IISD International Institute for Sustainable Development

SSI State of Sustainability Initiatives

SUSTAINABLE COMMODITIES MARKETPLACE SERIES

GLOBAL MARKET REPORT

Sugar cane prices and sustainability

Vivek Voora, Steffany Bermúdez, Han Le, Cristina Larrea, and Erika Luna

September 2023

Market Overview

Global production and consumption of sugar cane recover after the effects of the COVID-19 pandemic.

Sugar cane is one of the most efficient plants at converting sunlight into energy. It is common in diets around the world and is an important biofuel feedstock (UNICA, n.d.). This ancient agricultural commodity was traded for thousands of years as a product chewed for sweetness. Originally from New Guinea, sugar cane made its way across the world via trade routes to Southeast Asia, the Pacific islands, and India (Daniels & Daniels, 1993). It became a crop of great importance in the 15th century during European colonial expansion (Daniels & Daniels, 1993). A perennial crop grown mainly in tropical climates, sugar cane reaches 2 to 6 metres in height and takes 12 to 18 months to mature. Commercial sugar cane is a hybrid grass species accounting for 86% of global sugar production (Daniels & Daniels, 1993). Sugar has become so widespread that it is linked to global health challenges, such as rising obesity (World Cancer Research Fund International, n.d.).

Harvested sugar cane stalks are refined into cane sugar by extracting their juice, which is then boiled until crystallization and centrifuged to separate raw sugar, cane, and molasses. Most raw sugar cane is further refined into granulated sugar via filtration, crystallization, and drying for wide use in the food and beverage sector. In addition to sugar, processing sugar cane also yields molasses, a sweet, thick liquid used in food and distilled into alcohol (rum and cachaça) and bagasse, a residue burned to produce heat and steam to generate electricity. Cane juice can also be fermented and distilled into anhydrous ethanol, which is typically blended and used as biofuel feedstock (Dotaniya et al., 2016). About 81% of global sugar cane production is converted into cane sugar, while the rest is converted into biofuel (Organisation for Economic Co-operation and Development [OECD] & Food and Agriculture Organization of the United Nations [FAO], 2021).

The market value of the sugar cane sector exceeded USD 56 billion in 2022 (OECD

LIVELIHOODS

About 773,000 people work in the sugar cane sector in Brazil.

6 million smallholders grow sugar cane in India.

300,000 smallholders support the sugar cane sector in Thailand.

& FAO, 2021). Despite market disruptions due to the COVID-19 pandemic and Russia's invasion of Ukraine, sugar cane production is expected to continue growing to meet rising demand, particularly in developing countries (OECD & FAO, 2021). Sugar cane processing must be done quickly to preserve its sucrose. This fact, along with the high costs of transportation to the mill, is why sugar cane mills are located as close as possible to sugar cane fields, which generate considerable economic activity in rural areas. Sugar cane cultivation and processing employ more than 100 million people in around 120 sugar-producing countries (South African Sugar Association, 2022).

The Brazilian sugar cane sector produces 40% of the world's sugar cane and directly employs 773,000 people—down from upwards of 1 million jobs since the country transitioned to mechanized harvesting in 2017—and represents 25% of the rural workforce (ProTerra Foundation, 2020; UNICA, n.d.). The Thai sugar cane sector is supported by 300,000 smallholder sugar cane farmers on plots averaging 2 ha and provides employment for more than 1 million people along the supply chain, as well as seasonal migrant workers (Bonsucro, 2018a; OECD & FAO, 2021). The Indian sugar cane sector is supported by 6 million smallholders cultivating 1-ha plots and provides rural livelihoods for about 50 million people (Bonsucro, 2021c). The South African sugar cane sector is supported by more than 20,000 smallholders and provides 85,000 direct and 350,000 indirect jobs (South African Sugar Association, 2022).

Sugar cane production grew from around 1.71 billion tonnes in 2008 to 1.87 billion tonnes in 2020 from cultivating 26 million ha, according to the FAO (FAOSTAT, 2022a). Small production increases in that period in Brazil, India, and Pakistan offset decreases in China (FAOSTAT, 2022b). Sugar cane production has slowed over the last decade, as its compound annual growth rate (CAGR) of 1.23% from 2008 to 2019 dropped to 0.73% from 2014 to 2019. Most sugar cane is processed domestically into cane sugar for local consumption and export.

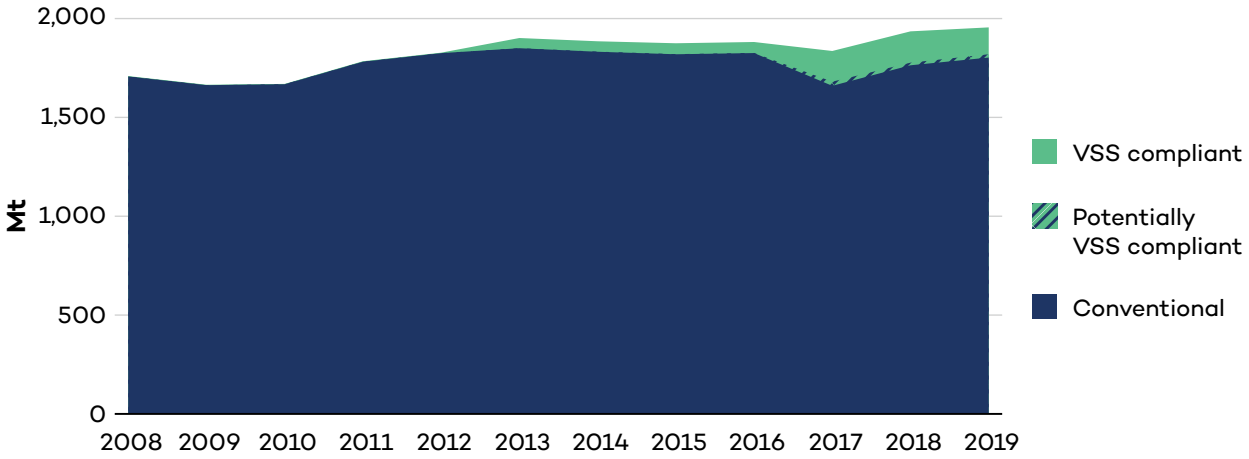
About 40%[1] of production is exported, providing an important source of foreign exchange revenue for exporting countries (Canadian Sugar Institute, 2022). Brazil, Thailand, and Australia have been the top exporting countries of raw sugar cane (HS 170111) since 2016, exporting approximately 25 million tonnes (Mt), 2.8 Mt, and 2.5 Mt, respectively, in 2020. China and Indonesia have mostly been the largest importers, importing around 5.2 Mt and 4.6 Mt in 2020, respectively, followed by Algeria and the United States, both with 2.4 Mt (ResourceTrade.Earth, 2022).

[1] This refers to total sugar produced in the world from sugar cane and beet. Sugar cane accounts for 87% of the aggregate output, with sugar beet making up the remainder.

Supply has slowed in many parts of the world due to unpredictable events, such as the COVID-19 pandemic, the war in Ukraine, soaring inflation, and extreme weather conditions, though global supply recovered in the 2021/2022 growing season and is expected to increase moderately going forward due to production rebounds and yield improvements (FAO et al., 2022; Husain, 2022; Mera et al., 2021; United Nations Conference on Trade and Development [UNCTAD], 2022). The global sugar cane supply exceeded demand prior to the pandemic, while in 2020/2021 and 2021/2022 demand was slightly higher than supply (Canadian Sugar Institute, 2022; European Commission, 2023a; International Sugar Organization, 2023). Demand is expected to rise moderately going forward, fuelled by population growth, increasing urbanization, and growing middle-class and young populations in low-income countries, especially in Asia and Africa (OECD & FAO, 2022). However, the OECD and FAO (2022) estimate that supply will outstrip demand in this decade.

In 2020, measures to prevent the spread of the COVID-19 virus disrupted the sugar cane supply chain by boosting production costs to meet sanitization requirements, limiting access to needed labour and agricultural inputs and causing logistical and transportation challenges. Lockdowns restricting the movement of people and products caused significant uncertainties, resulting in soaring food and fertilizer prices across the world (FAO et al., 2022; Jagtap

Figure 1. Global sugar cane production from 2008 to 2019: Sugar cane that complies with voluntary sustainability standards (VSSs) reached 7% to 8% of total production



Note: Conventional production volumes do not comply with a VSS, while VSS-compliant production volumes refer to sugar cane produced in compliance with at least one VSS. Production volumes that are defined as potentially VSS compliant cannot be definitively identified as conventional or VSS compliant with the data currently available.

Source: FAO, 2022a; Meier et al., 2021.

et al., 2022; OECD, 2022; Ustinova, 2022; World Trade Organization [WTO], 2022).

Non-essential foods made with cane sugar (i.e., beverages, desserts, and pastries) were particularly affected, and their demand declined (OECD & FAO, 2021; World Cancer Research Fund International, n.d.). Demand for ethanol-based biofuels also declined as governments urged citizens to stay home and off the roads. While global sugar consumption slightly dropped as a result of the pandemic, the OECD and FAO reported that demand rebounded during two consecutive seasons (from October 2020 to September 2021 and from October 2021 to September 2022) as national lockdowns were lifted, restaurants reopened, supply chain bottlenecks were removed, and economies recovered (OECD & FAO, 2021, 2022). Global sugar cane production also declined in the 2019/2020 and 2020/2021 seasons because of the effects of the pandemic, but it rebounded in 2021/2022 and 2022/2023, mainly due to increased production in India and Thailand (European Commission, 2023a; OECD & FAO, 2022).

Other factors have influenced the supply and demand of cane sugar post-pandemic. India and Thailand are among several producing countries that continue to regulate domestic cane sugar prices and intervene to address food security and market disruptions that can influence supply and demand dynamics. For example, India limited its cane sugar exports to maintain domestic supplies in March 2022 (Jadhav & Bhardwaj, 2022).

Sanctions and trade restrictions due to the Ukraine–Russia conflict have limited fertilizer exports from Russia and Belarus, major global producers of nitrogen, a key nutrient for sugar cane production. This action resulted in soaring fertilizer prices and shortages and caused turmoil and uncertainty in global food and fertilizer markets (FAO et al., 2022; Haddad, 2022). All this may lead to a decrease in global supply in the 2023/2024 growing season as producers are facing higher costs of production and may reduce the use of synthetic fertilizers, which can drop their yields (European Commission, 2023a.).

The International Fertilizer Association notes that it is rare for the fertilizer supply chain to face multiple disruptions in such a short period (Cross, 2022). Fertilizer prices have climbed 230% since May 2020 (Acciarino, 2022; Hebebrand & Laborde, 2022, a, 2022b). Soaring production costs have had a huge impact on Brazil—which imports 85% of its fertilizer, a quarter of which comes from Russia (Nti, 2022).

The high cost of imported fertilizers has driven farmers in countries like Brazil, India, and South Africa to look for greener alternatives. Although this transition can take time and effort, many sugar cane farmers have already switched to organic fertilizers, experimenting with organic fertilization. This, in turn, can reduce their dependency on imported synthetic fertilizers and lower their production costs and energy use while improving soil health. In India, farmers who have switched to organic farming are experiencing improved soil nutrient levels and sugar cane quality (Jain, 2022). Some farmers in Brazil, South Africa, and Thailand have also combined sugar cane cultivation with livestock rearing or obtained animal manure from neighbouring farms to replace chemical fertilizers and enrich their soils (Teixeira et al., 2022).

Climate change continues to threaten the viability of the sugar cane sector.

Besides adjusting to the challenges brought on by COVID-19 and the invasion of Ukraine, the sugar cane sector will have to continue adapting to the impacts of climate change. Indeed, erratic climatic conditions are predicted to shift the suitability of sugar cane production around the world due to changing precipitation patterns, extreme weather events (e.g., drought, floods, frost, typhoons), and pests and diseases. These changes will especially affect developing countries, where adaptation capacities are low and vulnerabilities to extreme weather events are high. Nevertheless, this impact will vary considerably depending on geographic location, crop variety, and adaptation strategies adopted.

Sugar cane yields in Thailand are expected to decline by 24% to 33% between 2046 and 2055, reducing its contribution to the global sugar supply by 3% to 4% (Pipitpukdee et al., 2020). Rising temperatures and changes in precipitation patterns will affect the Chinese sugar cane sector, as 80% of its sugar cane is rainfed. Furthermore, sea level rise will affect coastal sugar cane production areas in Australia (UN Comtrade, 2022), Florida, and Fiji (Linnenlueke et al., 2020). Records indicating how a changing climate has impacted sugar cane production in the past show that drought accounted for an 18% drop in production in 2004, and frost led to a 34% drop in yield in Guangxi, China (Zhao, 2021). Sugar cane rusts have spread quickly throughout the world, causing a 40% production loss equivalent to USD 150 million in the Australian sugar cane sector in 2000, 15%–30% production loss in the Brazilian State of São Paulo in 2009, and 40% crop loss equivalent to USD 63 million in Florida in 2013 (Selvakumar & Viswanathan, 2019; Zhao, 2021). Nevertheless, climate change may create favourable temperature conditions for some areas, such as the Brazilian state of São Paulo, which could see yield increases of 15%–59% by 2050 (Marin et al., 2013).

Sugar cane farmers will need to adapt to more unpredictable and extreme weather events. Enabling climate resilience among smallholder farmers is particularly important, as their livelihoods have already been harmed by the pandemic and current critical global economic uncertainty in interconnected food, fuel, and fertilizer markets (FAO et al., 2022; OECD, 2022; UNCTAD, 2022). Adaptation strategies focus on developing climate-resilient high-yielding cultivars, adopting climate-smart farming practices, and using irrigation and drainage systems. Brazilian farmers will nearly double the area planted with genetically modified sugar cane that is resistant to drought and stem-boring insects; borers cause the loss of more than USD 1 billion annually to Brazilian cane growers through lost productivity, lower quality, and insecticide costs (Samora, 2022).

Adaptation strategies in India, northeastern Brazil, South Africa, southern Thailand, and Zimbabwe have focused on developing drought-tolerant, disease-resistant, high-yielding varieties and improving irrigation systems (Flack-Prain et al., 2021; Linnenlueke et al., 2020). Nevertheless, irrigation systems must be sustainably developed to prevent depleting available

water resources, as sugar cane is a thirsty crop (Linnenlueke et al., 2020). Using climate-smart farming practices has to be supported by better decision-making tools, such as improved weather forecasting and soil moisture and fertilizer management (Linnenlueke et al., 2020). Government interventions include improving national adaptation strategies, shifting sugar cane-growing areas, and promoting economic diversification in rural areas (Linnenlueke et al., 2020).

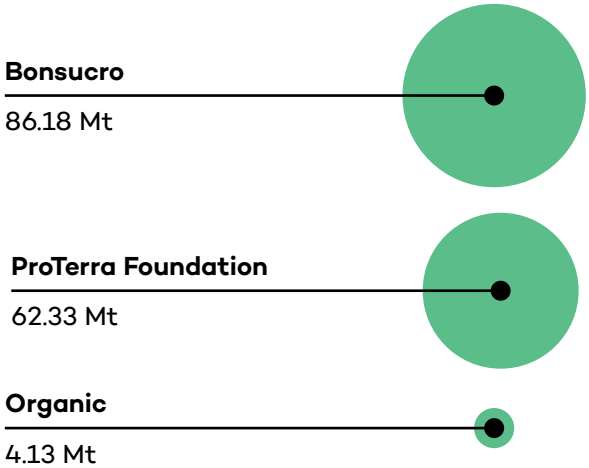
Climate change mitigation opportunities exist all along the sugar cane supply chain. At the farm level, greenhouse gas (GHG) emissions are greatly reduced with the shift away from pre-harvest sugar cane field burning—which facilitates harvesting by machete—to more sustainable harvest and mechanized practices. Brazil's largest sugar cane-producing state, São Paulo, mandated the gradual elimination of pre-harvest burning by 2017 (Sussman, 2021). Producers can also cut GHG emissions at the farm level by replacing synthetic fertilizers with organic fertilizers and by using renewable forms of energy. For instance, sugar cane plantations in South Africa and Eswatini have shifted from using coal to renewable energy to irrigate their crop (Pryor et al., 2016; United Nations Enviroment al Program, 2016). At the other end of the supply chain, the role of sugar cane as a key feedstock to produce biofuels has allowed consumers to move away from fossil fuels. Nevertheless, sugar cane-based biofuels need to minimize their carbon footprint and food security impacts. Here, life-cycle analysis can provide a more comprehensive understanding to compare other sources of energy, such as other biofuels, hydrogen, and renewables. For instance, Brazil's National Biofuels Policy (RenovaBio), launched in 2017, has been key to reducing GHG emissions to help meet the country's nationally determined contributions under the Paris Agreement (Ministério de Minas e Energia, 2021).

Producing VSS-compliant sugar cane can help build resilience and tackle climate change.

Moving the sugar cane sector toward sustainability and climate resilience is imperative for it to overcome its formidable challenges, such as labour rights infringements, deforestation, biodiversity loss, water depletion, land degradation, and climate change. Adopting VSSs, which began in the sector more than 10 years ago, represents one effort among others to do so. For instance, Bonsucro, ProTerra Foundation, and Organic require the sustainable management of water sources via more efficient water extraction and irrigation methods. Such practices can help preserve water sources for sugar cane cultivation and neighbouring communities, which is particularly valuable during times of drought. These VSSs also require the preservation of forests and High Conservation Value Areas, which can help prevent the loss of valuable natural environments, such as the Amazon, due to the expansion of sugar cane cultivation (Voora et al., 2022). Adopting VSSs allows farmers to differentiate themselves in the marketplace from conventional cane sugar farmers (Voora et al., 2020). In exchange for using more sustainable farming practices, farmers can label their

How much sugar cane is compliant with a VSS?

Figure 2. VSS-compliant sugar cane production volumes in 2019



Source: Meier et al., 2021.

products as VSS compliant or produced in accordance with a VSS.

In 2019, more than 37,000 farmers produced 136 Mt–153 Mt of VSS-compliant sugar cane with a farm gate value of at least USD 4 billion to USD 7 billion; that was down 19 Mt–22 Mt from the previous year (Meier et al., 2021). The most prominent VSSs in the sugar cane sector included in the dataset ordered by 2019 production volumes are Bonsucro (86.18 Mt), ProTerra (62.33 Mt), and Organic (4.13 Mt). Fairtrade is also an important VSS in the sugar cane sector, applying to a little more than half a million tonnes of cane sugar produced in 2019. Growing at a CAGR of 46%–47% between 2008 and 2019, VSS-compliant sugar cane now represents 7%–8% of total global production (Meier et al., 2021).

Despite this impressive growth, VSS-compliant sugar cane production may be slowing, as its CAGR dropped to 21%–24% from 2014 to 2019. Almost all the loss in VSS-compliant production is attributed to a drop in ProTerra-certified sugar cane volumes, which declined from 93 Mt in 2018 to 62 Mt in 2019. The International Sustainability and Carbon Certification (ISCC) also operates in the sugar cane sector and reported 89,745 ha of certified sugar cane in 2021 (ISCC, 2022).

Another challenge sugar cane producers face is the availability of VSS-compliant cane sugar sold as conventional sugar cane. For instance, only 23% of the total Bonsucro-certified cane sugar was sold as such in 2018 (Seixas et al., 2019). Nevertheless, this figure is increasing. Bonsucro sales of certified cane sugar rose to 29% of total production by 2020, in large part due to a credit trading system applied by the VSS that year (Bonsucro, 2020a; Viart et al., 2021). In some cases, sugar cane farmers who cannot sell their product as VSS compliant may not receive higher prices or premiums to pay for maintaining their certification. Furthermore, falling incomes and higher production costs as of 2020 due

MARKET VALUE

More than 37,000 farmers produced between 136 Mt and 153 Mt of VSS-compliant sugar cane with a market value of at least USD 4 billion.

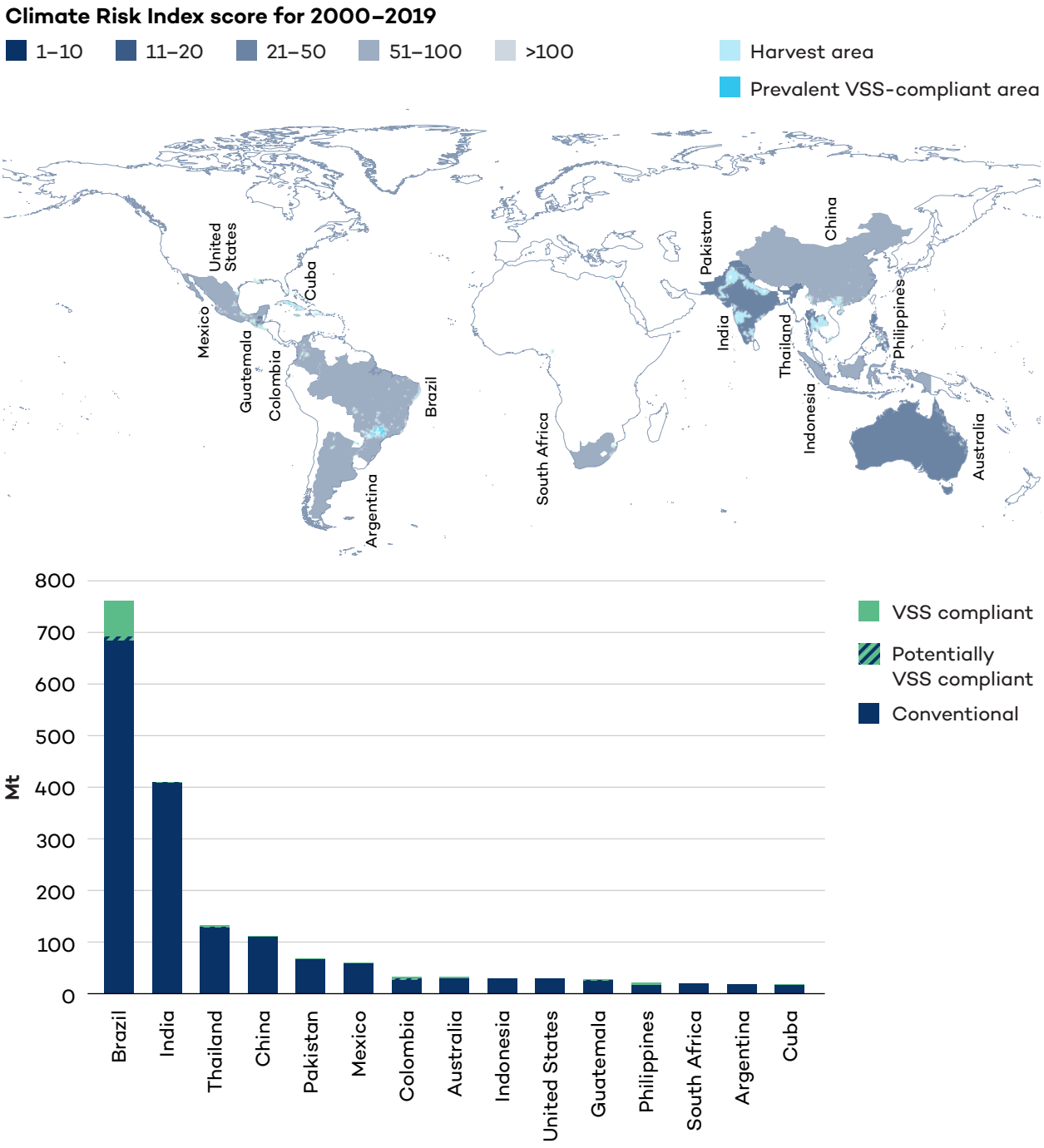
CAGR

Conventional production grew at a CAGR of 0.50% from 2008 to 2019 but decreased at -0.32% from 2014 to 2019.

VSS-compliant production grew at about 46% from 2008 to 2019 and at 21%–24% from 2014 to 2019.

Sugar cane-growing regions of the world

Figure 3. Distribution of sugar cane production in the top 15 producing countries in 2019



Note: Countries with lower Climate Risk Index scores have been most impacted by extreme weather events in the reference period.

Sources: Eckstein et al., 2021; FAO, 2022a; Meier et al., 2021; Voora et al., 2020.

to COVID-19 supply chain disruptions, along with global economic uncertainty because of geopolitical and trade tensions as of 2021 (OECD & FAO, 2022), may diminish the capacity of farmers to invest in sustainable production and climate resilience.

According to our analysis among sugar cane-producing countries, Brazil, China, India, Pakistan, and Thailand offer VSSs the greatest potential to expand based on the size of their conventional sugar cane production. Among the least developed sugar cane-producing countries, Sudan, Mozambique, the Democratic Republic of the Congo, Ethiopia, and Haiti offer VSSs the most opportunities to enable the adoption of more sustainable sugar cane farming practices based on their share of global sugar cane production, the limited presence of VSSs, and their Human Development Index ratings (FAO, 2022a; Meier et al., 2021). To make the most of this potential, sugar cane producers may need help from supporting actors to transition to VSS-compliant practices, such as extension services, better market relations, and increased demand for more sustainable cane sugar (Elder et al., 2021).

As importantly, VSS-compliant sugar cane can affect yields. According to our analysis, in 2019, VSS-compliant sugar cane yields were higher in five—potentially even in three—and lower in 23 sugar cane-producing countries (FAO, 2022a; Meier et al., 2021). This outcome may be due to the prevalence of the Organic standard in sugar cane-producing countries, as it tends to have lower yields compared to conventional production systems (Seufert, 2019). Eleven sugar cane-producing countries implemented the Organic standard in 2019 (Meier et al., 2021).

Demand for VSS-compliant sugar cane has recently grown, driven by the biofuel sector industry.

Higher retail prices and limited market access are the biggest challenges facing VSS-compliant sugar cane expansion (Husain, 2022; UNCTAD, 2022). Furthermore, cane sugar is often a hidden ingredient that is used in food processing or industrial applications, which makes its traceability challenging (Ustinova, 2022). In recent years, many countries, including Mexico, South Africa, and the United Kingdom, adopted taxation policies to lower the consumption rates of sugar-sweetened beverages, promote healthy diets, and encourage companies to reformulate their products to reduce sugar content; this has reduced demand for and consumption of cane sugar (World Health Organization, 2022).

Despite these challenges, demand for VSS-compliant sugar cane has steadily increased, driven by demand for it as a feedstock in the production of biofuels. VSSs such as the ISCC and Bonsucro have been certifying more sugar mills producing bioethanol in countries like Argentina, Brazil, India, and Thailand (Bonsucro, 2018a; ProTerra Foundation, 2020; South African Sugar Association, 2022). The market uptake of Bonsucro-certified ethanol grew by 68% in 2018 (Bonsucro, 2018b; South African Sugar Association, 2022). This is due, in large part, to European regulations that recognize VSS-compliant sugar cane as an acceptable feedstock for the production of sustainable biofuels (Bonsucro, 2021c). Sugar cane-producing countries in Latin America have

also benefited from the growing demand for organic cane sugar. In 2020, European imports of organic sugar rose 29% compared to 2018 (UNICA, n.d.).

Brazil, one of the world's largest sugar consumers (123 kg per capita) (FAOSTAT, 2022a), plays a critical role in the global market as both a producer and consumer. VSSs have expanded in the Brazilian sugar cane sector thanks to support from the government, cross-sectoral collaboration, and increasing consumer awareness. However, there is still potential to increase VSS-compliant cane sugar consumption locally. Brazil's organic market (valued at USD 81 million in 2021) only represents 0.1% of global organic market value, which is dominated by the United States and Europe (Statista, 2023). In 2019, 58% of Brazilian consumers said they buy more products that have a positive impact than they did 5 years earlier, and 82% of Brazilians aged 18 to 34 were familiar with "responsible consumerism" (Izquierdo, 2019).

In other countries, such as South Africa, cane sugar is mostly consumed as an ingredient in beverages and confectionary products and for direct human consumption (40% and 60% of domestic sugar sales, respectively) (International Sugar Organization, 2023). While the South African government adopted the Sugar Value Chain Master Plan 2030 in 2020 to ensure the long-term sustainability and profitability of the sector, the plan had very little input from sustainability experts or VSS bodies (personal communication, Bonsucro representative, March 2021; United States Department of Agriculture [USDA], 2023). Nevertheless, multinationals in South Africa increasingly demand sustainable sugar, and interest in certification is growing (personal communication, Bonsucro representative, March 2021). For example, in 2010, Unilever committed to sourcing 100% of its sugar cane from more sustainable sources (FAO et al., 2022), and ILLOVO, one of the biggest sugar cane producers and traders in Africa, has started implementing the SUSFARMS Sustainability Tool by the South African Sugarcane Research Institute, an initiative that assists farmers and millers to implement better management practices in line with relevant legislation and with the purpose of aligning it with Bonsucro (Dardagan, 2018; Global Environmetn Facility & United Nations Development Programme, 2019; Illovo Sugar Agrica, 2023).

As illustrated in Figure 4, the six largest cane sugar-consuming companies bought 16.2 Mt of cane sugar in 2020. About 5.5 Mt, or 33.7%, of that cane sugar was more sustainably sourced or complied with a VSS or corporate sustainability initiative. Corporate sustainability initiatives refer to sustainable sugar cane-production programs established by private companies rather than by independent third parties.

For instance, Kellogg's has set up a continuous improvement program on social and environmental practices, and Nestlé has created a Responsible Sourcing Standard. All but one of these six companies have sustainability sourcing commitments in place for 2020 and beyond. PepsiCo is the only company that reports meeting its target of sourcing 100% of its cane sugar from VSS-compliant sources (Bonsucro), mainly in the form of credits (PepsiCo, 2021). Three of five companies missed their target to source 100% sustainable cane sugar by 2020 (Voora et al., 2020). Kellogg's came the closest, sourcing 74% of its cane sugar from VSS-certified

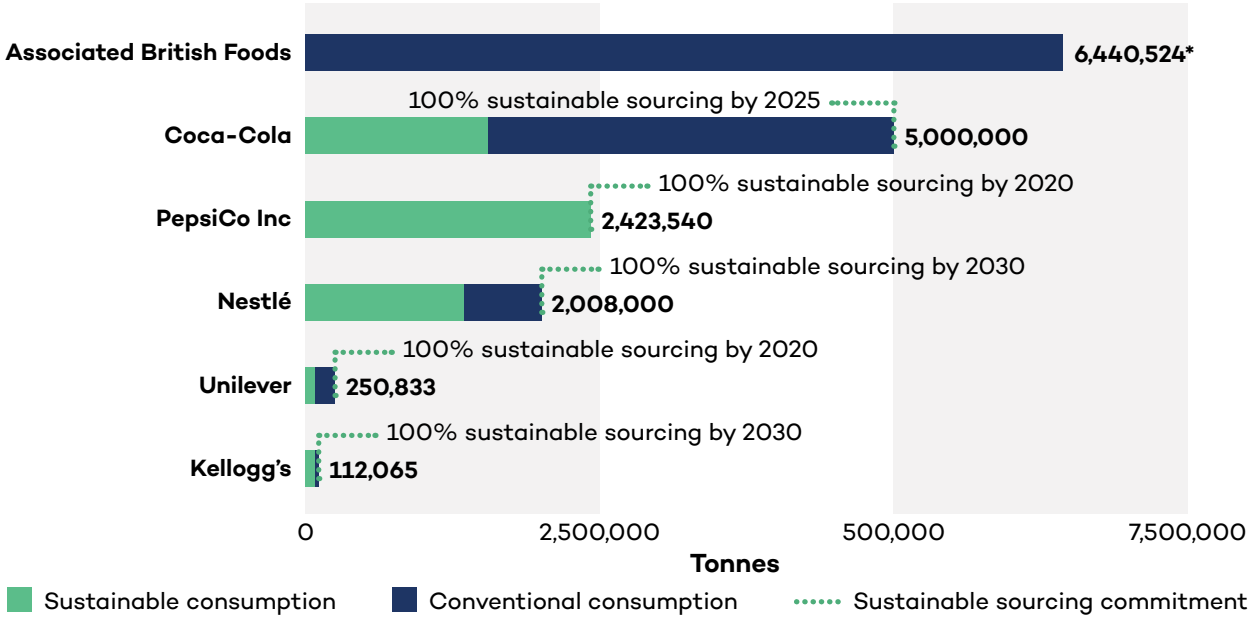
producers and/or its continuous improvement program in 2020. Unilever and Coca-Cola came in at 31%. Kellogg's has revised its target year to 2030 (Kellogg's, n.d.).

Figure 4 shows that Coca-Cola has also revised its target to source 100% sustainable cane sugar by 2025. Nestlé achieved its target to source 65% of its cane sugar from more sustainable sources by 2020 (Voora et al., 2020), and the Swiss company set a more ambitious goal to source 100% by 2030. Based on the sourcing commitments of some of the largest cane sugar-consuming companies examined and assessing them against current cane sugar-sourcing information, an additional 4.3 Mt of sustainable cane sugar could be sourced by 2025.

VSSs in the sugar cane sector initially focused on niche markets. With the establishment of Bonsucro and the involvement of the ProTerra Foundation, however, VSSs started to gain more traction in the sector. Although demand is expected to grow steadily until 2030 (OECD & FAO, 2021), forecasting VSS-compliant production is challenging because growth accelerated as Bonsucro expanded and the ProTerra Foundation started operating in the sector. In a more pessimistic outlook that weighs the slowdown in the growth of VSS-compliant production trend more heavily in the short term, VSS-

Progress on sustainable sourcing commitments

Figure 4. Major sugar cane–consuming companies, their sustainable sourcing commitments, and progress in 2020



*No sustainable consumption and sourcing commitments were found.

Sources: Associated British Foods, n.d.; EPA Monitoring, 2017; Kellogg's, 2019, 2021; Nestlé, 2019, 2020, 2021a, 2021b; PepsiCo, 2021; personal communication, S. Alastair, August 26, 2021; Swire Coca-Cola, n.d.; The Coca Cola Company, 2020; Unilever, 2022.

compliant production would increase to about 155 Mt by 2025.

A more optimistic outlook weighs the increasing long-term VSS-compliant production trend more heavily and projects a steady rise to more than 323 Mt by 2025. Although a few potential futures exist between these outlooks, we predict that VSS-compliant production could reach 240 Mt by 2025 as demand for sustainable cane sugar continues to grow, motivating sustainable cane sugar sourcing commitments and enabling VSS-compliant sugar cane farmers to enjoy more success selling their harvest as a VSS-compliant product. Consequently, we expect VSS-compliant sugar cane production to range from 154.68 Mt to 323.05 Mt by 2025.

A Dive Into Sugar Cane Prices

A complex and fragmented market creates price volatility in the sugar sector.

Pricing is important, as it can determine if sugar cane producers stand to gain financially from complying with a VSS. Efforts to shift the sector toward sustainability—such as by abiding by VSSs—are partly driven by a need to internalize the external, tangible costs associated with the industry, which are not factored into the price paid by end consumers. For example, converting sugar cane into a tonne of cane sugar emits 241 kg of carbon dioxide for the average sugar cane mill in Brazil, and an estimated 213 gallons of water is used for every pound of cane sugar produced (Sahai, 2022). Also, the external cost of conventional cane sugar produced in Mauritius in 2017 was found to be EUR 2.06 per kg versus EUR 1.96 per kg for Organic-certified cane sugar, with fewer detrimental socio-ecological impacts (True Price, 2017). Internalizing the external costs associated with the production and processing of conventional sugar cane in the market price would make VSS-compliant sugar cane more competitive. Therefore, examining how global sugar prices, including sugar cane, intersect with the sector's sustainability is paramount.

As with many other agricultural commodity markets, the international prices of cane sugar are largely correlated with macroeconomic dynamics and shifts in supply and demand. Raw or unrefined cane sugar is traded in the futures markets. Most of the world's sugar[2] trade is through the International Exchange Contract in New York (for raw sugar) and London (for white or refined sugar), which act as the dominant points of reference for pricing and market activity (International Exchange, 2023). Governments in main producing and exporting countries also have a large bearing on pricing due to the strict policies and subsidies that influence the price of cane sugar traded in their jurisdictions. Indeed, the international raw sugar price bears little resemblance to the prices used in domestic markets for most countries. A

[2] This includes beet and cane sugar.

large percentage of international cane sugar trade is carried out through governmental arrangements and long-term contracts that set the price. For liberalized free-traded cane sugar, however, the futures markets still act as the reference price.

The sugar cane market has been affected by highly variable price fluctuations in the last decade, mainly due to changes in production volumes in key countries such as Brazil, Thailand, and India. In the 2010/2011 season, for instance, cane sugar prices in the international markets reached an all-time high due to supply shortfalls tied to high production costs and the use of sugar cane to produce more ethanol in Brazil. Cane sugar prices then dropped due to a surplus in supply and less global demand (Voora et al., 2020). More recently, in 2020/2021, the sugar cane harvest dropped in Thailand due to widespread droughts, leading to low global cane sugar stocks and, consequently, high raw cane sugar futures prices (Gro Intelligence, 2021). The situation stabilized in 2022, however, as good rainfall led to a rebound in Thai sugar cane production and exports (Aisyah, 2023). According to the OECD and FAO's *Agricultural Outlook 2022–2031* (2022), international sugar prices, including cane and beet sugar, are likely to fall over the next 10 years due to improved production prospects and anticipated oversupply. However, price volatility may result from new and revised domestic policies in a few cane sugar exporters, such as changes in volumes destined for ethanol production and price-setting policies (OECD & FAO, 2022).

As the world's largest sugar cane producer, Brazil plays an important role in shaping prices in the physical and financial markets. International prices can be influenced by economic and political conditions that affect the country's ability to produce and export cane sugar, such as ethanol use and exchange rate fluctuations that also affect local production costs. When the U.S. dollar is strong against the Brazilian real, Brazilian sugar cane producers' costs are relatively lower, making production more profitable and exports more competitive in the global market (McConnell et al., 2010). This, in turn, can create a global oversupply, leading to a drop in prices. In addition, the country has developed an industry that easily switches between producing cane sugar for exports and producing ethanol for domestic use. As 60% of the world's ethanol production uses sugar cane crop as the primary feedstock, any changes in the allocation of Brazilian sugar cane to ethanol production is a key element in determining prices at the global level (Morris et al., 2017; OECD & FAO, 2022; Salassi, 2007). India, another key producer and importer, has started to promote a national ethanol blending program that would eventually make sugar cane less available for sugar production and reduce global stocks (OECD & FAO, 2022), putting pressure on international prices.

The ongoing Russia–Ukraine war and weather-related challenges have caused major disruptions in the sugar cane market and international prices (Lamba, 2022). Energy (petroleum and gas) and fertilizer prices have climbed because of the war, affecting sugar cane growers through increased input costs, leading to lower fertilizer usage (Ponnarong, 2023). The conflict has also affected the supply-and-demand dynamics for cane sugar as other crops become more favourable to growers. For instance, in Brazil, the state-owned petroleum company Petrobras reacted

to the changes in crude oil prices by raising its gasoline price in 2022, which provided an incentive for millers to divert more cane to ethanol production and less to sugar, therefore affecting global cane sugar supply (Millard, 2022). International sugar markets (cane and beet) will remain dependent in the medium term on the developments in Russia's invasion of Ukraine, weather-related production shortfalls in major producing countries due to climate change, and crude oil price volatility (OECD & FAO, 2022). These factors remain a major source of uncertainty for the sugar cane sector, especially sugar cane growers who depend on the crop for a living.

Volatility and rising production costs can threaten sugar cane growers' incomes and inhibit entrepreneurial activity.

Although cane sugar is considered one of the most valuable agricultural commodities in the world, many sugar cane growers grapple with the effects of wild price swings in the international market, as well as competition from other sugar sources, such as sugar beet crops, which are mainly produced in Europe and North America (Bonsucro, 2021d; FAOSTAT, 2023). The price of sugar cane delivered at the mill is often below production costs for many farmers in developing countries, who also must deal with crop losses due to uncertain weather patterns, high input prices, and rising debt (Bonsucro, 2021d; FAO, n.d.; Rajesh, 2021). All of this threatens the economic viability of the sector and causes some sugar cane smallholder farmers to live in poverty (Jenkins et al., 2015; Thibane et al., 2023). Sadly, suicides have been reported in the last decade among sugar cane growers in countries, including India, where farmers are not paid enough to cover the costs of production and are forced into debt with payments always in arrears (Chiala & Xavier, 2017).

Low and volatile cane sugar prices also discourage entrepreneurial activity and make it difficult for farmers to manage household expenses and budgets for farm inputs, such as fertilizers and pesticides, or invest in agricultural improvements (Fairtrade Foundation, 2013; Thibane et al., 2023). In Thailand in the 2019/20 season, for instance, severe droughts caused a drop in sugar cane production, with farmers losing almost their entire crop. The following year, farmers had to pay double the costs for harvesting due to increased labour expenses, causing many of them to stop planting sugar cane as they could not break even (Rajesh, 2021). However, it is important to note that the effects of external shocks on farmers' prices and incomes vary greatly by country, as cane sugar pricing at the domestic level is subject to strict regulations and a series of support systems that make domestic prices generally higher and decorrelated from world market quotes (Mpapalika, 2019).

Farm gate prices for sugar cane growers are influenced by different factors, including mill capacity utilization, production costs, the quality and quantity of cane delivered, and the level of sweetness in the cane—also known as sucrose content—as well as the implementation of government policies, such as minimum prices and subsidies (Jenkins et al., 2015; Kindred, 2023). Sugar cane

growers produce, harvest, and deliver cane sugar to the closest local mill—preferably within 24 to 48 hours of harvesting—before the sucrose content deteriorates, and are usually paid a return on their cane based on a weighted average from a pool of growers that supplied the sugar mill. The price growers receive is then based on the average returns of the mill, whether the cane sugar goes for export or to the domestic market. Most of the cane sugar produced in developing countries is for home consumption—that is, to satisfy the local market—and only a small proportion is exported (Kindred, 2023; Mpapalika, 2019).

The differences in prices received by farmers are mainly due to the level of government intervention in the domestic cane sugar industry. On average, producers in Brazil, India, and Thailand receive about 8% of the price of raw cane sugar negotiated in export markets (Zancaner, 2022). In Thailand, farmers got around USD 29/tonne in the 2021/22 crop season (Apisitniran, 2022; Makgopa & Woody, 2022). In India, they received about USD 35/tonne in 2021/22, or about 9% of the raw cane sugar price (Government of India, 2023), as per the producer price policies in both countries. In Brazil, producers received around USD 31.40/tonne in the 2021/22 crop season, which represented an increase of 55% compared to the previous season due to the higher prices of cane sugar and ethanol in local and international markets (Nogueira, 2023).

In Brazil, about 70,000 independent farmers supply around 40% of the cane processed by Brazilian sugar cane mills (VS Engineering, 2016). Cane prices received by farmers and mills are not set by the government but are based on a model called "Consecana," a formula that considers the prices for cane sugar and ethanol sold by processors in both the domestic and international markets to establish the "total recoverable sugar" value (or ATR in Portuguese), which represents the sucrose level of the sugar. This value is released monthly, and mills use it to determine the prices they pay cane suppliers (Akamine, 2021; Makgopa & Woody, 2022). The industry also pays more for sugar cane with higher sucrose content. This calculation is based on the ATR value, which corresponds to the amount of cane sugar available in the raw material minus the losses in the manufacturing process.

In India, the central government fixes a fair and remunerative price for sugar cane each year, indicating the minimum price at which mills should buy sugar cane from farmers. For the 2022/23 season, this price has been fixed at about USD 3.70 per quintal, or USD 36.90 per tonne (PIB Delhi, 2022). Some states also announce a state-advised price at higher levels than the fair and remunerative price to encourage more farmers to cultivate the crop. However, sugar cane production in India is extremely variable due to erratic weather patterns. Providing minimum fixed prices has not managed to increase smallholder farmers' incomes, as they still must cope with high production costs, including seedlings, labour, and fertilizer, as well as harvesting and transport costs. This has also led to a mismatch between the price the mills should pay farmers and the lower price mills receive from the market, making the sector uncompetitive in the international markets (Deloitte, 2021).

In Thailand, the Cane and Sugar Act (1984) allows the government to intervene in issues

such as planted area, farm, and mill price-setting and provide monetary incentives, such as direct payments and input subsidies, to encourage millers to increase their capacities and exports (Meriot, 2015). The price of sugar cane is predetermined annually by the government and announced in October/November, which marks the beginning of the season. The price is calculated based on the estimated revenues from domestic and export cane sugar sales for that year and is used by cane sugar millers as a basis to calculate the initial price paid to sugar cane growers (Manivong & Bourgois, 2017). The farmer receives an upfront or advance payment on delivery of the sugar cane to the mill based on this official price. At the end of the sugar production cycle, usually in September, the government re-evaluates the revenue from the sale of cane sugar and announces the final sugar cane price. If the upfront payment exceeded what was due through the final calculations at the end of the year, then the difference is deducted the following season (Athipanyakul et al., 2020; Manivong & Bourgois, 2017).

Production costs also vary from one country to another. In Brazil and Thailand, the cost of cane per tonne (which accounts for 70% to 75% of the cost of cane sugar) stood at USD 25.11 and USD 27.50, respectively, while in India, it stood at USD 42.30 for the 2017/18 season (Deloitte, 2021). These costs were higher than the official farm gate prices announced by these countries in the same season (FAOSTAT, 2022b).[3] Farm performance is also tied to the size of the farm, quality of seeds, yields, and the distance from farm to mill. In countries like Pakistan and the Philippines, farms of 5 or fewer ha represent a significant proportion of producers, while most farms in Brazil range from 20 ha to 500 ha. This makes a big difference in productivity and costs associated with cane cultivation (Ceres, 2017).

In India, for instance, about 25% of the cost of sugar cane cultivation stems from harvest and transportation (Agri Farming, 2019). The situation is similar in Thailand, where low technology leads to low yields, pushing down farmers' incomes (Morris et al., 2017; Rajesh, 2021). Smallholder farmers in Thailand usually burn the sugar cane crop residues to clear fields for future planting and do not have access to harvest machines, limiting productivity and adding to the issue of air pollution (Rajesh, 2021).

In other sugar cane-producing countries where the government does not regulate the industry, growers receive a small fraction of the international price for raw sugar, making it difficult for them to compete with those in countries with strong government support. In countries such as Tanzania, the domestic cane sugar sector has major shortfalls associated with low production and poor storage infrastructure, worsened by the importation of cheap sugar that discourages local production (Mpapalika, 2019). In Mozambique, commercial farmers face high irrigation costs because they rely on expensive diesel generators for power supply and transportation costs from farm gate to end markets that are significantly higher than in other producing countries such as Brazil (De Albuquerque & Hobbs, 2016). In low-income sugar cane-producing countries, farmers also

[3] The official producer prices for the 2017/18 season were of USD 19/tonne, USD 33/tonne and USD 23.6/tonne for Brazil, India, and Thailand, respectively (FAOSTAT, 2022b).

lack adequate agricultural inputs, such as fertilizer and farm equipment leasing, and they are unable to obtain finance and credit (Kalumbia, 2022).

Refiners and traders capture the most value in the cane sugar value chain.

The sugar cane market involves thousands of companies, including producers, mills, refiners, wholesalers, traders, and retailers around the world. The cane sugar value chain is highly concentrated, with a small number of players controlling refining and merchandising. The value of sugar is much higher than the value of the cane from which it is produced. In addition to this, the upstream part of the chain is very inflexible, as the role of small-scale farmers is restricted to growing and harvesting the cane that must be hauled by truck to the closest sugar mill. Farmers depend heavily on the mill to buy and process their produce, leaving little room for negotiation or innovation while coping with rising production costs and a lack of access to finance and quality inputs (Sattayathamrongthian & Vanpetch, 2020).

Sugar cane mills typically own some strategic farms, giving some vertical integration from the mill back to the farm. This helps the mill assure supply and maintain a constant minimum output through the season. Mills have also invested heavily in technology and innovation, which is needed in the processes of extraction, clarification, boiling, crystallization, and centrifuging. When the sugar cane is destined for domestic markets, it is transported from a mill to a local refiner for further purification (Spencer, 2020). Frequently, the company that owns the mill also owns the refinery. Wholesalers then purchase the cane sugar, although the refiner itself can be the brand and therefore manages the marketing logistics. The cane sugar would be sold either in supermarkets for home use or to industrial buyers for use in products such as baked foods, confectionary, and other products that end consumers will purchase. It is important to note that cane sugar prices vary according to the type, quality, and specification—for example, special unrefined brown sugar is more valuable than processed white sugar (Fairtrade International, 2020).

As for sugar destined for international markets, after processing, the raw cane sugar is transported to a terminal or port and shipped to refineries in consumer countries where it is further processed into white refined, brown, or granulated cane sugar and sold to large manufacturers of consumer products (Spencer, 2020). The most value in the chain is generated during the processing, refining, trading, and marketing stages. Globally, six firms control two thirds of the international trade in both raw and refined cane sugar—Bunge, Cargill, Czarnikow, ED&F Man, Louis Dreyfus, and Sucden—located in the United States and Europe (Ceres, 2017; Fairtrade Foundation, 2013).

These sugar-processing companies and large corporations benefit from higher bargaining power over the upstream growers (Simar, 2018). They also have more financial and human capacity to invest in capital-intensive technologies to process cane sugar. They are generally more protected against volatility and external shocks as they are increasingly integrated across the value chain and undertake arrangements

such as strategic alliances, licensing and franchising agreements, and joint ventures to gain market power at local and regional levels, which permits them to maximize profits and mitigate potential risks (Wood et al., 2021). Some of these companies have subsidiaries involved in growing and milling sugar cane in developing countries, and, in some cases, they are involved in marketing and packaging processes to retail (Fairtrade Foundation, 2013). However, even further up the value chain, cane sugar is not a freely traded commodity. This causes difficulties for exporters to access new markets in developed economies like the United States or the European Union that have policy instruments in place favouring domestic growers, such as supply management, private storage aid, and import quotas (relevant only to the United States) (Schnepf, 2021).

At the retail level, there is little change or innovation for refined or white cane sugar, which is also frequently on sale to attract interest from end consumers. There is not much value-added to retail cane sugar, except in specialty confections, such as coloured sugars for decorating candies and pastries. In general, the sugar cane market presents a more homogenous, flatter structure with difficulty in finding a value-added proposition that permits actors upstream in the supply chain to obtain higher margins. This contrasts with other commodities that have a high value added in the distribution channel, such as cocoa or cotton, where diversification into new product lines adds economic value and contributes to the bottom line.

What have VSSs done to pricing in the sugar cane sector?

Unlike the way they have for other agricultural commodities such as coffee, cocoa, or tea, VSSs have not yet implemented minimum price mechanisms or living income benchmarks for certified farmers in the sugar cane sector. VSSs such as Fairtrade and Bonsucro consider that price-setting mechanisms in the sector are very complex and distorted, and offering fixed minimum prices could be detrimental to VSS-compliant farmers and producers (Bonsucro, 2021d; Fairtrade, 2023b.; Fairtrade International, 2020).

However, Fairtrade International encourages the adoption of revenue-sharing systems from cane sugar mills to farmer organizations. The standard also has a system of premiums in place. Small-scale farmers and producers' organizations associated with the standard benefit from a Fairtrade premium of USD 60 per tonne of cane sugar and USD 80 per tonne of organic cane sugar sold on Fairtrade terms (Fairtrade International, 2023a). This premium is paid on top of the regular sales price, which can be the international market price or the fixed price settled by the producing country (Fairtrade International, 2023b).

Bonsucro has in place a system of credits and physically traded cane sugar. On the one hand, Bonsucro's certified products, such as cane sugar, ethanol, or molasses, can be sold through a physical supply chain following the

mass balance principle,[4] where producers (farms and mills) may receive premiums or higher prices than the conventional market. On the other hand, producers can also sell credits through an online platform launched in 2019. These credits are traded separately from the physical product, and the physical cane, sugar, ethanol, or molasses that each credit represents is sold as conventional in the market. One credit represents 1 tonne of sugar cane, raw cane sugar, or molasses or 1 cubic metre of ethanol produced under Bonsucro's terms (Bonsucro, 2023).

Through the platform, sellers (certified mills and farmers) can offer their credits, while buyers (traders, manufacturers, and retailers) can bid on these credits based on their needs. The system automatically matches transactions based on price, allowing producers to obtain premiums for products that were not purchased through a physical supply chain and buyers to make claims about their procurement objectives or publicly support the growth of a more sustainable sugar cane sector. Producers and buyers can also negotiate credits outside of the platform and, if they have reached an agreement, confirm the deal on the platform. According to Bonsucro data, credit prices vary by product, with sugar cane credits receiving the lowest average premiums of USD 0.18 per tonne, followed by molasses at USD 0.26 per tonne, raw cane sugar at USD 0.88 per tonne, and ethanol credits receiving the highest average prices of USD 2.34 per cubic metre (Bonsucro, 2023). The platform retains a fee that goes into the Bonsucro Impact Fund.

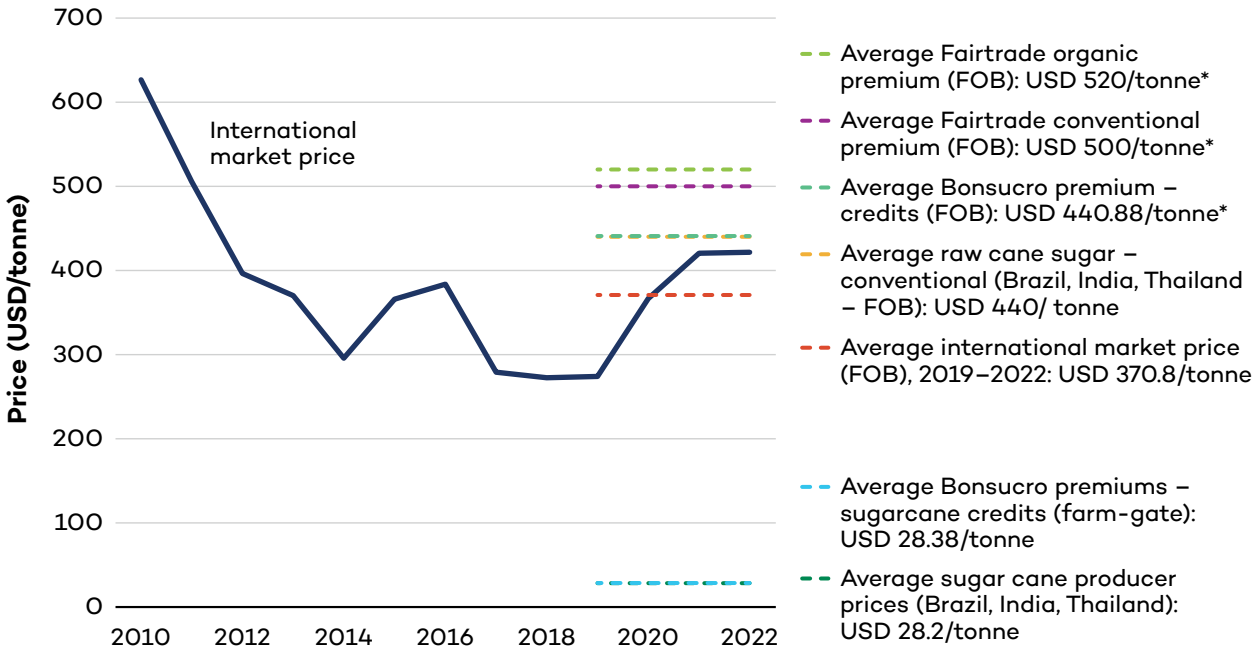
The market for physical trade and credit trades of sugar cane compliant with the Bonsucro standard has grown significantly in recent years (Bonsucro, 2020a). Between 2020 and 2021, more than 1.6 Mt of raw cane sugar credits were sold through the platform. Also, Bonsucro noted in its outcome report 2021 that certified farms reported up to 23% higher wages for the lowest-paid worker at the mill and 20% higher incomes at the farm level (Bonsucro, 2022). However, it is important to note that in terms of global supply, certified cane sugar still represents 7% to 8% of total global production, challenging the potential impact of VSSs to increase wages and incomes across the board.

To better illustrate how VSSs' premiums are positioned in the sugar cane sector, Figure 5 shows the average international free-on-board (FOB) price for raw sugar cane in 2010–2022 (ICE contract No. 11) and the average Fairtrade and Bonsucro prices (FOB), including premiums from 2019 to 2022. It also shows the average sugar cane producer prices in Brazil, India, and Thailand in the 2019–2022 period. It should be noted that the prices represented in the figure are estimates and do not reflect the reality of all sugar cane growers in these countries.

According to our analysis and the data shown in Figure 5, cane sugar producers associated with VSSs, such as Fairtrade and Bonsucro, may receive premiums above the average world FOB price for conventional raw cane sugar. As of 2019, producers in

[4] The Bonsucro Chain of Custody Standard focuses on the mass balance principle. This is a system for monitoring the inputs and outputs of certified material/product throughout the supply chain. It allows for mixing these materials/products with non-certified material at any stage of the supply chain, provided that the outputs of certified material/product do not exceed the inputs of certified material/products (Bonsucro, 2019).

Figure 5. International market price for raw cane sugar, 2010–2022 (FOB); average prices and premiums for Fairtrade and Bonsucro credits (FOB); and average prices received by raw cane sugar (FOB) and sugar cane producers in Brazil, India, and Thailand (farm gate), 2019–2022 (USD/tonne)



Note: Data for the raw cane sugar international market price is for 2010–2022; all the other data points in the figure are for 2019–2022.

*These values are for raw cane sugar.

Source: Author's elaboration based on Barros, 2021; The Economic Times, 2018; Fairtrade International, 2023a; FAOSTAT, 2023; Makgopa & Woody, 2022; OECD & FAO, 2022.

major producing and exporting countries that are compliant with these two standards may have received prices that are up to 20% higher than those selling conventional raw cane sugar when receiving premiums either through physical sales or credit trades. Mills or cooperatives that sell raw cane sugar pay sugar cane growers a share of this price, which can be negotiated between producers and millers or determined by the government. As an example, sugar cane producers in Brazil, Thailand, and India received between 6% and 9% of the average FOB price of raw sugar cane sold in the international market (Zancaner, 2022).

What stands out is that, as of 2019, producers in Brazil, Thailand, and India associated with Fairtrade International may have received higher FOB prices than those growing and selling conventional raw cane sugar to the export market (about 13% higher prices, including premiums). In addition, premiums tend to rise with double certification of Fairtrade and Organic, reaching as much

as 20% higher prices than producers selling conventional raw cane sugar (see Figure 5).

In addition, according to Figure 5, prices and premiums obtained through Bonsucro's credit platform in these three countries are at almost the same level as conventional raw cane sugar averages at FOB prices and farm gate prices, with producers obtaining less than 1% of higher prices per tonne of certified raw cane sugar or sugar cane sold. This is a minimal gain that hardly serves as a motivating factor for producers to go through the effort of pursuing certifications. However, this might be because the platform is relatively new; premiums are not fixed but rather depend on the willingness of the buyer; and the system is presented by Bonsucro as an alternative when volumes of certified sugar cane or raw cane sugar have not been sold in the physical market. Unfortunately, information is lacking regarding the prices or premiums that Bonsucro-certified producers receive when they sell physical certified sugar cane or raw cane sugar. These values in the physical market may vary from credit transactions negotiated through the platform.

Evidence of the direct effects of VSSs on farmers' prices and incomes is very limited. Some studies show that the benefits for farmers complying with VSSs in the sugar cane sector are not based on the provision of minimum prices and premiums but rather on other factors that ultimately increase their incomes or reduce their production costs. Standards usually offer guidance and support to farmers that can result in cost reductions. In India, for instance, VSS-compliant farmers are seeing benefits in yield improvements and more resilient crop varieties compared to non-certified farmers (Deloitte, 2021). However, obtaining premiums is critical to recovering investments, and this is proving difficult due to the government's strict pricing regulation, which leaves no monetary incentives for producers to become certified. Despite the challenges of accessing premiums, certified producers and mills can benefit from cost reductions that result in higher profits. These reductions are higher in sugar cane mills with bigger certified areas that have presented lower unit costs compared with non-certified ones (Deloitte, 2021).

For instance, a WWF Brazil study found that the average productivity of Brazil's Bonsucro-certified sugar cane plantations was 15% higher than the national average and 54% greater than non-certified growers from the same mill. The increase in productivity and quality of the raw material delivered to the mill led to a 9% increase in certified growers' incomes compared to non-certified growers and 22% compared to the average grower income in Brazil during the same harvest. These results were achieved due to better plantation management and the adoption of better techniques and use of resources (WWF Brazil, 2014).

In addition, the certification process facilitates data collection and better-quality data that are very helpful for planning investments (Deloitte, 2021). The adoption of VSSs in the sugar cane sector also creates an opportunity for greater awareness and consensus on the socio-economic issues in the sector, as many of them enable an environment where multistakeholder dialogue is encouraged (Jenkins et al., 2015). However, many argue that VSSs in the sugar cane sector are not strong enough to support a stable and sustainable increase in prices, as demand for sustainably produced cane sugar is still very nascent and, generally, it does

not come with a willingness to pay higher prices (Jenkins et al., 2015). Also, there is a lack of evidence across the board on how VSSs in the sector enhance productivity or production cost savings.

Although some farmers and mills can benefit from premiums and cost reductions from participating in VSSs, cane sugar is still considered a homogeneous product, and the scope for earning higher prices and premiums is very limited. Most buyers are unwilling to pay premiums, as end consumers do not demand sustainable cane sugar and are not concerned about the methods of sugar cane cultivation (Deloitte, 2021). Overall, there is a lack of awareness from governments, companies, and end consumers about the availability and benefits of more sustainable cane sugar.

In response to these concerns, VSSs, including Bonsucro, are working to implement living wage approaches in their standards for the years 2021–2026, as well as increasing legal minimum wages above 30% for farm workers and 45% for sugar cane mill workers after 5 years of certification (Bonsucro, 2021d), though there is no report yet about the implementation of living income approaches targeting farmers. Also, Bonsucro is partnering with financial providers to improve access to sustainability-linked finance for certified members by enabling them to disclose relevant data on carbon metrics and reduce financial risk. Furthermore, the standard is considering convening the sector around payment for environmental services (PES), seeking to pay landowners to adopt good agricultural practices and protect the environment (Bonsucro, 2020c).

The cane sugar sector is subject to public interventions that distort the global market.

The cane sugar sector is one of the most highly regulated industries in the world, subject to measures such as minimum prices, subsidies, import quotas and duties, and export subsidies (Jenkins et al., 2015; Mpapalika, 2019). As the crop is cultivated in many parts of the world, almost all producing and exporting countries attempt to protect the competitiveness of their local industries and insulate their domestic markets from price fluctuations.

For instance, the United States, traditionally a sugar-deficit country, has put policies in place to foster domestic production of both sugar cane and beet and restrict imports (OECD & FAO, 2022). The U.S. government imposes high tariff-rate quotas and high out-of-quota tariffs to restrict the amount of imported sugar, either beet or cane sugar (USD 0.339/kg for raw sugar) (Makgopa & Woody, 2022). The country also supports domestic prices at or above USD 0.20/lb. When world sugar prices are near or above the U.S. base support price, U.S. sugar prices, for both beet and cane, must be at least slightly higher than world prices to cover the marketing expenses arising from importing tariff-rate quota sugar. Other importers of cane sugar, such as the European Union, grant duty-free access to the their market to developing countries under the Everything but Arms agreement and economic partnership agreements with African, Caribbean, and Pacific countries, which have many sugar cane producers (European Commission, 2023b). China has

also imposed strict import quotas for more than a decade. Under those rules, companies with quota licences can bring in sugar at a preferential rate of 15%, while those that do not have a quota share import cane or beet sugar at a 50% tariff (Li, 2023).

Producing countries, including India and Thailand, have several regulations to support their domestic cane sugar industries and have been accused by other WTO members, such as Australia, Brazil, and Guatemala, of using subsidies and other pricing measures that distort the global sugar market (Deloitte, 2021). In 2022, Thailand amended its Cane and Sugar Act to deregulate domestic cane sugar price controls and terminate the government cane sugar sales administration after losing a WTO case against Brazil in 2016. Thailand was accused of violating WTO rules by fixing high domestic prices and subsidizing farmers and millers through its benefit-sharing system, a system that shared the profits from sales in the domestic and export markets, allocating 70% of the industry's net profit to sugar cane farmers and 30% to sugar companies or millers (Manivong & Bourgois, 2017; Prasertsri, 2023).

Thailand's Cane and Sugar Fund was created to support the sugar cane industry and boost research and development for sugar cane production. Sugar cane millers must contribute to the fund by collecting the price difference between domestic wholesale prices and world raw cane sugar prices (Prasertsri, 2023). This money is used to provide direct payments to growers when sugar cane market prices are lower than the minimum prices established by the government (Prasertsri, 2023). The fund also facilitates soft loans—at a fraction of market interest rates—to buy inputs or equipment and machinery and provides input subsidies to sugar cane growers and subsidies for the production of ethanol, mostly from cane molasses (Meriot, 2015).

In addition to fixing minimum prices for farmers, the Indian government regulates the domestic retail price by using marketing quotas and centrally managed stocks (McConnell et al., 2010). India has also been offering subsidies to help cane sugar exporters in the form of direct credits in the farmer's account on behalf of the mills. These subsidies cover marketing costs, handling, upgrading, and international and domestic transport charges. Furthermore, the government fixes minimum export quotas to reduce cane sugar stocks. This system settles the minimum quantity that the mills must export to ensure that excess stocks of sugar in the domestic market do not lead to a decline in cane sugar prices (Deloitte, 2021).

The policy environment around sugar cane production creates uncertainty, as the sector remains highly regulated despite the efforts of some exporting and importing markets, including the European Union and Thailand, to deregulate it (OECD & FAO, 2021). The FAO (n.d.) suggests that policies and government intervention have made the sugar sector (both beet and cane) the most distorted of all agricultural commodity markets. Also, these protective measures have had an impact on low-income sugar cane-producing countries that do not have the capacity to implement such domestic programs, representing significant losses to thousands of small-scale farmers and mills that cannot protect against price volatility or compete in the international market.

A Way Forward: What is needed to build a more sustainable sugar cane sector?

Despite some efforts to provide better price remuneration to sugar cane farmers, more must be done to ensure that production can expand sustainably, producers are rewarded for implementing more sustainable practices, and fair market access is assured. Addressing farmers' needs, especially in training on business, good agricultural practices, and access to market pricing information, can help improve the livelihoods of the large number of smallholders around the globe who make up the sugar cane sector.

The complexity of the value chain, along with heavy regulations from major producing, exporting, and importing countries, significantly weakens the leverage of stakeholders acting on their own to produce a meaningful change in the industry. Collaboration is needed from all actors to create effective incentives to promote a more sustainable sugar cane sector, develop coordinated government policies, and allocate responsibilities and financial costs for the negative externalities of producing sugar cane to all links in the value chain, especially those at the downstream stages.

Supporting the adoption of VSSs in the sector could be a way not only to produce higher-quality cane sugar and increase yields but also to promote stakeholder dialogues grounded at the country level. For sugar cane farmers to implement the necessary modifications in their operations, knowledge of the relative importance of the resource inputs affecting sugar cane yield is essential (Thibane et al., 2023). It is also important to understand the costs and benefits of driving the adoption of more sustainable production and consumption in the sugar cane sector and how they accrue to different players along the value chain.

Greater coordination is also required of VSSs, as well as among private initiatives. Both can play a key role in implementing measures to make the business case for VSSs and boost demand for more sustainably grown sugar cane. Following are some of the best practices and measures that governments in producing and consuming countries, private sector actors, and VSSs should consider to make the sugar cane value chain fairer, promote better distribution of value, increase farm gate prices, and mitigate the effects of external shocks on farmers' incomes.

Governments in major producing countries can adopt mechanisms and policies to support and financially reward more sustainably produced sugar cane by helping farmers join VSSs and improve their business cases. Producing countries have strong motives to push and transition toward more sustainable practices in the sugar cane sector, as climate change, unfavourable weather events, and political and economic turmoil are having a major impact on cane sugar output and prices. Severe episodes of drought are already forcing sugar cane growers to switch to alternative drought-resistant crops, given that sugar cane is water intensive (OECD & FAO, 2022).

Policy and regulatory support are necessary to ensure the adoption of more sustainable sugar cane production practices, better management, and procurement practices in

producing and importing countries, as well as to increase financial sustainability for farmers. Many producing countries have pricing systems in place and have developed formulas that consider criteria like recoverable sugar value content, export volumes, futures prices, and others. However, including a sustainability component in these formulas could be a way for these producing and exporting countries to maintain governance over pricing systems in the sector while providing an opportunity to remunerate farmers who implement more sustainable practices. For instance, Mexico has developed a Law for the Sustainable Development of Sugar Cane (Ley de Desarrollo Sustentable de la Cana de Azucar, 2005) that promotes more sustainable production practices. Despite sustainability being an important component in public policies in the domestic sugar industry, the chapter related to payment systems does not include a sustainability component in the price determination for sugar cane. There is an opportunity to revise these policies and adapt pricing systems to adequately compensate farmers and producers that grow, process, and sell more sustainable sugar cane.

Also, capacity building offered by VSSs, national industry associations, and mills is critical to supporting the livelihoods of farmers and workers in the sugar cane sector. These actors can implement measures, offer incentives, or pay for capacity-building activities by using membership fees (Jenkins et al., 2015). A great incentive to sugar cane farmers would be to improve harvesting and drive down the cost of transportation, as they are usually rewarded for quality and productivity, and it is therefore essential that careful attention is paid to costs and efficiencies wherever possible. It is often difficult for the millions of small farmers worldwide to compete against medium-sized and larger growers that can streamline costs with economies of scale. In this case, joining VSSs can be a way for farmers to organize in cooperatives and enjoy greater access to resources, as some evidence suggests that VSSs can strengthen cooperative organizations and contribute to enhanced social capital for producers, which can also facilitate better access to markets, training opportunities, reduction in transaction costs, and access to financing (Elder et al., 2021).

Some countries are already moving in that direction. In Mauritius, the government refunds sugar cane farmers and mills half of the costs related to certification, testing, and accreditation. The government has implemented this strategy as part of its plan to move the sector toward more sustainability, produce more sustainable energy based on certified ethanol, and grow the country's economy (Bonsucro, 2021b). VSSs can also support smallholder farmers in countries with little support from governments to increase productivity to meet growing demand while also breaking the cycle of poverty. In one example, in Belize, investments in quality-improvement programs and integrated pest management in sugar cane boosted productivity by 21%, resulting in a 30% increase in farmers' cane revenue (Ceres, 2017).

In addition, monetary incentives can be given to sugar cane farmers who diversify or adopt technologies, such as mechanization, that drive improved quality and productivity and other practices that reduce the environmental footprint of sugar cane, including those complying with

a certification scheme. These incentives could be payments for implementing good agricultural practices, environmental services, or carbon sequestration (Piñeiro et al., 2022). Governments can also support sugar cane farmers in protecting the integrity of freshwater bodies by enacting regulations and linking financial incentives to farmers who adopt measures to preserve aquifer reserves or biodiversity or to those who adopt mechanisms to preserve air quality and avoid cane burning. For example, since 2020, Thailand's government has offered a subsidy to farmers who refrain from burning their sugar cane fields during harvest to help ease air pollution. All farmers are entitled to THB 120/Mt of their harvest for the season, which represents about USD 3.43/tonne in addition to the minimum fixed price (Theparat, 2020; Vietnam Plus, 2021). In India, the government is also considering offering additional compensation of INR 6,000 (USD 72.45) per hectare as an incentive to farmers for using alternative cultivation patterns that are less water intensive (The Economic Times, 2020).

VSSs can work toward developing financing mechanisms and improving access to finance for growers and mills. Given that fixing minimum prices and premiums for sugar cane growers has proven a challenge for VSSs because the global sugar sector remains heavily regulated and distorted, they can further contribute to the well-being of farmers, incentivizing them to become certified by offering compliant farms and mills access to financing mechanisms. Some VSSs, such as Bonsucro, are exploring the possibility of partnering with financial providers to improve access to sustainability-linked credits for certified sugar cane farmers. In Brazil, for instance, Bonsucro-certified sugar cane farmers have been given access to credit lines with lower interest rates based on their sustainability credentials (Bonsucro, 2021a). The lack of access to finance for the sector is a major constraint in many countries, including South Africa (personal communication, Bonsucro representative, March 2021). Investments at the farm, transport, and mill levels, as well as for diversification, could have a huge positive impact on sugar cane growers and millers. However, banks and other financers in the country are reluctant due to the instability of the domestic and international cane sugar prices, the changes in climate resulting in longer droughts, and inadequate government policies on land reform (International Energy Agency, 2022). VSSs can leverage their experience in South Africa to influence and support ongoing processes, such as the implementation of its sugar cane master plan, to make environmental and social considerations a priority and regain investors' trust.

Bonsucro is also studying the viability of PES for sugar cane producers in Brazil. Its study shows that these types of incentives can add financial value for farmers and are an important stimulus to guide better practices to preserve land and habitats and enhance livelihoods in sugar cane-producing communities (Bonsucro, 2020c; Geoflorestas, 2020). Some PES models that can work for the sugar cane sector are carbon credit markets that could be implemented by the public and private sectors; development of green financial products (loans, bonds, insurance); government programs in which taxes are converted into PES investment funds; and co-shared programs between

brands, for instance, by rewarding the best-rated sugar cane suppliers and farmers based on environmental criteria (Bonsucro, 2020c; Geoflorestas, 2020)

Diversification is key to increasing farmers' incomes. Supporting farmers and processors in generating alternative sources of income when cane sugar prices are low is essential. There is an untapped opportunity to develop renewable outputs from sugar cane refinery operations. In addition, VSSs could support the diversification projects of associated smallholder farmers and mills into green energy products from sugar cane processing. This support could drive more VSS adoption, as such projects can contribute to climate mitigation efforts. The largest sugar cane producers, namely Brazil and India, have commercial-scale bagasse[5] co-generation plants, and other sugar cane-producing countries—such as Australia, Guatemala, Kenya, Mauritius, the Philippines, Uganda, and Vietnam—are also using the bagasse as an alternative source of energy (Seng To et al., 2018). In Australia, for instance, some of these milling companies use bagasse-generated electricity to operate their factories, while the surplus power is sold into the national electricity market (Bagshaw, 2022). Another way to diversify is to use bagasse as a feedstock for synthetic biology to make synthetic foods or fibres.

While sugar will continue to account for most of the end usage of sugar cane in the world, the crop has other potential uses that show promise (i.e., biofuel, sustainable aviation fuel, bioplastics, packaging, and paper from bagasse). For instance, the bioplastics market could add significantly to the demand for sugar, and potentially for VSS-compliant sugar cane, as the market is expected to grow exponentially (at a CAGR of 16.1% from 2020 to 2027), driven by policies such as the European Union's decision to reduce the production and consumption of single-use plastics by about 80% by 2022 (Bonsucro, 2021d)

The sustainable use of sugar cane, as well as certification, can be pursued in the emerging markets of sugar by-products to benefit farmers and increase their incomes as well. In India, for instance, the use of sugar cane for ethanol can be a viable option to absorb excess production and regulate prices (Deloitte, 2021). Another initiative that governments in producing countries can support in cooperation with VSSs is the production of biofertilizers from sugar cane waste. There is an interesting case of small farmers and students in Ghana who have joined to develop a bio-compost fertilizer from sugar cane waste that can ensure better soil quality, increase crop yields, and provide an additional source of income (they also sell to local farmers) (DW, 2021). These experiences have the potential to be replicated in other regions and used by smallholder farmers as a strategy to increase revenues from sugar cane farming.

Expanding these diversification efforts would require support from VSSs and industry actors, but also appropriate government policies and incentives to promote investment. For instance, increased policy support for ethanol production as part of Brazil's National Biofuels Policy to reduce GHG emissions, RenovaBio, has generated an additional revenue stream for sugar cane

[5] Bagasse is the fibrous material left over after the sugar cane has been crushed.

producers and processors, adding flexibility to switch between cane sugar and ethanol production depending on market conditions (Barros, 2021; McConnell et al., 2010). Future demand for ethanol biofuel could potentially expand sugar cane farming land in Brazil by 5 million ha by 2030 (ScienceDaily, 2019). Accordingly, sugar cane farmers can benefit from ethanol demand due to the strong demand for sugar cane. The lack of this type of policy support in other countries, such as South Africa, has limited investments in the biofuel sector, although the potential is being investigated as part of its sugar cane master plan.

Governments and the private sector should incentivize the consumption of more sustainable cane sugar in producing countries and by the private sector. Despite efforts made by VSSs and other actors in the sector, demand for sustainably produced cane sugar is still low. Multinationals operating in the food and beverage sector, based in Europe and North America, largely drive VSS compliance for sugar cane. The main reason they want sugar cane farmers to comply with VSSs is related to managing reputational risks. Indeed, one of the biggest limitations for the expansion of a more sustainable sugar cane industry is that these large companies buy only a small portion of VSS-compliant cane sugar. Other limitations are growing concerns about the relationship between sugar consumption and chronic diseases, the imposition of sugar taxes, and competition from other sources, such as sugar beet.

Most cane sugar is consumed in the country of production, where buyers usually have little awareness of environmental and social concerns in the sector. In Africa, for example, countries like South Africa, Mauritius, and Eswatini export significant volumes of their raw cane sugar, while in the rest of the continent, production goes to local markets and processors. The continent exports approximately 26% of its total production and consumes the remaining (Common Market for Eastern and Southern Africa, 2019; ResourceTrade.Earth, 2022). As long as the demand for conventional cane sugar remains strong in developing countries, VSSs will be ineffective in meaningfully curbing unsustainable practices in the sector. This is why expanding VSS compliance in sugar cane production and processing will have to happen by creating demand for more sustainable cane sugar in both producing and consuming countries.

Governments in producing countries can push for more sustainable consumption of cane sugar by developing targeted procurement programs and educational campaigns. The private sector can also play a role and move the sugar supply chain toward more sustainability. Food and beverage manufacturers, traders, and retailers can indirectly influence production practices and supplier standards in their supply chains. For this, it would be necessary not only to commit to purchasing more VSS-compliant cane sugar but also to implementing initiatives to support farmers financially to adopt more sustainable growing practices, promote better trade relations and direct trade relationships with mills run by producers' associations, and commit to paying premium prices to growers who implement more sustainable production practices.

These companies are sensitive to external pressure and responsive to market trends and consumer preferences (Ceres, 2017).

Indeed, sugar sector enterprises (traders, food manufacturers) need to perceive social, economic, and environmental issues in sugar cane production as a source of risk (Jenkins et al., 2015). Thus, procuring more sustainable sugar—such as VSS-compliant sugar—presents an opportunity to ensure the longevity of the sector.

References

Acciarino, A. (2022). *The severe effects of rising costs of fertilizers on farmers' communities and global food security.* World Farmers' Organization. https://www.wfo-oma.org/wfo_news/the-severe-effects-of-rising-costs-of-fertilizers-on-farmers-communities-and-global-food-security/

Agri Farming. (2019). Sugarcane Farming Project report, cost and profit. https://www.agrifarming.in/sugarcane-farming-project-report-cost-and-profit

Aisyah, P. (2023). *High demand for Thai sugar may result in shortages despite increased production.* Tridge. https://www.tridge.com/stories/high-demand-for-thai-sugar-may-result-in-shortages-despite-increased-production#:~:text=Previously%20in%202021%2C%20Thai%20sugar,21%25%20higher%20than%20in%202021

Akamine, H. (2021). *CS Brazil: Record cane price weakens mill returns.* Czapp. https://www.czapp.com/analyst-insights/cs-brazil-record-cane-price-weakens-mill-returns-3/

Apisitniran, L. (2022). TSMC seeks higher prices for sugarcane. *Bangkok Post.* https://www.bangkokpost.com/business/2260323/tsmc-seeks-higher-prices-for-sugarcane

Associated British Foods. (n.d.). *Sugar.* ABF Corporate. https://www.abf.co.uk/our-businesses/sugar

Athipanyakul, T., Choonhawong, K., & Potchanasin, C. (2020). *The challenge for Thai sugarcane farmers.* FFTC Agricultural Policy Platform. https://ap.fftc.org.tw/article/1840

Bagshaw, A. (2022, June 14). *Sugar already provides loads of renewable energy to the grid, so why won't it do more?* ABC Rural News. https://www.abc.net.au/news/rural/2022-06-15/volatile-market-harming-sugar-industry-expansion-into-energy/101150166

Barros, S. (2021, February 25). *Implementation of RenovaBio – Brazil's national biofuels policy* (BR2021-0008). United States Department of Agriculture & Global Agricultural Information Network. https://usdabrazil.org.br/wp-content/uploads/2021/05/Implementation-of-RenovaBio-Brazils-National-Biofuels-Policy_Sao-Paulo-ATO_Brazil_02-25-2021.pdf

Bonsucro. (2018a). *Empowering smallholder sugarcane farmers in Thailand: Bonsucro impact stories.* https://bonsucro.com/snowball/empowering-smallholder-sugarcane-farmers-in-thailand/

Bonsucro. (2018b). *Outcome report 2019.* https://bonsucro.com/wp-content/uploads/2020/06/Bonsucro-Outcome-Report-2019.pdf

Bonsucro. (2019, March). *Bonsucro mass balance chain of custody standard including implementation guidance* (Version 5.1). https://um3.salesforce.com/sfc/p/#24000000ceWp/a/1o0000001pzN/_7N09pD_Fpgh0xbFcOlpfQfTYIMqF9Z1eiv6_6JLlJ8

Bonsucro. (2020a). *Creating value across the sugarcane supply chain.* https://bonsucro.com/wp-content/uploads/Market-uptake.pdf

Bonsucro. (2020b). *First time trade – sugarcane credits reward sustainability.* https://bonsucro.com/first-time-trade-sugarcane-credits-reward-sustainability/

Bonsucro. (2020c, November). *Payment for environmental services in the context of sugarcane production.* https://www.bonsucro.com/wp-content/uploads/2021/02/Payment-for-environmental-services-in-the-context-of-sugarcane-production.pdf

Bonsucro. (2021a). *Better interest rates for sustainable sugarcane farming in Brazil.* https://www.bonsucro.com/better-interest-rates-for-sustainable-sugarcane-farming-in-brazil/

Bonsucro. (2021b). *Mauritian government announces 50% refund sugarcane certification costs.* https://www.bonsucro.com/mauritian-government-announces-50-refund-sugarcane-certification-costs/

Bonsucro. (2021c, May 11). *Over 5,000 smallholder farmers certified in India.* https://bonsucro.com/over-5000-smallholder-farmers-certified-in-india/

Bonsucro. (2021d). *Sustainable sugar cane changing for good Bonsucro strategic plan 2021-2026.* http://www.bonsucro.com/wp-content/uploads/2021/05/Bonsucro-2021-26-Strategic-Plan-full.pdf

Bonsucro. (2022). *Outcome report.* https://bonsucro.com/wp-content/uploads/Bonsucro-outcome-Report-2021.pdf

Bonsucro. (2023). *Bonsucro Credit Trading Platform.* https://credits.bonsucro.com/

Canadian Sugar Institute. (2022). *Global sugar trade (WTO).* https://sugar.ca/international-trade/global-sugar-trade-wto

Ceres. (2017). *An investor brief on impacts that drive business risks: Sugarcane.* Engage the Chain. https://engagethechain.org/sites/default/files/commodity/Ceres_EngageTheChain_Sugarcane.pdf

Chiala, J., & Xavier, V. (2017, April 3). *India's sugarcane farmers: A cycle of debt and suicide.* Aljazeera. https://www.aljazeera.com/features/2017/4/3/indias-sugarcane-farmers-a-cycle-of-debt-and-suicide

Colchero, M., Rivera-Dommarco, J., Popkin, B., & Wen, S. (2017). *In Mexico, evidence of sustained consumer response two years after implementing a sugar-sweetened beverage tax.* Health Affairs. https://www.healthaffairs.org/doi/10.1377/hlthaff.2016.1231)

Common Market for Eastern and Southern Africa. (2019, May 3). *COMESA countries maintain high sugar production.* https://www.comesa.int/comesa-countries-maintain-high-sugar-production/#:~:text=During%20the%20conference%2C%20it%20was,production%20of%2010%2C078%2C61%20MT

Cross, L. (2022). *Why are fertilizer prices so high?* International Fertilizer Association. https://www.fertilizer.org/news/why-are-fertilizer-prices-so-high/#:~:text=Global%20fertilizer%20prices%20are%20market,fertilizer%20purchases%20in%20a%20year

Daniels J., & Daniels C. (1993). Sugarcane in prehistory. *Archaeology in Oceania, 28*(1), 1–7. https://doi.org/10.1002/j.1834-4453.1993.tb00309.x

Dardagan, C. (2018, JUNE 4). *Midlands conservation activist drives SUSFARMS at Bonsucro.* Shukela South Africa. https://shukela.co.za/2018/06/04/midlands-conservation-activist-drives-susfarms-at-bonsucro/

De Albuquerque, A., & Hobbs, A. (2016). *Challenges and opportunities for efficient land use in Mozambique: Taxes, financing, and infrastructure.* Climate Policy Initiative. https://newclimateeconomy.report/workingpapers/wp-content/uploads/sites/5/2016/11/Challenges-and-Opportunities-for-Efficient-Land-Use-in-Mozambique.pdf

Deloitte (2021, April). *Final report: Business case study of Bonsucro certification in India.* http://www.bonsucro.com/wp-content/uploads/2021/09/Final-Report_Business-Case-Study-of-Bonsucro-Certification-in-India_6-Apr-1.pdf

Dotaniya, M. L., Datta, S. C., Biswas, D. R., Dotaniya, C. K., Meena, B. L., Rajendiran, S., Reger, K. L., & Lata, M. (2016). Use of sugarcane industrial by-products for improving sugarcane productivity and soil health. *International Journal of Recycling of Organic Waste Agriculture, 5,* 185–194 (2016). https://doi.org/10.1007/s40093-016-0132-8

DW. (2021). *Ghana turns sugarcane waste into fertilizer.* https://www.dw.com/en/ghana-turns-sugarcane-farming-waste-into-organic-fertilizer/a-59730966

Eckstein, D., Künzel, V., & Schäfer, L. (2021). *Global climate risk index.* Germanwatch. https://www.germanwatch.org/en/cri

The Economic Times (2020, June 18). *Government mulls raising minimum selling price of sugar.* https://economictimes.indiatimes.com/news/economy/agriculture/government-mulls-raising-minimum-selling-price-of-sugar/articleshow/76447398.cms

Elder, S., Wilkings, A., Larrea, C., Elamin, N., & Fernandez de Cordoba, S. (2023). *Standards and poverty reduction.* International Institute for Sustainable Development. https://www.iisd.org/system/files/2021-12/ssi-initiatives-review-standards-poverty-reduction.pdf

EPA Monitoring. (2017, May 29). *Sustainability: Choosing between beet sugar and cane sugar.* https://epamonitoring.net/sustainability-choosing-between-beet-sugar-and-cane-sugar/

European Commission. (2023a). *Sugar market situation.* AGRI E4-Expert Group Common Market Organization on Arable Crops. https://agriculture.ec.europa.eu/system/files/2023-08/sugar-market-situation_en.pdf

European Commission. (2023b). *Sugar: Overview.* https://agriculture.ec.europa.eu/farming/crop-productions-and-plant-based-products/sugar_en

Fairtrade International. (2020). *Fairtrade Factsheet: Why there is no fairtrade minimum price for sugar.* https://files.fairtrade.net/Sugar-FMP-factsheet-2021.pdf

Fairtrade International. (2023a). *Fairtrade minimum price and Fairtrade premium table.* https://files.fairtrade.net/Fairtrade-Minimum-Price-and-Premium-Table-EN-PUBLIC.pdf

Fairtrade International. (2023b). *Sugar.* https://info.fairtrade.net/product/sugar

Fairtrade Foundation. (2013). *Fairtrade and sugar* (Commodity briefing). https://www.fairtrade.org.uk/wp-content/uploads/legacy/Fairtrade-and-Sugar-Briefing-Jan13.pdf

FAOSTAT. (2022a). *Crops and livestock products.* https://www.fao.org/faostat/en/#data/QCL

FAOSTAT. (2022b). *Food and agriculture data*. https://www.fao.org/faostat/en/#home

FAOSTAT. (2023). *Crops and livestock products.* https://www.fao.org/faostat/en/#data/QCL

Flack-Prain, S., Shi, L., Zhu, P., da Rocha, H. R., Cabral, O., Hu, S., & Williams, M. (2021). The impact of climate change and climate extremes on sugarcane production. *GCB Bioenergy, 13*(3), 408–424. https://doi.org/10.1111/gcbb.12797

Food and Agriculture Organization of the United Nations. (n.d.). *Impacts of trade linearization on the world sugar market.* http://www.fao.org/3/X0513E/x0513e06.htm

Food and Agriculture Organization of the United Nations, International Fund for Agricultural Development, UNICE, World Food Programme, & World Health Organization. (2022). *The state of food security and nutrition in the world: Repurposing food and agricultural policies to make healthy diets more affordable.* Food and Agriculture Organization of the United Nations. https://www.fao.org/newsroom/detail/un-report-global-hunger-SOFI-2022-FAO/en

Geoflorestas. (2020, July). *Ecosystem services: Initiatives report.* http://www.bonsucro.com/wp-content/uploads/2020/11/Phase-1_Mapping-PES-initiatives.pdf

Global Environment Facility & United Nations Development Programme. (2019). *Project implementation review: Mainstreaming biodiversity for local development.* https://pims.undp.org/attachments/4719/213515/1729592/1744799/2019-GEF-PIR-PIMS4719-GEFID5058.docx

Government of India. (2023). *General policy: Sugarcane Pricing Policy.* Department of Food & Public Distribution. Ministry of Consumer Affairs, Food & Public Distribution. https://dfpd.gov.in/gen_policy.htm#:~:text=Accordingly%2C%20FRP%20for%202022%2D23,the%20recovery%20rate%20till%209.5%25

Gro Intelligence (2021). *Brazilian drought adds to sugar woes.* https://gro-intelligence.com/insights/articles/brazilian-drought-adds-to-sugar-woes

Haddad, L. (2022). The Ukraine crisis shows how fragile our food systems are. *Time.* https://time.com/6186174/global-food-system-diversify/

Hebebrand, C. & Laborde, Debucquet, D. (2022a). *High fertilizer prices contribute to global food security concerns.* International Food Policy Research Institute. https://www.ifpri.org/publication/high-fertilizer-prices-contribute-rising-global-food-security-concerns

Hebebrand, C., & Laborde, D. (2022b). *Short-term policy considerations to respond to Russia-Ukraine crisis disruptions in fertilizer availability and affordability.* International Food Policy Research Institute. https://www.ifpri.org/blog/short-term-policy-considerations-respond-russia-ukraine-crisis-disruptions-fertilizer

Illovo Sugar Africa. (2023). *Sustainable agriculture.* https://www.illovosugarafrica.com/sustainability

International Energy Agency. (2022). *Africa energy outlook 2022:World Energy Outlook Special Report.* https://iea.blob.core.windows.net/assets/27f568cc-1f9e-4c5b-9b09-b18a55fc850b/AfricaEnergyOutlook2022.pdf

International Exchange. (2023). *Sugar No. 11 Futures.* https://www.theice.com/products/23/Sugar-No-11-Futures

International Sugar Organization. (2023). *About sugar.* https://www.isosugar.org/sugarsector/sugar

International Sustainability and Carbon Certification. (2022). *Impact report 2022.* https://www.iscc-system.org/wp-content/uploads/2022/07/ISCC-Impact-Report-2022.pdf

Izquierdo A. (2019). *¿Quiénes son los más conscientes del consumo responsable en Colombia?* (in Spanish). P&M. https://revistapym.com.co/consumidor/consumo-responsable-en-colombia/

Husain, A. (2022). *The Ukraine war is deepening global food insecurity — What can be done?* United States Institute of Peace. https://www.usip.org/publications/2022/05/ukraine-war-deepening-global-food-insecurity-what-can-be-done

Jadhav, R., & Bhardwaj. M. (2022). *India restricts sugar exports at 10 million tonnes.* Reuters. https://www.reuters.com/markets/us/india-restricts-sugar-exports-first-time-6-years-government-order-2022-05-24/

Jagtap, S., Trollman, H., Trollman, F., Garcia-Garcia, G., Parra-López, C., Duong, L., Martindale, W., Munekata, P. E. S., Lorenzo, J. M., Hdaifeh, A., Hassoun, A., Salonitis, K., & Afy-Shararah, M. (2022). The Russia-Ukraine conflict: Its implications for the global food supply chains. *Foods, 11*(14), Article 2098. https://www.mdpi.com/2304-8158/11/14/2098

Jain, S. (2022). *Lessons from a 74-year-old farmer who switched to organic sugarcane farming.* Mongabay. https://india.mongabay.com/2022/03/photos-lessons-from-a-74-year-old-farmer-who-switched-to-organic-sugarcane-farming/

Jenkins, B., Baptista, P., & Porth, M. (2015). *Collaborating for change in sugar production: Building blocks for sustainability at scale*. The CSR Initiative at the Harvard Kennedy School and Business Fights Poverty. https://www.hks.harvard.edu/sites/default/files/csri-bfp-building-blocks-for-sustainable-sugar.pdf

Kalumbia, L. (2022). Sugarcane business a money spot for farmers. *The Citizen.* https://www.thecitizen.co.tz/tanzania/news/business/sugarcane-business-a-money-spot-for-farmers-4009546

Kellogg's (n.d.). *Responsible sourcing.* https://betterdays.kelloggcompany.com/responsible-sourcing

Kellogg's. (2019). *Responsible sourcing milestones.* https://filecache.mediaroom.com/mr5mr_kelloggs_esg/181213/Kellogg2019ResponsibleSourcingMilestones_8.21.20.pdf

Kellogg's. (2021). *Responsibly sourcing our ingredients*. https://crreport.kelloggcompany.com/responsible-sourcing-ingredients

Kindred, J. (2023). *Ask the analyst:Why are Thai farmers burning more sugar cane this year?* Czapp. https://www.czapp.com/analyst-insights/ask-the-analyst-why-are-thai-farmers-burning-more-sugar-cane-this-year/

Lamba, M. (2022). *Feature: Russia-Ukraine war swells spot sugar prices across the EU+UK.* S&P Global. https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/agriculture/041922-feature-russia-ukraine-war-swells-spot-sugar-prices-across-the-euuk

Ley de Desarrollo Sustentable de la Cana de Azucar (2005). Mexican United States. https://www.diputados.gob.mx/LeyesBiblio/pdf/LDSCA.pdf

Linnenluecke, M. K., Zhou, C., Smith, T., Thompson, N., & Nucifora, N. (2020). The impact of climate change on the Australian sugarcane industry. *Journal of Cleaner Production, 246,* Article 118974. https://doi.org/10.1016/j.jclepro.2019.118974

Li, R. (2023). *When will China's refiners buy raw sugar in 2023?* Czapp. https://www.czapp.com/analyst-insights/when-will-chinas-refiners-buy-raw-sugar-in-2023/#:~:text=The%20government%20issues%20a%20sugar,referred%20to%20as%20%E2%80%9CAILs%E2%80%9D

Makgopa, M., & Woody, K. (2022). *Sugar semi-annual report: Republic of South Africa* (SF2022-0030). United States Department of Agriculture & Global Agricultural Information Network. https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Sugar%20Semi-annual_Pretoria_South%20Africa%20-%20Republic%20of_SF2022-0030.pdf

Manivong, P., & Bourgois, E. (2017). *White Paper: Thai sugarcane sector & sustainability.* https://www.bonsucro.com/wp-content/uploads/2017/08/Thai-White-Paper-FINAL-LowRes.docx.pdf

Marin, F. R., Jones, J. W., Singels, A., Royce, F., Assad, E. D., Pellegrino, G. Q., & Justino, F. (2013). Climate change impacts on sugarcane attainable yield in southern Brazil. *Climatic Change, 117,* 227–39. https://doi.org/10.1007/s10584-012-0561-y

McConnell, M., Dohlman, E., Haley, S., & Waves, A. (2010, November 29). *Sugar price volatility intensified by market, policy factors.* FarmProgress. https://www.farmprogress.com/sugar-price-volatility-intensified-market-policy-factors

Meier, C., Sampson, G., Larrea, C., Schlatter, B., Bermudez, S., & Dang, D., & Willer, H. (Eds.). (2021). *The state of sustainable markets 2021: Statistics and emerging trends.* International Trade Centre, International Institute for Sustainable Development, & Research Institute of Organic Agriculture. https://intracen.org/fr/media/11643

Mera, C., Magdovitz, M., & Rawlings, A. (2021, November). *Outlook 2022: Hell in the handbasket* (Agri Commodity Markets Research). RaboResearch. https://research.rabobank.com/far/en/documents/842941_Rabobank_ACMR-Outlook-2022.pdf

Meriot, A. (2015). *Thailand's sugar policy: Government drives production and export expansion.* Sugar Expertise. https://sugaralliance.org/wp-content/uploads/2021/02/Meriot-Thai-Subsidy-062015.pdf

Millard, P. (2022, June 17). *Petrobras raises fuel prices in political setback for Bolsonaro.* BNN Bloomberg. https://www.bnnbloomberg.ca/petrobras-raises-fuel-prices-in-political-setback-for-bolsonaro-1.1780297

Ministério de Minas e Energia. (2021). *RenovaBio.* https://www.gov.br/mme/pt-br/assuntos/secretarias/petroleo-gas-natural-e-biocombustiveis/renovabio-1/renovabio-ingles/renovabio-ingles

Morris, E., Angel, A., & Hernandez, N. (2017). *The impact of falling sugar prices on growth and rural livelihoods.* Inter-American Development Bank. https://publications.iadb.org/publications/english/document/The-Impact-of-Falling-Sugar-Prices-on-Growth-and-Rural-Livelihoods.pdf

Mpapalika, J. (2019, October 18). *The regulation of sugar market price in developing countries.* SSRN. https://ssrn.com/abstract=3471629 or http://dx.doi.org/10.2139/ssrn.3471629

The Nation. (2022). *Mitr Phol urges government to hike sugar price as costs soar.* https://www.nationthailand.com/business/40016447

Nestlé. (2019). *Nestlé responsible sourcing key performace indicators (KPIs) 2019.* https://www.nestle.com/sites/default/files/2020-03/creating-shared-value-responsible-sourcing-kpis-2019.pdf

Nestlé. (2020). *Creating shared value and sustainability report 2020: Appendix.* https://www.nestle.com/sites/default/files/2021-03/creating-shared-value-appendix-2020.pdf

Nestlé. (2021a). *Our approach to sustainably produced raw materials.* https://www.nestle.com/sustainability/sustainable-sourcing/farming-communities-ecosystems

Nestlé. (2021b). *Sugar sourcing.* https://www.nestle.com/sustainability/sustainable-sourcing/sugar

Nogueira, S. (2023b). *Sugar annual report: Brazil.* United States Department of Agriculture & Global Agricultural Information Network. https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Sugar%20Annual_Sao%20Paulo%20ATO_Brazil_BR2023-0009.pdf

Nti, F. K. (2022). *Impacts and repercussions of price increases on the global fertilizer market.* United States Department of Agriculture. https://www.fas.usda.gov/data/impacts-and-repercussions-price-increases-global-fertilizer-market

Organisation for Economic Co-operation and Development. (2020). *COVID-19 and the food and agriculture sector: Issues and policy responses.* https://www.oecd.org/coronavirus/policy-responses/covid-19-and-the-food-and-agriculture-sector-issues-and-policy-responses-a23f764b/

Organisation for Economic Co-operation and Development. (2022). *The price of war* [Editorial]. https://www.oecd-ilibrary.org/sites/62d0ca31-en/index.html?itemId=/content/publication/62d0ca31-en

Organisation for Economic Co-operation and Development & Food and Agriculture Organization of the United Nations. (2021). *OECD–FAO agricultural outlook 2021–2030: Sugar.* https://www.oecd-ilibrary.org/sites/969526b0-en/index.html?itemId=/content/component/969526b0-en

Organisation for Economic Co-Operation and Development & Food and Agriculture Organization of the United Nations. (2022). *OECD-FAO agricultural outlook 2022-2031.* OECD Publishing. https://doi.org/10.1787/f1b0b29c-en

PepsiCo. (2021.). *2020 Sustainability report.* https://www.pepsico.com/docs/default-source/sustainability-and-esg-topics/2020-sustainability-report.pdf?sfvrsn=bf192307_5

PIB Delhi. (2022). *In another farmer's friendly step, government approves fair and remunerative price of sugarcane payable by sugar mills to sugarcane farmers for sugar season 2022-23.* https://pib.gov.in/PressReleasePage.aspx?PRID=1847997

Piñeiro, V., Arias, J., Dürr, J., Elverdin, P., Ibáñez, A. M., Kinengyere, A., Opazo, C. M., Owoo, N., Page, J. R., Prager, S. D., & Torero, M. (2020). A scoping review on incentives for adoption of sustainable agricultural practices and their outcomes. *Nature Sustainability, 3*(10), 809–820. https://doi.org/10.1038/s41893-020-00617-y

Pipitpukdee, S., Attavanich, W., & Bejranonda, S. (2020). Climate change impacts on sugar cane production in Thailand. *Atmosphere, 11*(15), 408. https://doi.org/10.3390/atmos11040408

Prasertsri, P. (2023). *Sugar annual report: Thailand.* United States Department of Agriculture & Global Agricultural Information Network. https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Sugar%20Annual_Bangkok_Thailand_TH2023-0024.pdf

ProTerra Foundation. (2020). *Sustainable sugarcane.* https://www.proterrafoundation.org/wp-content/uploads/2022/02/PROTERRA-SUGARCANE.pdf

Pryor, S.W., Smithers, J., & Lyne, P. (2016). Impact of agricultural practices on energy use and greenhouse gas emissions for South African sugarcane production. *Journal of Cleaner Production, 141,* 137–145. https://doi.org/10.1016/j.jclepro.2016.09.069

Rajesh, D. (2021). *Crushing burden: Small-scale sugar cane farmers bear the costs of Thailand's bio economy drive.* SEI. https://www.sei.org/featured/crushing-burden-small-scale-sugar-cane-farmers-bear-the-costs-of-thailands-bioeconomy-drive/

Resource Trade. Earth. (2022). *Trade data for raw sugar, cane, 2019- 2020.* Chatham House. https://resourcetrade.earth/

Sahai, S. (2022). *Not as sweet as it seems: The real costs of sugarcane farming.* Vital Strategies. https://www.vitalstrategies.org/not-sweet-seems-real-costs-sugarcane-farming/

Salassi, M. (2007). *The economic feasibility of ethanol production from sugar crops.* https://www.lsuagcenter.com/portals/communications/publications/agmag/archive/2007/winter/the-economic-feasibility-of-ethanol-production-from-sugar-crops

Samora, R. (2022). *Brazil's GMO sugarcane area to nearly double this year, company says.* Reuters. https://www.reuters.com/world/americas/exclusive-brazils-gmo-sugarcane-area-nearly-double-this-year-company-says-2022-04-06/

Sattayathamrongthian, M., & Vanpetch, Y. (2020). The sugar cane farming obstacle of the farmer in Samchuk District, Supahnburi Province Thailand. In *International Scientific Conference on Innovations in Digital Economy* (pp. 351–355). https://conferaces.com/index.php/journal/article/view/206

ScienceDaily. (2019, September 17). *Ethanol fuels large-scale expansion of Brazil's farming land.* https://www.sciencedaily.com/releases/2019/09/190917100453.htm

Schnepf, R. (2021). *EU agricultural domestic support: Overview and comparison with the United States.* https://crsreports.congress.gov/product/pdf/R/R46811

Selvakumar, R., & Viswanathan, R. (2019). Sugarcane rust: Changing disease dynamics and its management. *Journal of Sugarcane Research, 9*(2), 97. http://dx.doi.org/10.37580/JSR.2019.2.9.97-118

Seixas, R., Viart, N., Woodruff, J., & Earley, K. (2019, March). *Bonsucro outcome report 2018* (Version 1.0). https://www.bonsucro.com/wp-content/uploads/2019/04/Download-Bonsucro-Outcome-Report-201819.pdf

Seng To, L., Seebaluck, V., & Leach, M. (2018). Future energy transitions for bagasse cogeneration: Lessons from multi-level and policy innovations in Mauritius. *Energy Research & Social Science, 35,* 68–77. https://doi.org/10.1016/j.erss.2017.10.051

Seufert, V. (2019). Comparing yields: Organic versus conventional agriculture. In P. Ferranti, E. M. Berry, & J. R. Anderson (Eds.), *Encyclopedia of food security and sustainability,* vol. 3 (pp. 196–208). http://www.sciencedirect.com/science/article/pii/B9780081005965220271

Simar, H. (2018). *Vertical integration under external shocks: A theoretical approach* [Masters thesis, Université catholique de Louvain]. http://hdl.handle.net/2078.1/thesis:15747

South African Sugar Association. (2022). *The sugar industry at a glance*. https://sasa.org.za/the-sugar-industry-at-a-glance/

Spencer, R. (2020). *The Sugar Series: Sugar cane production – Growing, harvesting, processing and refinement.* https://www.czarnikow.com/blog/the-sugar-series-sugar-cane-production-growing-harvesting-processing-and-refinement#:~:text=banner%26utm_campaign%3Dlead_magnet_sugar%E2%80%9D%5D-,Total%20recoverable%20sugar%20(TRS),the%20quality%20of%20the%20cane.

Statista. (2023). *Sugar imports to the United States: from 2011/2012 to 2023/2024 (in million metric tons)*. https://www.statista.com/statistics/249666/us-sugar-imports/

Sussman, N. (2021, December 29). *Brazil shows you can harvest sugar cane without polluting the air: What Florida's sugar farmers can learn about burning cane*. WGCU PBS & NPR for Southwest Florida. https://news.wgcu.org/2021-12-29/brazil-shows-you-can-harvest-sugar-cane-without-polluting-the-air-what-floridas-sugar-farmers-can-learn-from-brazil-about-burning-cane

Swire Coca-Cola. (n.d.). *Sustainability.* https://www.swirecocacola.com/en/Sustainability.html

Teixeira, F., Nagaraj, A., & Harrisberg, K. (2022, April 1). As Ukraine war hikes prices, Global South farmers struggle to find fertilizer. *National Post.* https://nationalpost.com/pmn/environment-pmn/as-ukraine-war-hikes-prices-global-south-farmers-struggle-to-find-fertilizer

The Coca Cola Company. (2020). *2020 business & environmental, social and governance report.* https://www.coca-colacompany.com/content/dam/journey/us/en/reports/coca-cola-business-environmental-social-governance-report-2020.pdf#page=42

Theparat, C. (June 10, 2020). Cabinet approves subsidy rates for sugar cane farmers. *Bangkok Post.* https://www.bangkokpost.com/business/1932036/cabinet-approves-subsidy-rates-for-sugar-cane-farmers

Thibane, Z., Soni, S., Phali, L., & Mdoda, L. (2023). Factors impacting sugar cane production by small-scale farmers in KwaZulu-Natal Province-South Africa. *Heliyon, 9*(10) e13061. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9879781/

True Price. (2017). *Sugar: Tony's Chocolonely.* https://trueprice.org/consumer/sugar-tonys/

UN Comtrade (2022). *Database: International trade statistics.* https://comtrade.un.org/data/

UNICA. (n.d.). *Sustainable energy and food from Brazil to the world: Sugar.* https://unica.com.br/en/sugarcane-sector/sugar/

Unilever. (2022). *Annual report and accounts 2022 highlights.* https://www.unilever.com/investors/annual-report-and-accounts/

United Nations Conference on Trade and Development. (2022). *The impact on trade and development of the war in Ukraine.* https://unctad.org/system/files/official-document/osginf2022d1_en.pdf

United Nations Environmental Program (n.d.). *A feasibility study for the utilization of solar energy for sugarcane irrigation pumping to reduce GHG emissions from the use of carbon rich imported electricity for emerging commercial small cane growers in the Eswatini.* UN Climate Technology Centre & Network. https://www.ctc-n.org/technical-assistance/projects/feasibility-study-utilization-solar-energy-sugarcane-irrigation

United States Department of Agriculture. (n.d.). *Sugar sweeteners.* Economic Research Service. https://www.ers.usda.gov/topics/crops/sugar-sweeteners/policy.aspx#sugar

United States Department of Agriculture Foreign Agricultural Services. (2023). *Sugar: World markets and trade.* https://apps.fas.usda.gov/psdonline/circulars/sugar.pdf

Ustinova, E. (2022, March). *Brazil agriculture seeks remedies for potential fertilizer disruptions.* United States Department of Agriculture Foreign Agricultural Service & Global Agricultural Information Network. https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Brazil%20Agriculture%20Seeks%20Remedies%20for%20Potential%20Fertilizer%20Disruptions_Brasilia_Brazil_BR2022-0017

World Trade Organization. (2022). *Ministerial Declaration on the emergency response to food insecurity* (WT/MIN(22)/28; WT/L/1139). https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=q:/WT/MIN22/28.pdf&Open=True

Viart, N., Seixas, R., Foggitt, L., Chang, C. W., & Dorney, J. (2021, December). *Outcome report 2020* (Version 1.0). Bonsucro. https://bonsucro.com/wp-content/uploads/2021/12/Outcome-Report-2020.pdf

Vietnam Plus. (2021, May 12). *Thailand approves 192-mln-USD subsidy to reduce burning of sugarcane fields.* https://en.vietnamplus.vn/thailand-approves-192mlnusd-subsidy-to-reduce-burning-of-sugarcane-fields/201378.vnp

Voora, V., Bermúdez, S., & Larrea, C. (2020). *Global market report: Sugar.* International Institute for Sustainable Development (Sustainable Commodities Marketplace Series). https://www.iisd.org/system/files/publications/ssi-global-market-report-sugar.pdf

Voora, V., Larrea, C., Huppe, G., & Nugnes, F. (2022). *Standards and investments in sustainable agriculture.* International Institute for Sustainable Development. https://www.iisd.org/system/files/2022-04/ssi-initiatives-review-standards-investments-agriculture.pdf

VS Engineering. (2016, January 9). *Sweetening biofuel sector: The history of sugarcane ethanol in Brazil.* https://www.vsengenharia.com.br/en/blog/sweetening-biofuel-sector-the-history-of-sugarcane-ethanol-in-brazil

Wood, B., Williams, O., Nagarajan, V., & Sacks, G. (2021) Market strategies used by processed food manufacturers to increase and consolidate their power: A systematic review and document analysis. *Global Health, 17,* Article 17. https://doi.org/10.1186/s12992-021-00667-7

World Cancer Research Fund International. (n.d.). *Curbing global sugar consumption.* https://www.wcrf.org/policy/our-publications/curbing-global-sugar-consumption/

World Health Organization. (2022, December 13). *WHO calls on countries to tax sugar-sweetened beverages to save lives.* https://www.who.int/news/item/13-12-2022-who-calls-on-countries-to-tax-sugar-sweetened-beverages-to-save-lives

WWF Brazil. (2014, August 20). *Certification of sugarcane production increases productivity and income.* https://www.wwf.org.br/?40932/Certification-of-sugarcane-production-increases-productivity-and-income

Zancaner, A. (2022, December 14). *Sugar cost of production across the world.* https://www.czapp.com/analyst-insights/sugar-cost-of-production-across-the-world/

Zhao, D. (2021). *Potential impact of climate change on sugarcane production and mitigation strategies.* Agricultural Research Service, United States Department of Agriculture. https://www.ars.usda.gov/research/publications/publication/?seqNo115=384179

Vivek Voora, Cristina Larrea, and Erika Luna prepared the “Market Overview” section; Steffany Bermúdez, Han Le, and Cristina Larrea prepared the section “A Dive into Sugar Cane Prices.”

Peer reviewers: Judith Ganes and Boudewijn Goossens

Acknowledgements

We would like to acknowledge the contributions of Alix Albright, Jennah Landgraf, and Audrey Wagner in conducting research on sustainable consumption preferences in developing countries and collecting sustainable-sourcing information from cane sugar-consuming companies.

The Sustainable Commodities Marketplace Series provides a market performance overview and outlook for key agricultural commodities that comply with a number of voluntary sustainability standards (VSSs), focusing on global sustainable consumption and production. Each year, the series focuses on a different overarching theme, with individual reports for that year devoted to providing a market update for a chosen commodity. These reports are designed to be accessible and relevant for a range of audiences, including supply chain decision makers, procurement officers, policy-makers, and producers. The series builds on *The State of Sustainable Markets 2021*, a joint publication from IISD, the International Trade Center (ITC), and the Research Institute of Organic Agriculture (FiBL), which examines over a dozen sustainability standards for various commodities.

The *Global Market Report* analyzes trends in sugar cane production, consumption, trade flows, and other relevant areas. It uses 2019 data for sugar cane production that is VSS-compliant, given that this was the most current data available when we conducted the analysis. The report also examines prices and margins in the sugar cane sector, looking at how VSSs contribute to increasing farm prices. It also provides recommendations to VSSs and other actors to increase the price and income that farmers obtain for sugar cane and build sustainable and resilient sugar cane systems.

IISD's State of Sustainability Initiatives advances sustainable and inclusive value chains by providing credible and solutions-oriented research, dialogue, and strategic advice for decision-makers about voluntary sustainability standards and other supportive initiatives.

Published by the International Institute for Sustainable Development.

Head Office

111 Lombard Avenue, Suite 325
Winnipeg, Manitoba
Canada R3B 0T4

Tel: +1 (204) 958-7700
Website: www.iisd.org
Twitter: @IISD_news

In collaboration with ITC and Fibl

International Trade Centre

FiBL

With the support of the Swedish government

Sweden Sverige

IISD

iisd.org