towards ethanol production due to slight deterioration in Sugar and Ethanol Parity, leading to a fall of 15.9% in sugar production during MY 2021-22 (Exhibit 2.16).

Exhibit 2.16: Brazil's Sugar Production (MY18-MY22)

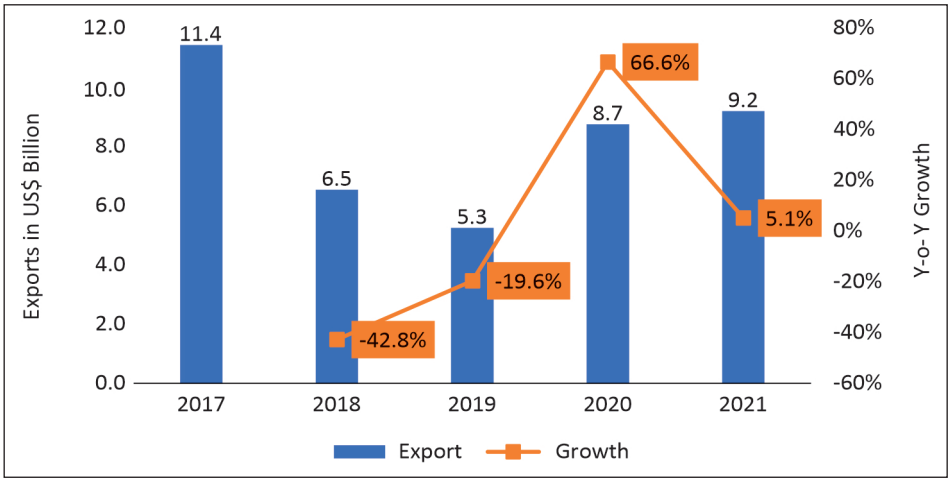


Note: Time period is the marketing year, which is April-March in case of Brazil.

Source: Foreign Agricultural Service, USDA, Exim Bank Research

Brazil was among the leading sugar exporters in 2021, with exports valued at US$ 9.2 billion. This is substantially below the sugar exports by the country in 2017. The higher demand in the international sugar market in 2016, had resulted in more sugarcane being diverted to sugar production in Brazil and consequently, a large increase in sugar exports by Brazil in 2017. Sugar exports from Brazil moderated thereafter in 2018 and 2019. In 2020, sugar exports from the country rebounded once again due to the increased sugar demand in the global market, as well as the diminishing attractiveness of ethanol production in domestic market, due to an improvement in the Sugar and Ethanol Parity. Sugar exports from Brazil increased by 66.6% to reach US$ 8.7 billion in 2020. This was followed by another year of strong growth, with sugar exports from Brazil recording an increase of 5.1% during 2021 (Exhibit 2.17).

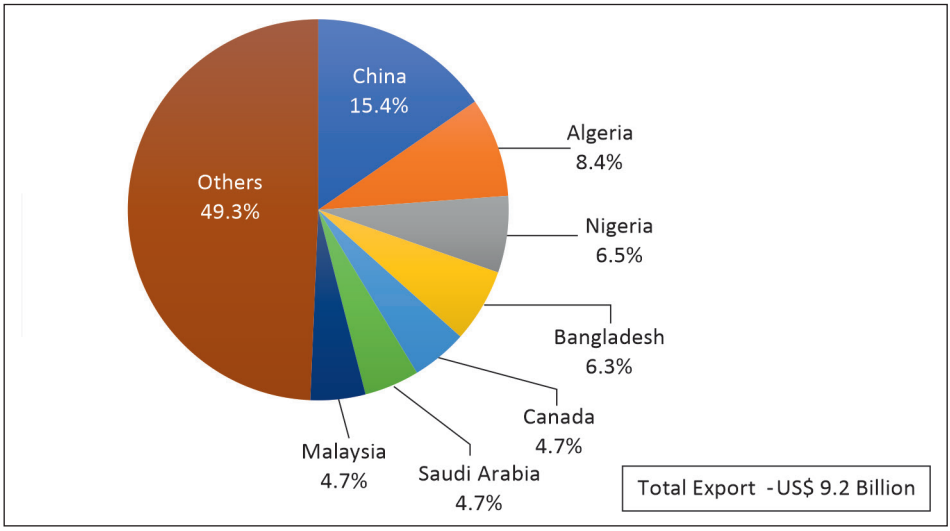
Exhibit 2.17: Brazil's Sugar Exports (2017-2021)



Source: ITC Trademap, Exim Bank Research

The major destinations for Brazil's sugar exports in 2021 included China (15.4%), Algeria (8.4%), Nigeria (6.5%), Bangladesh (6.3%), Canada (4.7%), Saudi Arabia (4.7%), and Malaysia (4.7%) (Exhibit 2.18).

Exhibit 2.18: Major Destinations for Brazil's Sugar Exports (2021)



Source: ITC Trademap, Exim Bank Research

The European Union (EU)

The European Union is the third largest producer of sugar, with a share of 9.1% in the total global sugar production during 2021. The EU mainly produces sugar from sugar beet which is grown in temperate zones.

In 2017, the EU's sugar production quota system (Box 1) was abolished, which resulted in an increase in domestic sugar production in the EU member countries. The EU produced 19.5 million tonnes of sugar in MY 2017-18. In the following year, there was a decline of (-) 14.1% in sugar production, taking the production in the EU to 16.8 million tonnes during MY 2018-19. This was due to adverse weather conditions, which affected the yield of sugar beet crops in major producing states. Sugar production witnessed a slight improvement in MY 2019-20 to reach 17 million tonnes, despite summer drought affecting sugar beet crops during the year.

Box 1: Sugar Quota System in the EU

Sugar was the only agricultural sector in the European Union where production was subject to a quota system. It was introduced with the first rules on the sugar common market organisation (CMO) in 1968, along with a support price for producers at a level significantly above the world market price. At the time, the Common Agricultural Policy (CAP) was recently introduced with the objective of self-sufficiency of the continent in food production through remunerative and stable prices for farmers. Quotas, together with a support price, incentivised achievement of the self-sufficiency goals in the sugar sector.

The total EU production quota of 13.5 million tonnes of sugar was divided between 20 Member States. Production in excess of the quota was known as "out-of-quota" sugar and strict rules governed its use. It could be exported up to the EU's annual World Trade Organisation (WTO) limit of 1.374 million tonnes, sold for biofuel or other industrial non-food uses, or be stored and counted against the following year's sugar quota. There was also a small quota of 0.72 million tonnes for an alternative sweetener called isoglucose (also known as Glucose Fructose Syrup) and surplus production of isoglucose was subject to similar restrictions.

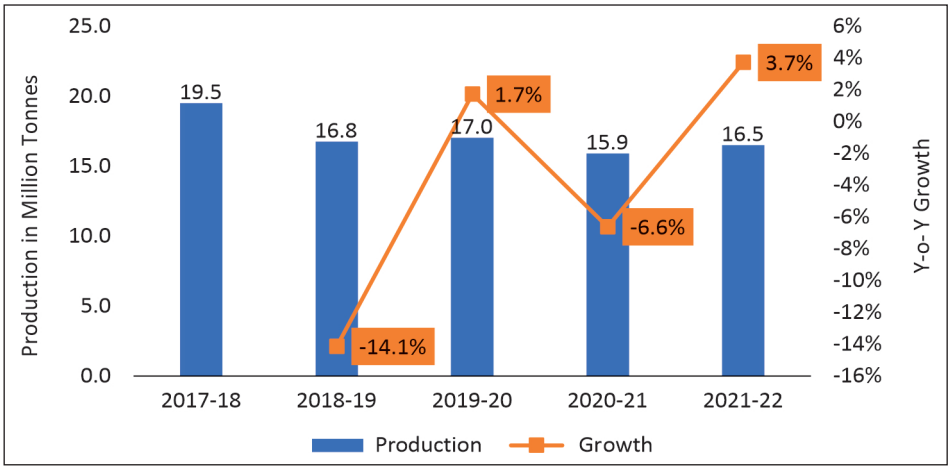
If there were signs that there would be an excess of sugar in the EU market in the following marketing year – which runs from 1 October to 30 September – a decision could be taken to withdraw some quantities. If, on the other hand, there was a risk of shortage, measures could be taken to increase supplies.

The end of the sugar quotas means that there are no further limits production or exports, allowing production to better adjust to market on demand, both within and outside the EU.

Source: The End of the Sugar Production Quotas in the EU, European Commission

In MY 2020-21, the EU's sugar production decreased once again by (-) 6.6%. The reasons for decline in sugar production during the year, included lower beet acreage, drought for the third consecutive year, and effect of beet yellow virus disease, which reduced sugar production in Germany, France, and Poland. Sugar production in the EU recorded moderate recovery in MY 2021-22 (Exhibit 2.19) but remained below the levels of production recorded in MY 2017-18. Sugar production in the EU is expected to decline in the upcoming years as farmers are shifting production away from sugar beet towards more profitable crops. Also, the frequent heatwaves and severe drought situation in many parts of the EU is likely to be detrimental to sugar yield.

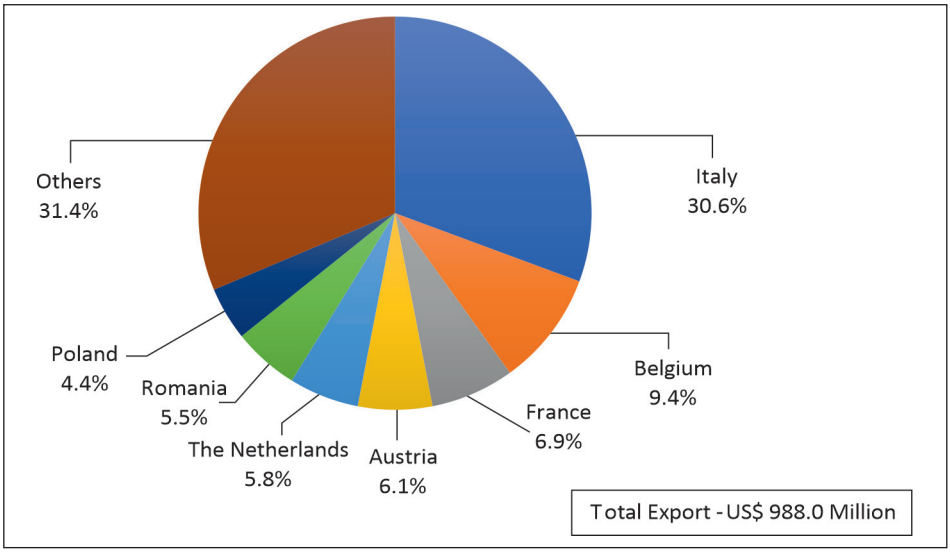
Exhibit 2.19: The European Union's Sugar Production Trend



Note: Time period is the marketing year, which is October-September in case of the EU.
Source: Foreign Agricultural Service, USDA, Exim Bank Research

The leading sugar producing states in the EU are Germany and France. Germany is also the fifth largest exporter of sugar globally, with a share of 3.6% in the global sugar exports during 2021. The major destinations for exports of sugar from Germany during 2021 included Italy (30.6%), Belgium (9.4%), France (6.9%), Austria (6.1%), the Netherlands (5.8%), and Romania (5.5%) (Exhibit 2.20).

Exhibit 2.20: Major Destinations for Germany's Sugar Exports (2021)



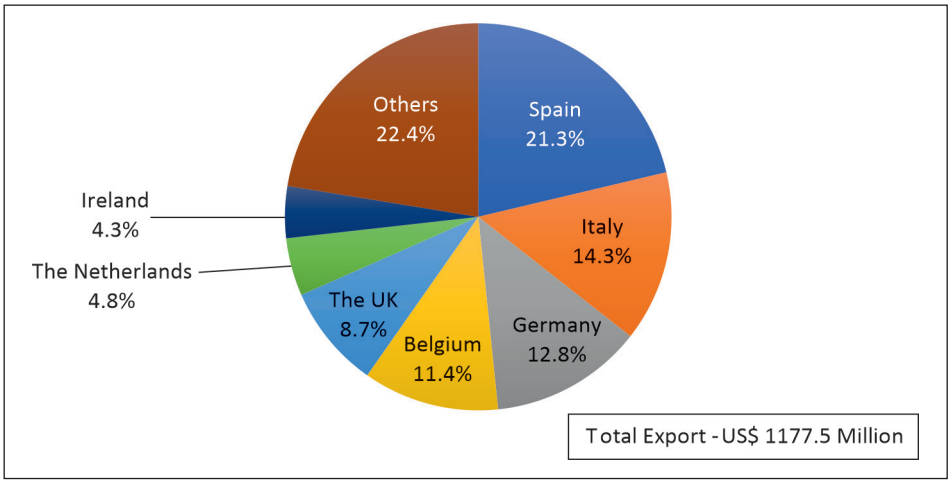
Source: ITC Trademap, Exim Bank Research

Germany also imported sugar worth US$ 467.2 million in 2021. France accounted for nearly 28.5% of the sugar imported by Germany during 2021. Other major import sources of sugar for Germany included Poland, the Netherlands, Belgium, Austria, and Colombia. The large share of intra-EU trade is partly because of the prominence of multinational alliances in the sugar production system in the EU. Sugar production in the EU is dominated by select sugar alliances/companies and individual sugar factories—does not matter where they are located—are controlled by companies based in Germany, France and the Netherlands[41], and the movement of sugar between the locations may account for part of the intra-EU trade in the product.

[41] Řezbová, Helena & Smutka, Lubos & Pulkrabek, Josef & Benesova, Irena. (2014). European Sugar factories, Sugar Companies and their Alliances: Who is in Control of European Sugar Market?.

France is the 4th largest sugar exporter globally, with exports valued at US$ 1.2 billion in 2021. The major destinations for France's sugar exports in 2021 included Spain (21.3%), Italy (14.3%), Germany (12.8%), Belgium (11.4%), the United Kingdom (8.7%), the Netherlands (4.8%), and Ireland (4.3%) (Exhibit 2.21). France also imported sugar worth US$ 0.3 billion in 2021, and the major import sources were Germany, Belgium, the Netherlands, Spain, and Brazil.

Exhibit 2.21: Major Destinations for France's Sugar Exports (2021)



Source: ITC Trademap, Exim Bank Research

Thailand

Thailand is the 4th largest sugar producer, with a share of 5.6% in the global sugar production during MY 2021-22. Sugar production in Thailand is majorly from sugarcane, with production evenly distributed in the Northern and the Eastern regions of the country. The Thai sugar industry has more than 300,000 producers, grouped into 33 planter associations and 55 processing plants. The commercial relation between the cultivators and sugar mills are regulated and administered by the Government[42].

The Thai sugar industry faces issues such as inadequate moisture, poor cane quality, small farm sizes, lack of mechanisation, underutilisation of cane mills,

[42] Thailand's sugar policy: a recent challenge, Agricultural Strategies, EU (2018)

etc[43]. But regardless of these challenges, Thailand has been able to enhance its sugar production through active government support (Box 2).

Box 2: Thailand Government's Support to Sugar Sector

Thai government has been closely involved with the Thai sugar industry for decades and has undertaken major steps to expand sugar production and exports. Since 1984, Thailand maintained a three tier quota system under the Cane and Sugar Act, under which a specific quantum was set aside for domestic consumption (Quota A), another specific quantum was set aside for state-sanctioned exports (Quota B), and surplus production was allocated for discretionary export by private sugar mills (Quota C). This system was implemented through a price floor for Quota A white sugar, which ensured domestic supply, and guaranteed the local farmers a consistent minimum return. The impact was that by ensuring a high price for sugar under quota A, producers were willing to export under Quota B and C at far lower prices than would otherwise be necessary to generate a sustainable return. The system reduced volatility in domestic sugar prices, provided protection to growers and millers, and also improved the price competitiveness of Thai exports.

With mounting international pressure, especially from Brazil, the quota system was completely abolished. The government deregulated domestic sugar price controls and terminated the quota administration, since January 15, 2018. Domestic sugar price is now derived from the combined average production cost of sugarcane and sugar including overhead costs and margin. Although the government has changed the method of computation, the domestic wholesale ex-factory price remains around the same as the controlled price set prior to the deregulation. In addition, this price is still higher than the current world sugar prices. The price difference between domestic wholesale ex-factory price and world sugar prices will be collected from sugar mills to fund the state-run Cane and Sugar Fund, which subsidizes cane growers when market prices of sugarcane are lower than the minimum prices.

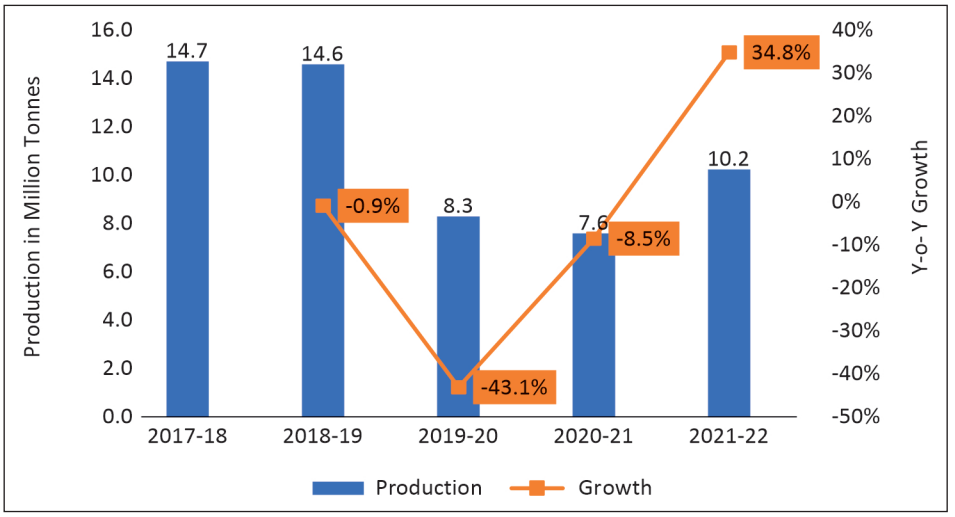
[43] Thailand's Sugar Policy: Government drives production an export expansion, American Sugar Alliance (ASA) Report

The Government of Thailand has also announced a 3% interest rate subsidy for farmers and agricultural cooperatives that take out soft loans from the state-owned Bank for Agriculture and Agricultural Cooperatives (BAAC) to buy machinery and invest in water supply development. The BAAC is scheduled to offer soft loans to farmers worth 6 billion baht (approx. US$ 175 million) over a period of three years, from 2022-2024.

Source: USDA, Exim Bank Research

Thailand produced 14.7 million tonnes of sugar in MY 2017-18 and maintained similar levels of production in MY 2018-19 as well. Many farmers shifted to sugarcane cultivation during this period. However, thereafter, the production registered two consecutive years of decline in MY 2019-20 and MY 2020-21, as large sugarcane area went unharvested due to drought situation in Thailand during that period. The production of sugar witnessed a sharp decline of (-) 43.1% during MY 2019-20 to reach 8.3 million tonnes and declined further to 7.6 million tonnes in MY 2020-21. Thereafter, sugar production in Thailand witnessed an increase in MY 2021-22 due to normalcy in weather conditions, but the production levels remained below the peak levels achieved in MY 2017-18 (Exhibit 2.22).

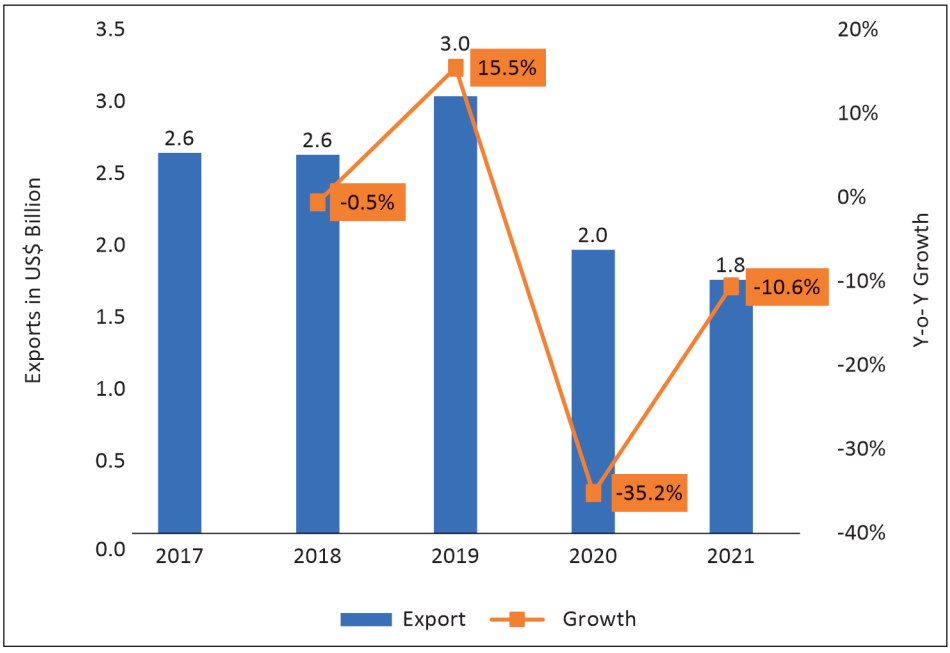
Exhibit 2.22: Thailand's Sugar Production Trend



Note: Time period is the marketing year, which is December-November in case of Thailand.
Source: Foreign Agricultural Service, USDA, Exim Bank Research

Thailand's sugar exports were valued at US$ 2.6 billion during 2017. The exports remained in similar range in 2018, since the sugar prices rebounded in the global market. In 2019, since many of the leading sugar producers were facing production shortage, due to the drought condition in these countries, there was a reduction in global supply of sugar. This increased demand helped promote Thailand's sugar exports in 2019, as the availability of previous stock helped Thai sugar producers in fulfilling the global supply gap. Many Asian countries have free trade agreements (FTA) with Thailand which facilitate preferential import of raw, white, and refined sugar, and these FTAs were leveraged by Thailand to enhance sugar exports during the year. But following this period, the exports declined in 2020 by (-) 35.2% (reaching US$ 2.0 billion), mainly due to adverse weather conditions in Thailand which impacted production. The exports further declined to US$ 1.8 billion during 2021, due to subdued production (Exhibit 2.23). The sugar exports from Thailand are expected to rebound in 2022, as production is already on an upward trajectory.

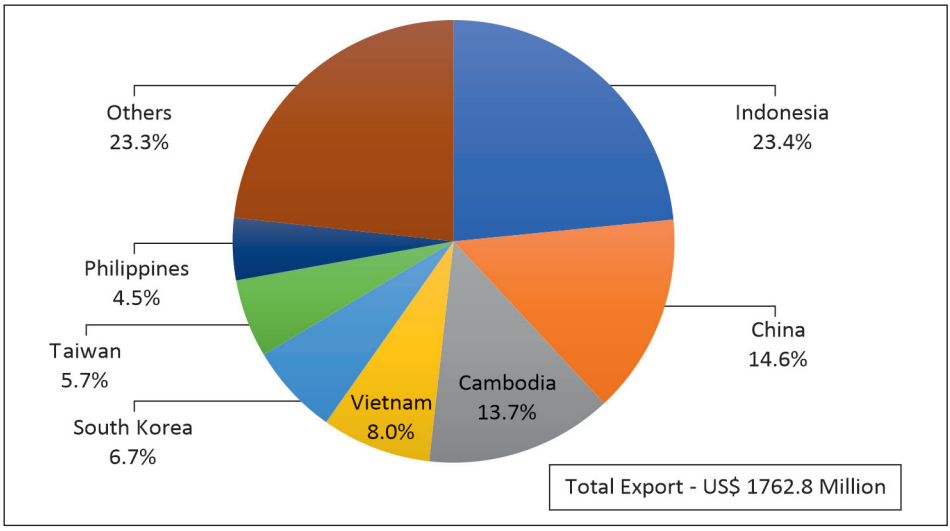
Exhibit 2.23: Thailand's Sugar Export Trend



Source: ITC Trademap, Exim Bank Research

Thailand's major destinations for sugar exports in 2021 included Indonesia (23.4%), China (14.6%), Cambodia (13.7%), Vietnam (8.0%), South Korea (6.7%), and Taiwan (5.7%) (Exhibit 2.24). In 2021, Thailand exported sugar to almost 54 countries around the world.

Exhibit 2.24: Major Export Destination for Thailand's Sugar Exports (2021)



Source: ITC Trademap, Exim Bank Research

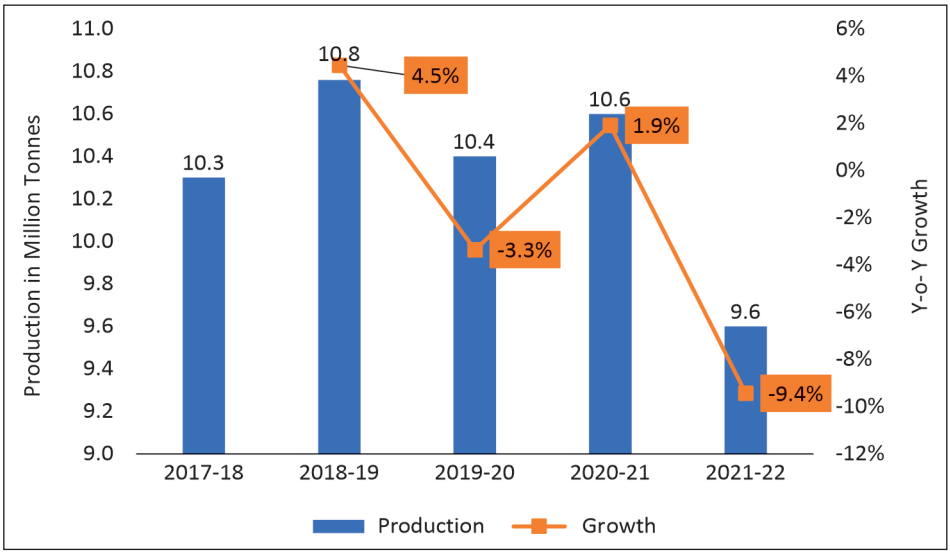
China

China is the fifth largest producer of sugar with a share of 5.3% in the global sugar production during MY 2021-22. Even though it produced 9.6 million tonnes of sugar in MY 2021-22 season, China is not self-sufficient in sugar production due to its high consumption demand. The country is in fact the world's largest sugar importer, with a share of 8.2% in the global sugar imports during 2021.

China manufactures sugar from both sugar beet and sugarcane. Sugar production in China remained over 10 million tonnes during the period MY 2017-18 to MY 2020-21. In MY 2021-22, however, sugar production declined as many farmers shifted to corn cultivation due to strong growth in corn prices and rising land rent costs. Sugar production declined by (-) 9.4% to

reach 9.6 million tonnes during MY 2021-22 (Exhibit 2.25). China's sugar production is expected to increase in the coming years, due to the expected favourable weather conditions[44].

Exhibit 2.25: China's Sugar Production Trend



Note: Time period is the marketing year, which is October-September in case of China.

Source: Foreign Agricultural Service, USDA, Exim Bank Research

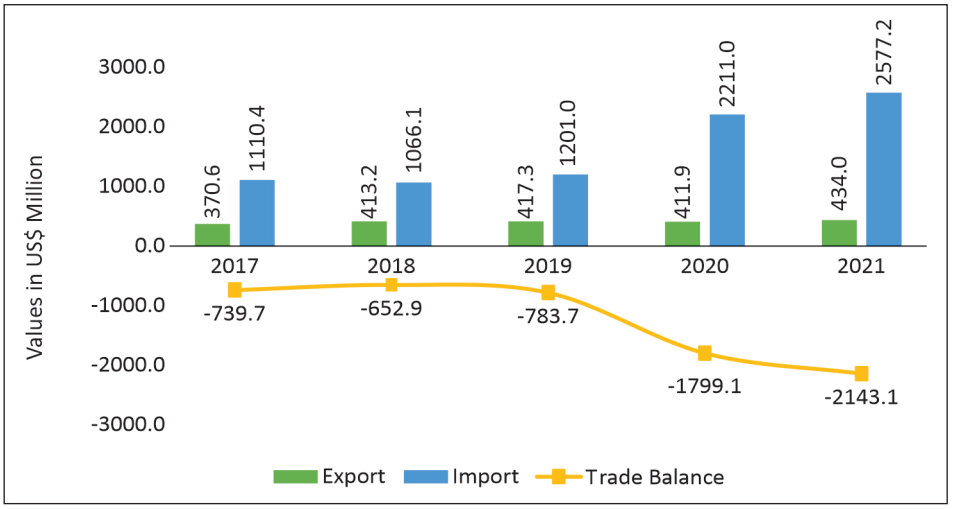
Although China's domestic production of sugar remained stable during the period under consideration high sugar consumption and demand within the country required China to import sugar from other markets. Moreover, China's domestic sugar prices are often higher due to the high domestic production cost, making imports competitive.

China is a net importer of sugar, with estimated trade balance of US$ (-) 2.1 billion during 2021 (Exhibit 2.26). In 2017, China imported sugar worth US$ 1.1 billion. The imports remained stable till 2019, but increased thereafter by 84.1% in 2020, to reach US$ 2.2 billion. During 2020, the Chinese government's sugar import safeguard policy expired, which was in effect since 2017. As per the safeguard policy, China imposed hefty tariffs

[44] Foreign Agricultural Service, USDA

on sugar imports from major exporting countries after years of lobbying by domestic mills. China allowed 1.94 million tonnes of sugar imports a year at a tariff of 15%, and out-of-quota imports were charged a higher tariff and needed special permits. With the removal of the additional safeguards on imported sugar and recovery in sugar consumption to pre-COVID levels, China's sugar imports further rose to US$ 2.6 billion in 2021 and the trade deficit worsened. Brazil accounted for almost 70% of China's sugar imports during 2021.

Exhibit 2.26: China's Sugar Trade Trend



Source: ITC Trade Map, Exim Bank Research

In 2022-23, China's sugar imports are expected to slightly decline[45]. China might be able to source sugar for domestic consumption from its own stock due to the expected increase in domestic production of sugar.

CONCLUSION

The global sugarcane production is expected to increase due to an expected increase in global consumption as well as increasing focus on ethanol. The consumption of sugar in direct form and in sugar confectionary is expected

[45] Foreign Agricultural Service, USDA

to increase with the increasing income levels and growth in population. With the expected increase in the global consumption, the opportunities for the major sugar producers are also immense. India is already leveraging the opportunities and has become the largest exporter of sugar. In its pursuit to further enhance market share in global sugar exports, India is likely to face stiff competition from countries such as Brazil, which is the largest cane growing region in the world, and Thailand, which provides strong government support to the sector.

The ethanol blending programmes across many of the countries would also create incentives for diversification away from sugar production. Meeting the demand for both ethanol and sugar would necessitate growth in acreage and improvement in yields across major sugar crops producing countries. Sustainability would also be a key trend across countries, given the significant water required for cultivation of sugarcane.

3. INDIAN SCENARIO OF SUGAR AND SUGARCANE

India's sugar sector has a significant contribution to the country's rural development and economic growth. The sector supports over 7 million farmers[46], and also contributes significantly to the national GDP. The sugar industry, which includes around 550 operating sugar mills, 309 distilleries and 213 cogeneration plant[47] is the second largest agro-based industry in India after textile industry. India's sugar industry also plays a significant role in the global sugar market, producing nearly one-fifth of both global sugarcane production and global sugar production.

INDIA'S SUGARCANE PRODUCTION

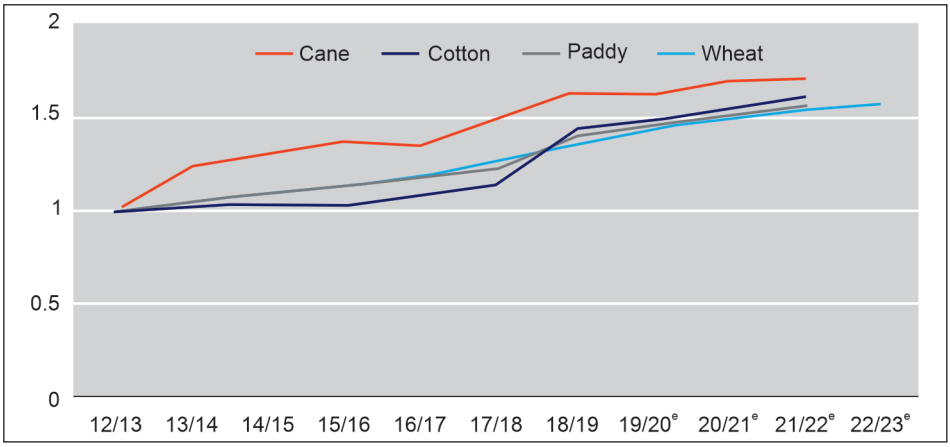
Sugarcane is the most important cash crop and primary source of sugar production in India. It also contributes to the production of green energy such as biofuels, bioelectricity, etc. There are strong incentives for farmers to cultivate sugarcane in India. Since sugarcane production involves less risk, farmers can expect a profit even under challenging circumstances, which encourages the cultivation of the crop. The returns on sugarcane cultivation in India have also been higher than the returns on several other crops (Exhibit 3.1). As a result, the area under cultivation of sugarcane has increased in India. The area under sugarcane cultivation in India was around 44.3 lakh hectares during 2016-17, which increased to 48.5 lakh hectares in 2020-21[48].

[46] S. Solomon. M. Swapna, Indian Sugar Industry: Towards Self-reliance for Sustainability (2022)

[47] Solomon, S., Rao, G.P. & Swapna, M. Impact of COVID-19 on Indian Sugar Industry. Sugar Tech (2020)

[48] Ministry of Agriculture and Farmers' Welfare, Government of India

Exhibit 3.1: Index of Minimum Support Prices for Indian Crops (2012/13 = 1)



e-estimated

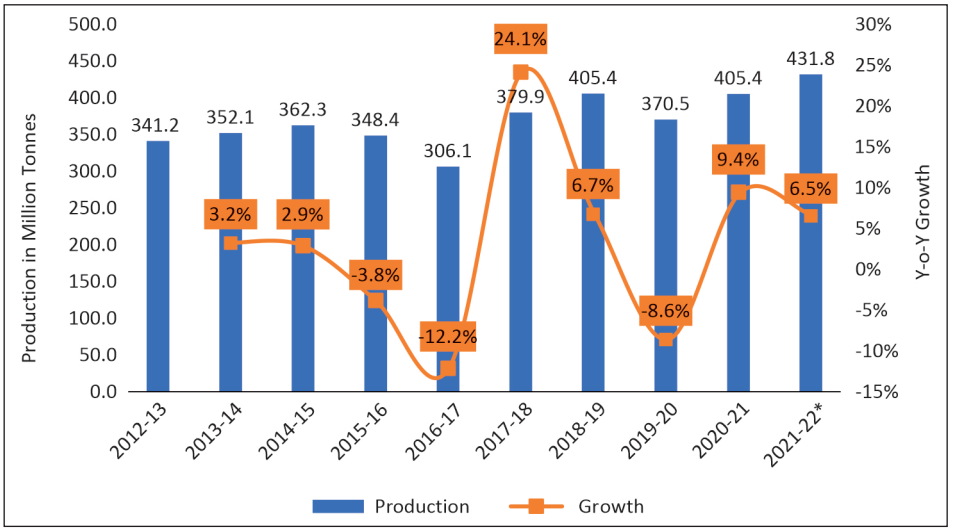
Source: Stephen Geldart (2022). Should India Abandon Ethanol To Make Food?, CZAPP, May 4, 2022, Exim Bank Research

The production of sugarcane in India reached record level of 431.8 million tonnes during 2021-22[49], registering an increase of 6.5% as compared to the production in 2020-21 (Exhibit 3.2). During the period from 2012-13 to 2021-22, sugarcane production in the country recorded a moderate CAGR of 2.7%. The production of sugarcane during this period witnessed intermittent periods of growth and decline, mainly due to the change in weather conditions. During this period, the most precipitous fall in production of sugarcane was in 2016-17, due to the drought in 2015-16 which had a lingering effect on cane development even in 2016-17. Thereafter, sugarcane production recorded two strong years of growth during 2017-18 and 2018-19. There was a fall in sugarcane production in the following year (2019-20), which can be attributed to bad crop and weather condition in the major cane producing areas[50]. There was not much impact of the COVID-19 pandemic on sugarcane production during 2019-20, as sugarcane harvesting season is generally from December to March in India, and the pandemic induced disruptions were visible only from end-March. During 2020-21 and 2021-22, sugarcane production in India remained resilient, registering strong growth rates during both the years.

[49] As per Third Advance Estimates, Ministry of Agriculture and Farmers' Welfare, GoI

[50] Based on Indian Sugar Mills Association (ISMA) estimates

Exhibit 3.2: Trend in India's Sugarcane Production



**As per Third Advance Estimates*

Source: Ministry of Agriculture and Farmers' Welfare, Government of India, Exim Bank Research

Development and use of improved sugarcane varieties, application of new agricultural techniques, mechanisation, and modernisation of sugar mills have all contributed to the improvement in India's cane production and productivity[51]. With the strong support from government and increasing crop area, India is expected to witness a steady rise in its sugarcane production in the upcoming years.

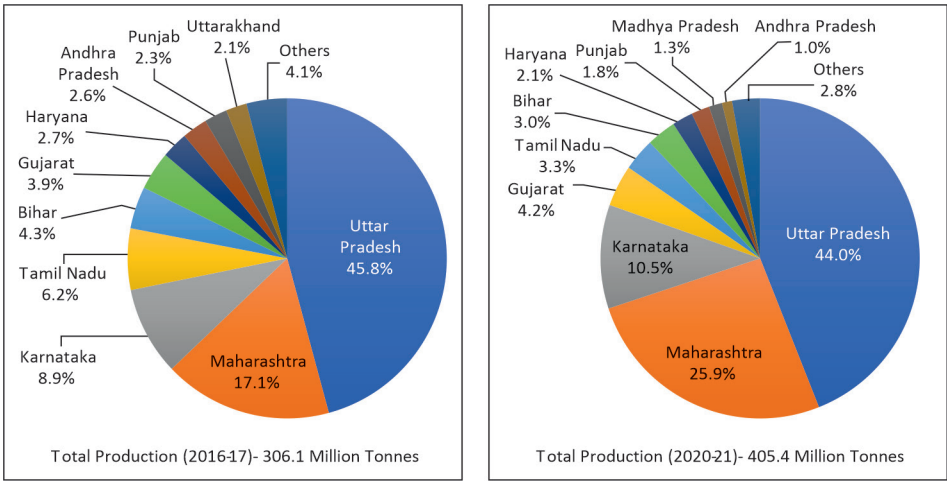
State-wise Production of Sugarcane

Cultivated in subtropical and tropical regions of the country, sugarcane is majorly produced in three states of India, namely, Uttar Pradesh, Maharashtra, and Karnataka. The three states together produced almost 80.4% of the total sugarcane produced in India during 2020-21. Other states like Gujarat, Tamil Nadu, Bihar, Haryana, and Punjab also contribute to the sugarcane production in the country.

[51] Solomon, S., Swapna, M. Indian Sugar Industry: Towards Self-reliance for Sustainability. Sugar Tech 24, 630–650 (2022)

With estimated production of 178.3 million tonnes (Exhibit 3.4), Uttar Pradesh was the largest sugarcane producing state in India during 2020-21, accounting for 44.0% of India's sugarcane production during the year. Meerut, Bareilly, Saharanpur, and Bulandshahar are the major sugar producing districts in Uttar Pradesh. During 2016-17 to 2021-21, the share of Uttar Pradesh in sugarcane production has decreased from 45.8% to 44.0% (Exhibit 3.3), despite an increase in sugarcane production in the State during this period.

Exhibit 3.3: State-wise Production of Sugarcane in India (2016-17 vis-à-vis 2020-21)



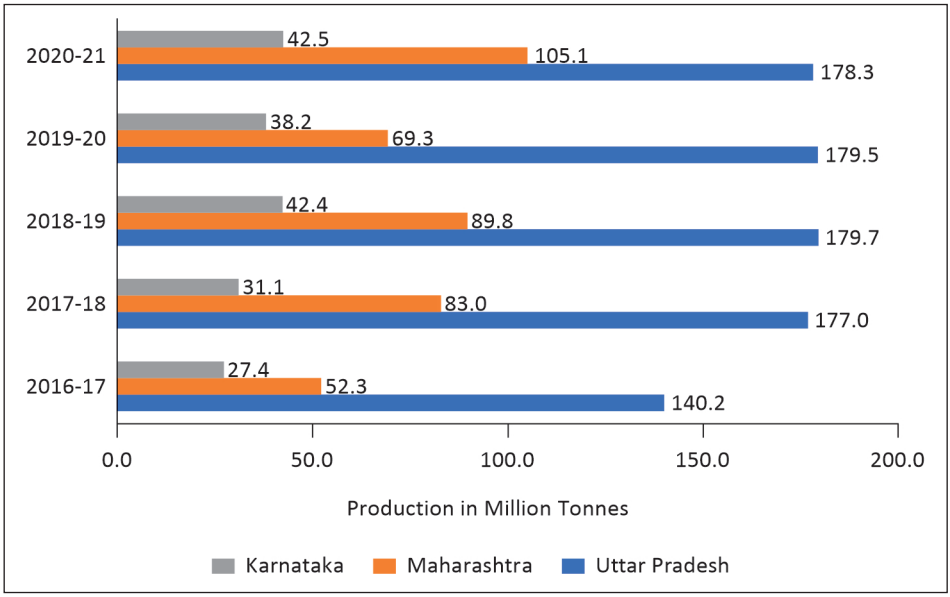
Source: Ministry of Agriculture and Farmers' Welfare, GoI, Exim Bank Research

Maharashtra was the second largest sugarcane producing state during 2020-21 in India with an estimated production of 105.1 million (Exhibit 3.4). Main districts producing sugarcane in Maharashtra are Pune, Satara, and Solapur. There has been a substantial increase in Maharashtra's sugarcane production during the period 2016-17 to 2020-21, with production recording a CAGR of 19.1% during this period. The increase in production is in line with the increase in area under cultivation for sugarcane in Maharashtra, which has increased from 6.3 lakh hectare in 2016-17 to 11.4 lakh hectare in 2020-21. The rising area under cultivation and production of sugarcane in Maharashtra has led to a substantial increase in the share of the State in India's sugarcane production- increasing from 17.1% during 2016-17 to 25.9% during 2020-21

(Exhibit 3.3). The growth in sugarcane production in Maharashtra has been exceptionally strong at 51.7% in 2020-21 due to favourable weather conditions, as also base effect over the previous year.

Karnataka was the third largest sugarcane producing state in India, with estimated production of 42.5 million tonnes (Exhibit 3.4) during 2020-21. Karnataka accounted for 8.9% of sugarcane production in India during 2016-17, which increased to a share of 10.5% during 2020-21 (Exhibit 3.3). The sugarcane production in the State has witnessed a steady increase during 2016-17 to 2020-21, registering a CAGR of 11.6% during this period. The state's excellent climatic conditions, with low humidity, sunny days and cold nights are suitable for sugarcane production.

Exhibit 3.4: Quantity of Sugarcane Produced by 3 Major Producers in India



Source: Ministry of Agriculture and Farmers' Welfare, GoI, Exim Bank Research

Other major sugarcane producing states in India, during 2020-21, included Gujarat (share of 4.2% in India's sugarcane production), Tamil Nadu (3.3%), Bihar (3.0%), Haryana (2.1%), and Punjab (1.8%) (Exhibit 3.3).

Sugarcane yield is higher in the tropical states as compared to subtropical states of India. The tropical sugarcane region includes the states of Maharashtra, Andhra Pradesh, Tamil Nadu, Karnataka, Gujarat, Madhya Pradesh, Goa, Pondicherry and Kerala. The states of U.P, Bihar, Haryana and Punjab come under the sub-tropical sugarcane region[52]. The tropical states had a sugarcane yield of 88.4 tonnes/ha during 2021-22 and the sub-tropical states had a yield of 80.3 tonnes/ha (Exhibit 3.5). Sugarcane grown in the tropical states have higher sucrose content, thereby leading to higher yield per unit area compared to the sub-tropical states. Also, in the tropical states of Southern India, sugarcane is cultivated with better practices and higher irrigation level, due to which floods, water logging and diseases like red rot are not major problems. Maharashtra and the neighbouring states of Karnataka and Andhra Pradesh also have the highest recovery rates, due to the long hours of sunlight and cooler nights. The latitudinal position of these states is favourable for sugar accumulation. However, there are also some challenges to sugarcane production in the tropical states. Sugarcane production in states such as Maharashtra and Karnataka is dependent on monsoon rainfall, and in times of drought, not only is the yield affected, but it also becomes difficult for farmers to plant new cranes on the black soil in the region which dries out, hardens and cracks during drought years[53].

In comparison with the tropical regions, the sub-tropical regions have extreme climate, but the dependence on monsoon is less pronounced. The cane yield is lower in these regions than the tropics due to various reasons like, short growing season, high temperature disparity, pests and disease problems, water logging, etc. The gap in yield level between the tropical and sub-tropical regions has narrowed in recent years, due to significant increase in sub-tropical yield due to introduction of new cane varieties in 2009 (Box 3) and a marginal decline in yield due to adverse weather conditions in the tropical region.

[52] Price Policy for Sugarcane 2022-23, CACP

[53] Stephanie Rodriguez (2022). Can India Sustain High Sugar Production? CZAPP, May 24, 2022

Box 3: How Co-0238 Changed the Fortune for UP's Sugar Farmers

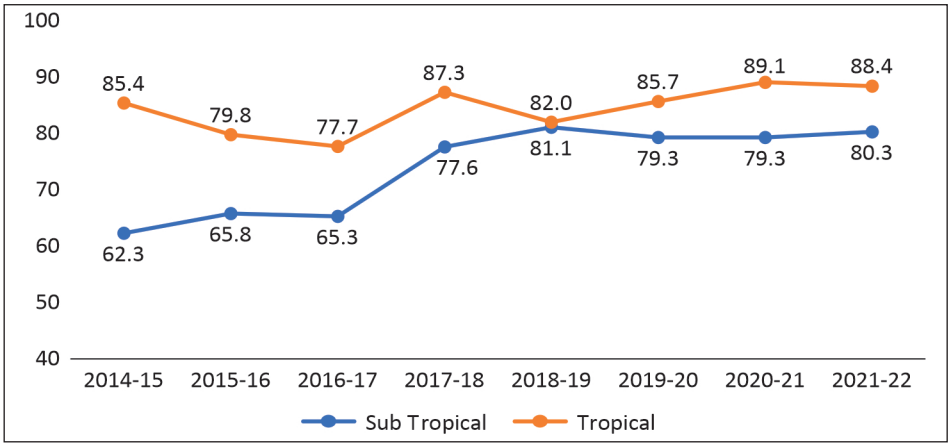
Co-0238 (Karan 4) is a high yielding and high sugar content variety of sugarcane. This variety was developed at the Sugarcane Breeding Institute, Regional Centre, Karnal. It was released during 2009 as an early maturing variety for commercial cultivation in north-west zone comprising the states of Haryana, Punjab, Western and Central Uttar Pradesh, Uttarakhand and Rajasthan.

In its evaluation, Co-0238 ranked 1st for cane yield (81 ton/ha), 2nd for sugar yield and 5th for sucrose content. In comparison to CoJ 64, a well-known early maturing variety of north west zone, the Co-0238 showed 19.96%, 15.83% and 0.50% improvement in cane yield, sugar yield and sucrose percentage, respectively. The variety is moderately resistant to the prevalent races of red rot pathogen. As it has both high cane yield and better quality juice, it is being preferred by both farmers and sugar industry.

There was higher cane yield and sugar recovery in 20 districts of UP due to increase in area under Co-0238. The mean cane yield of these 20 districts was higher by 2.7 ton/ha as compared to the mean cane yield of 24 districts with negligible area of Co-0238. This helped in increasing the per hectare profitability of farmers in UP.

Source: Indian Council of Agricultural Research

Exhibit 3.5: Region-wise Yield Trends of Sugarcane (Tonnes/ha)



Source: Price Policy for Sugarcane 2022-23, CACP, Ministry of Agriculture and Farmers' Welfare, government of India, Exim Bank Research

SUGAR BEET PRODUCTION IN INDIA

Sugar beet, which contributes to 20% of the world sugar production, was first introduced in India in 1950. Even though it is a crop of the temperate region, its cultivation is now being expanded to the subtropical and tropical regions through genetic engineering.

For India, sugar beet can emerge as an important crop to supplement sugarcane production, as it has high potential for ethanol production in a lower growth span. The growth span of sugar beet is 6-7 months as compared to 10-12 months of sugarcane. Sugar beet also has higher sugar content (15%-17%), higher sugar recovery (12%-14%) and higher purity (85%-90%)[54] than sugarcane. Apart from its ability to produce sugar, beet can be used for other purposes like, production of bioethanol, as a fertilizer, in the fermentation industry, etc. Exploratory trials for sugar beet cultivation were conducted in different parts of India by the Indian Institute of Sugarcane Research, Lucknow.

Development of tropicalised sugar beet varieties and seed production was taken up by multinational sugar beet seed companies in 2004. At the same time, ICAR also launched a Network Research Project to assess the feasibility of new sugar beet varieties under tropical conditions.

Despite these advancements, sugar beet is not cultivated for commercial purposes in India, due to lack of market. There are no government incentives to industries for installing additional machinery required for beet processing, unlike sugarcane.

SUGAR PRODUCTION

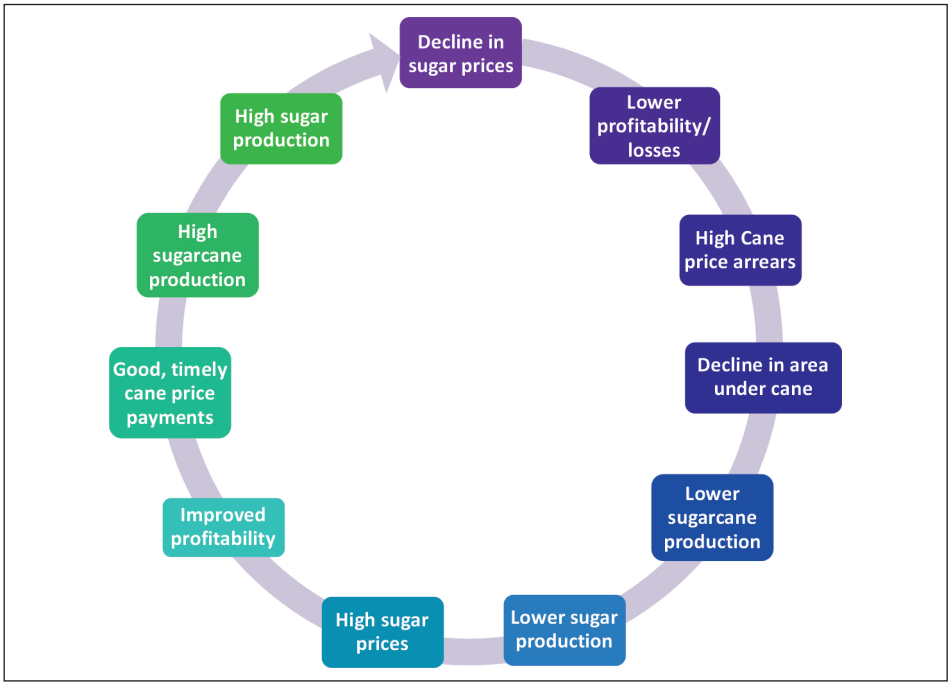
India is among the major producers of sugar, globally. Over the years, sugar production in India has increased at a steady rate due to use of better crop varieties, better technology, increasing sugarcane acreage due to better

[54] Pathak, A.D., Kapur, R., Solomon, S. et al. Sugar Beet: A Historical Perspective in Indian Context. Sugar Tech 16, 125–132 (2014)

returns, etc. Use of varieties like Co-0238 also helped in increasing the sugar recovery rate in India. On account of these reasons, since 2011-12, India's sugar production level has been consistently greater than domestic consumption, generating considerable exportable surplus.

Sugar is a cyclical industry in India, with typical cycles of 4-5 years, of which 2 years witness increasing prices and declining production, while 2 years register declining prices and rising production. During the years of excess sugarcane production, sugar prices fall in the market and consequently, sugar mills delay the payments to sugarcane farmers. As a result, farmers tend to shift their sugarcane acreage to other crops. However, after one or two years, when sugar cycle reverses and prices start rising due to shortage of sugar in the market, farmers again switch towards sugarcane cultivation marking a four-year cyclical cob-web phenomenon which is a major cause for instability in sugar industry (Exhibit 3.6).

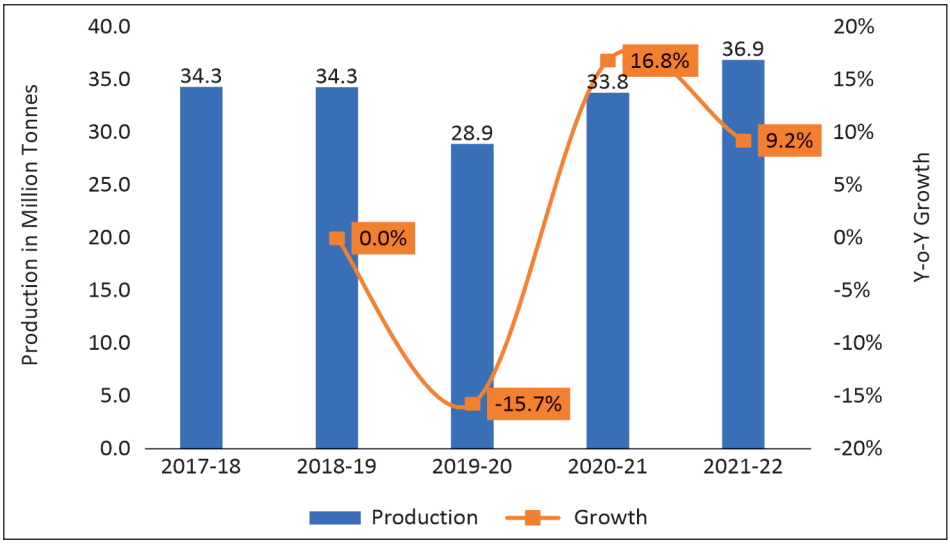
Exhibit 3.6: Cyclicality in Indian Sugar Industry



Source: Indian Sugar Sector Sugar to Bioenergy – A paradigm shift, Systematix Institutional Equities, 21 February 2022

In MY 2017-18, India's sugar production was estimated at 34.3 million tonnes, which remained stable at the same level during the next year. However, there was a sharp decline in India's sugar production in MY 2019-20, with production declining by (-) 15.7%. The fall in India's sugar production during the year can be largely attributed to the drought in Maharashtra which led to a decline in sugarcane production during the year. During MY 2020-21, the sugar production increased by 16.8%, as compared to MY 2019-20 as the production of sugarcane rebounded. The production of sugar further increased to 36.9 million tonnes during MY 2021-22, witnessing a y-o-y increase of 9.2% (Exhibit 3.7). The steady increase in production helped India overtake Brazil to emerge as the world's leading sugar producer in MY 2021-22.

Exhibit 3.7: India's Sugar Production



Note: The years are Marketing Year, as considered by the USDA Foreign Agricultural Services' Sugar World Markets and Trade Report. In case of India, the reference period is October-September.

Source: Foreign Agricultural Service, USDA, Exim Bank Research

Maharashtra was the leading sugar producing state in MY 2021-22. Maharashtra overtook Uttar Pradesh to regain its position as India's largest sugar producing state, after a gap of 5 years. The State is estimated to have

recorded an all-time-high sugar production in the crushing year 2021-22[55]. Maharashtra is, in fact, the largest sugar producing region in the world after Brazil[56]. One of the main reasons for the record sugar production in Maharashtra was the good monsoon rains. Favourable rains induced farmers to plant more area under sugarcane. Hence, there was an increase in area under cultivation in Maharashtra. Unregistered cane cultivation in Maharashtra also contributed to the peak in the State's sugar production. During MY 2020-21, the state's reported area under sugarcane cultivation was 11.4 lakh hectares, while data as per the sugar commissioner's office indicates an area of 12.4 lakh hectares under cultivation. Many of the farmers in the state did not register for supplying to any factory. The unregistered areas are mostly in the Marathwada region closer to the districts of Ahmednagar and Solapur. In normal years, crushing operations are over by April-end, rarely extending beyond mid-May. However, the excess cane during MY 2021-22 led the Maharashtra government to announce a ₹ 20/quintal subsidy to compensate mills for lower sugar recovery (from cane crushed in extreme summer heat) and also requisition the services of mechanical harvesters (including from other states).

A significant share of the sugar industry in Maharashtra is organised on cooperative lines, with farmers owning a share in sugar factories. However, in recent times, the number of private mills operating in the sugar sector is more as compared to the mills in the cooperative sector[57].

Box 4: Labour Migration Economy in Maharashtra

Circulatory migration is a significant part of the livelihood strategies of the rural population in India. Contemporary forms of circulatory migration in India can be divided into two types - "accumulative migration" and "coping migration". Accumulative migration is the migration by the better-off and relatively more educated/skilled ones, which results in accumulation of assets, savings and investment, whereas coping migration by the poor and

[55] ISMA

[56] As per USDA data

[57] As per Chinimandi.

least educated is a kind of forced migration for the sake of survival. Migration for sugar cane harvesting has been a major coping livelihood strategy for poor labourers from arid and drought-prone areas of Maharashtra.

The sugar industry thrives on three types of labour. One is the sugar cane producing farmers, who make the raw material available for the factories. Second, the sugar cane harvesters and transporters, who harvest the sugar cane and transport it to the factories. Third is the one who works on monthly wages at the sugar factories. Out of these three sections, the sugar cane harvesters are typically seasonally migrating unorganised labourers.

The migrant labourer is the backbone of the sugar economy, especially in Maharashtra. Unlike UP where the responsibility of mowing and transporting is on the cane farmers, labour is employed for cane cutting and transporting in Maharashtra. This can be attributed to the historical development of sugar industry in the state. The method of recruitment of labour was adopted during the colonial times and continues till today. Now it is a well-developed grid of sugar industry, contractors and labourers from deep rural pockets of Maharashtra.

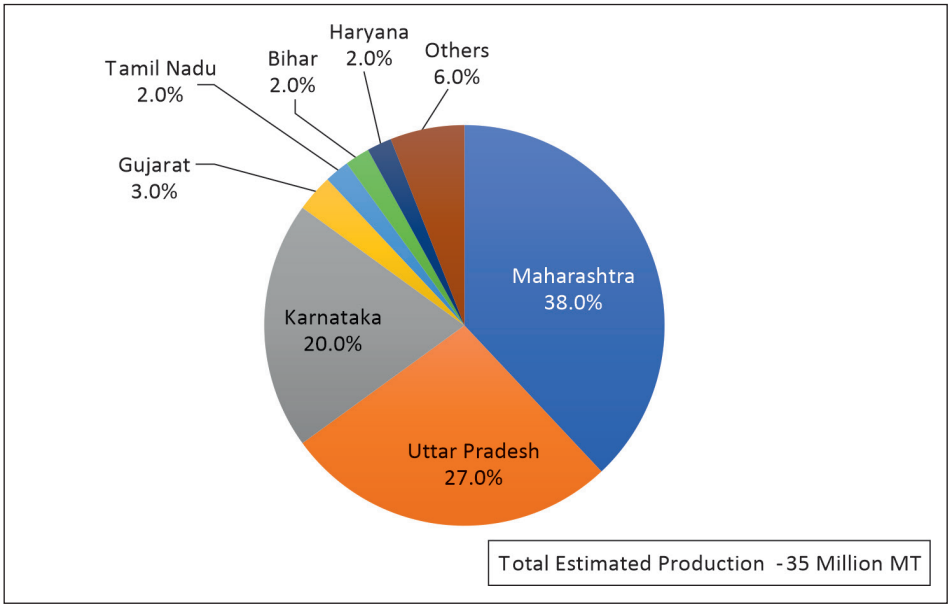
Uttar Pradesh, which was the largest sugarcane producing state in 2020-21, was also India's second largest sugar producing state in MY 2021-22, accounting for an estimated share of 27.0% in India's total sugar production during the year. Prior to this period, Uttar Pradesh was the largest sugar producing state during 2016-17 to 2020-21. Although cane production has remained consistent in Uttar Pradesh, the share of the state in India's sugar production has declined from 37.0% in 2017-18 to an estimated 27.0% during 2021-22. There are several reasons for the decline in Uttar Pradesh's share in India's sugar production. The State is India's largest ethanol producer, with the highest blending-in-petrol ratio among all states. The diversion of sugarcane towards ethanol production is one of the key reasons for the relatively lower sugar output in Uttar Pradesh. Moreover, 82.2% of the cane area in UP is cultivated with a single variety, Co-0238[58]. While this variety has

[58] Price Policy for Sugarcane (2021-22 Sugar Season), CACP

significantly boosted the cane yield and sugar recovery rate in Uttar Pradesh, it is more susceptible to the red rot disease.

Other major sugar producing states in India during MY 2021-22 included Karnataka (estimated share of 20.0% in India's sugar production), Gujarat (3.0%), Tamil Nadu (2.0%), Bihar (2.0%), and Haryana (2.0%) (Exhibit 3.8).

Exhibit 3.8: Major Sugar Producing States (MY 2021-22)



Note: The total sugar production data for state-wise production is slightly different from the data at all-India level due to difference in sources for the two data, which may be due to the different time periods when the data was recorded by the two agencies.

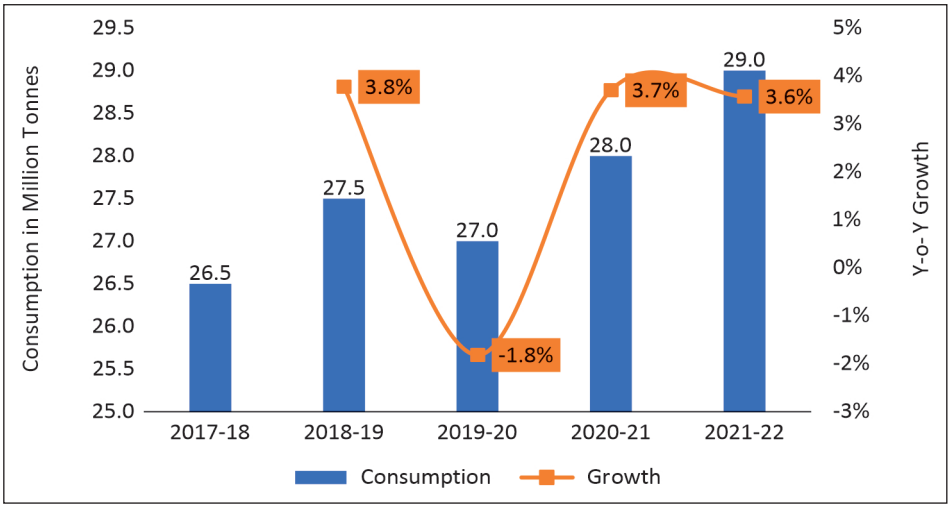
Source: ISMA, Exim Bank Research

SUGAR CONSUMPTION

India is the world's largest sugar consumer as per USDA data. There has been a nearly consistent growth in consumption of sugar in India, except for a minor decline in MY 2019-20, when the consumption declined by (-) 1.8% to reach 27.0 million tonnes, owing to a fall in demand because of COVID-19 related disruptions. In MY 2020-21, sugar consumption in India recovered to surpass the pre-COVID consumption level. Sugar consumption in the country

further increased to 29.0 million tonnes of sugar in MY 2021-22, witnessing a y-o-y increase of 3.6% (Exhibit 3.9).

Exhibit 3.9: India's Sugar Consumption



Source: Foreign Agricultural Service, USDA, Exim Bank Research

Despite the increase in sugar consumption, in per capita terms, India's sugar consumption remains relatively low compared to other countries[59]. India's per capita sugar consumption is estimated at 19 kg per year, which is below the global average per capita sugar consumption of 22 kg per year.

GOVERNMENT POLICIES

Apart from climatic advantages that play a significant role in sugar production in India, government support also plays a major role in India's sugar production. Sugar is considered an essential commodity under the Essential Commodities Act of 1955, which allows the Government of India to intervene and regulate the sugar sector[60]. The Government of India supports the domestic sugar industry primarily through three different ways:

[59] Indian Sugar Mills Association (ISMA), 2020

[60] Department of Food and Public Distribution (DFPD), Ministry of Agriculture and Farmers' Welfare, GOI

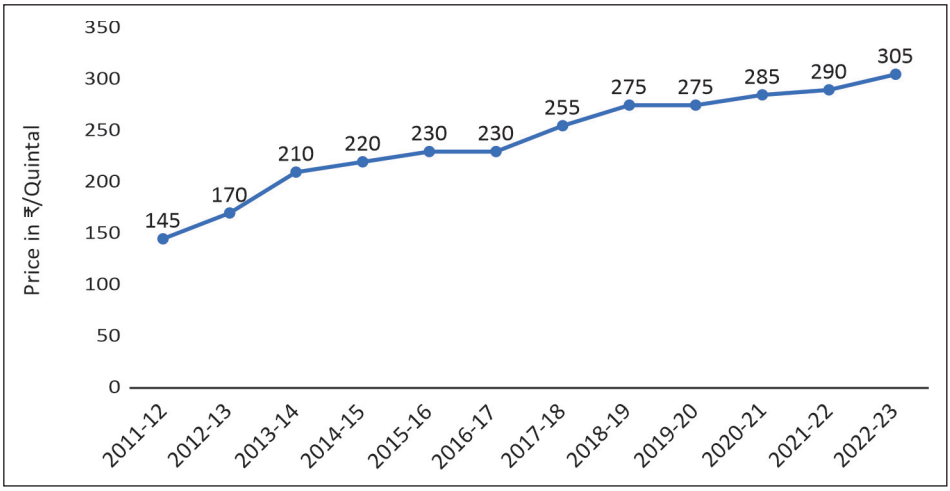
- Sugarcane Subsidies
- Sugar Supply Regulations and
- Support for Modernisation and Diversification

India has employed protective policies for sugarcane farmers and sugar mill owners. Until 2009, the government fixed a Statutory Minimum Price (SMP) for sugarcane, which was ascertained in consultation with the Commission for Agricultural Costs and Prices (CACP). The central government, through a clause in the Sugarcane (Control) Order, 1966, provided for sharing of profits in the approximate ratio of 50:50 between sugar mills and farmers, but the sharing of profits remained virtually unimplemented. Based on this experience, the concept of SMP was replaced by the Fair and Remunerative Price (FRP) of sugarcane in 2009-10. FRP is the minimum price at which sugarcane should be purchased by sugar mills from farmers. The price is announced by the Central Government and is decided based on the recommendations of the CACP after consulting the State Governments and associations of sugar industries.

The FRP for 2021-22 sugar season was fixed at ₹ 290 per quintal, which was increased to ₹ 305 per quintal for 2022-23 sugar season (Exhibit 3.10). The FRP is linked to a basic recovery rate of sugar, with premium payable to farmers for higher recoveries of sugar from sugarcane. In addition to this, states can declare state-specific sugarcane prices called State Advised Prices (SAP) which is usually higher than the FRP. Various states maintain SAP that distinguish among different varieties of sugarcane, based on their maturity period and quality.

As per the CACP, Haryana, Punjab, Uttarakhand and Uttar Pradesh intervened in sugarcane pricing in 2022-23 season, with a higher SAP than the FRP. In fact, Haryana announced a ₹ 10 per quintal increase in the SAP of sugarcane to ₹ 372 for 2022-23 season. In Uttar Pradesh the SAP for the general variety of cane was fixed at ₹ 340 per quintal while the procurement price for early and late maturing variety was fixed at ₹ 350 and ₹ 335 per quintal, respectively. In its 'Price Policy for Sugarcane: 2022-23 Sugar Season', the CACP has recommended that the states should stop fixing the SAP.

Exhibit 3.10: Fair and Remunerative Price (FRP) for Sugarcane



Source: CACP, Ministry of Agriculture and Farmers' Welfare, Exim Bank Research

Price of sugar is market driven and depends on the demand and supply of sugar. However, with a view to protect the interests of farmers, the concept of Minimum Selling Price (MSP) of sugar was introduced in 2018 to ensure that the mills get at least the minimum cost of production of sugar and can clear cane price dues of farmers. Government initially fixed MSP of white/ refined sugar at ₹ 29/kg for sale by sugar mills at the factory gate for domestic consumption, which was revised to ₹ 31/kg in 2019. MSP of sugar has been fixed after taking into account FRP of sugarcane and minimum conversion cost of the most efficient mills[61].

In addition to the support provided by the central government, various state governments also support the sector in various ways. This includes loan waiver to the farmers by state governments, the State Advised Prices maintained by state governments, which is above the FRP declared by the central government, among other incentives. An example of such support by state governments is the Transitional Production Incentive by the Government of Tamil Nadu, under which incentive of ₹ 42.5 per metric tonne of sugarcane is provided to farmers. Apart from this, the Government of Tamil Nadu also

[61] Department of Food and Public Distribution, Ministry of Agriculture and Farmers' Welfare, Government of India

announced a special incentive of ₹ 150 per metric tonne of sugarcane over and above the Fair and Remunerative Price fixed by the Government of India to the farmers who supplied sugarcane to sugar mills during 2020-21 crushing season.

A crucial point in the growth trajectory of the sugar sector in India was the recommendations of the Rangarajan Committee on deregulation of the sector. Based on the recommendations, de-regulation of the sugar sector was undertaken in 2013-14 to improve the financial health of sugar mills, enhance cash flows, reduce inventory costs, and ensure timely payments of cane price to sugarcane farmers. The recommendations were in the areas of cane area reservation, minimum distance criteria, revenue sharing, levy on sugar, trade policy, and compulsory jute packaging, among others (Table 3.1). Some of the recommendations are the prerogatives of the state governments for adoption and implementation.

Along with the Rangarajan Committee recommendations, there are other regular interventions undertaken by the Government of India for the growth and improvement of sugar sector in India. Some of these include Minimum Indicative Export Quotas (MIEQ), Maximum Admissible Export Quantity (MAEQ), production subsidy, imposition of stock holding limit on sugar mills, etc.

The MIEQ orders allocate minimum sugar export quotas to sugar mills, whereas the MAEQ allocates maximum sugar export quotas, on a per-mill basis. MIEQs are determined based on the inventory levels of the sugar industry, with the aim of facilitating achievement of financial liquidity. The MIEQ was issued during MY 2015-16, MY 2017-18 and MY 2018-19. The MAEQ was applicable during MY 2019-20 and MY 2020-21, and was linked to an export subsidy scheme. To qualify for the export subsidy, a sugar mill was required to export at least 50% of its MAEQ allocation.

Table 3.1: Recommendations of Rangarajan Committee for Sugar Sector and Status of Implementation

Issues	Gist of Recommendations	Status
Cane Area Reservation	Every designated mill is obligated to purchase from cane farmers within the cane reservation area, and conversely, farmers are bound to sell to the mill. This ensures a minimum supply of cane to a mill, while committing the mill to procure at a minimum price. Over a period of time, states should encourage development of market-based long-term contractual arrangements and phase out cane reservation area and bonding. In the interim, the current system may continue.	States have been requested to consider the recommendations for implementation as deemed fit. So far, none of the States have taken action, and the current system continues.
Minimum Distance Criteria	Under the Sugarcane Control Order, the central government has prescribed a minimum radial distance of 15 km between any two sugar mills, for ensuring a minimum availability of cane for all mills. However, this criterion is market distortionary. As per the committee, the criteria is not in the interest of development of sugarcane farmers or the sugar sector and may be dispensed with as and when a state does away with cane reservation area and bonding.	States have been requested to consider the recommendations for implementation as deemed fit. There is no reservation of area in Maharashtra. Rest of the States have not made any changes in the current arrangement.

Issues	Gist of Recommendations	Status
Sugarcane Price Revenue Sharing	The committee had suggested that the revenue should be shared between the growers and the sugar mills. Based on an analysis of the data available for the by-products (molasses and bagasse / cogeneration), the revenue-sharing ratio was estimated to amount to roughly 75% of the ex-mill sugar price, i.e., 75% proceeds from the sale of sugar should go to growers while the rest should remain with the mill as their operational expenses.	States have been requested to consider the recommendations for implementation as deemed fit. So far only Karnataka & Maharashtra have passed state acts to implement this recommendation.

Issues	Gist of Recommendations	Status
Levy Sugar	Every sugar mill mandatorily surrendered 10% of its production to the central government at a price lower than the market price – this was known as levy sugar. This enabled the central government to get access to low cost sugar stocks for distribution through Public Distribution System (PDS). The Committee recommended that levy sugar may be dispensed with. The states should procure sugar provided under PDS from the market directly as per their requirement and could also fix the issue price. Since there was an implicit cross-subsidy on account of the levy, the Committee recommended that some level of Central support be provided to help states meet the cost to be incurred on this account for a transitory period.	Central Government has abolished levy on sugar produce from 1st October 2012. Procurement for PDS operation is being made from the open market by the states/UTs and Government is providing a fixed subsidy @ Rs 18.50 per kg for restricted coverage to Antyodaya Anna Yojana (AAY) families only, who are provided 1 kg of sugar per family per month.

Issues	Gist of Recommendations	Status
Regulated Release Mechanism	The central government allowed release of non-levy sugar into the market on a periodic basis. Thus, sugar produced over the four-to-six month sugar season was sold throughout the year by distributing the release of stock evenly across the year. This mechanism was not serving any useful purpose and the Committee suggested that it may be dispensed with.	Release mechanism has been dispensed with.
Trade Policy	As per the committee, trade policies on sugar should be stable. Appropriate tariff instruments like a moderate export duty not exceeding 5% ordinarily, as opposed to quantitative restrictions, should be used to meet domestic requirements of sugar in an economically efficient manner.	Import duty on sugar has been enhanced to 100%. There are quantitative restrictions on exports of sugar.

Issues	Gist of Recommendations	Status
By-products	There should be no quantitative or movement restrictions on by-products like molasses and ethanol. The prices of the by-products should be market-determined with no earmarked end-use allocations. There should be no regulatory hurdles preventing sugar mills from selling their surplus power generated from bagasse to any consumer.	The Department for Promotion of Industry and Internal Trade amended the Industries (Development and Regulation) Act, 1951, in 2016. With this amendment, the States can legislate, control and/or levy taxes and duties on liquor meant for human consumption only. Other than that, de-natured ethanol, which is not meant for human consumption, will be controlled by the Central Government only. With the amendment of I(D&R) Act, 1951 not only will the movement of fuel grade ethanol become smoother, but the industry will also be encouraged to produce more ethanol, thereby increasing the blending percentage with petrol further.
Compulsory Jute Packing	The Jute Packaging Materials (Compulsory use in Packing Commodities) Act, 1987 (JPMA) mandates that sugar be packed only in jute bags. The Committee recommended that this may be dispensed with.	The compulsory packaging of sugar in jute bags has been relaxed, and only 20% of the production is to be mandatorily packed in jute bags.

Source: Department of Food and Public Distribution, Ministry of Agriculture and Farmers' Welfare, Exim Bank Research

INDIA'S SUGAR TRADE

India is among the major exporters of sugar as sugar production in the country has consistently exceeded the domestic consumption over the recent period. The Government of India controls almost all segments of the sugar industry in the domestic market, starting from licensing, cane area and procurement to sugar pricing, distribution, imports, and exports. Due to the frequent changes in trade policies adopted by the Government of India for sugar, international trade in sugar for India also varies from time to time. A brief evolution of the trade policy of sugar in recent times is delineated below:

- Due to record sugar production during the MY 2017-18, domestic prices remained depressed during the year and in order to stabilise sugar prices at reasonable level and promote exports, the Government withdrew duty on exports of sugar in March 2018 and fixed mill-wise MIEQ of 20 lakh tonnes. In addition, Government allowed Duty Free Import Authorization (DFIA) Scheme to facilitate and incentivise export of surplus sugar. On the import side, the Government had raised import duty from 40% to 50% from 10th July 2017, which was further increased to 100% on 6th February 2018 and continues to be at the same level.
- In MY 2018-19, anticipating surplus sugar production and excess carryover stocks, the Government fixed the mill-wise MIEQ at 50 lakh tonnes of sugar, and sugar mills were required to export their MIEQ allocation by 30th September 2019. In October 2018, Government also notified a scheme for extending assistance towards internal transport, freight handling and other charges to facilitate exports during MY 2018-19.
- In MY 2019-20, the Government announced an MAEQ for sugar mills. In order to facilitate exports of sugar to clear high stocks of sugar during 2019-20 season and improve liquidity of sugar mills to enable them to clear cane price dues of farmers, the Government of India notified a Scheme for providing assistance at the rate of ₹ 10,448 per tonne to sugar mills for their expenses on marketing costs including handling, upgrading and other processing costs, costs of international and internal

transport and freight charges on export of 60 lakh tonnes under MAEQ[62]. The Government also allowed mills that had partially exported their MAEQ quota for MY 2019-20 till 30th September 2020, to export the balance quantity of their quota by 31st December 2020.

- In MY 2020-21 as well, the GOI had announced MAEQ. The Government also notified export incentives at the rate of ₹ 6,000 per tonne (for marketing expenses, internal transport and ocean freight) for MAEQ of 60 lakh tonnes. The lump sum assistance was meant for those sugar mills which exported domestically manufactured sugar (of their own or through an exporter) under Open General License (OGL) and not under "advance license". This incentive was, however, reduced to ₹ 4,000 per tonne of sugar vide a notification on 20th May 2021. The reduced assistance was limited to only internal transport and ocean freight.
- In 2021, due to production shock in Brazil and higher international prices compared to domestic prices, exports of Indian sugar were competitive in the international market, and the GOI did not offer any export subsidies during MY 2021-22. The Government of India placed restrictions on the exports of sugar from June 1 to October 31, 2022, to prevent a surge in domestic prices. The Government decided to allow export of sugar only upto 10 million MT during MY 2021-22, i.e., October 2021-September 2022. The Government later allowed additional 1.2 million tonnes of sugar exports.

- The Government of India extended the quantitative restrictions on sugar exports till October 2023, allowing exports of up to 6 million MT of sugar on quota basis during MY 2022-23.

Trends in India's Sugar Exports

India's sugar[63] exports registered a CAGR of 43.5% during 2018-19 to 2022-23, to reach an estimated US$ 5.8 billion during 2022-23. There has been a consistent increase in sugar exports from the country during this period.

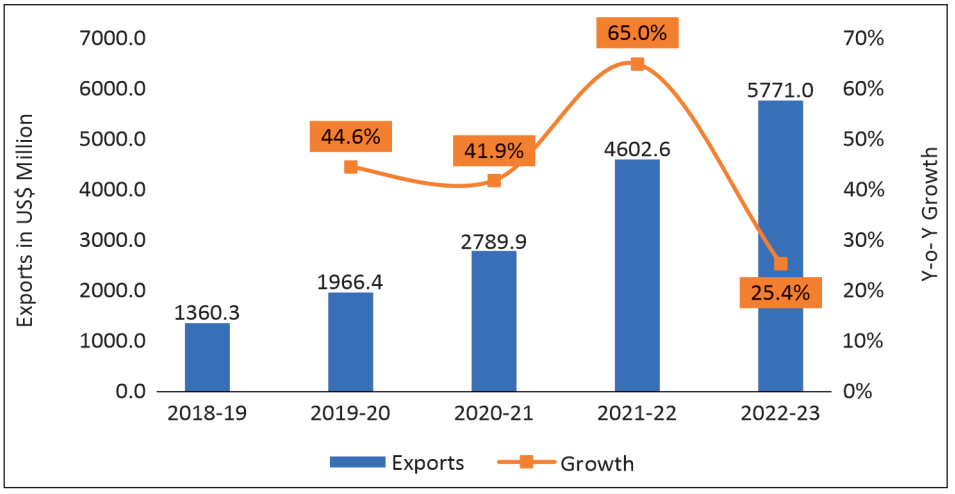
During 2021, India was the second largest sugar exporter, after Brazil. During FY 2022-23, sugar exports from India witnessed a y-o-y increase of 25.4%

[62] Price Policy for Sugarcane, CACP

[63] Includes HS 1701 and HS 170290 as per principal commodity classification of DGCIS

(Exhibit 3.11), despite logistical challenges posed by COVID-19 pandemic such as high freight rates, container shortages, etc. The increase in the exports of sugar during 2021-22 was partly attributable to the increase in the international sugar prices. The prices of sugar witnessed a y-o-y increase of 17.4% during 2021-22[64]. As India's domestic production remained well above the domestic demand for sugar during this period, the increase in the export value was also due to an increase in the quantity of exports from India, which registered a y-o-y increase of 39.1% during 2021-22. The record exports in 2022-23 enabled the sugar producers to reduce their stocks and also benefitted the sugarcane farmers, as greater demand improved their realisations. During 2022-23, the trend of increase in exports of sugar from India continued. While value of sugar exports increased by 25.4%, the quantity supplied by India also witnessed a y-o-y increase of 12.4% during 2022-23.

Exhibit 3.11: India's Sugar Exports



Note: The years represented are financial years.
Source: DGCIS, Exim Bank Research

India's Export Destinations for Sugar

As per the data from DGCIS, India exported sugar to 160 countries across the globe during 2022-23. Sudan was the largest destination for India's exports

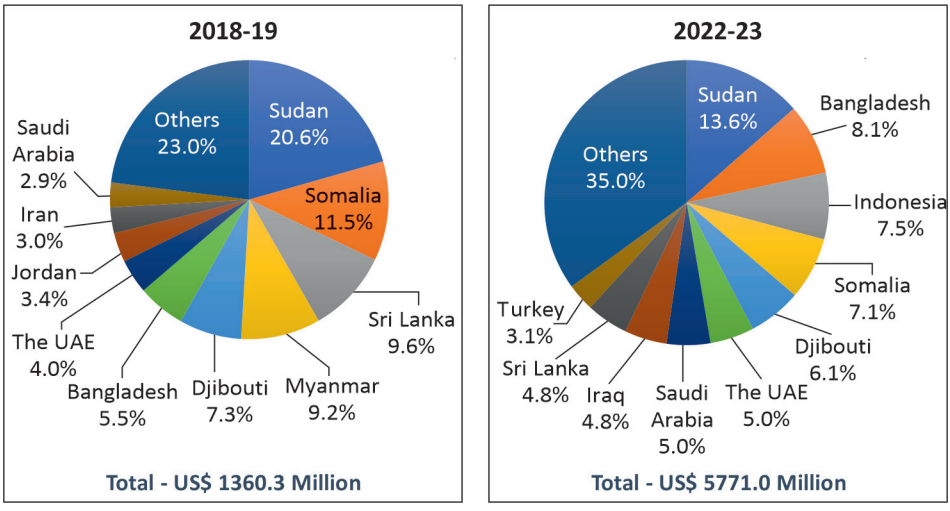
[64] As per London White sugar prices in US$/tonne, CMIE Industry Outlook

of sugar during 2022-23, with exports amounting to US$ 782.4 million, accounting for 13.6% of the overall exports of sugar from India during the year.

Bangladesh was the second largest destination for India's sugar exports, with exports valued at US$ 465.1 million during 2022-23. Bangladesh accounted for 8.1% of sugar exports from India during the year, an increase over its share of 5.5% in India's sugar exports during 2018-19.

Indonesia was the third largest destination for India's sugar exports, with estimated exports of US$ 435.4 million during 2022-23, a share of 7.5% in India's sugar exports during the year. It may be noted that Indonesia was not among the major export destinations for India in the earlier years. As discussed in Chapter 2, Indonesia increased its imports from India by changing the colour specification for imports of raw sugar in 2020, in response to the reduction in supply from Thailand, which was the largest import source for Indonesia. Other major destinations for India's sugar exports during 2022-23 included Somalia (a share of 7.1% in India's sugar exports), Djibouti (6.1%), the UAE (5.0%), and Saudi Arabia (5.0%) (Exhibit 3.12).

Exhibit 3.12: India's Major Export Destinations for Sugar

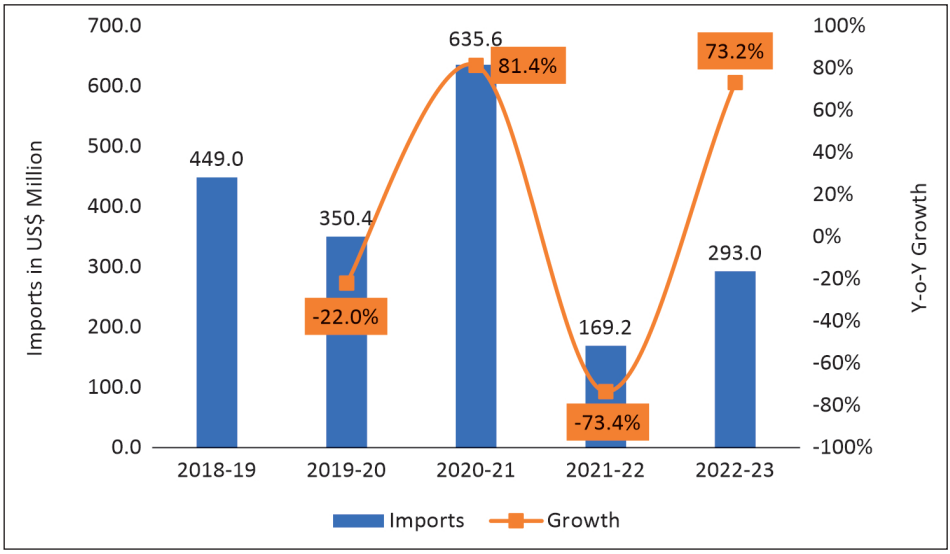


Source: DGCIS, Exim Bank Research

Trends in Sugar Imports by India

Due to improvements in sugar production, India's sugar imports have reduced overtime. India's sugar imports were estimated at US$ 449.0 million during 2018-19, which reduced to US$ 169.2 million in before witnessing an increase in 2022-23, to reach US$ 293.0 million (Exhibit 3.13). India's sugar imports registered a CAGR of (-) 10.1% during 2018-19 to 2022-23. India imports sugar primarily from Brazil, with Brazil accounting for 97.2% of the sugar imports by India during 2018-19 and 95.9% during 2022-23. Presently, there is a 100% custom duty on sugar imports, to prevent unnecessary imports of sugar and to stabilise the domestic prices.

Exhibit 3.13: India's Sugar Imports



Note: The years represented are financial years.
Source: DGCIS, Exim Bank Research

CONCLUSION

Going forward, heightened uncertainties due to the Russia-Ukraine conflict and an increased diversion of sugarcane towards ethanol blending in Brazil could disrupt international sugar supply and countries importing from Brazil would look beyond Brazil to other suppliers like India and Thailand. With

expected increase in production and associated increase in the surplus, India could look towards increasing sugar exports. However, the Government of India's Ethanol Blending Programme, the dependence on monsoons for sugarcane cultivation in several states, and the quantitative restrictions on sugar exports, can impact India's ability to scale up sugar exports.

4. GLOBAL AND INDIAN SCENARIO OF ETHANOL INDUSTRY

Ethanol is formed from the fermentation of sugars in their natural occurrences or derived from starch-rich crops or feedstocks. It has emerged as a sustainable alternative to fossil fuels. Ethanol's clean, affordable, and low-carbon nature makes it the perfect substitute for petroleum, particularly for use as transportation fuel. Some of the major challenges faced by the global transportation sector, such as crude oil market volatility which pushes the cost of transportation upwards, fossil fuel depletion, etc., can be addressed with greater usage of ethanol, as the availability of ethanol is increasing and the cost is also low and less volatile. Moreover, it can also generate enormous environmental benefits. From an environmental perspective, ethanol is preferred over gasoline because no particulate matter is released into the atmosphere from ethanol. The only gases emitted by this fuel are carbon dioxide, carbon monoxide, water, and formaldehyde. Further, according to estimates, if ethanol is blended with 95% gasoline, it can lead to about 90% reduction in carbon dioxide emissions, and thereby help alleviate the challenge of air pollution[65].

Currently, ethanol is produced commercially from a variety of feedstocks via fermentation, wherein the yeast *Saccharomyces Cerevisiae* is utilised to ferment the sugars derived from sugar cane and sugar beets, or the starch in corn and other grains. Sugar crops are among the major feedstocks for ethanol production, in addition to other starch-rich crops like corn, wheat, and cassava. Global increase in demand for biofuels, particularly ethanol,

[65] Hoang, T.-D., & Nghiem, N. (2021). Recent developments and current status of commercial production of fuel ethanol. Fermentation, 7(4), 314

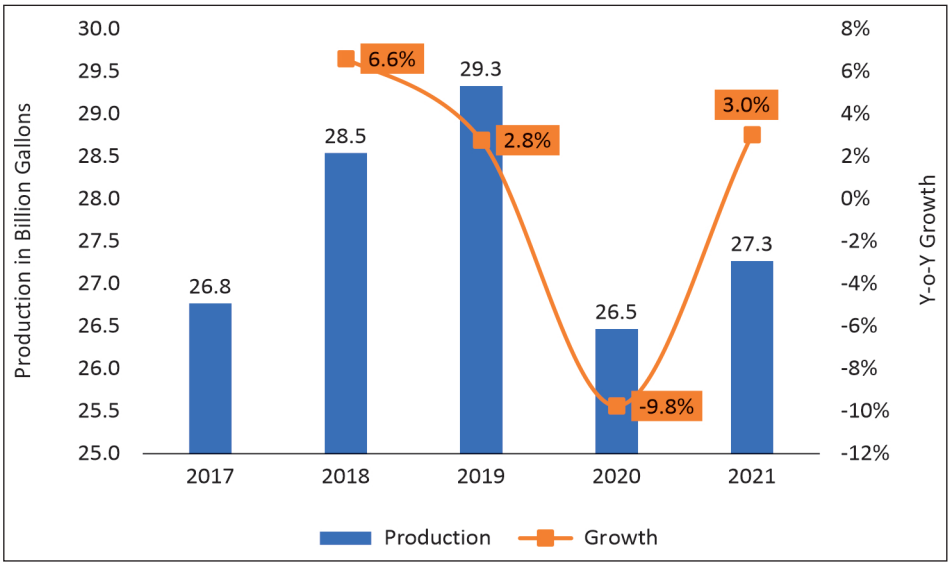
has led to substantial diversion of both sugar beet and sugar cane towards ethanol production. A sizeable share of the sugar crops is being transformed into biofuels rather than sugar.

GLOBAL ETHANOL PRODUCTION

The global production of ethanol during 2021 was estimated at 27.3 billion gallons, witnessing a y-o-y increase of 3.0% (Exhibit 4.1). In the previous year, ethanol production witnessed a decline of 9.8%, due to the COVID-19 related supply chain disruptions and decrease in the demand of fuel during the year. As ethanol is generally used for blending with fuel, reduction in demand of fuels during the COVID-19 induced lockdowns resulted in a decline in demand for ethanol. With the gradual lifting of the lockdowns, there was a recovery in ethanol production in 2021, but the production levels remained below the pre-pandemic level.

Apart from the decline in production registered in 2020, the global ethanol production has witnessed an overall increase during the period 2017 to 2021, with production registering a CAGR of 0.5% during this period.

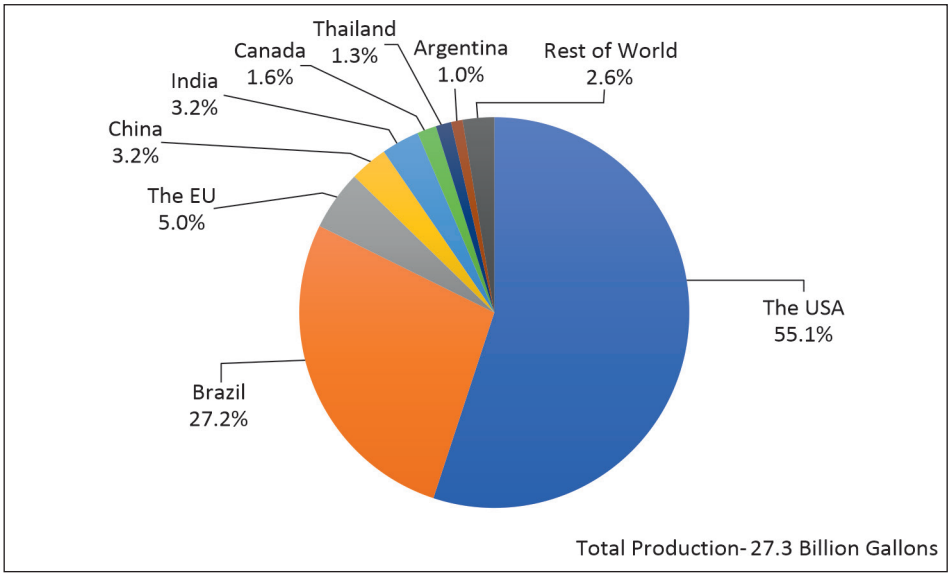
Exhibit 4.1: Global Ethanol Production



Source: Renewable Fuels Association

The USA was the largest ethanol producing country during 2021, with estimated production of 15.0 billion gallons, a share of 55.1% in the global ethanol production during the year. Brazil was the second largest ethanol producer with estimated production of 7.4 billion gallons, a share of 27.2% in the global ethanol production. The EU is the third largest ethanol producing region with estimated production of 1.4 billion gallons during 2021, a share of 5.0% in the global ethanol production. Other major ethanol producing countries in 2021 included China (a share of 3.2% in the global ethanol production), India (3.2%), Canada (1.6%), Thailand (1.3%), and Argentina (1.0%) (Exhibit 4.2).

Exhibit 4.2: Major Ethanol Producing Countries (2021)



Source: Renewable Fuels Association (RFA)

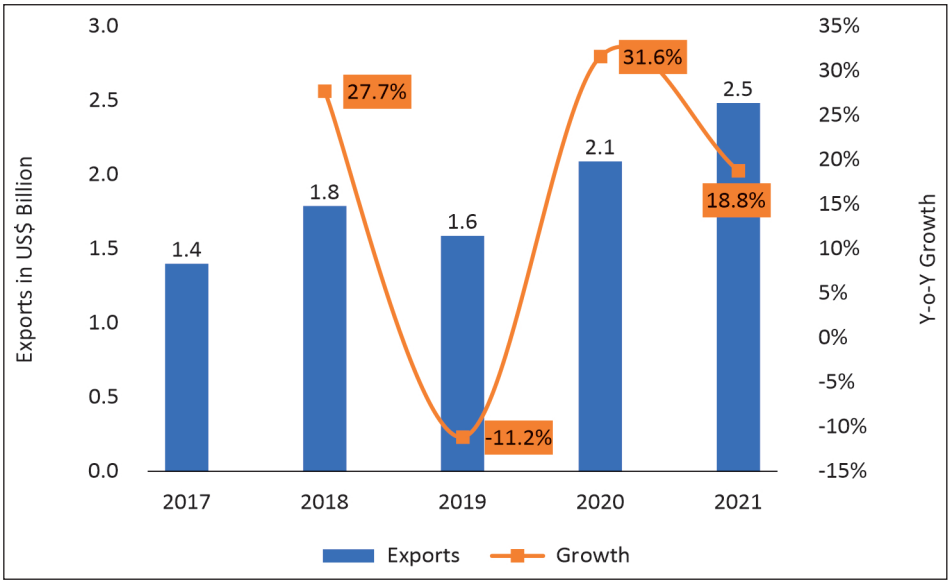
GLOBAL TRADE IN ETHANOL

The global exports of ethanol[66] were estimated at US$ 2.5 billion during 2021, witnessing a y-o-y increase of 18.8% (Exhibit 4.3). The global exports of ethanol registered a CAGR of 15.4% during 2017 to 2021. During this period,

[66] HS 220720 Denatured ethyl alcohol and other spirits of any strength. The denatured ethyl alcohol is used for blending in gasoline.

the exports of ethanol witnessed a decline only during 2019. Unchanged exportable supply, weaker Brazilian demand and higher tariffs in China led to the decline in ethanol exports during 2019. The higher prices of ethanol in the subsequent years helped in increasing the value of exports by a higher margin than the volume of exports.

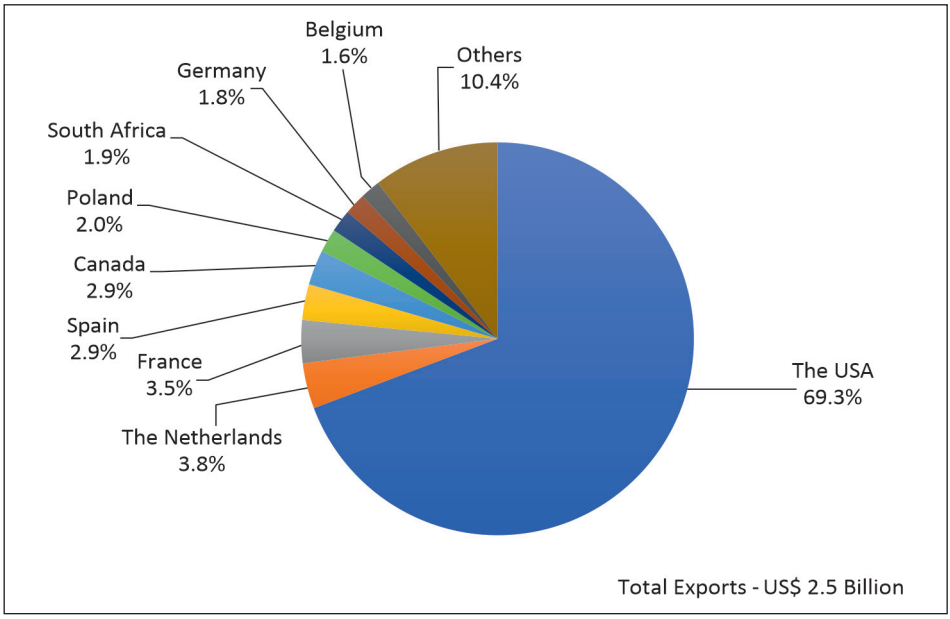
Exhibit 4.3: Global Ethanol Exports



Source: ITC Trademap, Exim Bank Research

The USA is the largest exporter of ethanol with estimated exports of US$ 1,719.1 million during 2021, a share of 69.3% in the global ethanol exports during the year. The USA's share in the global ethanol exports declined from 71.1% in 2017 to 69.3% in 2021, despite ethanol exports from the USA registering a CAGR of 14.6% during 2017 to 2021. The Netherlands was the second largest exporter of ethanol during 2021, with estimated exports of US$ 93.2 million and a share of 3.8% in the global ethanol exports. France was the third largest exporter of ethanol with estimated exports of US$ 87.5 million, and a share of 3.5% in the global exports of ethanol during 2021. Other major exporters of ethanol included Spain (a share of 2.9% in the global ethanol exports during 2021), Canada (2.9%), Poland (2.0%), and South Africa (1.9%) (Exhibit 4.4).

Exhibit 4.4: Major Exporters of Ethanol (2021)



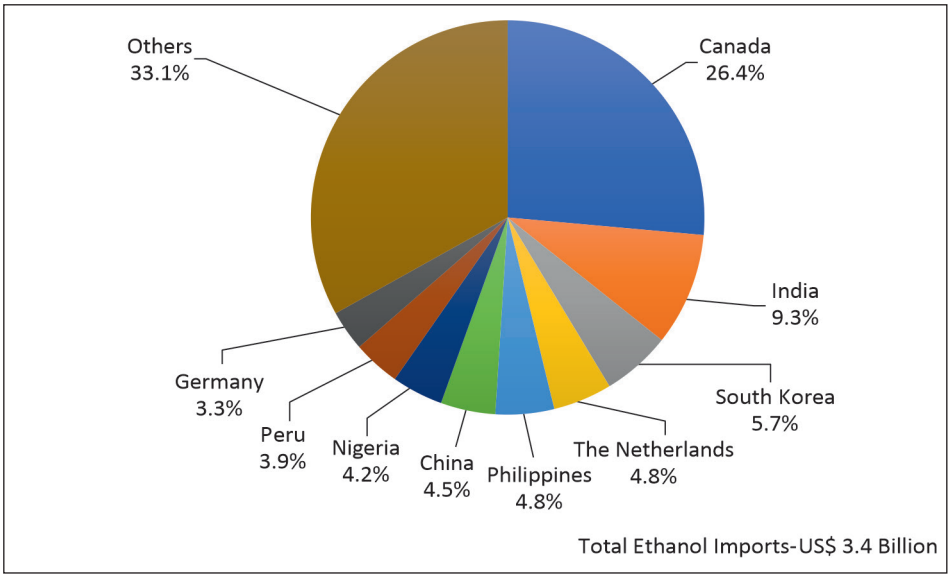
Source: ITC Trademap, Exim Bank Research

Canada is the largest importer of ethanol with estimated imports of US$ 895.5 million during 2021, a share of 26.4% in the global ethanol imports. The USA is the largest ethanol import source for Canada, contributing to around 99.9% of the value of ethanol import by Canada. The imports of ethanol by Canada witnessed a y-o-y increase of 77.1% during 2021. The increase in the ethanol imports during 2021 can be contributed to a meteoric rise in price of ethanol imports as the volume of imports of Canada from the USA rose by a mere 8% during the year[67].

India is the second largest importer of ethanol with estimated imports of US$ 313.7 million, a share of 9.3% in the global ethanol imports during 2021. Other major importers included South Korea (a share of 5.7% in global ethanol imports during 2021), the Netherlands (4.8%), Philippines (4.8%), and China (4.5%) (Exhibit 4.5).

[67] ITC Trademap

Exhibit 4.5: Major Importers of Ethanol (2021)



Source: ITC Trademap, Exim Bank Research

MAJOR PRODUCERS OF ETHANOL

United States of America

The USA is the largest producer of ethanol in the world, producing 15,015 million gallons of ethanol in 2021. The petrochemical manufacturing base, coupled with large area of corn cultivation in the country, favours ethanol production in the USA[68]. Out of the total ethanol produced in the country, 94% is produced from corn[69].

The USA's ethanol production capacity and annual production have witnessed substantial increase overtime. Total ethanol production capacity in the USA increased from 13.6 billion gallons per year in 2011 to 17.5 billion gallons per year in 2021[70]. This increase in production capacity was mainly driven by the fuel blending requirements in the Renewable Fuel Standard (RFS) Programme

[68] Ethanol Production and Distribution, Alternative Fuel Data Center, US Department of Energy
[69] Energy Efficiency and Renewable Energy, U.S. Department of Energy
[70] US Energy Information Administration

in the USA (Box 3). The RFS programme was introduced in the USA to increase ethanol production and consumption. It is a federal program that requires transportation fuel sold in the USA to contain a minimum volume of renewable fuels. Apart from the RFS, there are also several other incentives for ethanol production and greater adoption of ethanol in the USA (Box 4).

Box 5: Renewable Fuel Standard Programme

The RFS is a federal program that requires transportation fuel sold in the USA to contain a minimum volume of renewable fuels. The RFS requires renewable fuel to be blended with transportation fuel in increasing amounts each year, increasing to 36 billion gallons by 2022. Each renewable fuel category in the RFS program must emit lower levels of greenhouse gases (GHGs) relative to the petroleum fuel it replaces. The RFS was first introduced with the Energy Policy Act of 2005, and was expanded and extended by the Energy Independence and Security Act of 2007 (EISA).

RFS Requirements

The US Environmental Protection Agency (EPA) administers the RFS programme and establishes the volume requirements for each category based on EISA-legislated volumes and fuel availability. The EPA tracks compliance through the Renewable Identification Number on (RIN) system, which assigns an RIN to each gallon of renewable fuel. Entities regulated by RFS include oil refiners and gasoline and diesel importers. The volumes required of each obligated party are based on a percentage of its petroleum product sales. Obligated parties can meet their renewable volume obligations by either selling required biofuels volumes or purchasing RINs from parties that exceed their requirements. Failure to meet requirements results in levy of significant fine.

Renewable Fuels Categories

Each year, the RFS programme requires the sale of specified volumes of renewable fuels according to the categories below. EISA established life cycle GHG emissions thresholds for each category, requiring a percentage improvement relative to the emissions baseline of the gasoline and diesel they replace.

- **Conventional Biofuel:** Any fuel derived from starch feedstocks (e.g., corn and grain sorghum). Conventional biofuels produced in plants built after 2007 must demonstrate a 20% reduction in life cycle GHG emissions.
- **Advanced Biofuel:** Any fuel derived from cellulosic or advanced feedstocks. This may include sugarcane or sugar beet-based fuels; biodiesel made from vegetable oil or waste grease; renewable diesel co-processed with petroleum; and other biofuels that may exist in the future. Nested within advanced biofuels are two sub-categories: cellulosic biofuel and biomass-based diesel. Both biomass-based diesel and cellulosic biofuel that exceed volumes in their respective categories may be used to meet this category. Fuels in this category must demonstrate a life cycle GHG emissions reduction of 50%.

Source: Energy Efficiency and Renewable Energy, U.S. Department of Energy

Box 6: Ethanol Incentives in the USA

Advanced Biofuel Feedstock Incentives

The Biomass Crop Assistance Programme (BCAP) in the USA provides financial assistance to landowners and operators that establish, produce, and deliver biomass feedstock crops for advanced biofuel production facilities. Qualified feedstock producers are eligible for a reimbursement of 50% of the cost of establishing a biomass feedstock crop, as well as annual payments for up to five years for herbaceous feedstocks and up to 15 years for woody feedstocks. In addition, BCAP provides qualified biomass feedstock crop producers matching payments for the collection, harvest, storage, and transportation of their crops to advanced biofuel production facilities for up to two years. The matching payments are US$ 1 for each US$ 1 per dry ton paid by a qualified advanced biofuel production facility, up to US$ 20 per dry ton.

Advanced Biofuel Production Grants and Loan Guarantees

The Biorefinery Assistance Programme provides loan guarantees for the development, construction, and retrofitting of commercial scale biorefineries that produce advanced biofuels. Grants for demonstration scale biorefineries are also available. Advanced biofuel is defined as fuel derived from renewable biomass other than corn kernel starch. Eligible applicants include, but are not limited to, individuals, state or local governments, farm cooperatives, national laboratories, institutions of higher education, and rural electric cooperatives. The maximum loan guarantee is US$ 250 million, and the maximum grant funding is 50% of project costs.

Advanced Energy Research Project Grant

The Advanced Research Projects Agency - Energy (ARPA-E) was established within the US Department of Energy with the mission to fund projects that would develop transformational technologies that reduce the dependence of the USA on foreign energy imports; reduce energy related emissions, including greenhouse gases; improve energy efficiency across all sectors of the economy; and ensure that the USA maintains its leadership in developing and deploying advanced energy technologies. The ARPA-E focuses on various concepts in multiple programme areas including, but not limited to, vehicle technologies, biomass energy, and energy storage.

Alternative Fuel Infrastructure Tax Credit

Fuelling equipment for natural gas, propane, liquefied hydrogen, electricity, E85, or diesel fuel blends containing a minimum of 20% biodiesel installed through December 31, 2022, are eligible for a tax credit of 30% of the cost, not exceeding US$ 30,000. Fuelling station owners who install qualified equipment at multiple sites are allowed to use the credit towards each location. Beginning January 1, 2023, fuelling equipment for natural gas, propane, hydrogen, electricity, E85, or diesel fuel blends containing a minimum of 20% biodiesel, are eligible for a tax credit of 30% of the cost or 6% in the case of property subject to depreciation, up to a revised limit of US$ 100,000.

Biodiesel and Ethanol Infrastructure Grants

Competitive cost-share grants are available through the US Department of Agriculture's Higher Blends Infrastructure Incentive Program for the installation, retrofitting, or otherwise upgrading of fuelling equipment and infrastructure required to dispense ethanol blends greater than 10% or biodiesel blends greater than 5%. Eligible new facilities may receive up to 50% of total eligible project costs, or US$ 3 million, whichever is less. Existing fuelling stations that require upgraded, retrofitted, or additional underground storage tanks may request assistance of up to 25% of total eligible project costs or up to US$ 1,250,000, whichever is less.

Ethanol Infrastructure Grants and Loan Guarantees

The Rural Energy for America Programme provides loan guarantees and grants to agricultural producers and rural small businesses to purchase renewable energy systems or make energy efficiency improvements. Eligible renewable energy systems include flexible fuel pumps, or blender pumps, that dispense intermediate ethanol blends. The maximum loan guarantee is US$ 25 million, and the maximum grant funding is 25% of project costs. At least 20% of the grant funds awarded must be for grants of US$ 20,000 or less.

Source: Energy Efficiency and Renewable Energy, U.S. Department of Energy

Ethanol is available in several different blends for use in conventional and flexible fuel vehicles in the USA. E10 is a low-level blend composed of 10% ethanol and 90% gasoline. It is approved by the US Environmental Protection Agency for use in any conventional, gasoline-powered vehicle. The use of E10 was spurred by the Clean Air Act Amendments of 1990 (and subsequent laws), which mandated the sale of oxygenated fuels in areas with unhealthy levels of carbon monoxide. This kicked off the growth of modern ethanol industry in the USA. Today, E10 is sold in every state in the USA and more than 98% of the USA's gasoline contains up to 10% ethanol[71]. The E10 can be used by

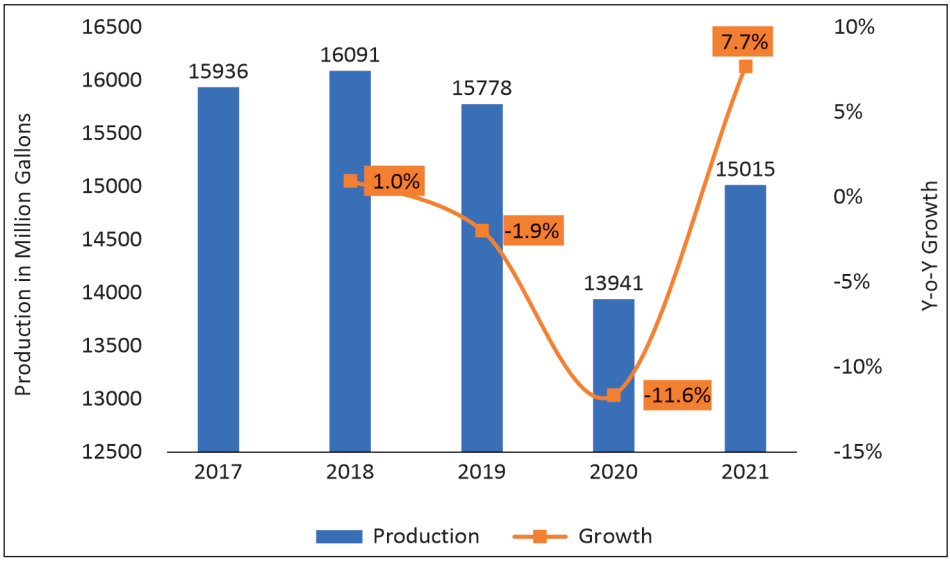
[71] Alternative Fuels Data Center, U.S. Department of Energy

any vehicle which is powered by gasoline, and any special amendment in the engine is not required.

E15 is a low-level blend composed of 10.5%-15% ethanol and gasoline. E15 is approved for use in model year 2001 and newer light-duty conventional vehicles. Stations in the USA must adhere to several requirements and regulations when selling E15, of which an important requirement is implementation of a misfuelling mitigation plan to reduce the risk of vehicles older than model year 2001 being refuelled with E15.

E85 (or flex-fuel) is an ethanol-gasoline blend containing 51% to 83% ethanol. E85 can be used in flexible fuel vehicles (FFVs), which have an internal combustion engine and are designed to run on E85, gasoline, or any blend of gasoline and ethanol up to 83%.

Exhibit 4.6: Ethanol Production in the USA



Source: Renewable Fuels Association

The US ethanol industry produced 13,941 million gallons of ethanol in 2020, which was 11.6% lower than the production of 15,778 million gallons during the previous year (Exhibit 4.6). Several factors contributed to the drop in production during the year, of which the most important ones were reduced

demand for gasoline on account of the COVID-19 pandemic, small refinery exemptions[72] and lower exports due to protectionist trade policies followed by Brazil (20% import duty on imports of ethanol from the US)[73]. The ethanol production in the USA recovered to almost 90% of the pre-pandemic level in 2021, with production recording a y-o-y growth of 7.7% during the year.

Most ethanol plants in the USA are concentrated in the Midwest, but gasoline consumption is highest along the East and West Coasts. According to the US Department of Agriculture, 90% of ethanol is transported by train or truck. The remaining 10% is mainly transported by barge, with minimal amounts transported by pipeline.

In 2021, the USA's ethanol exports were valued at US$ 1.7 billion[74]. Compared to 2020, the value of exports from the USA rose by 42.1% in 2021 due to higher export unit value, recovery in Canadian gasoline demand, and strong sales of non-fuel grade product to South Korea. The major destinations for the USA's ethanol exports are Canada, South Korea, India, and the EU.

Domestic regulations, limited infrastructure and resistance by oil companies have limited the growth of ethanol blending above 10% in the USA market. Limited growth in higher blends and demand for mostly static fuel limits the USA's domestic market expansion. The surplus ethanol production is therefore used for exports. The USA has free trade agreements with some of the top ethanol importing markets, which helps enhance access to these markets for ethanol exports.

Brazil

Brazil is the world's second largest ethanol producer and the largest sugarcane-based ethanol producer. During 2021, 70% of the total ethanol produced in Brazil came from sugarcane as feedstock, while the remaining was produced from corn, molasses, and cane straw[75].

[72] Small refineries can apply for an exemption from the Renewable Fuel Standard

[73] Foreign Agricultural Service, U.S. Department of Agriculture

[74] ITC Trademap

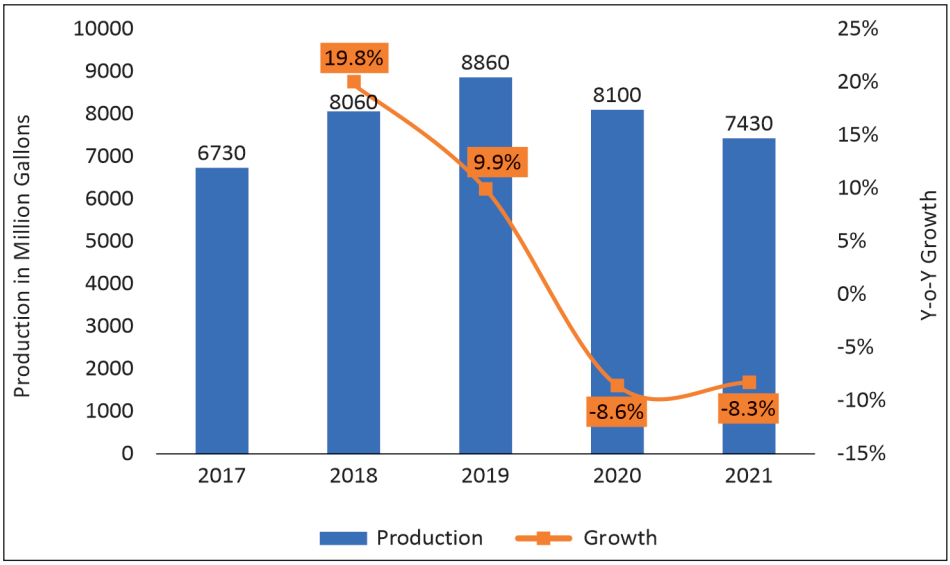
[75] Brazilian Sugarcane Industry Association (UNICA)

In 2020, Brazil produced 8,100 million gallons of ethanol, witnessing a y-o-y decline of (-) 8.6%. The production of ethanol dipped further in 2021, with estimated production of 7,430 million gallons, a y-o-y decline of 8.3%. The reduction in ethanol production was due to lower sugarcane output and decision of sugar-ethanol plants to divert more sugarcane towards sugar production. As highlighted in Chapter 2, in Brazil, the mills have both sugar and ethanol producing capabilities and they decide ahead of time which commodity to produce based on the 'sugar and ethanol parity' which is the point at which sugar and ethanol prices are equal and therefore deliver the same return to the mill. During 2020 and 2021, there was a negative impact on the oil prices because of the COVID-19 related disruptions while the sugar prices were elevated and provided record returns. As a result, a larger portion of sugarcane was diverted towards sugar production. Some amount of the reduction due to diversion towards sugar production was offset by the ethanol production from corn.

The share of corn-based biofuel is increasing in Brazil, due to the country's growing production capacity. One of the major factors that inspired Brazil to pursue corn ethanol production was the availability of low-cost corn. The first corn-based ethanol plant in Brazil was set up in 2017, and there has been substantial expansion in corn-based ethanol plants thereafter. Moreover, there is also cogeneration of electric power, which most plants sell back to the grid. Each ton of corn can produce on average 417 litres of ethanol, 313 kilograms of distiller's dried grains with solubles (DDGS), and 18 litres of corn oil. Total Brazilian corn-ethanol production in 2021 was estimated at 3.39 billion litres, an increase of 40% from the production in 2020[76]. The UNEM (National Union of Corn Ethanol) projects an increase in corn ethanol production in Brazil to 8 billion litres by 2028.

[76] Biofuel Annuals, USDA

Exhibit 4.7: Brazil's Ethanol Production Trend



Source: Renewable Fuels Association

Most of the ethanol produced in Brazil is consumed in the domestic market itself, where it is sold either as pure ethanol fuel (E100) or blended with gasoline (E27).

Biofuel production in Brazil started on a significant scale in 1975, in response to the first oil shock. The Brazilian government launched the Proálcool programme to develop an ethanol-based transport industry to reduce the dependence on fossil fuels. The Proálcool programme led to substantial increase in ethanol production in Brazil and positioned it as a global leader in this industry. In fact, until 2005, Brazil was the top producer of ethanol, globally. The key success factors for Brazilian ethanol industry have been favourable environmental conditions, technological innovations, and government interventions[77].

[77] Moncada, J. A., Verstegen, J. A., Posada, J. A., Junginger, M., Lukszo, Z., Faaij, A., & Weijnen, M. (2018). Exploring policy options to spur the expansion of ethanol production and consumption in Brazil: An agent-based modeling approach. In Energy Policy (Vol. 123, pp. 619–641). Elsevier BV. https://doi.org/10.1016/j.enpol.2018.09.015

The Proálcool programme had different phases with different characteristics. From 1975-1985, there were very strong government interventions. The Brazilian government gave incentives to ethanol producers, such as soft agricultural and industrial loans and guaranteed purchase of their product through the Sugar and Ethanol Institute. Further, based on the sugar prices, the ethanol prices were fixed so that producers remained indifferent to manufacturing sugar or ethanol from the same raw material, sugarcane. Many of these early initiatives were financed by high taxes on gasoline and were complemented by a World Bank loan. Public sector subsidies to ensure adequate compensation to the producers, along with tax breaks in the sale and licensing of ethanol vehicles, also helped the programme[78]. This initial push proved quite successful: farmers planted more sugarcane and investors built distilleries to convert the crops into ethanol. By the mid-1980s, ethanol accounted for roughly half of Brazil's liquid fuel supply. However, by 1985, Proálcool began experiencing problems as world oil prices dropped sharply in the period 1985-86, reducing the immediate benefit of replacing oil imports with ethanol. Reductions in international oil prices and increases in sugar prices in the international market at the end of the 1980s drove producers to redirect production away from ethanol. Alongside, huge fiscal deficits and high inflation led Brazilian Government to implement economic reforms that included a cutback on ethanol production subsidies. As part of a broader reduction of subsidies, the price differential between ethanol and gasoline was eliminated, soft loans for the construction of new refineries were cut, and support for the ethanol programme from state trading companies slowed at first and then stopped completely. The reductions in government incentives for ethanol production pushed prices of ethanol, leading to a significant decrease in demand and, alongside, in the sales of cars powered by this fuel. Despite the collapse of the Proálcool program in 1990s, ethanol remained an integral part of Brazilian fuel matrix as production capacities were already built.

The resurgence of the ethanol industry in Brazil began with the development and launch of flex-fuel vehicles (FFV) in 2003. Flex-fuel cars allowed the consumers to freely choose between gasoline and hydrated ethanol (E100).

[78] Moraes, M., Rodrigues, L. 2006. Brazil Alcohol National Program. Piracicaba

Tax incentives were also given to promote the use of ethanol fuel. The Brazilian government agreed to give FFVs the same preferential tax treatment as ethanol-fuelled vehicles, such as a 14% sales tax, rather than the 16% sales tax on non-ethanol cars. FFV technology was largely accepted by consumers and producers and marked a new era for Brazilian ethanol, leading to a revival of the declining industry. Between 2006 and 2008, Brazil was considered to have emerged as the world's first sustainable biofuel economy[79]. In 2009, Flex Fuel Motorcycles (FFM) were also launched in Brazil. As per a report by NITI Aayog, Brazil has about 19 automakers producing more than 200 FFV models and 14 FFM models. As of 2020, nearly 97% of the vehicles produced in Brazil are FFVs, and 74% of all the vehicles in Brazil are run on flex fuels, 24% run on gasoline and remaining 2% on ethanol[80].

Brazilian government sets the ethanol blending percentage based on the sugarcane harvest and ethanol production from sugarcane. The ethanol-use mandate has been mandatory since 1977, when legislation required a 4.5% blend of anhydrous ethanol to gasoline. According to the current legislation, the ethanol blend can vary from 18% to 27.5% and it is currently set at 27%.

In 2019, Brazil officially launched a new national biofuel policy, RenovaBio, to reduce the carbon intensity of Brazil's transportation matrix by increasing the use of biofuels[81]. The goals of RenovaBio include helping to meet Brazil's commitments under the COP21 Paris Agreement, as well as contributing to the reduction of GHG emissions in the production, commercialisation, and use of biofuels. It also promotes the expansion of the production and use of biofuels in the national energy matrix, focuses on continuity in the supply of the fuel, and contributes to the predictability of various biofuels in the national fuel market. The programme provides a framework to certify biofuel production by its efficiency in reducing GHG emissions and allows for the sale and trade of decarbonization credits (CBios). As of September 2022, 316 biofuel plants (representing over 75% of the total plants in Brazil) are certified to issue CBios which includes 269 sugarcane ethanol plants, six sugarcane and

[79] Brazil: Biofuels Annual (2010), USDA

[80] Report of Task Force on Sugarcane and Sugar Industry, NITI Aayog (2020)

[81] RenovaBio, Brazilian Sugarcane Industry Association (UNICA)

corn ethanol plants, one cellulosic ethanol plant, five corn-ethanol plants, 32 biodiesel plants, and 3 biomethane plants. RenovaBio is expected to increase the ethanol supply in Brazil by 45% by 2030.

In addition to this, there are other programmes in Brazil like the National Biodiesel Production Program (PNPB), that focus on greater integration of biodiesel in the Brazilian energy matrix. The PNPB was launched in 2004. Under PNPB, the biodiesel market was earlier regulated by the government through a public auction system that set the volume of biodiesel that should be produced and delivered to fuel distributors in a particular period of the year and the average sales price. On December 30, 2020, National Council for Energy Policy in Brazil issued guidelines to implement a new system for biodiesel trade, which replaced the biodiesel public auctions. In the earlier model, the Brazilian National Agency of Petroleum, Natural Gas and Biofuels held bimonthly sales auctions that linked biodiesel producers and fuel distributers. In the new model, biodiesel producers and fuel distributers are free to directly sign sales and supply agreements. In the earlier model, the PNPB program required that only domestically produced biodiesel be eligible to participate in the auction system. With the new biodiesel market model, imported biodiesel could become competitive in the Brazilian market.

The European Union (EU)

Biofuel production in the Europe started on a significant scale between 1973 to 1979, when the oil crisis created the need for alternative fuels. There was a further push towards promotion of biofuels in the EU in the 1990s, with introduction of a variety of policy instruments for promoting distinct segments of the biofuels production chain. The evolving Common Agricultural Policy supported the growth of energy crops during the 1990s. The 1992 CAP reform required farmers to set aside a certain percentage of land where intensive agricultural production could not be undertaken by farmers. This land was set aside mainly to counteract on the surplus production of cereals. In 1993, a Non-food Set Aside scheme (NFSA) was introduced as part of the CAP that allowed set-aside land to be planted with energy crops, while farmers could

still claim the set-aside premium[82]. Moreover, the Fuel Quality Directives of 1998 in the EU allowed blending, and the Energy Taxation Directive of 2003 made it possible for Member States to grant tax reductions/exemptions in favour of biofuels.

In 2003, the EU Biofuel Directive formally aimed at reduction of CO_2 emissions from transport, reduction of dependence on imported energy and creation of new opportunities for sustainable rural development. The directive required Member States to strive for replacement of at least 5.75% of transport fossil fuels with biofuels by 2010, with an intermediate target of 2% by the end of 2005. In 2009, the biofuel directive was repealed by the Renewable Energy Directive (RED). According to the new directive, all the EU member states were required to ensure that at least 10% of their total consumption of energy in transport came from renewable sources by 2020. Further, a target of 20% energy consumption from renewable energy was set. The EU overachieved its target in 2020 with a 22% share of gross final energy consumption from renewable sources[83]. The transport sector was also slightly above the planned trajectory, with the share of renewables reaching 10.2% in 2020. After the expiry of RED on December 2020, the EU adopted a new Renewable Energy Directive for the period 2021-2030 (RED-II). The RED-II sets an overall binding renewable energy target of at least 32% by 2030, with a 14% target for the transport sector.

Manufactured in biorefineries by fermenting sugars into alcohol, most of the Europe's ethanol is made from domestic feedstock. This includes a variety of agricultural sources like wheat, corn, barley, rye, triticale, and sugar beet. The feedstock used for production varies depending on market conditions, but majority of the ethanol biorefineries in Europe are built to process either grains or sugar beet. As per the USDA FAS report, sugar beet is expected to be the primary ethanol feedstock in 2022 at 8.1 million metric tons, followed

[82] Why does the European Union produce biofuels? Examining consistency and plausibility in prevailing narratives with quantitative storytelling, Energy Research & Social Science (January 2021)

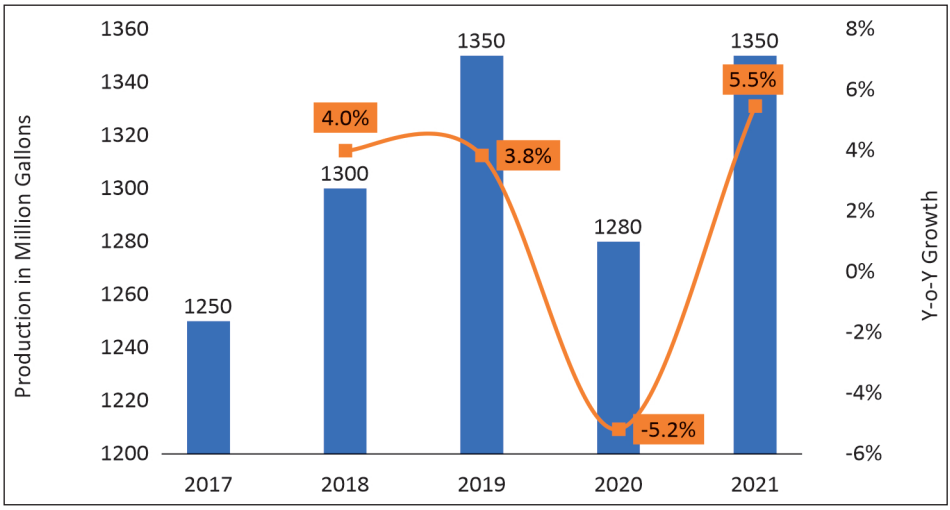
[83] Report from the Commission to the European Parliament and the Council, (15 November 2022)

by corn, wheat, and barley. Europe also produces advanced ethanol by using agricultural residues like straw, non-food lignocellulosic (plant dry matter) materials and waste[84].

During 2022, the EU had 55 first generation ethanol refineries, and the total combined capacity of EU ethanol plants is estimated at 6.4 billion litres[85]. France is the largest producer of fuel ethanol in the EU. Germany is the largest consumer of fuel ethanol (consuming 1,520 million litres in 2021), followed by France and the Netherlands.

The ethanol production in the EU increased from 2017 till 2019 due to the increase in domestic consumption. After 2019, due to the increased feedstock prices, the profit margins for ethanol producers eroded. Moreover, the producers faced stiff competition from the imported ethanol from the USA as well. In 2020, there was also a sharp decline in demand for bioethanol due to the COVID-19 disruptions to demand. Resultantly, the EU's ethanol production reduced to 1,280 million gallons in 2020 from 1,350 million gallons in 2019 (Exhibit 4.8).

Exhibit 4.8: The European Union's Ethanol Production Trend



Source: Renewable Fuels Association

[84] What is E10, ePURE, European Renewable Ethanol

[85] EU: Annual Biofuels Report (2022), USDA

Thereafter, ethanol production in the EU recovered during 2021, witnessing a y-o-y increase of 5.5% to reach 1,350 million gallons. The EU's ethanol production registered a CAGR of 1.9% during 2017 to 2021.

The EU's exports of ethanol were estimated at US$ 461.9 million during 2021, witnessing a y-o-y decline of (-) 10.4%. Despite the decline in 2021, the exports of ethanol registered a CAGR of 18.2% during 2017 to 2021.

E10 has been declared compatible in most of the post-2000 petrol vehicles in Europe. E85, a fuel with 85% renewable ethanol is also used in Europe. Widely available in France and Sweden, it can be used in flex-fuel vehicles and petrol cars equipped with conversion systems[86].

China

In 1986, the Chinese government initiated its first research and development programme on biofuels, however, the move to domestic ethanol production only occurred 15 years later, in 2001, with the 10th Five Year Plan for the 2001-2005 period. The initial scope of China's biofuel policies in 2001 was experimenting with bioethanol production, marketing, and support measures[87]. Pilot tests for ethanol fuel use in the transport sector were carried out in five cities in the country's Central/North-eastern provinces of Henan (Zhengzhou, Luoyang and Nanyang) and Heilongjiang (Harbin and Zhaodong).

In 2003, the first of four government-approved ethanol production facilities became operational. The following year, the government expanded the pilot projects for mandatory E10 blending in six provinces (Heilongjiang, Jilin, Liaoning, Henan, Anhui, and Guangxi), and 27 cities in four other provinces (Hebei, Shandong, Jiangsu and Hubei).

[86] E85: an Ethanol Blend to Fuel Europe's Clean Mobility, ePURE

[87] The Potential of Biofuels in China, IEA Bioenergy 2016

Initially, ethanol production was from stale grains in government reserves that were no longer suitable for human consumption. This included corn as the main feedstock, also known as the 'Generation 1', as there was a historical stockpile of corn in China[88]. As the stockpile decreased and refineries started to use newly harvested corn for feedstock, the government stopped approving additional Generation 1 ethanol refineries. In China's 11th Five Year Plan for 2006-2011, a new policy was announced which prohibited the construction of any new ethanol production facilities based on grains (i.e., maize/corn, wheat) due to concerns over food security. As nearly 70% of grain in China was used for feeding animals, there were concerns over potential conflicts between the demand for animal feed and the demand for fuel. On account of these considerations, China shifted to 'Generation 1.5' feedstock, which included cassava and sweet sorghum.

In 2010, new ethanol targets were set by the Chinese government, which included production of 5.1 billion litres of fuel ethanol by 2015. In 2015, China produced 2.9 billion litres, less than two-third of the original goal set in 2010.

In 2017, there was a further push towards ethanol production in China, with announcement of the Nationwide Ethanol Mandate, which required mandatory use of E10 fuels in the entire country by 2020. Beyond the environmental benefits, the purpose of the mandate was also to bring down the corn stockpile which had increased in 2015-16, due to the corn price support policy, under which Chinese corn producers were being paid more than twice the international price level until 2016. The E10 mandate was expected to increase the demand of corn and to speed up the reduction of stockpile.

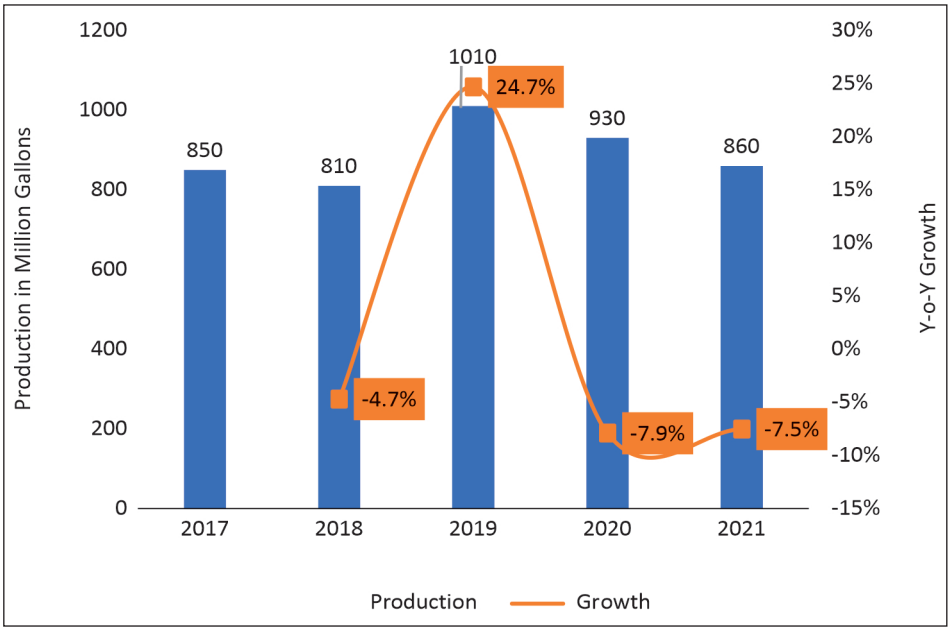
The Chinese government unofficially abandoned the mandate in 2019 (except in certain areas where mandate was already implemented), as high corn prices and stagnant ethanol prices eroded the biofuel profit margins in China. Also, the corn stocks became too low and production capacity was not enough to implement the E10 mandate nationwide.

[88] Agricultural Policy Review, Iowa State University (April 2017)

In the outline of Economic and Social Development (2021-2025), published in 2021, China has set a target of 18% reduction in 'CO_2 intensity' and 13.5% reduction in 'energy intensity'. But the extent to which fuel ethanol will be used to reach this target remains unclear.

Being the fourth largest ethanol producer in 2021, biofuels are a part of China's long-run strategic plan to protect environment, conserve resources and reduce the dependence on imported energy. The development of bioenergy is also required to meet China's rising energy demand. China produces different ethanol products at a commercial scale, like potable alcohol, industrial chemicals, and fuel ethanol. But unlike the major ethanol producing countries, China's major end use market is non-fuel industrial chemicals rather than fuel ethanol[89].

Exhibit 4.9: China's Ethanol Production Trend



Source: Renewable Fuels Association

China's ethanol production has been declining since the record production of 1,010 million gallons in 2019. In 2021, China produced 860 million gallons

[89] China: Biofuels Annual (2021), USDA FAS

of ethanol, witnessing a y-o-y decline of 7.5% (Exhibit 4.9). China's ethanol blending rate in fuel in 2021 was estimated at 2.1%, slightly greater than the blending rate in 2020.

China's import of ethanol was estimated at US$ 152.4 million during 2021, witnessing a y-o-y increase of 391%. The USA is the largest source of import for China, contributing 65.2% of China's ethanol import during 2021. The exports of ethanol from China remains negligible in comparison to its imports.

India

India is highly dependent on the import of fuel as nearly 85% of its demand of fuel is met through imports. To reduce the import dependence and due to an increased focus on sustainability, the Government of India is promoting the use of ethanol.

To promote the growth of the agricultural sector, and to reduce the huge import bill on fossil fuels, the Government of India launched a pilot project in 2001, wherein 5% ethanol blended petrol was supplied to retail outlets. This was later modified as the Ethanol Blending Programme.

Ethanol Blending Programme in India

The Ethanol Blending Programme (EBP) seeks to promote blending of ethanol with motor sprit with a view to reduce pollution, conserve foreign exchange and increase value addition in the sugar industry. The programme also aims at clearing cane price arrears of sugarcane farmers. The Government of India launched the EBP as a pilot project in 2001, wherein 5% ethanol blended petrol was supplied to retail outlets. By January 2003, 5% ethanol blended petrol was available for sale in nine states and four union territories across India. This was further extended to twenty states in 2006.

Till 2013-14, the EBP programme showed mixed results in India, and the average blending rate ranged between 0.1% to 1.5%. During this period, India's ethanol distillation capacity was less than 200 crores litres[90]. In

[90] Annual Report 2021-22, Department of Food and Public Distribution

2013-14, the supply of ethanol to Oil Marketing Companies (OMCs) was only 38.0 crore litres with a blending level of 1.5%.

Following this period, there were several policy changes by the government to support the EBP programme, which resulted in near quadrupling of India's ethanol distillation capacity from 215 crore litre prior to 2014, to 923 crore litre in 2022[91]. In 2014, the Indian government introduced the administered price mechanism for ethanol to be procured under the EBP Programme, wherein the Government decided the price. Earlier, OMCs set a price benchmark and a tendering process was followed, in which OMCs would invite price bids for specified quantities. However, actual volumes transacted were low, as mills asked for more than what OMCs were willing to pay. Under the new scheme, the Government fixed a price at which OMCs are obliged to procure, and mills to supply.

National Policy on Biofuels

The National Policy on Biofuels was launched in 2018. The policy targets 20% ethanol blending in the country by 2030. The policy also marked the beginning of differentiated ethanol pricing based on raw material utilised for ethanol production. Prior to that, a single price was fixed for ethanol, irrespective of the raw material utilised for production of ethanol. The National Policy on Biofuels also allowed the conversion of B heavy molasses (the B-heavy molasses have some sucrose content left in them for sugar production as compared to C-heavy molasses where no sucrose content is left), sugarcane juice and damaged food grains to ethanol. These decisions have significantly improved the supply of ethanol, leading to an increase in ethanol procurement by Public Sector OMCs from 38 crore litre in Ethanol Supply Year[92] (ESY) 2013-14 to over 452 crore litre in ESY 2021-22.

For the upcoming sugar season 2022-23, the Government has approved a hike of 2.8%-5.9% in the price of ethanol made from various sugarcane-based raw materials. For the ESY 2022-23 starting from December 2022, the procurement price of ethanol from C-heavy molasses has been raised from

[91] Ethanol Growth Story, Ministry of Petroleum and Natural Gas (2021)

[92] 1st November to 31 October

₹46.6 per litre to ₹49.41 per litre. Also, price of ethanol made from B-heavy molasses has been increased from ₹59.08 per litre to ₹60.73 per litre. Ethanol made from sugarcane juice or sugar syrup would also attract a higher price of ₹65.61 per litre as against ₹63.45 per litre earlier.

The Government has also eased the tender conditions to promote ethanol production and blending. With the objective to augment ethanol supplies, the Government allowed procurement of ethanol produced from other non-food feedstock besides molasses, like cellulosic and lignocellulosic materials, including petrochemical route.

The target of 20% ethanol blending under EBP Programme by 2030, was advanced by the Government of India to 2025 (from 2030) with the release of "Roadmap for ethanol blending in India 2020-25". India achieved the target of 10% ethanol blending ahead of the scheduled period of November 2022 and considering the encouraging performance, the target of 20% ethanol blend was advanced.

To help achieve the target of ethanol blend, the government has also introduced interest subvention scheme for setting up new distilleries or expansion of existing distilleries or converting molasses-based distilleries to dual feedstock. The Government would bear interest subvention for five years including one year moratorium against the loan availed by project proponents from banks at 6% per annum or 50% of the rate of interest charged by banks, whichever is lower.

The Government of India has also issued advisory to the automobile sector to start producing flex-fuel vehicles. Flex-fuel or Flexible fuel has been gaining traction on the heels of being alternative, environment-friendly fuels that can help combat both rising fuel prices and pollution levels. These are seen as an alternative fuel which are a combination of regular gasoline and methanol/ethanol. In flex-fuels, the ratio of ethanol to petrol can be adjusted but the most commonly used flex-fuels use 85% ethanol and 15% petrol. Ethanol has the quality to burn cleaner than gasoline, which simply makes flex-fuel vehicles leave fewer toxic fumes into the environment. Carmaker Toyota has launched India's first Ethanol-ready flex-fuel hybrid car during October 2022.

Also, India's second-largest two-wheeler maker, Honda Motorcycle & Scooter India, plans to launch flex-fuel vehicles in the Indian market by 2024.

Box 7: Industry Push for E20

The automotive industry is taking a lead on the E20 initiative by bringing in technologies and vehicles which are material compliant to the fuel standards. Further, the auto industry body, Society of Indian Automobile Manufacturers has also signed a Memorandum of Understanding with the US Grains Council, as part of which they would create ethanol awareness, increase production capacity and efficiency, and advocate for ethanol's wide adoption.

The companies are aligned for rolling out E20 material-compliant vehicles and production of E20-tuned vehicles. For instance, Tata Motors is introducing a Bharat Stage 6 Phase II range of passenger vehicles which have E20-compliant engines. Hyundai Motor India's is also offering E20 fuel ready engine options. Further, like Brazil where flex-fuel E100 motorcycle models are available, Honda Motorcycle and Scooter India plans to introduce flex-fuel E20 models in 2023 and flex-fuel E100 models in 2025. Automakers such as TVS and Bajaj have also developed two-wheelers that can run entirely on ethanol.

Impact on Sugar Industry

To meet the target of 20% ethanol blend by 2025, the capacity of distilleries is expected to increase to 1430 crore litres by 2024-25[93], while the current ethanol production capacity is 923 crore litres per annum.

There is greater push from the Government of India for ethanol production which is expected to encourage mills to divert higher amount of sugar towards ethanol production. In sugar season 2018-19, only about 3 Lakh Metric Tonne (LMT) of sugar was diverted to ethanol production, but this increased to 35 LMT in 2021-22 (Table 4.1). Diversion of sugar for ethanol production is expected to reach 50 LMT in 2022-23, which would generate revenue for sugar mills amounting to about ₹ 25,000 crores.

[93] Roadmap for Ethanol Blending in India 2020-2025, Niti Ayog (June 2021)

Table 4.1: India's Sugar Diversion for Ethanol

Year	Diversion of Sugar for Ethanol Production (in LMT)
2018-19	3
2019-20	9
2020-21	22
2021-22	35
2022-23*	50

**Expected*

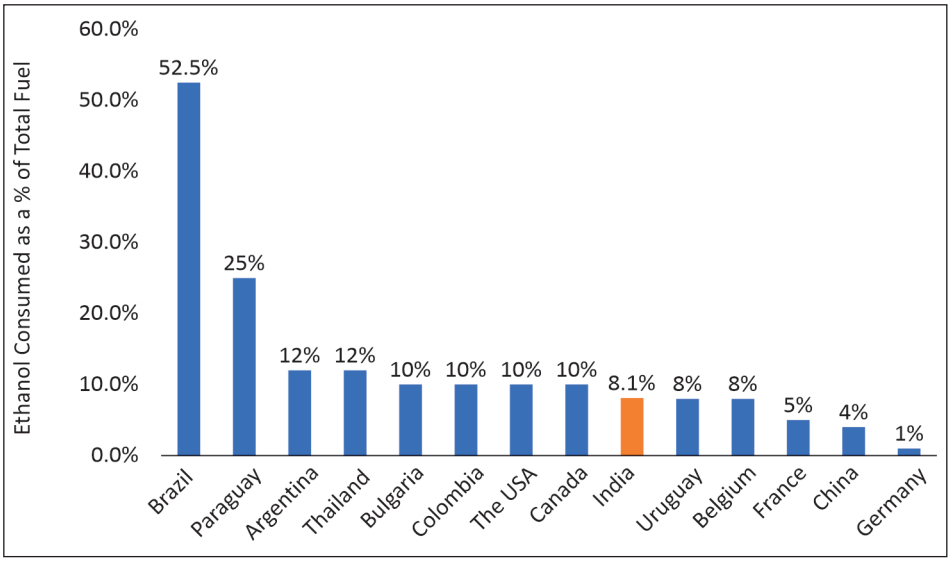
Source: Ministry of Consumer Affairs, Food & Public Distribution, Ministry of Consumer Affairs, Food and Public Distribution, Government of India

Greater diversion of sugar to ethanol solves the problem of surplus sugar inventory and reduces business volatility. As discussed in Chapter 3, sugar has been a cyclical industry, in India with a typical cycle of 4-5 years, of which 2 years witness rising prices (and falling production) while 2 years see declining prices (and increasing production). Diversification towards ethanol is expected to reduce this cyclicality in the industry. Ethanol blending also helps sugar mills maintain their cash flows and enables better financial positions of sugar mills due to faster payments, reduced working capital requirements and less blockage of funds due to less surplus sugar with mills. This enables sugar mills to make timely payment of the FRP, which is fixed by the Government, to sugarcane farmers.

India's Ethanol Consumption and Production

India's ethanol consumption has been growing and the consumption of ethanol as a percentage of total fuel was estimated at 8.1% during 2020. As compared to countries like Brazil, Paraguay, Argentina, Thailand, Bulgaria, the USA, and Canada, India's ethanol consumption as percentage of total fuel consumption was low during 2020 (Exhibit 4.10). Brazil has the highest share of ethanol in total fuel consumption, estimated at 52.5% due to its proactive approach towards ethanol consumption.

Exhibit 4.10: Ethanol Consumption as Percentage of Total Fuel (2020)



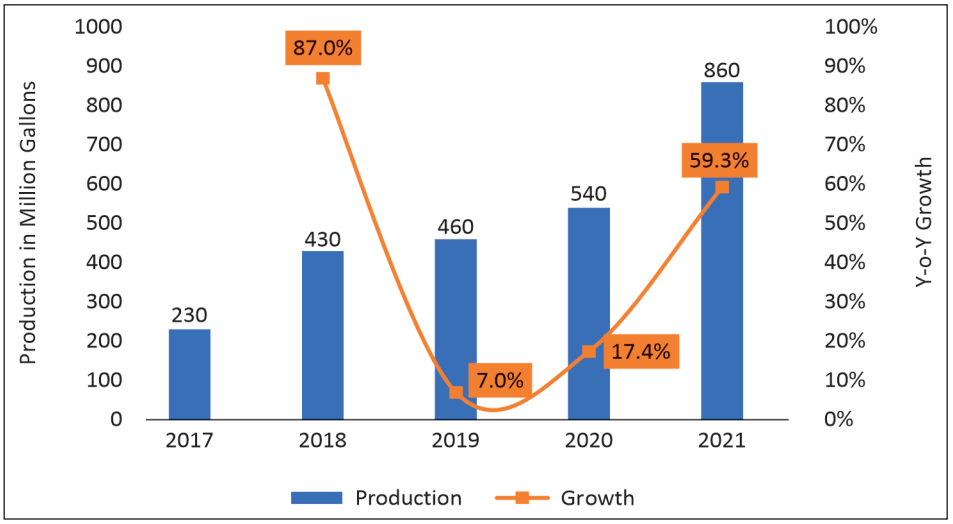
Source: Systematix Institutional Equity

Growth in India's vehicle population and increasing petroleum prices has enhanced the focus on ethanol as fuel. The Government of India's initiatives are set to increase the consumption of ethanol in the country. Further, since most of the petroleum products imported by India are used in the transportation sector, the E20 programme can also help the country save almost US$ 4 billion annually[94].

India's ethanol production was estimated at 540 million gallons in 2020, witnessing a y-o-y increase 17.4% (Exhibit 4.11). The ethanol production increased due to a greater focus of the Government on ethanol blending and above normal sugarcane crop during 2020-21. Thereafter production of ethanol witnessed a sharp increase of 59.3% in 2021, reaching an estimated 860 million gallons. India's ethanol production has witnessed a consistent growth over the past several years, registering a CAGR of 39.1% during 2017 to 2021.

[94] Roadmap for Ethanol Blending in India 2020-2025, Niti Ayog (June 2021)

Exhibit 4.11: India's Ethanol Production Trend



Source: Renewable Fuels Association

India's import of ethanol[95] was estimated at US$ 313.7 million during 2021, witnessing a y-o-y growth of 2.7%. India's imports are majorly sourced from the USA, which accounted for 88.3% of India's imports of ethanol during 2021. India's exports of ethanol are negligible as compared to imports, with estimated exports of only US$ 0.1 million during 2021.

CONCLUSION

With the increased focus of the Government of India on the use of ethanol and the shift in the target for 20% ethanol blend, the supply of ethanol is increasing. However, the current ethanol production in India is mainly from sugarcane, and there are concerns about the impact on food security and potential increases in price of sugar. Additionally, there are challenges in terms of infrastructure and logistics for the transportation and distribution of ethanol. Despite these challenges, ethanol production in India is expected to increase and the blending target is expected to be met. Going forward, experiences of other countries, such as Brazil, can be useful for India's transition towards greater ethanol blending.

[95] HS 220720 Denatured ethyl alcohol and other spirits of any strength

5. CHALLENGES AND STRATEGIES

India is the largest sugar producing country and sugar exports from the country in the recent years have been encouraging. However, there are some challenges faced by the industry in terms of productivity, pricing, innovation, product placement, among others. Some of the key challenges faced by the sugar and ethanol sector, and strategies for alleviating these challenges, improving export competitiveness, and unleashing the export potential in the sector have been discussed in this chapter.

STRATEGIES FOR THE SUGAR INDUSTRY

Rationalising Pricing Policy

Large cane arrears to be paid by the sugar mills to farmers is one of the main issues faced by the Indian sugar industry. In India, the pricing of sugarcane is determined by the government through the FRP policy wherein the farmers are guaranteed at least the FRP for their sugarcane produce. The FRP is set by the Central Government's CACP and is based on the cost of production, cost of living, and other factors. The FRP in the 2021-22 sugar season was ₹ 290 per quintal, and it was raised to ₹ 305 per quintal for the 2022-23 sugar season. The farmers are also eligible for premium on account of higher sugar recovery rates as the FRP is linked to a certain sugar recovery rate. The state governments can also announce a State Advised Price (SAP) which is higher than the FRP. Additionally, there have been instances of state governments announcing bonuses for sugarcane farmers.

However, due to lack of liquidity with sugar mills for upfront payments to the sugarcane farmers, there are cane price dues from time to time. The problem of cane price arrears aggravates during periods of high sugar production

and low sugar prices[96]. For the sugar season 2019-20, the cane arrears as percentage of the total payable amount were estimated as high as 13.6%, but it moderated thereafter (Table 5.1).

Table 5.1: Cane Price Arrears (Values in ₹ Crore)

Sugar Season	Total Price Payable	Total Price Paid	Arrears	Arrears as % of Price Payable
2015-16	60,282	56,993	3,290	5.5%
2016-17	57,206	55,205	2,001	3.5%
2017-18	85,196	73,499	11,697	13.7%
2018-19	86,533	78,737	7,796	9.0%
2019-20	75,929	65,587	10,342	13.6%
2020-21	91,676	85,418	6,258	6.8%
2021-22**	1,15,196	1,05,322	9874	8.6%

*Note: Values are as on 30th September of the respective Sugar Season Year. ** for 2021-22, the data is as on 01.08.2022*

Source: CACP, Ministry of Agriculture and Farmers' Welfare, Cabinet Committee on Economic Affairs (CCEA), Exim Bank Research

The Sugarcane (Control) Order, 1966 (as amended up to 7th January 2010) provides for payment of cane price within 14 days of the delivery of sugarcane either at the gate of the factory or at the cane collection centre and any failure in making payment attracts penal interest on the amount due at the rate of 15% per annum for the period of such delay beyond 14 days. This further increases the amount of cane price arrears.

Further, the dual cane pricing of FRP and SAP in some states distorts the economics of cane and sugar and leads to substantial cane price arrears. The SAP is higher than the FRP, which creates further pressure on the sugar mills, as the outlay of funds towards the purchase of sugarcane increases, exerting a pressure on the profitability due to a direct increase in the cost. This leads to further increase in the cane price arrears of the sugar mills.

[96] CACP

In recent times, ethanol production has proved to be helpful in reduction of cane price arrears, as the sale of ethanol to the oil marketing companies helps the mills in earning additional revenue. In the four sugar seasons ending 2020-21, sugar mills/distilleries generated revenue of about ₹ 35,000 crore from the sale of ethanol to oil marketing firms, which helped in reducing the sugar cane price arrears owed to farmers[97].

A three-pronged strategy can be adopted to resolve the issue of large cane price arrears—revenue sharing policy, staggered payments to sugarcane farmers, and holding off further increases in FRP for some time.

Revenue Sharing Policy

In the past, suggestions have been made by the CACP and the Rangarajan Committee for adoption of a rational cane pricing policy. The Rangarajan Committee recommended a Revenue Sharing Formula (RSF) in 2012, wherein cane price payable by the sugar mills could be fixed at 70% of the revenue of sugar mills from sugar and by-products, or at 75% of revenue from sugar alone. The Committee further recommended that the farmers could be guaranteed a minimum cane price at the level of FRP. In case the RSF price is lower than the FRP, the gap could be paid to the farmers by the government through a Price Stabilization Fund (PSF). As per the Rangarajan Committee, the PSF should be a self-financing mechanism, and possibility of dual pricing of sugar for bulk consumers and household sector, sugar tax on soft drinks/ beverages, retention of part of surplus fund generated under RSF when sugar prices are high, contribution by sugar mills in lieu of discontinuation of levy sugar obligation on mills, etc., may be explored to create the PSF.

The revenue sharing system is also prevalent in several other sugar producing countries. In Thailand, a revenue-sharing system is practised for splitting the revenue between sugarcane growers and sugar millers. The system splits incomes from both domestic and export markets for each growing season between sugar growers, who receive 70% of the income as compensation for the sugarcane, and sugar millers, who receive 30% as compensation for

[97] Department of Economic Affairs

the sugar production. This helps reduce the risk of fluctuations in the price of sugarcane paid by mills and leads to stable gross profits for the millers. The system also allows Thai mills to manage costs better than the mills in other countries, helps to develop upstream segments of the supply chain (i.e. sugarcane production) and provides security of supply of raw materials.

In India as well, the RSF recommended by the Rangarajan Committee can be adopted for win-win outcomes for farmers and mills. Since the Rangarajan Committee recommendation was made in 2012, the formula could be reviewed and updated according to the current sugar market conditions.

Staggering the Payment made to Farmers

Staggering the payment made to the sugarcane farmers could also be beneficial for alleviating the challenge of large cane price arrears. A revenue model where 60% of the payment can be made upfront, and the remaining 40% is paid in instalments depending on the sale of sugar, could be adopted. The balance 40% payment needs to be staggered in a way that it balances the interests of both farmers and sugar mills. Arrangements can also be made through the banking channels, which includes support from government through some specially curated fund, to make sure that the farmers are not inconvenienced by the staggered payment of remaining 40%.

Holding Off Increases in FRP

To solve the liquidity crisis in the sugar industry, the Government of India introduced the concept of Minimum Selling Price (MSP) of sugar in 2018, to ensure that the industry gets the minimum cost of producing sugar and the interests of the farmers are protected. This policy was expected to allow the mills to clear the cane price due to the farmers, as it was expected to generate enough liquidity. The minimum selling price of sugar was fixed at ₹ 31 per kilogram in 2019, after taking the FRP and minimum conversion cost of sugarcane into consideration. But as per industry bodies, this amount fails to cover the cost of manufacturing, given that the FRP has increased every year and is at a reasonably high rate of ₹ 305 per quintal for a basic recovery rate of 10.25% for the sugar season 2022-23. Moreover, the high FRP has led

to over-production of sugarcane, and surplus sugar production. Eventually it has led to delays or defaults in making payments to farmers and is exerting pressure on mill profitability.

The higher FRP also creates incentives for farmers to produce more sugarcane, instead of other less water-intensive crops. Sugarcane is a more profitable crop than other crops/crop combination grown by Indian farmers (Table 5.2). Returns from sugarcane at all-India level in the triennium ending 2019-20 were about twice the returns from crop combinations of 'cotton and wheat' and 'paddy plus wheat', 2.6 times the crop combination of 'soyabean plus wheat', and 4.2 times the crop combination of 'soyabean plus gram'.

Considering the adverse incentives due to high FRP, the Government could keep the FRP constant for a period of time till the monetary benefit to the sugarcane farmers is in comparable range to that of other food crops. Further, over time, the Government could also consider moving from a price support based system towards an income support based system, which would also ensure a WTO compliant incentive structure.

Table 5.2: Relative Average Gross Returns of Crop Combinations with respect to Sugarcane during Triennium Ending 2019-20

Crops	Relative Average Gross Returns over A2 + FL with respect to Sugarcane
Sugarcane	100
Paddy + Wheat	49
Cotton + Wheat	53
Soyabean + Gram	24
Soyabean + Wheat	39

Note: A2 + FL is actual paid out cost plus imputed value of family labour

Source: CACP

The rationalisation of sugarcane prices, and thus sugar prices, would also bode well for international competitiveness of Indian sugar as India's sugar prices are generally much higher than the global market price (Table 5.3). The cane price paid in India is much higher than the prices paid across countries

such as Thailand, Brazil and Australia (Exhibit 5.1). Rationalisation of cane pricing policies would therefore engender parity with returns of other crops in India, and also bring the cane prices in tune with the global prices, thereby facilitating greater exports.

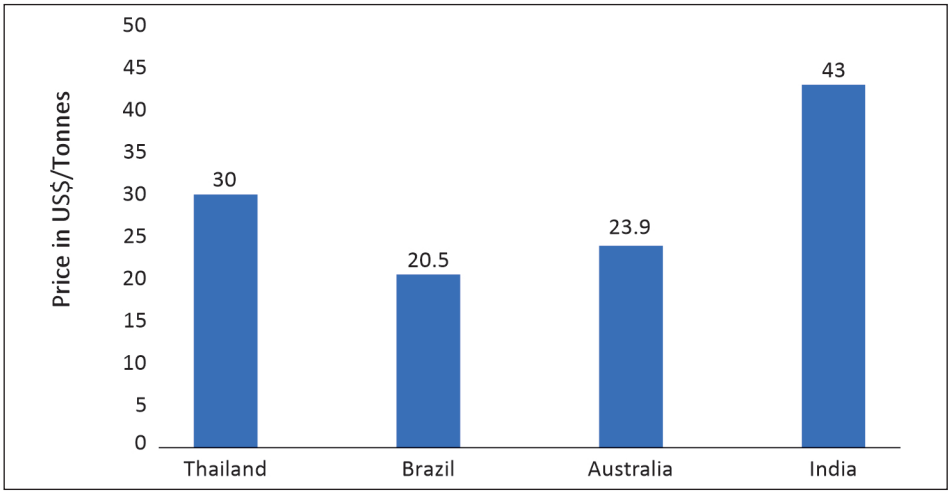
Table 5.3: India and International Sugar Prices- A Comparison

Year	India Sugar Price (Rs/kg)*	International Sugar Price (Rs/kg)
2015-16	34.2	30.2
2016-17	39.1	31.8
2017-18	33.5	22.6
2018-19	33.0	23.6
2019-20	33.7	25.5
2020-21	33.6	33.0
2021-22	35.4	39.1

*Note: *The price is wholesale price of sugar in domestic market. The international price in converted into Rs/Kg by taking RBI's annual average exchange rate of the Indian Rupee vis-à-vis US$ for the years mentioned in the table.*

Source: CMIE Industry Outlook, Exim Bank Research

Exhibit 5.1: Cane Price Paid across Countries



Note: The reference period is 2019-20 for Australia and 2020-21 for other countries.

Source: ISMA

Reviewing Minimum Distance Criteria and Cane Reservation Area

Under the Sugarcane Control Order (1966), the central government has prescribed a minimum radial distance of 15 km between any two sugar mills. In addition, the state governments can also prescribe a minimum distance higher than 15 km. This regulation was introduced to ensure a minimum availability of cane for all mills so that the mills do not compete for the same resources. However, there are several issues with this minimum distance criteria.

This criterion often causes distortion in the market. The virtual monopoly over a large area can give the mills disproportionate bargaining power compared to farmers, especially where landholdings are smaller. Moreover, in addition to restricting competition, the regulation inhibits entry and further investment by new entrepreneurs with better technologies. It can also restrict the establishment of new sugarcane mills in areas where there is a high supply for sugarcane, which can be catered by a greater number of mills.

The minimum distance criteria can also result in inefficient use of resources, as mills may be established far away from the main sources of sugarcane, leading to increased transportation costs and reduced efficiency.

In India, the sugar mills and industries are generally located near to the sugarcane fields because of two reasons. Firstly, sugar is a weight-losing industry. The raw material used for sugar production is much heavier than the final product, i.e., 100 kilograms of sugarcane can only result in the production of 9-10 kilograms of sugar. Due to the significant weight of the raw material, transportation can become expensive. Secondly, sugarcane needs to be crushed within 24 hours of harvesting, as it contains sucrose, and the sucrose content starts deteriorating with longer heat exposure. With the minimum distance criteria, the time taken for crushing the sugar after harvesting may increase, due to the greater transportation time involved or because of supply of sugarcane being greater than the mill capacity. In such cases, the minimum distance criteria can restrict investments where it would make commercial sense otherwise, lead to delays in sugarcane processing, and reduce the quality of sugar produced.

Another policy that needs to be reviewed, which is complementary to the minimum distance criteria, is that of cane reservation area and bonding. Under this, every designated mill is obligated to purchase from cane farmers within the cane reservation area, and conversely, the farmers are bound to sell to the mill. The expected result of this policy is to ensure a minimum supply of cane to sugar mills, but it can also reduce the bargaining power of the farmers, particularly when they are forced to sell to the mill even when there are cane arrears.

Notwithstanding these disadvantages, these policies can have a positive impact in regions where sugar mills are underperforming due to the lack of raw materials. The policies would ensure a minimum supply of cane to the industries and ensure that the fixed capital is not left underutilised.

Therefore, these policies need to be carefully reviewed, taking into consideration the capacity and efficiency level of sugar mills. The Economic Advisory Council to the Prime Minister in its 'Report on the Regulation of Sugar Sector in India: The Way Forward' in 2012, had also recommended that the minimum distance criteria and cane reservation area and bonding are not in the interest of sugarcane farmers or the sugar sector and may be dispensed with[98]. Even though the adoption and implementation of this recommendation was left to the state governments, it has not been well accepted by the sugarcane farmers or sugar mills in many areas, as it could increase the competition and the revenue would be shared among more mills.

Even though the states have been requested to consider the recommendations for implementation, none of the states have taken action on either of the policies so far[99]. Instead of having a state-wide mandate that may be difficult to implement given the varying scenario across the various regions of the state, the state governments can adopt a differential policy for each region depending on the capacity of mills, efficiency, and production levels.

[98] Department of Food and Public Distribution, Government of India
[99] Department of Food and Public Distribution, Government of India

Utilisation of By-products

Sugarcane is a rich source of food (sucrose, jaggery, and syrups), fibre (cellulose), fodder (cane tops, bagasse, molasses), fuel, and chemicals (bagasse and molasses). By-products from the industry are widely used in several industries such as chemical and pharmaceuticals (Table 5.4). The four main by-products of the sugarcane industry are cane tops, bagasse, press muds, and molasses. In India, processing 100 tonnes of sugarcane yields 10 tonnes of sugar, 30-34 tonnes of bagasse, around 4.45 tonnes of molasses, 3 tonnes of pressed mud, 120 tonnes of flue gases and 1500 kWh of surplus electricity[100].

Table 5.4: Uses of Different By-products of Sugarcane

By-Product	Formation	Uses
Bagasse	Fibrous residue left when sugarcane is processed	Fuel, Animal feed, biochemicals like enzymes, lactic acids and organic acids, furfural, paper, particle boards etc
Molasses	Syrup from the final stage of crystallisation in sugar production	Brown Sugar, ethyl alcohol (ethanol), industrial production of vinegar, citric acid, acetone, etc.
Press Mud	Residue eliminated during cane juice filtration process	Fertilizer (conserves moisture), cement, foaming agent, pharmaceutical uses, etc.
Cane Tops	Dry leaves and tops	Cattle fodder, charcoal briquettes

Source: Exim Bank Research

Bagasse- Bagasse is the fibrous residue that is obtained after sugarcane is processed. Being highly combustible, it is used as a fuel in sugar factories, and the cellulose content in bagasse allows it to be used in almost all fibre-based industries. India has made considerable progress in the use of bagasse for manufacturing agglomerated products. Bagasse is used as animal feed, in power generation, and raw material for production of ethanol. It is also used

[100] Solomon, S. (2011). Sugarcane By-Products Based Industries in India. In Sugar Tech (Vol. 13, Issue 4, pp. 408–416)

in producing biochemicals such as enzymes, lactic acid, or organic acids that can act as revenue sources. However, there are many unexplored areas in bagasse-based industry.

Sugarcane bagasse, the fibrous lignocellulosic residue obtained after extraction of juice from sugarcane, accounts for 25–30% of the sugarcane on a wet basis. Consequently, it is a prominent waste generated in sugarcane cultivating countries. India generates about 75–90 million tonnes of bagasse waste annually on a wet basis, and is mainly used for cogeneration in medium and large sugar mills. However, a significant amount of bagasse still remains unutilised, and valorising it to produce high-value biochemicals is an attractive option. Researchers from the Department of Chemical Engineering, Indian Institute of Technology Bombay and the Department of Alcohol Technology and Biofuels, Vasantdada Sugar Institute, Pune, have conducted a study on production of economically viable lactic acid from sugarcane bagasse[101]. The Study further noted that lactic acid production facility attached to sugar mills can have significant environmental benefits as well.

There is also a substantial scope for producing newsprints, writing papers, particle boards, cattle feed, chemicals, etc. Export markets can be explored for items like furfural, which is a poisonous, flammable compound that is widely used as a solvent for refining lubricating oils, as a fungicide and weed killer, and in the production of tetrahydrofuran, an important industrial solvent. The main raw materials for producing furfural are pentosan-rich plant components such as bagasse. The global furfural market is estimated at around US$ 552 million in 2022, and is expected to register a CAGR of 7.0% during 2023 to 2030[102].

Molasses- It is the syrup from the final stage of crystallisation in the sugar production process, and is the residue left over after sugar crystals are extracted from sugar syrup. Commercial products made from the fermentation of molasses include, ethanol, carbon dioxide, acetone, etc.

[101] Life cycle and economic assessment of sugarcane bagasse valorization to lactic acid, Waste Management, Volume 126 (May 2021)
[102] Grands View Research

In India, the molasses production was estimated at 14.9 million tonnes during sugar season 2020-21[103]. It is a valuable source for ethanol and agro chemicals. Nearly 90% of molasses produced in the country is used by industrial alcohol manufacturers and remaining 10% for other uses like potable liquor[104]. The demand for molasses is expected to increase in the coming years due to the ethanol blending programme.

Cane Tops- Usually referred to as Tops and Trash, it is composed of dry leaves and tops. It is used as fodder for the cattle and fetches a good price in the market. Another possible use for cane tops is producing charcoal briquettes, which could help in supplementing the income of small-scale cane growers.

Press Mud/Filter Cake- It is the residue eliminated during the cane juice filtration process. Even though filter cake is produced as an impurity during sugar extraction process, it has many uses in the agriculture as well as pharmaceutical industry. Filter mud is useful as a moisture conserver and as a soil conditioner. It is used for making distemper paints, foaming agents, activated carbon, filter aids and protein, etc. The National Chemical Laboratory, Pune, has developed a method for preparing steroids and superior quality of wax from Filter Cake[105]. Press mud can also be used to produce compressed biogas. The biogas produced from press mud can be further upgraded, for the production of Bio-CNG as well.

There has been a growing interest in the by-products of sugarcane industry over the years, and its optimal use can lead to greater profits for the sugar industry. The sugarcane and its by-products are useful raw material in over 25 industries, including food, health, fertilizer, and energy. Even though Indian sugar industry has been processing these by-products to generate bioethanol, bioelectricity, and many other value-added products, it is not developed up to its full potential.

[103] Indian Sugar Mills Association

[104] Birla Sugar

[105] Sugarcane Wax - A Par Excellent By-product of Sugar Industry - A Review, Agricultural Reviews, Volume 42 (September 2021)

Many sugar units have transformed themselves into sugar-agro industrial complexes producing a variety of chemicals and utility products from sugarcane. However, at the overall level, there is an underutilisation of the by-products from the sugar industry. There is need for technology upgradation in the sugar industry for better utilisation of sugarcane, its co-products, and by-products, and production of value-added goods from the by-products.

Encouragement for Sugar Beet Production

Sugar beet was first introduced in India in 1950[106], and exploratory trials for the crop were conducted by the Indian Institute of Sugarcane Research, Lucknow. The institute also identified suitable sites all over the country for the cultivation of sugar beet. Later, in 1971, an All-India Coordination Project launched by ICAR conducted a multi-location research on sugar beet and established a sugarcane-cum-sugar beet factory in Rajasthan. Even though the project and factory were operational for almost three decades and the crop was well established in the region, there was no expansion in the area of cultivation due to lack of sugar factories with the required machinery to process the sugar beet crops. Presently, even though sugar beet is cultivated in isolated parts of the country, it is not grown on a commercial scale due to the lack of factories with capacity to process sugar beet.

Sugar beet contributes to almost 20% of the world sugar production. Primarily used to produce sucrose for manufacturing sugar and other sweeteners, sugar beet is also used in many other industries. It is used for the production of beverages, unrefined syrup, etc. Pulp and molasses, which are by-products from processing sugar beet into sugar, are used as fibre-rich feed for livestock. These by-products could also be used for alcohol production and in production of pharmaceuticals. All these makes sugar beet an almost zero-wastage crop.

Sugar beet also has several advantages over sugarcane. Sugar beet has a growth span of 6-7 months, compared to 10-12 months taken by sugarcane.

[106] Pathak, A. D., Kapur, R., Solomon, S., Kumar, R., Srivastava, S., & Singh, P. R. (2014). Sugar Beet: A Historical Perspective in Indian Context. In Sugar Tech (Vol. 16, Issue 2, pp. 125–132).

It also has a higher sugar content (15%-17%), higher sugar recovery rate (12%-14%), and higher purity (85%-90%). Sugar beet has the potential to produce yield comparable to sugarcane, in half the time with water saving of 30-40%[107]. Further, sugar beet only requires a smaller acreage of land, and has potentially lower environmental cost. This makes sugar beet a more sustainable crop than sugarcane.

In India, sugar beet cultivation also has the potential to meet the large and growing ethanol requirement. It can also be grown as an intercrop with sugarcane to increase sugar productivity per unit and time. Studies have found that sugar beet can be efficiently grown in the black cotton soil, in the deccan tract of Maharashtra, Karnataka, Andhra Pradesh and Tamil Nadu. It can also be grown in the plains of North India during the rabi season[108]. Cool weather, adequate rainfall and bright sunshine helps in the growth of sugar beet.

The suitable varieties of sugar beet have been identified by ICAR, and mechanization for sowing operation is also available. Despite all this progress, sugar beet industry is still an unexplored area for India. A market for sugar beet needs to be developed for motivating the farmers to cultivate sugar beet on a commercial scale. Incentives and subsidies, as available for sugarcane, are required for promoting large-scale production of sugar from sugar beet. The Government of India could announce funds for capacity development of sugar mills for processing of sugar beet for sugar and ethanol production. The farmers could be encouraged to produce sugar beet by providing incentives such as fixing a minimum price and guaranteeing the offtake of sugar beet from the farmers. The Government could also establish partnerships with European countries for technology transfer for sugar production from sugar beet.

[107] Souvenir, IISR-Industry Interface on Research and Development Initiatives for Sugarbeet in India (2013)

[108] Sugar Beet: A Historical Perspective in Indian Context, Pathak et al. (2014)

Product Diversification in Exports

Diversification towards exports of value-added sugarcane and sugar items can bode well for the industry. There are various products that can be made from sugarcane and in the subsequent sugar formation process, which can be marketed and sold in international markets.

Sugarcane Edible Strips- Sugarcane was originally grown for the sole purpose of chewing, in South-eastern Asia and the Pacific countries. Sugarcane chewing has some health benefits as it contains iron and vitamins A, C, B1, B2, B3, B5 and B6, phytonutrients, antioxidants and soluble fibre[109]. Edible sugarcane stalks are now being sold in speciality markets as these can be used as drinking stirrers and garnishes. These stalks have international demand as well. In countries like Vietnam, these sticks are packed, tightly wrapped and kept in the refrigerator. Manufacturers of these items in Vietnam are equipped with frozen rooms and peeling machines, and also have quality certificates. Similar business opportunities could be explored in India for meeting domestic as well as international demand.

Sugarcane Juice- Fresh sugarcane juice is a major product obtained from sugarcane stalk and is consumed extensively during the summers in India. The juice contains minerals, protein, calcium, iron and antioxidants. Apart from sugarcane juice, non-carbonated sugarcane juice beverages blended with fruit juices, like kinnow, amla and lemon, are gaining popularity. Though sugarcane juice has large market demand, it is rarely available in packaged form due to short shelf life and need for adherence to safety procedures. Production of value-added beverages made from sugarcane with treatments and use of preservatives to keep the sugarcane juice fresh and ensure quality can lead to wider market for these products. This can also lead to potential exports.

Sugarcane Syrup- Sugarcane syrup is prepared by the evaporation of sugarcane juice. It is made in open kettles by simmering the sugarcane juice until it forms a thick, dark syrup with medium flavour intensity that resembles molasses. Cane syrups and blends are sold for use in pancakes, biscuits, cereals and cooking. In Louisiana and Hawaii in the USA, cane syrups are processed in sugarcane factories, or in refineries. The syrup has a very

[109] Sugar and Sugar Derivatives: Changing Consumer Preferences, 2020

high market value in the preparation of commercial foods, confectionary and bakery. Similarly, "Golden Syrup", which is very popular in the UK, Canada, South Africa and Australia, is prepared by partially inverted syrup[110], filtered several times over bone charcoal to give it a special golden colour. Production of different sugarcane syrups and its value addition with natural fruit and vegetable flavours can be targeted by domestic industry for the export market.

Jaggery Production- Jaggery/Gur and Khandsari are products of the sugar industry, whose consumption declined in India over time, despite their high nutritional values. Jaggery has very high export potential. The global import of jaggery was estimated at US$ 2.2 billion during 2021, with China being the largest importer with estimated imports of US$ 296.5 million. Other major importers included the USA (imports worth US$ 178.5 million), Germany (US$ 151.3 million), and the Netherlands (US$ 108.5 million)[111]. India's exports of jaggery were estimated at only US$ 13.6 million during 2021-22.

Jaggery processing is an important agro-based cottage industry in India. Technological interventions and infrastructure development in jaggery sector can help in increasing the production, profitability and exports of jaggery. Similarly, Khandsari (unrefined raw white sugar) industry also has substantial potential for growth, but there is a lack of efforts to modernise or improve the manufacturing processes in the industry.

As there is a visible lifestyle change, people are increasingly preferring jaggery over white sugar. This is also visible in the fact that jaggery has higher prices in the market compared to white sugar. However, the lack of standardised processes in jaggery making in India is hampering the growth in exports from the segment.

Measures need to be taken to develop the small scale Khandsari and Jaggery industries in India and position them to capture greater share in international markets. In this regard, there is a need for development of quality standards in the jaggery production. Further, the international demand for jaggery

[110] liquid sweetener made from granulated table sugar and water

[111] Tridge

and the type of jaggery based products being demanded could be analysed and communicated to Indian producers for them to produce as per the international demand. Value added innovative jaggery products, like vitamin infused or protein rich jaggery can be produced for the international markets.

Indian Confectionary and Packaged Sweets - Sugar has extensive use in the confectionery, bakery, beverage and preservation industries, and the development of these sectors can contribute significantly to the sugar industry.

Indian sweets market is characterised by a wide range of products, from the traditional sweets produced by the unorganised and local sweet shops, to specialised sweets and confectioneries produced by organised bakeries and establishments. Enormous opportunities exist in this area, for making these products available in the international market. India has been producing sugar confectionery for exports for a long time. The popularity of Indian sweets, along with the tightening of norms around food labelling and general hygiene has contributed to the growing demand for Indian sugar confectionery. The global import of sugar confectionery[112] was estimated at US$ 12.9 billion during 2021. The USA was the largest importer with estimated imports of US$ 2.4 billion. Other major importers included Germany (US$ 805.0 million), the UK (US$ 761.2 million), Canada (US$ 479.5 million), France (US$ 465.9 million), the Netherlands (US$ 464.2 million), and China (US$ 370.4 million). India's exports of sugar confectionery was estimated at US$ 156.6 million during 2021, a share of 1.2% in global exports during the year.

Food promotion campaigns can increase the popularity of the Indian sugar confectionery. The Government of India has undertaken several food promotion campaigns in the past, including the 'Incredible Tiffin' initiative. Other countries have also popularised their food items through similar campaigns. In South Korea, for example, a group of young Koreans undertook a promotional campaign for a well-known Korean dish, Bibimbap. Known as the "Bibimbap Backpackers", this group travelled to over 20 cities in 15 countries on a 255-day trip to cook bibimbap. The campaign started in 2011 and was mostly paid for by the Ministry of Agriculture, Government of Korea,

[112] HS 1704 Sugar confectionery not containing cocoa, incl. white chocolate

and a major Bibimbap chain. They served over 9,000 bowls of bibimbap at 100 events at universities and other places, and received substantial domestic and international media coverage. Turkey has also taken steps to promote its food products, including sweets in the international markets. The Turkish Exporters Assembly is a Turkish government organisation that promotes Turkish food and beverage products, including sweets such as baklava and Turkish delight, in international markets through various initiatives, such as trade missions and international exhibitions. Similar programme could be sponsored by the Indian government for Indian sugar confectionery. Focus on quality and hygiene aspects in such initiatives could also help in dissipating the negative perception about Indian food being greasy and unhealthy.

Geographical Indication Tags for Niche Products

Geographical Indication (GI) tag is a form of intellectual property certification given to products with specific qualities or reputation due to their origin. Geographical Indication status for niche products in the sugar industry can function as product differentiators and serve as important tool for marketing. Several products in the Indian sugar industry have a GI tag. Variants of jaggery like Central Travancore Jaggery, Marayoor Jaggery/ Marayoor Sharkara and Kolhapur Jaggery have been granted GI for their distinct geographical identities (Table 5.5). The reference to geographical origin, along with the use of traditional practices and processing methods, can help in export marketing of the products.

Table 5.5: Products of Sugar and Jaggery with GI Tag

Product	State
Central Travancore Jaggery	Kerala
Kolhapur Jaggery	Maharashtra
Marayoor Jaggery (Marayoor Sharkara)	Kerala

Source: Ministry of Commerce and Industry, Exim Bank Research

To reap the benefits of the GI Status, it is important for the GI brand to be recognised as a reliable and preferred brand in the market, with distinguishable positioning. Products such as Darjeeling Tea, for example, have been able to gain substantial market share on account of this brand

building. In order to attain similar levels of success, key value proposition needs to be defined for the products having GI status. The logo and the GI brand name need to be developed and marketed, and mechanism needs to be devised for ensuring that all products marketed under the GI brand adhere to minimum specific standards. To ensure the quality and uniqueness of the products, the state governments could set up a certification body, that can provide certificate of authenticity to select sugar-based high-potential export items. A repository of information about the artisans involved in production and exports of the GI products could be maintained by the certifying body.

In addition to these, there are many other Indian sugar varieties and delicacies that can be accorded GI tags for their quality and unique ways of production. The Udangudi Karupatti/ Udangudi Palm Jaggery of Tamil Nadu and Gajapati Date palm Jaggery of Odisha are some of the jaggery varieties of India known for their unique qualities and preparation methods. Granting GI to these items will help provide more recognition and market opportunities to the products.

RoDTEP Incentives for Sugar Exports

The Remission of Duties and Taxes on Exported Products (RoDTEP) scheme rebates various Central, State and local duties/taxes/levies which are incurred in production of exported items, but not refunded under any other duty remission schemes. This is a measure towards zero-rating of exports, which means that the entire value chain is exempt from taxes.

Sugar exporters received RoDTEP benefit of 0.5% on FOB value of exports, until the export of sugar was put in the restricted category. To regulate the domestic supply and prices of sugar, the Government of India placed restriction on the exports of sugar during MY 2022-23, allowing only 6 million tonnes of sugar exports during the year. The Government has extended the restriction on exports of sugar till 31 October 2023. Any commodity falling under the restricted category is not eligible for export benefits.

The Government could consider reinstating the benefits of RoDTEP for the sugar sector, for improving the export competitiveness of sugar.

Removal of Non-tariff Quantitative Restrictions

Presently, the sugar sector has mill-wise export quotas and quantitative restrictions on exports. The limit for sugar exports from India for the sugar season 2022-23 is set at 6 million tonnes. Alongside, India has also imposed 100% import tariff on import of cane or beet sugar[113]. According to Gulati et. al. (2013), the restrictive export policy indicates a "pro-consumer" and "antifarmer" bias, with export bans reflecting an "implicit taxation" of the producers and "cross-subsidization of consumers". Imposing export bans deprives farmers of getting the best prices for their produce. On the other hand, high import duties reflect "anti-consumer" and "pro-producer" bias[114]. Clearly, the motive of India's trade policy in sugar, with restrictions on both exports and imports, is unclear. Moreover, the policy is also not aligned with the Agriculture Export Policy (AEP) of India, which aims at providing assurance that processed agricultural products and all kinds of organic products will not be brought under the ambit of any kind of export restriction (viz. minimum export price, export duty, export bans, export quota, export capping, export permit etc.).

The Rangarajan Committee had also recommended that trade policies related to sugar should be stable. The Committee recommended that appropriate tariff instruments like export duty should be applied, as opposed to quantitative restrictions, for meeting domestic requirements of sugar in an economically efficient manner. The industry body ISMA has also requested the Government of India to consider allowing exports under open general licensing.

Against this backdrop, the government could consider shifting from quantitative restrictions to tariff-based restrictions that are less trade-distortive than export quotas. This move could also help India gain a reputation as a reliable supplier of sugar in the international market.

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[113] HS 1701

[114] Gulati A., Jain S. and Hoda A., 2013, "Farm trade: tapping the hidden potential", Discussion paper no: 3, Commission for Agricultural Costs and Prices, Department of Agriculture & Cooperation, Ministry of Agriculture, Government of India

Promotion of Organic Sugar

Organic sugar is a healthier and more environment friendly alternative to traditional sugar. It is made from sugar cane that is grown without the use of synthetic pesticides or fertilizers, and it is minimally processed to preserve its natural nutrients. The promotion of organic sugar can benefit both consumers and the environment, as it offers a healthier alternative to traditional sugar while also supporting sustainable farming practices. It is therefore becoming increasingly popular in the international markets because of a movement towards a healthier lifestyle. Globally, farmers and large-scale producers are also opting for no pesticides and no chemicals in the growing of sugar crops, in response to the growing demand for organic sugar.

India's exports of organic sugar were estimated at US$ 28.0 million during 2020-21, which declined to US$ 16.5 million in 2021-22, witnessing a y-o-y decline of 41.2%.

Given the health and environmental benefits of organic sugar, and its growing international demand, there is a need to promote the production of organic sugar in India. The Government could provide WTO compliant incentives for the development of the organic sugar industry in the country.

STRATEGIES FOR THE ETHANOL INDUSTRY

Incentives for Flex-fuel Vehicles

The corrosive nature of ethanol requires fuel material compatibility countermeasures in existing vehicles. The countermeasures lead to significant reduction in fuel efficiency. For example, when using E20, there is an estimated loss of 6-7% in fuel efficiency for 4 wheelers which are originally designed for E0 and calibrated for E10, 3-4% for 2 wheelers designed for E0 and calibrated for E10, and 1-2% for 4 wheelers designed for E10 and calibrated for E20[115].

For a further increase in the blending rate target, such calibrations would not be sufficient, and there would be need for introduction of flex-fuel vehicles,

[115] Roadmap for Ethanol Blending in India 2020-25, Niti Ayog

which have entirely new engine architecture and engine management systems.

Flexible-fuel vehicles or dual-fuel vehicles are alternative fuel vehicles with an internal combustion engine designed to run on more than one fuel, usually petrol blended with either ethanol or methanol fuel, and both fuels stored in the same common tank. Flex-fuel vehicles are capable of running on a combination of 100% petrol or 100% bio-ethanol and their blends. The flex-fuel engines are equipped with a fuel mix sensor and engine control module (ECM) programming that can adjust to any ratio of mixed fuels. These vehicles require change in several critical components and would require substantial investments.

These vehicles are already prevalent in countries like the USA, Brazil, China, and the EU. The automobile companies have been advised by the Government of India to start producing flex-fuel vehicles. In fact, India is expected to see some flex-fuel models in 2023. The Production Linked Incentive (PLI) scheme for Automobile & Auto Components also incentivises the Auto OEMs (Original Equipment Manufacturers) to accelerate the introduction of flex-fuel vehicles in India, with a few auto components of flex-fuel engine included in the list of eligible products under PLI (Table 5.6).

Table 5.6: Auto Components of Flex-Fuel Engine Considered under PLI

1	BS6 compliant Flex Fuel Engine capable of running upto Ethanol 85 (E85) fuel
2	Heated Fuel Rail for Flex Fuel Engine
3	Heating Element for Flex Fuel Engine
4	Heating control Unit for Flex Fuel Engine
5	Electronic Control Unit (ECU) for Flex Fuel Engine (Processor minimum 32 bits)
6	Ethanol sensor for Flex Fuel Engine

Source: Ministry of Road Transport and Highways, Exim Bank Research

Given the importance of flex-fuel vehicles in reducing carbon emission as well as saving import bill of crude oil, there is a need to further incentivise the production as well as usage of flex-fuel vehicles. In the case of Electric

Vehicles, the Government is incentivising the manufacturers with schemes like Faster Adoption and Manufacturing of Electric Vehicles (FAME), where government provides subsidies to the manufacturers. The Government is also incentivising consumers by giving purchase incentives, interest subvention, registration fee exemption, income tax benefits, among others[116]. Similar incentives could be provided for the production and usage of flex-fuel vehicles.

Flexibility in Sugar and Ethanol Production in Sugar Mills

Brazil's sugar and ethanol production units are unique. Majority of the country's sugar mills can produce both sugar and ethanol. Sugar processing facilities are considered biorefineries and can make sugar, bioethanol, and electricity from bagasse. These plants are flexible, producing more sugar or more ethanol depending on the price premium of one over another. This flexibility is a key reason for the Brazilian ethanol industry's success[117]. Such flexibility helps adapt to changing market dynamics and optimise product mix, for better realisation and achievement of better margins. There is a need to replicate such production technologies in India, with the ability to switch between the production of sugar and ethanol. To incentivise investments in such production technologies, in the 'scheme for extending financial assistance to sugar mills for enhancement and augmentation of ethanol production capacity', the Government could consider providing marginally higher interest subvention for integrated plants with such flexibilities.

Focus on Use of Alternative Feedstock for ethanol

Ethanol can be produced from sugarcane, sugar, molasses, maize, damaged food grains and surplus rice with the Food Corporation of India. Production of sufficient feedstock for ethanol production, without compromising on the food security of India is a big challenge. Further, there is also need for feedstocks which are less water-intensive and therefore more environmentally sustainable.

[116] Niti Ayog

[117] Charting the future of India's sugar industry, IFPRI

The production of alternative raw materials like sugar beet, maize, sorghum could help in increasing the production of ethanol, while being environmentally more sustainable and without putting a dent in the food security objective of the Government. Maize is one of the emerging crops in India, which can be cultivated in varied agro climatic conditions due to its adaptability. Maize contributed nearly 10.2% to India's total food grain production during 2020-21[118], and there is scope for further enhancing its production for alternative uses such as ethanol production. During 2020-21, India's total demand of maize was estimated at 23.4 million tonnes as compared to total supply of 38.8 million tonnes, resulting in a closing stock of 15.4 million tonnes[119]. The excess supply can be utilised for ethanol production. Moreover, it is a quick growing crop, and is less water intensive than sugarcane. Around 76% of the maize crop is rain fed, while more than 96% of the land under sugarcane is irrigated[120]. Clearly, it can serve as a sustainable alternative for ethanol production.

Another alternative crop for ethanol production can be sweet Sorghum, also known as jowar. Sorghum/jowar is a multipurpose crop, which yields food in form of grain and fuel in the form of ethanol from its stem. It is also one of the most drought resistant crops. The Government of India is already focussing on increasing the production of millets in India, and several announcements have been made to give a push to the sector. The Government of India also sponsored the proposal for the International Year of Millets 2023, which has been accepted by the United Nations General Assembly. The Government could provide further push for the production of sweet sorghum not only for food security purpose, but also as a raw material for ethanol production.

Biofuel production from used cooking oil is another promising alternative. Utilising used cooking oil for biofuel production has dual advantage of greater production of biofuel and reduction in environmental problems due to the disposal of used cooking oil.

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[118] Ministry of Agriculture and Farmers' Welfare

[119] ANGRAU Maize Outlook Report-January to December 2021

[120] Water Productivity Mapping of Major Indian Crops, NABARD (2018)

The National Policy on Biofuels, released by the Government of India in 2018, envisages production of biofuel from Used Cooking Oil (UCO). In India, approximately, 22.7 MMTPA (2700 crore litres) of Cooking Oil is used, out of which 1.2 MMTPA (140 Crore) UCO can be collected from bulk consumers such as hotels, restaurants, canteens, etc., for conversion, which will give approximately 110 crore litres of Biodiesel in one year[121]. The state-run OMCs launched a programme to procure biodiesel made from used cooking oil in 100 cities across the country. OMCs are periodically floating Expression of Interest for procurement of Biodiesel produced from UCO. The Government also launched a 'Repurpose Used Cooking Oil (RUCO)' sticker and a phone app to enable the collection of used cooking oil. Restaurants and hotels interested in supplying used cooking oil can affix the sticker to show availability. Going forward, there is a need for effective implementation of the current initiatives and amplifying these efforts.

Cooperation with Brazil in areas of Bioenergy and Biofuels

Brazil is the second largest ethanol producing country and flex-fuel vehicles accounted for 76.6% of the new vehicle registrations in the country during 2021[122]. There has been remarkable transformation of the transportation sector in Brazil on the back of increased ethanol production. The support by the Brazilian Government, the large sugarcane production, and the ability to easily switch between sugar and ethanol production, have been crucial factors for the transformation of the transportation sector in Brazil.

India and Brazil have undertaken several bilateral and international activities/ initiatives in the biofuels sectors in recent years, including the exchange of technical visits, the Brazil-India Ethanol Talks, Symposium on Aviation Biofuels, the Joint Working Group on Bioenergy Cooperation, Roundtable on India-Brazil Collaboration in Biofuels in the automobile sector etc. Brazil is keen to work with India on the introduction of flexible fuel vehicles, and share its vast experience in the field.

[121] PIB, Ministry of Petroleum & Natural Gas (2019)
[122] Brazilian Automotive Industry Yearbook 2022

Being the two largest sugarcane producing countries, there is immense potential for collaboration between India and Brazil to scale up production and use of sustainable bioenergy and biofuels. The two countries could work towards joint development of ethanol and biomethane fuel cell vehicles, leveraging Brazil's experience in flex-fuel vehicles and the advanced capabilities of India in the automotive sector. Also, given the significant dependence on sugarcane for ethanol production in the two countries, collaborative efforts need to be taken to develop less water intensive and higher yield sugar crops.

Easier, Sustainable and Cost-effective Transportation of Ethanol

As mentioned in Chapter 4, India's ethanol procurement by Public Sector OMCs has soared from 38 crore litres in supply year 2013-14 to over 452 crore litres in 2021-22. The encouraging number comes with a logistical challenge of moving the fuel from distilleries to blending depots and retail points. There are some states that produce more ethanol than the blending requirements, while some states have a deficit in production. The surplus production needs to be transported to other states with lower production capacity. Currently, majority of ethanol is transported through road by tankers. Not only is this costly but also leads to expenditure on transportation fuel, which in turn generates huge amount of carbon emission. There is a need for alternate methods of transportation of ethanol which includes dedicated pipelines, use of railways and coastal ways. In Brazil, which is the second largest ethanol producing country, the movement of fuel and ethanol is entirely through pipelines, rail or coastal ships. Transport by truck-tankers happens only in the last leg, from the depots to retail outlets.

Along with a change in method of transportation of ethanol, there is also a need to implement the amendments made in the Industries (Development and Regulations) Act 1951, to vest exclusive control of denatured ethanol to the central government for smooth movement of ethanol across the country. The amendments have not been implemented by many states, which is restricting the movement of ethanol. There is a need for speedy implementation of the amendments for easier transportation of ethanol.

CONCLUSION

In conclusion, promoting sugar and ethanol production in India requires a multifaceted approach. Some long-pending, structural issues in the sugar sector that have been highlighted need to be resolved at the earliest. This includes rationalising pricing policies for cane, and reviewing minimum distance criteria and cane reservation areas. Encouraging sugar beet production can also improve the economic viability and sustainability of sugar and ethanol production. Further, utilising by-products and diversification of exports towards value-added items can help create additional revenue streams. GI tags for niche products can also be leveraged for effective marketing for exports of these products. RoDTEP incentives for the sugar sector can also improve the export prospects for the industry.

In the ethanol segment, incentivising the use of flex-fuel vehicles, promoting flexibility in sugar and ethanol production through integrated mills, use of alternative feedstocks including waste for ethanol production, cooperation with Brazil in the areas of bioenergy and biofuels, and better transportation of ethanol, can help bolster the segment and ensure success of India's ethanol programme.

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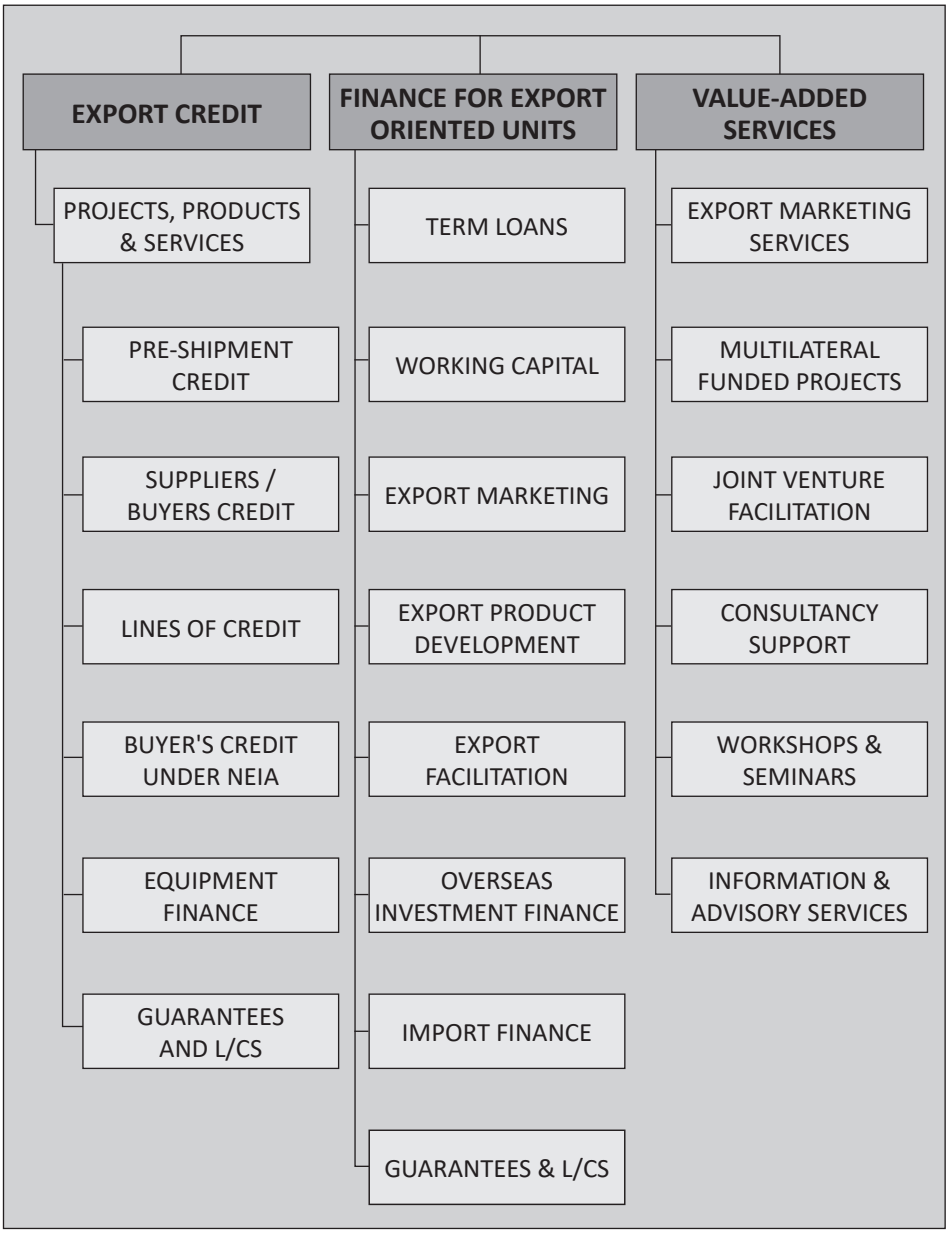

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Signature Building, Bhamburda,
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OVERSEAS OFFICES

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Abidjan,
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