International Labour Organization

VISION ZERO FUND

Assessment of drivers and constraints to occupational safety and health improvement in the SUGAR CANE supply chain in Colombia

RESEARCH REPORT

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Acronyms

ANDI National Business Association of Colombia

ARL Administrative Entity for Labour Risks

ASOCAÑA Association of Sugarcane Growers in Colombia

BASC Business Alliance for Secure Commerce

BONSUCRO Global sugarcane sustainability platform

CCS Colombian Security Council

CENICAÑA Colombian Sugarcane Research Center

CIAMSA Commercial International Society of Sugars and Molasses S.A. Colombia

CIAT Tropical Agriculture Research Center

CGT General Confederation of Labour

GSC Global Supply Chains

CTC Confederation of Colombian Workers

CUT Unitary Central of Colombian Workers

DIAN National Tax and Customs Directorate

DNP National Planning Department

EPS Health Promotion Entity

FASECOLDA Federation of Colombian Insurers

FENALCO National Federation of Merchants

FEPA Sugar Price Stabilization Fund

GDP Gross Domestic Product

ICA Colombian Institute of Agriculture

ICBF Colombian Institute of Family Welfare

ILO International Labour Organization

INVIMA National Institute for Food and Drug Surveillance

IPS Health Service Provider Institutions

ITC International Trade Centre

PROCAÑA Colombian Association of Producers and Suppliers of Sugar Cane

SENA National Learning Service

TECNICAÑA Colombian Association of Sugarcane Technicians

Foreword

The International Labour Organization (ILO) promotes safe and healthy working environments as a fundamental right at work, which is essential for social justice.

Through Vision Zero Fund, the ILO works to prevent occupational deaths, accidents, and illnesses in supply chains. The Fund was Initiated by the G7, and is part of the ILO's flagship programme, Safety + Health for All.

In Colombia, the sugar cane sector is emblematic due to its contribution to the national economy and its social impact, presenting challenges in protecting labour rights and ensuring the well-being of its workers. Its supply chain spans from land preparation to the production and export of various products, significantly impacting the national GDP and providing employment to thousands in rural regions.

This study, titled "Drivers and Constraints for Occupational Safety and Health improvement in the Sugar Cane Supply Chain in Colombia," provides a detailed analysis of the factors influencing the implementation of effective prevention and protection measures in this sector.

Conducted by the ILO Vision Zero Fund with co-funding from the European Union, the study highlights the need for comprehensive occupational safety and health management that includes improving production processes and commits to the well-being of workers.

By adopting a collective action approach[1] involving government, employers, and workers, the study demonstrates that it is possible to overcome current limitations and move towards a more inclusive, responsible, and sustainable development model for Colombia's sugar industry.

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1 A multi-stakeholder approach that involves governments, workers and trade unions, employers and their organisations, multilateral organisations, civil society and development agencies, working together so that each meets its responsibilities consistent with organizational roles, to implement an agreed plan or set of actions to reduce severe or fatal work accidents, injuries or diseases in global supply chains.

Acknowledgments

This publication was possible thanks to the ILO`s Vision Zero Fund initiative to improve occupational safety and health (OSH) in supply chains, with co-funding from the European Union.

The document reflects the results of the collection and analysis of information from secondary sources in Colombia related to the sugar cane supply chain. It also shows the results of the analysis of the perceptions of different key actors in the sugar cane supply chain, such as the government, employers and workers.

Special thanks are extended to Ítalo Cardona, ILO director for the Andean countries, and Teresa Torres, ILO labour law and labour administration specialist, for their support in the process. This document was written by Schneider Guataqui Cervera, national project coordinator and ILO focal point for the Andean countries, and Yuber Liliana Rodríguez Rojas and Juan Carlos Munevar Pérez, ILO external consultants. With the review and inputs from Maria Munaretto, Senior Programme and Operations Officer, Vision Zero Fund, ILO, and Ana Catalina Ramirez, Occupational Safety and Health and the Working Environment Branch (OSHE), ILO and Ockert Dupper, Global Project Manager, Vision Zero Fund, ILO.

Executive summary

The sugar cane supply chain in Colombia is an integrated system encompassing several key stages. It begins with preparing land to cultivate sugar cane, followed by harvesting and transporting the sugar cane to sugar mills, where its juice is extracted and processed. Technological advancements and research developments have significantly expanded the range of products derived from sugar cane, which now include various types of sugar, syrups, industrial and potable alcohol, fuel alcohol, electrical energy, food preparations, and organic fertilizers. Additionally, every part of the sugar cane is utilized: the leaves and bagasse (the fibrous residue left after the extraction of juice from sugar cane) serve as animal feed, while the fibre is used in paper manufacturing.

In 2023, Colombia exported sugar to over 60 countries, with the top 13 destinations being the United States of America, Chile, Ecuador, Haiti, Peru, Jamaica, Belgium, Germany, Spain, Italy, Trinidad and Tobago, France, and Canada. Between 2022 and 2023, exports to key European Union (EU) countries—Belgium, Germany, Spain, Italy, and France—totalled 135,916 tonnes, representing 11 per cent of total exports. While most of the sugar production was allocated for domestic consumption, exports to the European Union and the United States increased, supported by trade agreements. Colombia's sugar cane industry continues to be a cornerstone of the local and national economy, driving sustainable development and generating employment opportunities in rural areas.

Colombia produced 5.9 million tonnes of bagasse in 2023, primarily utilized for paper production and the generation of electrical, thermal, and mechanical energy. The country also produced 1.96 million tonnes of sugar and 328 million litres of bioethanol, supporting the government's petrol oxygenation programme[2]. Additionally, the industry generated 1,800 GWh of cogenerated electricity and 180,000 tonnes of honey. Sugar production from sugar cane plays a vital role in Colombia's development, contributing 2.4 per cent to agricultural GDP, 2.0 per cent to industrial GDP, and 0.6 per cent to the country's total national GDP.

Colombia is home to 15 sugar cane processing plants: 8 dedicated exclusively to sugar production, 6 producing both sugar and ethanol, and 1 focused solely on ethanol production. The year-round harvesting process sustains employment for 286,692 people, indirectly benefiting an estimated 1.2 million individuals in surrounding communities. This structure underscores the vital role of the sugar industry in advancing Colombia's economic and social development.

Workers in the sugar cane industry face a variety of occupational hazards at every stage of production, emphasizing the critical need for comprehensive occupational safety measures. These risks include **mechanical and biomechanical hazards**, such as injuries and musculoskeletal disorders caused by tasks like land preparation, manual planting, and cutting sugar cane. **Biological and safety risks**, such as drowning, may arise during the maintenance of river pumping stations, especially when cleaning water suction devices. Chemical hazards, including intoxication or dermatitis, can occur during weed control and when applying ripening agents. Furthermore, workers are exposed to both **physical and chemical risks** during the production of sugar and ethanol.

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2 Law 693 of 2001 creates the general framework for the gasoline oxygenation programme with fuel alcohol (ethanol). As of the entry into force of this law, gasoline used in the country in urban centers with more than 500,000 inhabitants will have to contain oxygenated components such as fuel alcohols, in the quantity and quality established by the Ministry of Mines and Energy, in accordance with the regulations on control of emissions derived from the use of these fuels and the environmental sanitation requirements established by the Ministry of the Environment for each region of the country.

Other potential risks in the sugar cane industry include falls on the same level, which are common due to tasks performed on uneven terrain, slippery surfaces, or during sugar production processes. The most critical risk factors are associated with maintenance activities, where high-risk tasks are often carried out. These tasks include working at heights, in confined spaces, performing hot work that involves the use of open flames, heat, or sparks, lifting heavy loads, and exposure to electrical hazards. Each of these activities requires stringent safety protocols to minimize the risk of accidents and ensure worker protection.

Between 2009 and 2022, data on the sugar manufacturing and refining sector, collected from workers affiliated with the General System of Occupational Risks, revealed significant trends. The number of affiliated companies decreased from 38 in 2009 to 33 in 2022, while the number of individual affiliates grew substantially, rising from 2,929 to 17,182 during the same period. In 2022, Occupational accidents showed a modest decline, from 1,578 cases in 2009 to 1,488 cases. Additionally, 904 cases of occupational illnesses were reported over this period, underscoring the ongoing need to enhance workplace health and safety measures.

This study identified nine aspects that drive improvements in occupational safety and health (OSH) in the sugar cane supply chain:

1. Stakeholders in the sugar cane supply chain **perceive OSH as a moral and ethical responsibility**, which positively impacts their overall **corporate responsibility and reputation** by working to reduce accidents through prevention and control measures.

2. Buyers **demands, certifications, and sustainability labels** play a crucial role in improving OSH conditions by ensuring that products come from supply chains that meet labour standards.

3. The sector's robust **institutional framework** enables various entities to support the development of OSH strategies and promote good practices within the sugar cane industry.

4. The participation of trade union organizations in OSH matters, through **collective bargaining** and their participation in dialogue platforms such as OSH joint committees, strengthens the sector's commitment to improving workplace safety and health.

5. The **existence of productivity indicators is key for ensuring efficiency and competitiveness.** These include both traditional metrics, such as the volume of sugar cane cut and processed daily, and OSH indicators.

6. Initiatives like **skills certification and access to specialized educational programmes** represent a comprehensive and collaborative approach to enhancing individual and professional capacities in the sugar cane supply chain.

7. Targeted **training for labour inspectors** from the Ministry of Labour is critical to ensure compliance with OSH regulations, identify hazards and effectively implement corrective actions.

8. Epidemiological **surveillance systems** are in place to monitor health risks in the sugar sector, thereby enhancing worker protection and boosting productivity.

9. The **adoption of advanced technology** in the sector has facilitated automation and mechanization of processes, reducing operational risks in sugar cane production and improving worker safety.

Five constraints affecting the improvement of OSH in the sugar cane supply chain were also identified:

1. **Insufficient knowledge of OSH legislation**, coupled with regulations that fail to account for sector-specific characteristics, undermines worker protection and impedes the implementation of effective preventive measures.
2. **Rising temperatures and extreme weather events** disrupt operations and intensify safety and health risks for workers.
3. **Civil insecurity** in regions such as Cauca and Valle del Cauca, along with inadequate road infrastructure, heightens safety risks at work and hampers the effective enforcement of OSH control measures.
4. **High turnover among young workers** and evolving job expectations poses significant challenges to job security, requiring ongoing adjustments to human resources policies.
5. **The lack of specialized OSH training in the agricultural sector** limits the ability to effectively address its unique challenges, highlighting the urgent need for tailored and accessible educational programmes.

The sugar cane supply chain in Colombia plays a critical role in both the economic and social development of the country. Despite the existence of numerous incentives aimed at strengthening OSH, several limitations still hinder the effectiveness of preventive measures. Addressing these challenges comprehensively is essential for creating safer, healthier, and more sustainable work environments, which will not only protect the well-being of workers but also support the continued growth of the agribusiness sector.

In this context, six intervention models were established to enhance OSH outcomes in the sugar cane chain in Colombia, as follows:

1. **Generating knowledge on OSH conditions within the sugar cane supply chain**, with a focus on specific topics, such as the impacts of climate change on workers.
2. **Strengthening the capacities of ILO constituents** and other stakeholders in the sugar cane supply chain to effectively address OSH challenges.
3. **Enhancing institutional capacities** of relevant stakeholders through tailored educational and training programmes that address the specific hazards of the sugar cane sector.
4. **Promoting a preventative occupational safety and health culture** in the sugar cane sector.
5. **Adapting OSH legislation** to better suit the rural sector, informed by a comprehensive regulatory analysis; and
6. **Facilitating the exchange of knowledge, experiences, and tools** to improve OSH between national and regional tripartite dialogue bodies, global sectoral platforms and multi-stakeholder initiatives.

Introduction

The sugar cane supply chain employs millions of workers globally, producing a wide range of products such as sugar, honey, alcoholic beverages (industrial and fuel), electrical energy, food preparations, and organic fertilizers, among other products.

This report, entitled "Drivers and constraints to occupational safety and health improvement in the sugar cane supply chain in Colombia," offers a comprehensive analysis of the factors impacting the occupational safety and health (OSH) workers in this vital sector in Colombia.

As of 2022, Colombia ranked 15th among the world's sugar producers. Sugar and its derivatives are significant for both domestic consumption and export, contributing to 2.4 per cent of agricultural gross domestic product (GDP), 2.0 per cent of industrial GDP and 0.6 per cent of the total national GDP. In addition to generating thousands of direct and indirect jobs, the sugar cane sector plays a key role in the development of numerous rural communities, particularly in the departments of Valle del Cauca and Cauca (ASOCAÑA 2024).

This report is divided into three sections. The first section provides an overview of the sugar cane supply chain, covering market and product aspects, chain structure, commercialization, the institutional framework, and OSH regulations, among other considerations. It also identifies priority OSH issues within the sector in Colombia. The second section examines the drivers and constraints to improving OSH, offering a comprehensive analysis of the current conditions. Finally, the third section highlights intervention models aimed at enhancing policies and practices to improve occupational safety and health in the sugar cane supply chain.

Methodology

This report is based on the ILO methodology "Occupational safety and health in global value chains: Assessing incentives and constraints to improve occupational safety and health in global value chains and formulating interventions"[3] (ILO, 2018). Data collection involved a literature review (academic studies, sectoral publications, existing regulations and technical reports from the sector) that took place from November 2023 to April 2024. Additionally, tripartite focus groups discussions were held between May and June 2024, enabling key stakeholders, including representatives from government, employers' and workers' organizations, to share their first-hand insights and experiences.

3 https://vzf.ilo.org/wp-content/uploads/2021/04/La-seguridad-y-salud-en-el-trabajo-en-las-cadenas-mundiales-de-valor-Kit-de-inicio.pdf


Manuelita

1. The sugar cane supply chain

1.1. Market and product

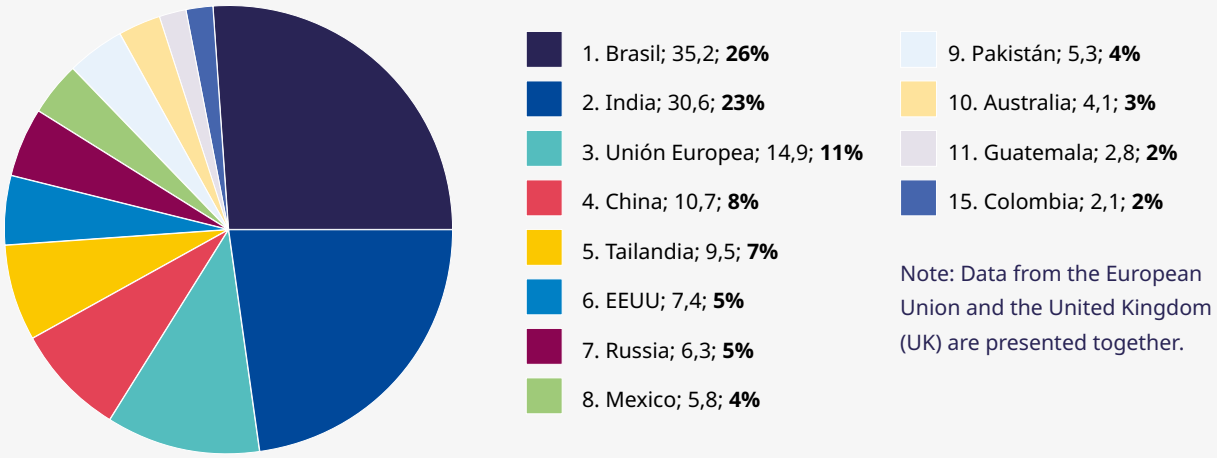
1.1.1 Market

Today, more than 100 countries around the world produce sugar cane. Sugar cane accounts for almost 80 per cent of the world's sugar production, with consumption increasing at a rate of approximately 1 per cent per year.[4] The international market is highly concentrated in a few players. On average, during the period 2018-2022, the five main sugar-producing countries (Brazil, India, EU+UK, Thailand and China) accounted for 60.3 per cent of global supply. In terms of exports, just three countries accounted for 61.7 per cent of external sales.

Over the past decade, global sugar production has experienced stable growth.[5] However, since 2020, this stability has contributed to rising sugar prices. Climatic conditions in key producing countries, such as India and Thailand, combined with increased post-pandemic demand for sugar, have significantly influenced the overall supply (ASOCAÑA, 2024).

In this context, Colombia holds a notable position in the international sugar market, ranking 15th in production and 9th in exports (ASOCAÑA, 2024).

Figure 1: Distribution of world sugar production 2019-2021



Source: own elaboration, based on information from (Campos, 2023).

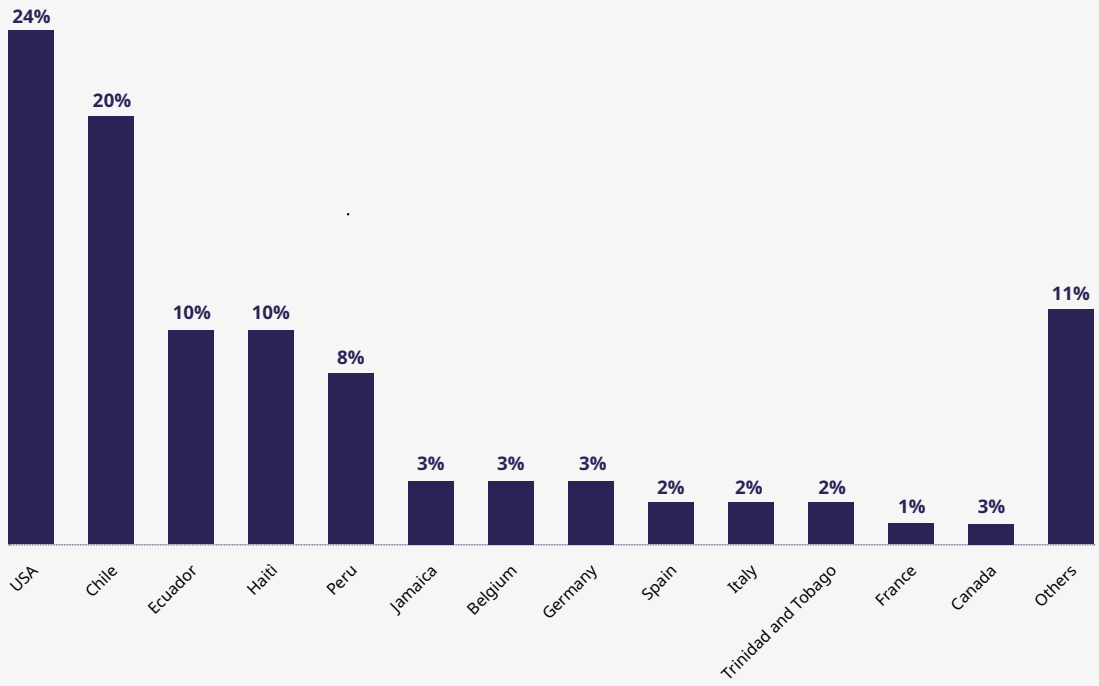
4 https://www.isosugar.org/sugarsector/sugar

5 In 2021, global sugar production reached 135 million metric tonnes (MMMT). During that period, Brazil stood out with a record production of 35.2 MMMT. In 2022, global consumption was 176 318 million tonnes, 7 045 million tonnes more than the previous year, an increase of 4.2 per cent.

Colombia's sugar cane agro-industry stands out internationally for its high productivity, leading the ranking of agro-industrial productivity, which is measured by the world's main sugar producing countries as the number of tonnes of sugar extracted from one hectare of harvested sugar cane.

In 2022, Colombia's overall national production of sugar reached approximately 2.1 million tonnes, with an average of 605,000 tonnes of sugar exported between 2021-2023. Stronger international sugar prices drove a 16.4 per cent increase in the value of these exports from 2022 to 2023, generating US$431 million in foreign exchange for the country. This positioned sugar cane as Colombia's fifth-largest agricultural export, following coffee, flowers, bananas, and palm oil. In 2023, Colombia exported sugar to over 60 countries, with the top 13 main destinations being the United States, Chile, Ecuador, Haiti, Peru, Jamaica, Belgium, Germany, Spain, Italy, Trinidad and Tobago, France and Canada (ASOCAÑA, 2024).

Figure 2: Main export destinations for Colombian sugar in 2022 and 2023



Source: Own elaboration based on data from ASOCAÑA annual report 2023 - 2024.

In 2022 and 2023, EU countries, mainly Belgium, Germany, Spain, Italy and France, represented 11 per cent or 135,916 tonnes of Colombia's total sugar exports.[6] The trade agreement with the EU has been instrumental in driving this growth, particularly as the EU is a major importer of Colombian organic sugar. This has spurred an increase in both the production and export of organic sugar. The agreement includes a tariff-free quota of 62,000 tonnes, with an annual growth rate of 3 per cent (Martínez and

6 Commonly, sugar in any of its presentations and according to customer requirements, is packaged and distributed in bags of 25 kilos, 50 kilos (also known as a quintal) or 1 tonne. Most countries, except for Chile, receive the product in 50 kg bags.

Tremolada, 2012), further enhancing opportunities for Colombian sugar to access the European market.

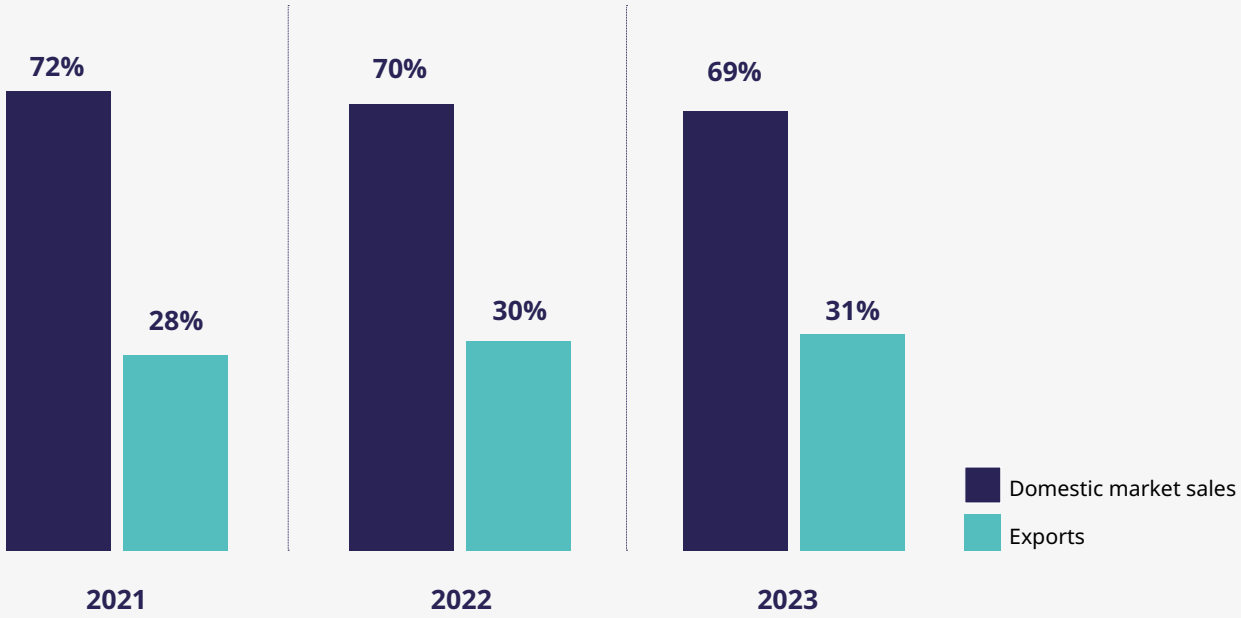
The Trade Agreement between Colombia and the EU highlights the importance of upholding labour principles and rights. Under "Title IX - Trade and sustainable development", the agreement reinforces commitments within the framework of the International Labour Organization (ILO), including the promotion of labour rights, dialogue, and cooperation, thereby strengthening the link between trade and labour policies.

As one of the EU's key suppliers of agricultural and agro-industrial products, Colombia must ensure sustainable supply chains to maintain access to the European market. These supply chains need to comply with the regulations of the **EU Green Pact**, a programme designed to establish sustainability-based trade standards. Key requirements include ensuring traceability and verifying the origin of products to prevent agricultural practices that harm the environment or violate human rights (ASOCAÑA, 2024).

Exports under the **American Quota**—the quantity of sugar the US government permits for import—performed strongly. Between 2021 and 2022, sugar exports to the United States grew by 7.4 per cent annually.[7] This market is influenced by both the quota system and by the trade agreement between Colombia and the US (FEPA, 2022).

Despite a 7.1 per cent decline in domestic sales in 2023 compared to the same period in 2022, domestic sales of sugar still account for the largest share.

Figure 3: Domestic sales vs exports



Source: adapted from ASOCAÑA annual sustainability report 2023 - 2024.

7 In 2022, 1,292,678 quintals of sugar were exported. In 2021, 1,203,826 quintals. One quintal of sugar corresponds to 50 kilograms.

1.1.2 Product

Sugar cane (Saccharum officinarum) was brought to Colombia in Cali, with Sebastián de Belalcázar credited for its introduction. During colonial times, the production of **panela** (a type of unrefined whole cane sugar), sugar, and honey was carried out using artisanal methods. These traditional practices persisted until the early 20th century, when the Manuelita sugar mill inaugurated a steam-powered plant in Palmira.

By 1930, only three sugar mills operated in Valle del Cauca: Manuelita, Providencia, and Riopaila. From that point onward, the sugar cane agro-industry experienced significant growth in the region, eventually reaching 22 mills (ASOCAÑA, 2017a).

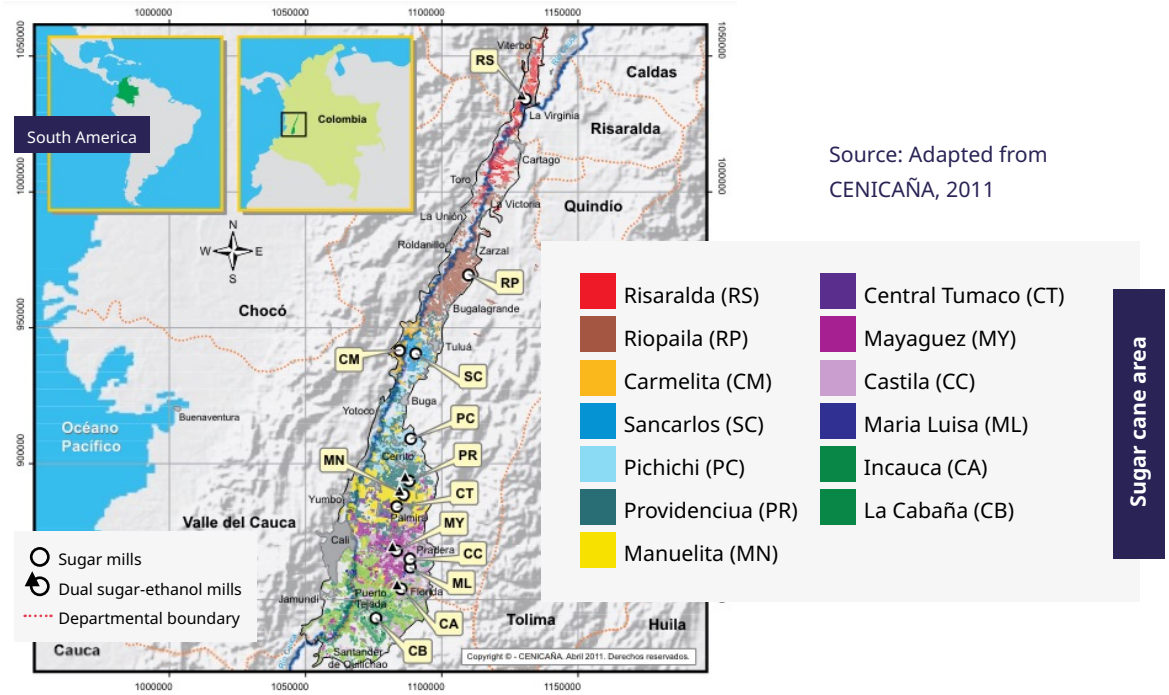
Currently, Valle del Cauca is home to 15 sugar cane processing plants. Among these, 8 are dedicated exclusively to sugar production, 6 produce both sugar and ethanol, and 1 focuses solely on ethanol production (ASOCAÑA, 2023).

Technological advancements and ongoing research have significantly expanded the range of products derived from sugar cane. These innovations enable sugar mills to produce various types of sugar, honeys, industrial alcohol, potable alcohol, fuel ethanol, electrical energy, food preparations, organic fertilizers, and more.

Sugar cane is fully utilized, with its leaves and bagasse (the fibrous residue left after the extraction of juice from sugar cane) repurposed as animal feed for cattle and pigs. Additionally, the honeys and sugars are key ingredients in the production of confectionery, sweets, and beverages, while sugar cane fibre is widely used in paper manufacturing.

The spatial distribution of sugar cane cultivation in the Cauca River valley is closely linked to the areas influenced by the region's sugar mills, as shown below (CENICAÑA, 2011).

Illustration 1: Spatial distribution of sugar cane cultivation in the Cauca River valley



Source: Adapted from CENICAÑA, 2011

By 2023, the sugar cane industry produced 5.9 million tonnes of bagasse, utilized for the production of paper, electrical energy, thermal energy, and mechanical energy. Additionally, 1.96 million tonnes of sugar and 328 million tonnes of bioethanol were produced for the government's petrol oxygenation programme. The sector also generated 1,800 GWh of cogenerated electricity and 180,000 tonnes of honey.

However, climate change has had an impact in the sector's output. The prolonged La Niña phenomenon, which lasted until the first half of 2023, prevented the sugar cane agro-industry from operating at full capacity, affecting both production and sales. Soil saturation from intense rainfall made it difficult to access the fields and perform essential agricultural tasks during the 2021-2022 period and the first quarter of 2023. As a result, key activities such as land preparation, sowing, fertilization, and crop harvesting were significantly disrupted, severely impacting sugar cane production.

Existing varieties of sugar according to industrial process

Raw sugar: crystallized product obtained by boiling sugar cane juice, composed of loose sucrose crystals covered by a film of their original mother honey.

White sugar: crystallized product created by boiling sugar cane juice, composed of loose sucrose crystals obtained by appropriate industrial processes and used to obtain refined sugar.

Refined sugar: crystallized product primarily composed of loose sucrose crystals derived from the dilution of raw or white sugar. Pulverized sugar is also a product of this process.

Organic sugar: sugar produced from sugar cane using organic production standards and organic fertilizers. Weed control is performed manually, and practices to protect the soil and environment are used (USAID, 2010).

Ethanol: Also known as ethyl alcohol, ethanol is an alcohol that occurs as a colourless, flammable liquid with a boiling point of 78°C. It is the main product of alcoholic beverages. When blended with gasoline, ethanol is known as denatured anhydrous fuel ethanol (fuel alcohol) and has a minimum ethanol concentration of 96.3 per cent and a maximum of 2 per cent gasoline. At this concentration, it leaves the distilleries and is then added or blended by distributors with standard gasoline, the two common blends being E10 and E85 in a proportion containing 10 per cent and 85 per cent ethanol, respectively. The use of fuel ethanol blended with gasoline can significantly reduce petroleum use, greenhouse gas emissions and improve air quality in metropolitan areas (resolution 789, 2016).

1.2. Supply chain structure

1.2.1 Process to produce sugar and its derivatives from sugar cane

The sugar cane supply chain in Colombia operates as an integrated system with interconnected stages. It begins with farmers **preparing and adapting the land** for sugar cane planting and cultivation. During this initial phase, the irrigation system is carefully planned based on soil characteristics, water availability, and the specific sugar cane variety to be cultivated.

Once the land is prepared—an activity that can take place at any time of the year—the **sugar cane seeds are sown**. This process, performed either manually or mechanically, follows the crop renewal plan, typically scheduled every four to eight years. Before sowing, carefully selected sugar cane stalks are cut into pieces for planting. After sowing, the initial watering is carried out using one of several irrigation methods, including sprinkling, gravity, drip, or pivot systems.

Next, pre-emergence **irrigation** is conducted, followed by weed control. Weed management involves applying herbicides, which can be done manually using a backpack sprayer, mechanically with sprinkler equipment mounted onto tractors, or aerially using ultra-light aircraft or drones.

After weed control, **fertilization** provides the nutrients essential for plant growth. Weed management continues throughout the growth cycle, accompanied by irrigation as needed, based on the water balance. Irrigation is sourced from nearby water bodies or groundwater, delivered through canals or pipes, and applied using methods such as gravity irrigation in alternate furrows or sprinkling.

Before harvesting or cutting the sugar cane, irrigation is suspended, and a ripening agent[8] is applied aerially with ultra-light aircraft or drones.

Harvesting, which can be performed either manually or mechanically, begins with the cutting of sugar cane. In manual harvesting, workers use a sharp-edged tool called a machete to cut the sugar cane. This process places a significant physical strain on the cutters, exposing them to high dynamic loads caused by repetitive movements of the upper limbs and stress on the lumbar spine.

In Colombia, the sugar cane harvest is not seasonal. The year-round activity ensures continuous operations and provides steady employment opportunities.

Mechanical harvesting uses specialized machinery known as *cosechadoras*, to cut the sugar cane stalks into pieces and load them onto dump wagons towed by tractors.

8 Ripener: an organic compound which, when applied in small quantities, inhibits, or modifies physiological processes in the plant. In sugar cane, it acts as a growth regulator and favours sucrose concentration, as indicated by Villegas and Arcila (n.d.).

The harvested sugar cane is then **transported** to sugar mills using tractor-trailers, where it serves as raw material for producing various products, including sugar, alcohol, energy, and by-products such as bagasse, the fibrous residue of the sugar cane.

The process begins with the **extraction of sugar cane juice**, during which foreign matter and impurities are separated. The removed impurities, known as *cachaza*, are organic by-products that are repurposed as fertilizer. Meanwhile, the bagasse, is utilized as fuel in boilers or as raw material for paper production.

Once the juice is purified, it is heated, and through evaporation, water is removed to concentrate the sugars and produce syrup (juice concentrate). The syrup is then crystallized, forming a cooked mass that contains both sugar crystals and molasses, known as "A" or virgin honey. This honey undergoes a centrifugation process, separating the molasses from the sugar crystals to produce raw sugar. If the syrup is clarified, the result is white sugar. To produce refined sugar, the white sugar is dissolved in water, and the syrup undergoes further clarification, evaporation, and crystallization. This additional processing yields refined sugar.

The process for producing **organic sugar** follows the same extraction steps as with conventional sugar. However, to ensure that no chemicals are used, all equipment is thoroughly cleaned, and natural practices are utilized during clarification.

Following extraction, the sugars undergo a **drying process** to remove excess moisture, and the final product is then ready for packaging. Throughout these operations, various forms of hazardous energy—such as electrical, mechanical, pneumatic, hydraulic, and thermal—are employed, creating additional occupational health and safety risks for workers.

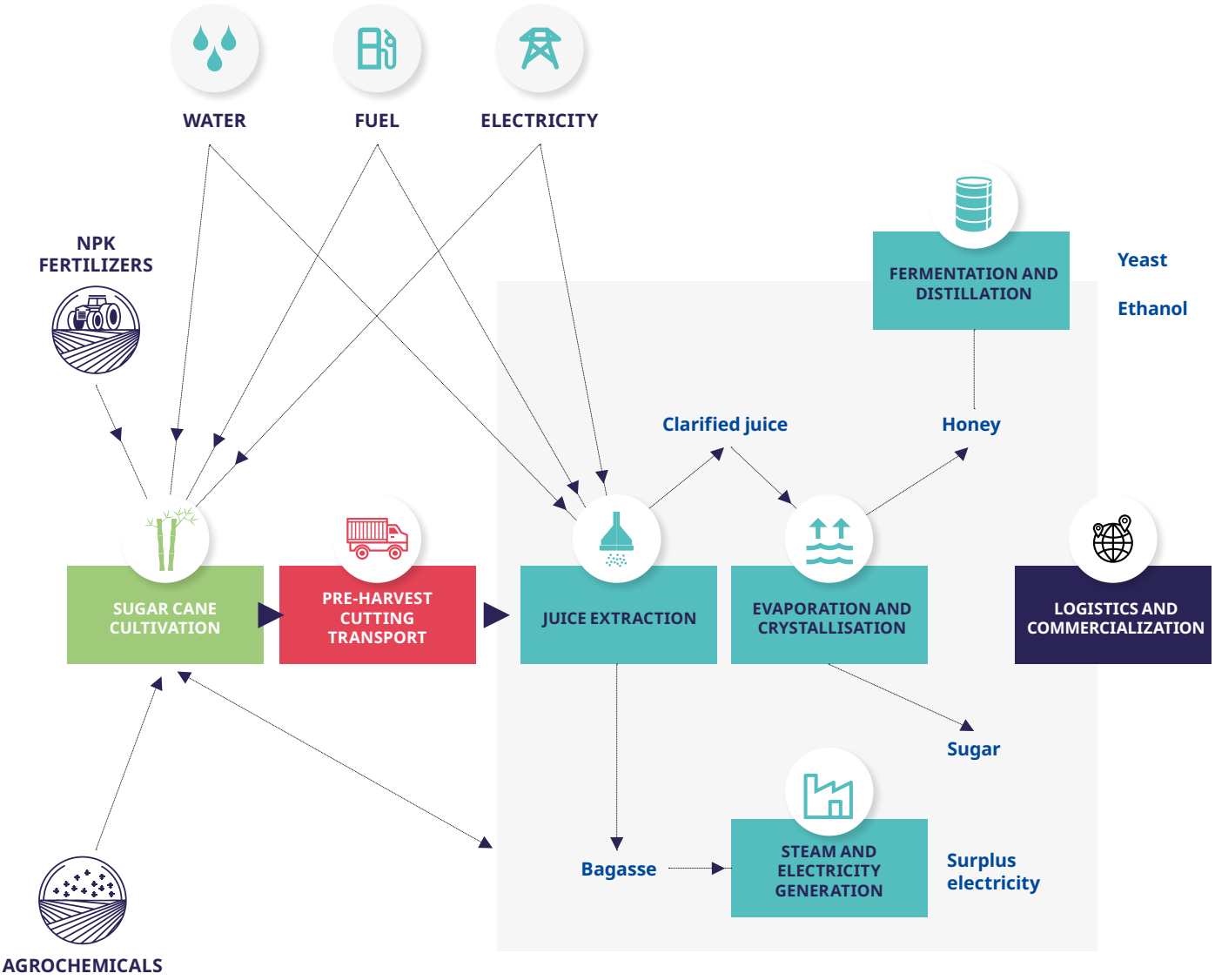
Once **packaged**, the sugar is stored in distribution centres or finished product warehouses, from where it is dispatched and distributed to customers.

The **alcohol production** process begins with the fermentation of honey B, a by-product from the sugar mill. With the help of yeast, the sugars in the honey are transformed into alcohol. The alcohol is then separated from the fermented wine using distillation columns, reaching a concentration of 96.5 per cent. It is further processed through molecular sieves, where it is dehydrated to a concentration of 99.5 per cent (resolution 789, 2016). These facilities present significant risks, including the potential for explosions and fires due to the flammable nature of alcohol, as well as the danger of contact burns from corrosive substances.

In addition to alcohol production, the mills generate **electricity** which is sold to generators and electricity traders.

Based on information gathered through focus groups, the stages of the sugar cane production process are as follows:

Illustration 2: Stages of production



Source: own elaboration.
*NPK: nitrogen, phosphorus and potassium.

1.2.2 Actors involved in the supply chain

The sugar cane supply chain involves a diverse range of actors, starting with the farmers responsible for cultivating the crops, followed by the workers in the mills who process the sugar cane. It also includes distributors who oversee the transportation of the product, ultimately reaching the national and international consumers who purchase the final goods.

Ilustration 3: Sugar cane supply chain diagram

Sugar cane value chain	Cultivation and harvesting of sugar cane***.	Processing and production of products	Commercial
Product	Sugar cane in bush*, cane in share** and own cane***	Raw, brown, white, refined and organic sugar, fuel alcohol or ethanol, electrical energy	Raw Sugar, Organic Sugar, Refined Sugar, Ethanol, Electric Power
Job size	156 715 jobs are related to agricultural processes	129 977 jobs are related to industrial processes	-
Operations	Land adaptation and preparation, cane planting, irrigation, fertilization, weed control, pre-harvest and ripening, cane cutting (manual or mechanical), cane transport to the mill, equipment maintenance	Cane preparation and juice extraction, juice clarification, evaporation, crystallization, centrifugation, refining, drying, packaging, equipment maintenance	Finished product, warehousing, distribution and logistics, marketing
Supply of inputs	Mineral and organic fertilizers, herbicides, biological control and ripening agents	Flocculants, california, bleaching agents, sulphur, phosphoric acid, surfactants, caustic soda, sulphuric acid	
Provision of services	Seed cutting, seed transport, irrigation application, application irrigation, cane cutting, cane transport, machinery rental, weed control	Specialized maintenance, high pressure hydro washing, cleaning, disinfection and cleaning, physical security	Storage and transport of finished product

Source: Own elaboration based on data from CENICAÑA, ASOCAÑA, PROCAÑA and analysis of focus group discussions.

*Cane in bush: when the owner of the crop carries out agricultural work and the mill buys the sugar cane from the owner. ** Cane in participation: the owner of the land, through a contract, hands over the management of the crop to the sugar mill. *** Own cane: sugar cane produced in crops owned by mills.

1.2.3 Producer stratification

In the geographical valley of the Cauca River, 6 departments[9] and 51 municipalities manage a total of 193,003 hectares dedicated to sugar cane production, reflecting a 5.6 per cent increase in area compared to 2022. Within this valley, 75 per cent of the sugar cane land is owned by 4,500 suppliers or growers, while the remaining 25 per cent is controlled by 13 sugar mills (ASOCAÑA, 2024).

The sugar cane agro-industry generates more than 286,000 direct and indirect jobs. Of these, 156,715 jobs are linked to agricultural processes, while 129,977 are associated with industrial processes. These jobs benefit approximately 1.2 million people (Quimbaya, 2022). Sex-disaggregated data is not available for the information presented in Table 1.

Table 1 Presence of sugar cane crops

Sector	Direct	Indirect	Total
Agricultural	91 646	65 069	156 715
Industrial	24 386	105 591	129 977
Total	**116 032**	**170 660**	**286 692**

A study[10] found that sugar cane-growing municipalities in Colombia exhibit unemployment rates lower than both the national average and those of municipalities dominated by other crops (ASOCAÑA, 2024). These municipalities ranked fourth in terms of employment rate, surpassed only by those where the main crops are potatoes, pineapple and avocado.

Municipalities where the main crops are potatoes, avocado, pineapple and sugar cane had the lowest percentages of youth neither studying nor working (ASOCAÑA, 2024).

Data obtained from focus groups[11] provides insights into the work performed by gender. It is estimated that **98 per cent of agricultural workers** (in manual labour and machinery operation) a**re men, while 2 per cent are women**; in industrial, manufacturing or transformation work, men make up 96 per cent of the workforce, with women comprising 4 per cent. **Women are more prominently represented in administrative roles**, accounting for 37 per cent, and in management positions, where they make up 26 per cent.

9 Valle del Cauca, Cauca, Risaralda, Caldas, Quindío and Meta.

10 DANE's National Population and Housing Census. Capital cities were excluded from the analysis, as they have different dynamics from the rest of the country.

11 The focus group discussions were held in the city of Cali. Participants included representatives of ASOCAÑA, PROCAÑA, sugar mills, the trade unions CUT, CTC and CGT, the government (Ministry of Labour, Health Secretariats) and other key stakeholders such as ARLs, the Colombian Safety Council and academia.

Additionally, data collected from the focus groups indicated that the year-round nature of sugar cane production, unlike seasonal operations in other regions, supports the stable hiring and retention of workers, along with the provision of corresponding social benefits.[12]

1.2.3.1. Distribution of sugar cane producers by size

Of the land planted with sugar cane, 65.3 per cent consists of plots equal to or smaller than 40 hectares (ha). The owners of these crops supply the sugar cane to the mills in two ways. In the first, known as *cane in bush*, the supplier manages and performs the agricultural work, selling the sugar cane to the mill once it has reached maturity. In the second, called *cane in bush* ("*caña en participación*" in Spanish), the landowner leases the land to the mill, which takes full responsibility for managing and developing the sugar cane crop.

Table 2 Percentage share of cane producers by size

Producer size	Farms	Participation (in %)	Accumulated (in %)
Less than 10 ha	736	21.9	21.9
Between 11 and 20 ha	394	11.7	33.6
Between 21 and 40 ha	630	18.7	52.3
Between 41 and 60 ha	437	13	65.3
Between 61 and 100 ha	465	13.8	79.2
Between 101 and 200 ha	437	13	92.2
Between 201 and 400 ha	193	5.7	97.9
Between 401 and 600 ha	51	1.5	99.4
Between 601 and 1000 ha	15	0.4	99.9
More than 1000 ha	4	0.1	100.0
Total	**3 362**	**100**	

Source: (Ministry of Agriculture and Rural Development, 2020).

12 Affiliation to the General System of Occupational Risks includes benefits such as a) Medical, surgical, therapeutic, and pharmaceutical assistance; b) Hospitalization services; c) Dental services; d) Supply of medicines; e) Auxiliary services for diagnosis and treatment, among other services. Financial benefits which include a) temporary disability allowance; b) compensation for partial permanent disability; c) disability pension; d) survivors' pension; and e) funeral allowance.

1.2.3.2 Installed capacity of the mills

The mills have an installed milling capacity of 87,000 tonnes of sugar cane per day, operating year-round, and fuel alcohol production capacity of 2.2 million litres per day, as detailed in the table below:

Table 3 Installed milling capacity of the mills

Mill	Installed milling capacity (lt/day)	Fuel alcohol production capacity (lt/day)
Riopaila Castilla	17 600	400 000
Incauca	17 000	350 000
Manuelita	11 500	250 000
Providence	10 000	300 000
Mayagüez	10 000	300 000
La Cabaña	5 200	0
Risaralda	5 000	100 000
Pichichí	4 400	0
Carmelite	2 500	0
San Carlos	2 000	0
Maria Luisa	800	0
West	1000[13]	0
Bioenergy	0	500 000
Total	**87 000**	**2 200 000**

Sources: Adapted from Ministry of Agriculture and Rural Development (2020) and Fedebiocombustibles (2020).

13 https://www.elpais.com.co/informacion-comercial/ingenio-del-occidente-una-empresa-con-sentido-social.html

1.2.4 Institutional framework

1.2.4.1 Government

In Colombia, several entities are responsible for promoting and enforcing safety and health conditions in the sugar cane sector:

- **The Ministry of Labour:** This entity is tasked with formulating and implementing policies, general plans, programmes, and projects aimed at promoting employment, ensuring respect for workers' fundamental rights and providing guarantees for their well-being. It is also committed to fostering understanding and social dialogue to support healthy labour relations (Decree No. 4108, 2011).
- **The Occupational Risks Fund:** This special national trust fund is attached to the Ministry of Labour, with its resources managed through a trust and without its own legal personality. Its responsibilities include conducting studies, campaigns, and educational initiatives, as well as implementing preventive measures and investigating occupational accidents and diseases across Colombia.
- **The Ministry of Health and Social Protection:** Within its mandate, this ministry formulates, adopts, directs, coordinates, executes, and evaluates public policies related to health, public health and social promotion. It also contributes to policy development on pensions, periodic economic benefits, and occupational risks (Decree No. 4107, 2011).

Another key institution in Colombia´s health sector is the **National Institute of Health**, which plays a vital role in public health. Its responsibilities include overseeing the collection, analysis and distribution of epidemiological data, as well as conducting scientific health research.

The **Ministry of Agriculture and Rural Development** is responsible for promoting rural development through a territorial approach. It aims to enhance productivity and competitiveness of agricultural products by implementing comprehensive actions to improve rural living conditions, promote the sustainable use of natural resources, create employment opportunities, and foster equitable and sustained growth across various regions (Decree No. 2369, 2015).

Lastly, the Colombian **Ministry of Finance** holds several critical functions for the country's economic management. These include preparing the national budget, managing public debt and overseeing public finances.

1.2.4.2 Employers' organizations

The **National Business Association of Colombia (ANDI)** seeks to promote and disseminate the political, economic and social principles of a healthy and free enterprise system. ANDI covers various sectors, including industry, agribusiness, food, trade and finance, among others. ASOCAÑA is an affiliated member of ANDI (ANDI, 2023).

The **Association of Sugarcane Growers in Colombia (ASOCAÑA)** is a trade association representing sugar mills and sugar cane growers[14] in their dealings with the government, private entities, communities, organizations, unions and international bodies. ASOCAÑA spearheads initiatives in sustainability, environmental protection, community welfare, development, and innovation.

The **Colombian Association of Producers and Suppliers of Sugar Cane (PROCAÑA)** represents both individual and legal entities involved in sugar cane cultivation. It advocates for sugar cane producers and suppliers with both public and private organizations.

In addition, the following entities are integral to the institutional framework of the Colombian sugar cane sector:

- **Commercial International Society of Sugars and Molasses S.A. Colombia (CIAMSA)** is responsible for managing the logistics of sugar and honey export and commercialization. Additionally, it plays a role in the production and distribution of fertilizers for Colombian agriculture.
- **Colombian Sugarcane Research Center (CENICAÑA)** focuses on researching and developing sugar cane varieties, as well as improving cultivation efficiency to optimize water resource usage and enhance weed control.
- **Colombian Association of Sugarcane Technicians (TECNICAÑA)** is dedicated to research and technological advancements in plant development and manufacturing processes in the sugar cane sector.

Finally, the **Autonomous Regional Corporations**, departmental entities under the Ministry of Environment and Sustainable Development, play a critical role in regulating environmental permits, land use and water consumption. Among the most influential in the sugar cane sector and its surrounding areas are the Autonomous Regional Corporation of the Valle del Cauca (Corporación Regional Autónoma del Valle del Cauca) and the Autonomous Corporation of the Cauca (Corporación Autónoma del Cauca).

1.2.4.3 Workers' organizations

Trade unions play a crucial role in promoting OSH through dialogue processes. In the sugar cane sector, workers who belong to trade union organizations are primarily grouped into three main confederations:

- CUT: Central Union of Workers
- CGT: General Confederation of Labour
- CTC: Confederation of Colombian Workers

14 ASOCAÑA's members include the following sugar mills: Carmelita, Incauca, La Cabaña, Manuelita, María Luisa, Mayagüez, Del Occidente, Pichichí, Risaralda, Providencia, Riopaila-Castilla and Sancarlos, as well as a significant number of sugar cane growers in the region.

Table 4 Industry and grassroots trade union organizations

Industry unions	Trade unions
• SINTRA AGROINCOL: The National Union of Colombian Agro-industrial Branches, affiliated to the Confederation of Colombian Workers. • SINTRAICAÑAZUCOL: The Sugarcane Industry Workers Union of Colombia, affiliated to the Central Union of Workers of Colombia. • SINTRAINAGRO: National Union of Workers of the agricultural industry, affiliated to the Central Unitaria de Trabajadores de Colombia. • SINTRACATORCE: National Union of Workers of the Sugar Industry - 14 of June, affiliated to the Central Union of Workers of Colombia. • SINTRACAÑAVALC	• SINTRACAUCA • SINTRAPICHICHI • SINTRAMAYAGUEZ • SINTRA SAN CARLOS • SINTRA RIO PAILA/CASTILLA • SINTRA CARMELITA • SINTRA RISARALDA • SINTRA CABAÑA • SINTRA PROVIDENCE

In the focus groups discussions, participants mentioned that trade unions play an active role in promoting OSH through various bodies, including Joint OSH Committees, Work-Labour Co-existence Committees and Regional or Local OSH Committees across different regions of the country.

It was highlighted that, through collective bargaining agreements, trade unions propose OSH improvements, including the provision of Personal Protective Equipment (PPE) and work tools, among other safety measures.

1.2.5 OSH Regulations

1.2.5.1 International level

Colombia has 49 ILO conventions in force. A detailed overview is provided in Table 5 below.

Table 5 List of OSH-relevant ILO conventions ratified in Colombia

Convention	Date	Status
C012 – Workmen's Compensation (Agriculture) Convention, 1921 (No. 12)	June 20 / 1933	In force
C017 – Workmen's Compensation Convention, 1925 (No. 17)	June 20 / 1933	In force
C018 - Occupational Diseases Convention, 1925 (No. 18)	June 20 / 1933	In force
C019 - Equality of Treatment (Employment Injuries) Convention, 1925 (No. 19)	June 20 / 1933	In force
C024 - Sickness Insurance (Industry) Convention, 1927 (No. 24)	June 20 / 1933	In force
C025 - Sickness Insurance (Agriculture) Convention, 1927 (No. 25)	June 20 / 1933	In force
C081 - Labour Inspection Convention, 1947 (No. 81) (excluding Part II N)	Nov. 13 / 1967	In force
C129 - Labour Inspection (Agriculture) Convention, 1969 (No. 129)	Nov. 16 / 1976	In force
C161 - Occupational Health Services Convention, 1985 (No. 161)	Jan 25 / 2001	In force
C167 - Safety and Health in Construction Convention, 1988 (No. 167)	Sep. 06 / 1994	In force
C169 - Indigenous and Tribal Peoples Convention, 1989 (No. 169)	Aug. 07 / 1991	In force
C170 - Chemicals Convention, 1990 (No. 170)	Sep. 6 / 1994	In force
C174 - Prevention of Major Industrial Accidents Convention, 1993 (No. 174)	Dec. 9 / 1997	In force

Source: own elaboration. Last update: February 2025.

In 2022, the International Labour Conference adopted a resolution recognizing the right to a safe and healthy working environment as a fundamental principle and right at work. This means that ILO member states, including Colombia, are obliged to respect, promote and implement this principle in good faith, regardless of whether they have ratified the relevant fundamental conventions (ILO, 2022). The **Occupational Safety and Health, 1981 (No. 155)** and ILO Convention on the **Promotional Framework for Occupational Safety and Health, 2006 (No. 187)** were both approved as fundamental conventions, but **Colombia has yet to ratify either of them.**

The Violence and Harassment Convention, 2019 (No. 190) and Violence and Harassment Recommendation, 2019 (No. 206) provide a legal framework for preventing, addressing, and eliminating violence and harassment in the world of work (ILO, n.d.). As of June 2024, the draft law ratifying the Convention was approved in first debate in the Second Committee of the Senate of the Republic of Colombia (Legis, 2024).

At the regional level, the **Andean Community (CAN) enacted Decision 584 in 2004, which established the Andean Instrument on Occupational Safety and Health for the Construction of Public Policies** (CAN, 2004). This instrument emphasizes that all workplaces must implement measures to reduce occupational risks, based on guidelines on OSH management systems and their environment.

In addition, the Andean Community created the **Regulation of the Andean Instrument for Safety and Health at Work** (resolution 957, 2005).

1.2.5.2 National level

Over the past decade, Colombia has seen a significant increase in its occupational risk regulations. One key piece of legislation is **Law No. 100 of 1993**, which established the comprehensive social security system and introduced several provisions. This law created the General Health System, the General Pension System, the General System of Occupational Risks and complementary services as components of the General Social Security System (Law No. 100, 1993).

Another important legislative development is **Decree Law No. 1295 of 1994**, which outlines the organization and administration of the General System of Occupational Risks (“Hoy laborales”) (Decree Law No. 1295, 1994). However, its scope and operations underwent significant changes with the enactment of **Law No. 1562 of 2012**.

This regulation introduced significant reforms to the General System of Occupational Risks, aiming to strengthen risk prevention and improve care for occupational accidents and diseases. It marked the shift from the concept of occupational health to occupational safety and health (Law No. 1562, 2012, Art. 1) and transformed occupational health programmes into **OSH Management Systems** (Law No. 1562, 2012).

Through **Decree No. 2923 of 2011** (now compiled in Decree No. 1072 of 2015) the Quality Assurance System of the General System of Occupational Risks was created. This system consists of four components: the Minimum Standards System, the Audit for the Improvement of the Quality of Occupational Health Care and Occupational Risks, the Accreditation System and the Quality Information System (Decree No. 1072, 2015).

Subsequently, **Decree No. 1443 of 2014** (currently referred to as **Decree No. 1072 from 2015**) established provisions for the implementation of the OSH management system. Another key document, **Decree No. 1072 of 2015**, also known as the Sole Regulatory Decree of the Labour Sector, consolidates and regulates various labour-related regulations.

Additionally, **resolution 0312 of 2019** was issued, establishing the minimum standards of the OSH management system. These standards consist of a set of mandatory rules, requirements and procedures for employers and contractors. They define the essential conditions of technical-administrative capacity, which must be verified and controlled, as well as the necessary financial and asset sufficiency for the operation, exercise and development of activities within the scope of the OSH management system (Resolution 0312, 2019).

This resolution applies to the entire Colombian agricultural sector, including sugar production and the sugar cane agro-industry. Specifically, article 7 of resolution 312 establishes minimum standards applicable to Agricultural Production Units with ten (10) or fewer permanent workers, classified as risk categories[15] I, II or II. These standards are:

- Identify the hazards in the production processes of the agricultural production unit, evaluate and assess the associated risks, and establish the necessary control measures within the OSH management system framework.
- Implement activities to prevent workplace accidents and occupational diseases.
- Ensure all individuals involved in production activities within the agricultural unit work in a safe and healthy manner.

In the same year, **resolution 3710 of 2019** was issued, restructuring the National Sectoral Commissions for Occupational Safety and Health. This resolution established the formation of the National Commission for Occupational Safety and Health in the Agricultural Sector. Its primary function is to coordinate and implement various programmes, actions, plans and activities aimed at preventing occupational hazards and promoting health in the agricultural sector (Resolution 3710, 2019).

Additionally, **resolution 3077 of 2022** established the National Plan for Safety and Health at Work 2022 - 2031. This plan aims to foster a culture of self-care, enhance occupational safety and health, prevent occupational accidents and diseases, and promote hazard identification and risk management by employers, contractors and independent workers (Resolution 3077, 2022).

This plan is structured around seven strategic lines of action, some of which are particularly relevant to the rural sector, as outlined below:

- Strategic line one aims to expand the coverage of the General System of Occupational Risks. To achieve this, the plan proposed various actions, including awareness campaigns highlighting the importance of system affiliation and the establishment of permanent working groups with organizations representing vulnerable worker groups.

15 Article 25 of Decree-Law No. 1295 of 1994 established five risk classes classifying companies according to their main activity. Category I, identified as minimum risk, assigns a contribution of 0.522 per cent, indicating the lowest risk exposure. Class II, categorized as low risk, has an assignment of 1.044 per cent, while Category III, associated with medium risk, has a quote of 2.436 per cent. As one moves up the scale, class IV, with high risk, shows a quote of 4.350 per cent, and class V, characterized by maximum risk, exhibits the highest quote, reaching 6.960 per cent.

- Strategic line four focuses on fostering a culture of self-care, promoting the safety and health of workers and preventing occupational hazards to enhance well-being and ensure a high quality of working life.
- Strategic line six aims to strengthen research, development and innovation in the prevention of occupational hazards.

1.2.6 Market trends and incentives

For the sugar cane sector, several certifications facilitate product access to international markets, including the following:

Table 6 Certifications applicable to the sector

Certification	Objective	Competitive advantages / market	Decent work and OSH-related elements	Other information
Fairtrade	To improve social and economic conditions, fair trade, and responsible agricultural practices. Ensure that producers receive fair compensation and work under safe, adequate conditions.	Offers preferential access to ethical markets; improves brand reputation. Opens markets in Europe and in other countries that value fair trade and social sustainability.	Basic requirements for decent and safe working conditions, emphasizing labour and social aspects. Includes health and safety requirements to protect workers.	Aligns with the principles of freely chosen work and fair working conditions.
Bonsucro	To increase sustainability in sugar cane production, water resource management, biodiversity, labour rights.	Offers international recognition, access to global markets that value sustainability, especially in Europe and North America.	Includes reference to OSH standards to protect agricultural workers specifically within the sugar cane sector. Seeks to create value throughout the supply chain and strengthen human rights and decent work in sugar cane cultivation and milling.	Currently comprises more than 300 members worldwide.

Certification	Objective	Competitive advantages / market	Decent work and OSH-related elements	Other information
SMETA	Integrates environmental and labour sustainability, natural resource management, and labour rights. Evaluates ethical management in the sugar cane supply chain.	Strengthens access to markets that value integrated sustainability. Improves transparency and accountability in the sugar cane supply chain; meets international standards.	Focuses on OSH together with environmental aspects to improve safe and healthy working conditions. Promotes safe and ethical working practices, including labour rights.	Increasingly serves as a benchmark for European markets, with a particular interest from the United Kingdom. In COL, only one mill currently has this certification.
RUC	Colombian Safety Council (CCS) Uniform Contractors' Register (RUC)	Seeks to make the organization visible to the country's contractors, thus contributing to strengthening accountability and sustainability in the sector.	Allows contracting companies, through an information system, to make decisions regarding the performance of safety, occupational health and environmental protection risk management, contributing to the achievement of their sustainability strategy in the sugar cane supply chain.	Eight mills participate in the RUC.

Source: own elaboration as per the information obtained from the websites of the certifications listed.

1.2.7 Training and capacity building in the sector

Training and capacity building in Colombia's agribusiness sector are crucial for fostering sustainable development. This approach emphasizes equipping supply chain actors with the knowledge, skills, and tools necessary to enhance efficiency, improve quality, and boost the competitiveness of agro-industrial production across the country.

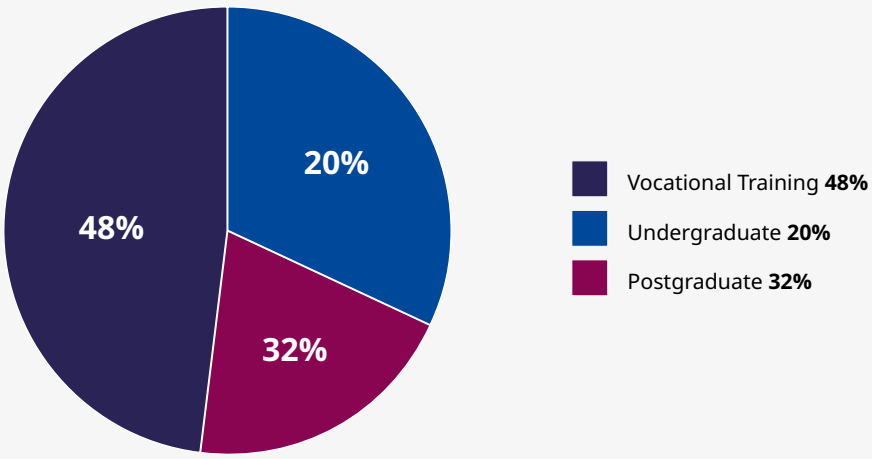
1.2.7.1 Technical education and training

As of 6 October 2024, the Ministry of National Education in Colombia approved a total of 276 OSH academic programmes offered by Higher Education Institutions. Of these, 75 per cent are offered by private institutions and 25 per cent by public schools. Undergraduate programmes account for 41 per cent of the total, with the remaining 59 per cent as postgraduate programmes designed for individuals seeking specialized knowledge and training in OSH. However, sector-specific OSH academic programmes have not yet been identified.

The Administrative Entity for Labor Risks (ARL) runs training initiatives to strengthen the OSH capacities of their member companies. One such example is the AgroPositiva 360 programme, an initiative of ARL Positiva that focuses on identifying hazards associated with farming processes for reducing both the inherent risks and the overall number of occupational accidents and illnesses.

Formal education in the agro-industrial sector is supported by 172 academic programmes offered by higher education institutions. Of these programmes, 65 per cent are provided by public institutions and 35 per cent by private ones. These programmes cover a range of topics, including agribusiness, agro-industry, agricultural practices, administration, management, processes, and production (National Higher Education Information System, SNIES, December 2023).

Figure 4: Percentage of academic programmes



Source: own elaboration based on information from SNIES (2023).

In Colombia, technical training represents the largest share of national programmes related to the agricultural sector, accounting for 48 per cent of the total offerings. These programmes focus on essential topics such as agricultural administration, sustainable production, agribusiness management, and organic production.

Undergraduate programmes constitute 20 per cent of the country's academic offerings in the agricultural sector. These include fields such as agricultural engineering, agribusiness administration, and agricultural and agro-industrial business administration, providing foundational knowledge and skills for future professionals.

Postgraduate programmes make up the remaining 32 per cent of educational options in this sector. These advanced programmes address specialized areas, including Agricultural Waste Management, Agribusiness Logistics, and Commercial Management of the Agricultural Sector, equipping students to tackle complex industry challenges.

The National Learning Service (Servicio Nacional de Aprendizaje, SENA) plays a pivotal role in delivering specialized training in agro-industrial processes, the transformation of agricultural raw materials and agricultural management. SENA's programmes combine practical skills with theoretical knowledge, preparing students to effectively address contemporary challenges in the agricultural sector.

For instance, SENA, in collaboration with ASOCAÑA and sugar mill workers in Valle del Cauca, successfully updated knowledge and enhanced sugar cane production processes through specialized, continuous training initiatives. In 2022, 3,790 workers from 12 sugar mills and 50 affiliated producers participated in these training programmes. The topics covered included sugar production, sugar cane cultivation, the enhancement of administrative and organizational skills, the implementation of new technologies, and adaptation to the digital era (SENA, 2022).

These initiatives play a vital role in developing a workforce of highly skilled and committed professionals, equipped to drive productivity, sustainability, and competitiveness in Colombia's agricultural industry.

1.2.7.2 Research and development

In the field of research and development, there are specialized research centres in the food agro-industry that aim to stimulate process innovation, product development and the application of specific technologies for the sector. Among them is the Colombian Agricultural Research Corporation, AGROSAVIA.

CENICAÑA also promotes technological innovation for sugar cane mills and growers in the region through research programmes. These initiatives provide specialized support services designed to enhance the productivity and profitability of commercial sugar cane plantations.

Similarly, the strong collaboration between universities and businesses promotes applied research projects and technology transfer. The Ministry of Science, Technology, and Innovation (Minciencias) plays a key role in the development and strengthening of Colombian agribusiness. Through strategic research and development programmes, Minciencias promotes the application of innovative technologies, efficiency in agricultural processes, improved product quality, and environmental sustainability.

The Occupational Risks Fund, under the Ministry of Labour, has established several initiatives that support studies, activities and campaigns focused on education, prevention and research across the country. The fund has also launched extensive prevention programmes, allowing for specialized initiatives to target specific sectors, such as the sugar cane industry.

1.2.7.3 Public-private initiatives for the economic and social development of the sector's stakeholders

Within the sugar cane sector, various dialogues with key stakeholders have resulted in the development of strategies aimed at strengthening the industry. The initiatives that emerged from these sectoral dialogues include:

- **Valle Commitment** brings together public, private, and community actors to address socio-economic gaps and promote sustainable development in Valle del Cauca, fostering trust and social capital. The initiative has reached over 63,000 participants, generated more than 3,300 jobs, and engaged over 669 companies of all sizes.[16]
- **Rural Commitment** is a public-private alliance involving sugar mills and growers affiliated with organizations such as ASOCAÑA PROCAÑA, Association of Cane Growers Committee of the Risaralda Sugar Mill (Azucari), CENICAÑA, SENA and Colombian Institute of Family Welfare (ICBF). Its objectives include creating employment opportunities in rural areas and fostering entrepreneurship. In its first year, the initiative successfully hired 1,851 people and provided psychosocial support to approximately 900 individuals in collaboration with SENA and ICBF.[17]
- ***Corazón de Caña*** was established as a sector brand with the goal of raising awareness about the sugar cane industry. It aims to identify and establish "ambassadors" or "sector champions" to foster a sense of belonging and pride among all stakeholders.

1.2.8 Priority OSH issues

1.2.8.1 Hazards identified in sugar cane production in Colombia

In the sugar cane production chain, there is a consistent hazard, at all stages of the sugar cultivation and production process, that can lead to accidents. In sugar production, **maintenance activities** present the most critical risk factors. These activities involve high-risk tasks such as working at heights, confined spaces, hot work, lifting heavy loads, exposure to hazardous energies, and electrical risks.

The most significant hazards at each stage of sugar cane production and their potential consequences are outlined below.

During **land preparation**, workers face significant safety hazards, including the risk of being crushed by the moving parts of agricultural machinery. Additionally, falling while climbing on or off machinery is a common risk. Landslides during the construction or maintenance of water channels and irrigation systems pose further hazards.

16 https://www.compromisovalle.org/

17 https://tecnicana.org/2024/05/21/asociaciones-centros-investigacion/asocana-fortaleciendo-vinculos-con-las-comunidades-del-norte-del-cauca-a-traves-de-compromiso-rural/?v=056158413026

Biomechanical hazards, such as overextending the shoulder and spine from handling agricultural implements, also contribute to OSH hazards at this stage.

During **manual planting of sugar cane seed**, workers are exposed to hand injuries from machete use, eye injuries from contact with the sugar cane leaves, as well musculoskeletal injuries. Musculoskeletal injuries can result from repetitive actions and movements, such as from performed outside the angle of comfort and when bending down to cut sugar cane stalks and to assemble seed bundles.

Irrigation, whether through sprinkling or piping, also poses safety risks. Drowning in rivers is a hazard, particularly when water suction grenades in the pumping stations are cleaned. Workers can become trapped between pipes or in rotating parts of the motor pumps and machinery. Other OSH hazards include infections from contact with contaminated water during the cleaning of water suction grenades in the pumping stations or while maintaining irrigation canals. Biomechanical hazards caused by uncomfortable movements and by lifting heavy loads during the handling of pipes and irrigation equipment also exist.

In **weed control**, safety hazards include eye injuries from contact with cane leaves and falls from heights when moving over uneven terrain with a back pump. Biomechanical hazards occur during herbicide application with a back pump, which can be awkward and heavy to handle, as well as chemical hazards, including intoxication from chemicals or dermatitis from contact with the chemical mist used to kill weeds.

During the **fertilization process**, workers are exposed to osteomuscular injuries from movements outside the comfort angles, and from lifting, loading and unloading heavy fertilizer bags (weighing approximately 50 kg). Chemical hazards exist, such as skin damage from exposure to particulate material during the preparation of NPK mixtures consisting of nitrogen, phosphorus, potassium, and urea, among other chemicals. In addition, there is a risk of poisoning or dermatitis due to contact with mist while **applying ripeners**.

Sugar cane can be cut manually or mechanically. Each method presents unique safety challenges.

Manually cutting sugar cane poses safety risks. The use of machetes to cut the sugar cane stalk can cause leg and hand injuries, while contact with sugar cane leaves and stalks, can cause eye injuries. The repetitive, awkward motion required during cutting increases osteomuscular injuries, particularly those to the spine and upper limbs. Other hazards are caused by natural phenomena, for example, being hit by lightning during storms or from the effects of solar radiation (fatigue, dehydration, skin cancer, among others). There are also psychosocial hazards such as the stress caused by productivity and performance-based wage compensation, used to supplement a workers' basic wage.

Mechanized cutting sugar cane introduces additional risks related to the use of machinery. A key safety concern is the potential for workers to be run over by the equipment during harvesting. There is also the risk of electrocution from nearby electrical lines, towers, and posts within the fields. Other hazards include falls when getting in or out of the equipment, such as the cab of the machinery or tractor-trailers. Physical injuries can also occur during machinery maintenance or repairs, and workers are at risk of being pinned or trapped if wagons or equipment overturn, especially when transferring loads onto low beds. Additionally, the stressful nature of the work raises concerns about mental health and overall well-being.

The **transport of sugar cane to the sugar mill** presents several safety risks. Road accidents can occur, particularly when driving heavily loaded tractor-trailers. If the trailer or other machinery overturns or flips, drivers may become trapped or pinned. Additional OSH risks include potential falls when exiting the cab or while inspecting the tractor-trailer´s hydraulic and electrical systems.

In the **milling process**, maintenance poses significant risks. One major risk is falling from heights. Other safety concerns include lifting heavy loads during mill assembly and disassembly. Moving machine parts can also cause significant physical injuries and another danger is that of asphyxiation due to deficient oxygen levels in the sugar cane juice channel. Mill workers are also exposed to high levels of noise, which can lead to hearing loss over time. Chemical hazards also exist; there is an increased risk of eye injuries from exposure to bagasse.

During the **clarification process**, two main OSH risks include hearing loss due to high noise levels and a chemical burn from contact with hot substances, such as cane juice and water vapour.

In the **evaporation stage**, one of the major risks is asphyxiation due to oxygen deficiency, which can occur during maintenance of the evaporator. Noise exposure remains a concern, contributing to potential hearing loss. Chemical hazards, such as burns due to contact with hot substances like sugar cane juice, water vapour and caustic soda, exist at this stage of production, as does exposure to the high temperatures and heat created by the evaporation process.

During the **crystallization and centrifugation stages** several safety hazards arise, particularly in confined spaces. These include asphyxiation due to oxygen deficiency during maintenance in closed containers (tanks, vats, centrifuges) and being pinned or trapped by moving parts of the machinery as well as chemical and physical burns due to contact with hot substances (syrup or honey, water vapour). There is also the possibility of hearing loss caused by exposure to high noise levels as well as thermal discomfort due to heat.

In **sugar drying**, several safety hazards exist. Workers face the risk of falls from elevated levels during equipment maintenance, as well as the danger of being caught in moving machinery. Additionally, there is a significant chemical explosion risk due to the presence of sugar dust, which can become highly flammable under certain conditions.

In the **packaging stage**, biomechanical hazards are possible due to repetitive movements and actions that require workers to move outside of their comfortable range of motion, potentially leading to musculoskeletal injuries. Psychosocial hazards also exist, particularly from the way the work is organized, with continuous line work potentially causing stress and fatigue among workers.

In the s**torage and dispatch of sugar**, safety risks include the possibility of being run over by forklifts and falling from higher levels while loading and unloading tractor-trailers. Biomechanical hazards are also present, particularly from movements that exceed an individual's natural range of motion, which can result in strain, injury, or long-term health problems. The lifting of heavy bags, often weighing up to 50 kg, can contribute to musculoskeletal issues over time.

The **production of alcohol** generates many possible chemical and other hazards. There is the possibility of fire or explosion due to the presence of liquid alcohol and alcohol vapours. Burns are also a concern from contact with corrosive substances during loading and unloading. High noise levels in the production environment can also lead to hearing loss over time.

Generating power also involves several risks and safety concerns. Workers are at risk of entrapment in moving parts, such as conductors, cane conveyor belts, and coal screw conveyors. Additional hazards include the potential explosion or implosion of pressurized equipment and pipes, as well as chemical hazards from the presence of dust, slag, and coal. Burns can occur from contact with water vapor, while respiratory issues may arise from exposure to cane slag and coal dust.

Finally, **maintaining process plants, agricultural machinery, pumping stations and electrical substations** presents significant safety risks. Death or severe trauma can result from high-risk tasks such as work at heights, working in confined spaces, hot work, lifting of loads, maintaining equipment and pipes with dangerous or hot substances and hoses or pipes under high pressure. Electrocution can also occur during the maintenance of electrified equipment or systems.

1.2.8.2 Statistics

As of May 2024, the agriculture, livestock, hunting, forestry and fishing sector reported a total of 49,962 **occupational accidents** and 652 proven **occupational diseases**, according to data from the Federation of Colombian Insurers.

In the specific context of sugar manufacturing and refining (code 4157101)[18] data from FASECOLDA spanning the period from 2009 to 2022[19] highlights the frequency and nature of occupational accidents and diseases in this industry.[20] Additionally, ASOCAÑA has provided data on the accident rate and severity of incidents within the sugar agro-industry. This data covers 11 sugar mills, which together account for 98.9 per cent of the country's sugar production.

This economic activity, identified in risk classification IV as high risk,[21] shows a decrease in the number of affiliated companies - from 38 in 2009 to 33 in 2022 - but a significant increase in the number of affiliates, from 2,929 to 17,182 in the same period.

Over the past 14 years, 21 departments have **affiliated** to the General System of Occupational Risks in the sugar industry. The three departments of Valle del Cauca, Cauca and Risaralda have the highest affiliation rates, collectively accounting for more than 80 per cent of affiliates, as shown in Figure 5. Notably, in recent years, Risaralda has seen a steady increase in affiliates.

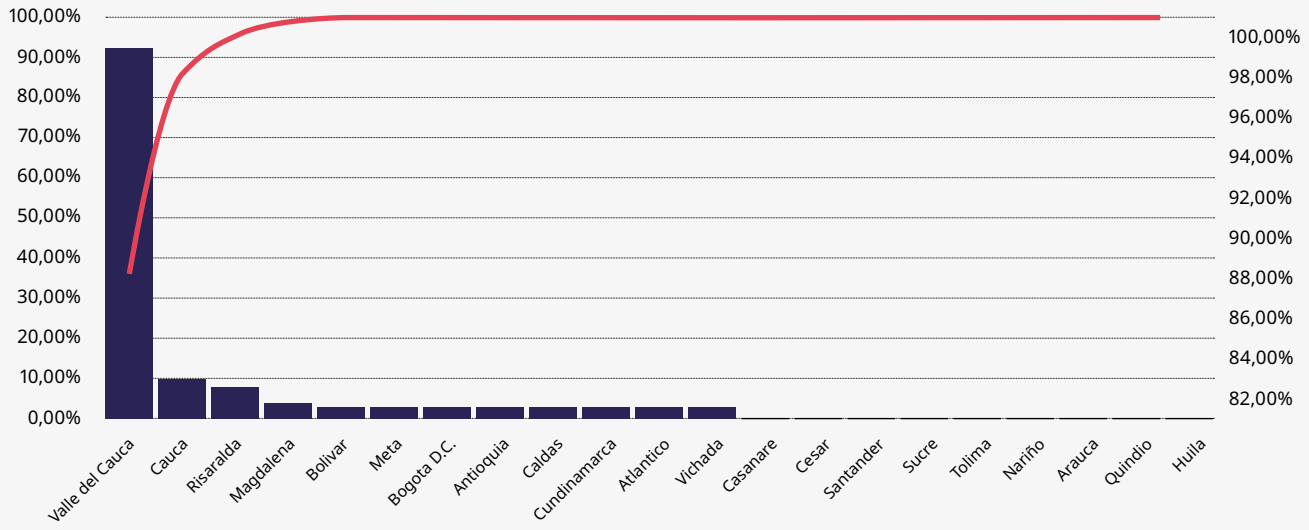
18 Existing information only covers workers formally affiliated to an ARL (FASECOLDA, 2024).

19 Data for economic activity 4011401 - Sugar cane production were not included, as they cover both sugar cane production for sugar cane and sugar cane, which makes it impossible to identify specific data.

20 It represents the insurance sector's relationship to oversight and control entities, as well as society in general. In this context, Fasecolda's Technical Chamber of Occupational Risks promotes the growth, development and sustainability of this type of insurance. It also represents all the ARLs currently operating in the sector (FASECOLDA, 2024).

21 This risk category is high; organizations should quote 4.350 per cent.

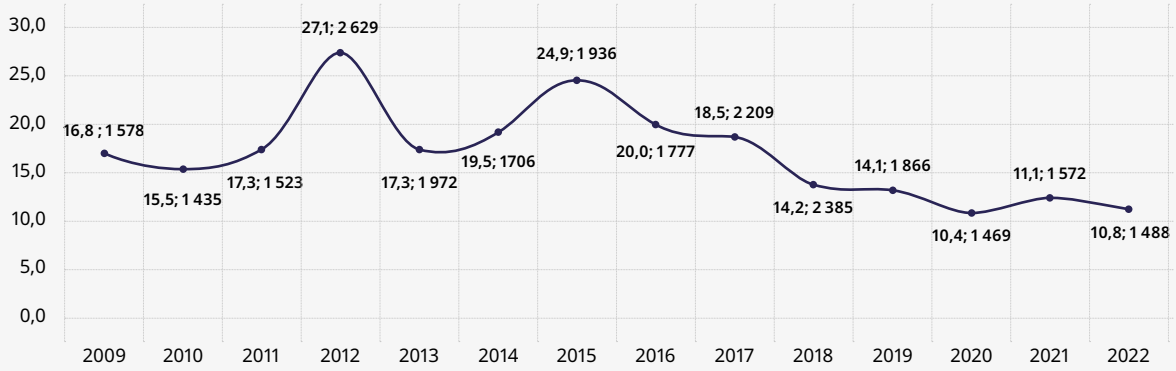
Figure 5: Average distribution of members by department of sugar manufacturing and refining companies



Source: own elaboration as per the information obtained from the websites of the certifications listed.

The number of **occupational accidents** shows a clear decrease from 1,578 to 1,488 cases in the period 2009-2022. However, when examining the number of affiliates, an annual accident rate was found to be less than 20 per 100 workers, with two exceptions in 2012 and 2015 that presented an accident rate higher than 20, as shown in Figure 6. While the Colombian information system does not specify the reasons, information from the focus groups suggests the decrease is due to the mechanization of the sector.

Figure 6 Annual rate of occupational accidents in enterprises engaged in the manufacture and refining of sugar



Note: The first data related within the Figure corresponds to the accident rate and the second data, followed by; corresponds to the total number of accidents per year.

Source: own elaboration based on information from FASECOLDA 2009-2022.

The analysis of the accident rate in departments involved in sugar manufacturing and refining reveals a clear correlation between the number of affiliations and the frequency of occupational accidents. To assess this, the total number of annual affiliations registered by each department over the 14-year period was calculated. Valle del Cauca stands out as the department with the highest number of occupational accidents, followed by Cauca and Risaralda.

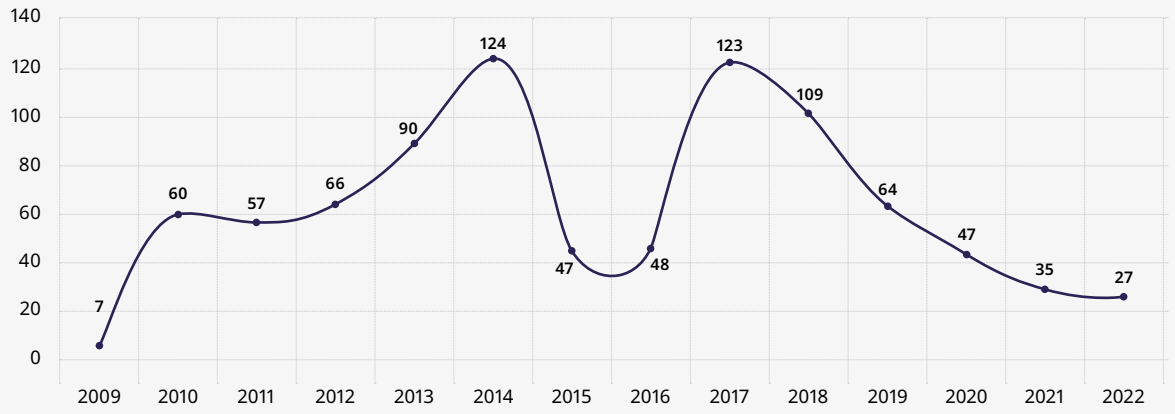
Table 7 Occupational accidents by region in companies involved in the manufacture and refining of sugar

Department	Number of accidents at work 2009-2022	Total number of memberships 2009-2022 period
Valle Del Cauca	23 439	139 993
Cauca	1 284	9 942
Risaralda	650	6 399
Magdalena	55	844
Bolivar	38	347
Bogota D.c.	38	112
Goal	9	127
Antioquia	9	81
Quindío	4	0
Atlantic	4	6
Caldas	3	7
Casanare	2	0
Arauca	2	0
Santander	2	0
Tolima	2	0
Sucre	1	0
Vichada	1	4
Cesar	1	0
Cundinamarca	1	7

Source: own elaboration based on information from FASECOLDA 2009-2022.

Regarding **occupational diseases**, a total of 904 cases were recorded in the period from 2009 to 2022. The year with the highest number of registered cases was 2014, with 124 cases; another peak was in 2017, with 123 cases. Finally, the year 2009 stands out, with 7 reported cases (see figure 7).

Figure 7: Number of occupational diseases in sugar manufacturing and refining companies



Source: own elaboration based on information from FASECOLDA 2009-2022.

Occupational diseases have been registered in five regions. Cauca and Risaralda have recorded the lowest number of cases of occupational diseases over the past 14 years, relative to their number of affiliates. Additionally, Bogotá stands out for having a relatively low number of affiliates in the period analysed (see table 8).

Table 8 Occupational diseases by region in sugar manufacturing and refining companies

Region	Number of occupational diseases 2009-2022	Sum of the number of affiliations 2009-2022 period
VALLE DEL CAUCA	751	139 993
BOGOTA D.C.	101	112
CAUCA	45	9 942
RISARALDA	6	6 399
MAGDALENA	1	844

Source: own elaboration based on information from FASECOLDA 2009-2022.

The two departments which reported fatal accidents during this 2009 to 2022 period were Valle del Cauca and Cauca. Valle del Cauca recorded the highest number of total fatalities in 2018, with a total of 21 fatalities overall. During the same period, the department of Cauca reported three fatalities (see table 9).

Table 9 Number of deaths by region in sugar manufacturing and refining enterprises

Region	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
VALLE DEL CAUCA	3	1	2	-	-	2	-	1	2	6	-	2	2	-
CAUCA	-	-	2	-	-	-	-	-	1	-	-	-	-	-

Source: own elaboration based on information from FASECOLDA 2009-2022.

Below are statistics of accidents and severity of the sugar agroindustry, constructed by ASOCAÑA. The statistics are based on information reported by 11 sugar mills, which represent 98.9 per cent of the country's sugar production.

Table 10 accident rate in the sugar agroindustry

Accident rate				
Year	Factory	Field / harvesting*	Administrative	Total sector
	TA%	TA%	TA%	TA%
2022	3.20	9.56	3.66	5.86
2023	2.45	8.73	3.08	5.02

Source: ASOCAÑA (2024).

Table 11 Sugar agribusiness severity rate

Severity rate				
Year	Factory	Field / harvesting*	Administrative	Total sector
	TS%	TS%	TS%	TS%
2022	0.62	0.76	0.17	0.64
2023	0.46	0.48	0.20	0.44

*Field and harvesting refer to crop-related agricultural work like lifting and harvesting. This does not include cane cutters.

Source: ASOCAÑA (2024).

Table 12 clarifies the rates and severity of accidents that occurred during sugar cane cutting, based on the information provided by the mills and cutting companies.

Table 12 Accident and severity rate - manual sugar cane cutting work

Year	Accident rate	Severity rate
	TA%	TS%
2022	25.4	1.0
2023	22.2	1.0

Source: ASOCAÑA (2024).


PELIGRO
VEHICULO
RA LARGO
KENWORTH
DE LA MONTAÑA
8295
JPO·425
BELLO

2. Drivers and constraints to improve OSH

The following section describes the drivers and constraints for OSH improvement in the sugar cane supply chain in Colombia. This information was compiled through secondary sources, as well as from the perspectives of tripartite actors involved in the supply chain.

2.1 Drivers for OSH improvement

This section identifies positive experiences and/or possible entry points for improving OSH practices and outcomes in the sugar cane supply chain.

2.1.1 High level of stakeholder commitment to occupational safety and health

During the sectoral dialogues held in relation to this study, stakeholders recognized the critical role of workers in the production, processing and distribution of sugar cane, along with the OSH risks inherent to these activities. The implementation of OSH measures and sectoral programmes was perceived as both a legal and a moral obligation, and an ethical responsibility. Moreover, stakeholders´ strong commitment to fostering a culture that prioritizes prevention of occupational accidents and diseases, while promoting the physical, mental and emotional well-being of workers, is integral to building a corporate reputation centred on responsibility and care. OSH was identified as a value that transcends mill operations, supporting society`s well-being.

Adopting OSH Management Systems has significantly contributed to reducing both the frequency and severity of accidents. The active engagement of leaders and managers at all levels of the organization has been crucial in ensuring that OSH is prioritized and effectively managed. Key actions identified include training in the proper handling of machinery and equipment, as well as the promotion of safe and healthy work environments. These initiatives help workers feel better protected and more motivated to carry out their tasks, fostering a culture of safety and well-being throughout the organization.

2.1.2 Customer requirements, certifications and seals in sustainability and their contribution to OSH

During the sectoral dialogue, the growing demands from sugar industry customers regarding decent work were highlighted, particularly through certifications, sustainability seals, and compliance audits. It was emphasized that adhering to labour standards, including OSH, not only facilitates access to markets but also enhances the sector’s visibility and commitment to sustainability. These customer demands play a significant role in promoting decent work and strengthening OSH practices across the entire sugar cane supply chain.

For instance, the Colombian Safety Council (CCS) and the Single Registry of Contractors (RUC) have actively contributed to OSH management in Colombia’s sugar cane sector. They do so by implementing OSH standards that are regularly assessed to ensure compliance with regulations and by adopting safe and healthy practices in contractors’ operations (CCS, n.d.).

2.1.3 High degree of institutionalization within the sector

Institutionalization plays a key role in promoting OSH within the sugar cane sector. Mills in this industry often have specific organizational structures that consider OSH issues. For instance, mills have dedicated departments or teams responsible for designing and implementing plans and programmes aimed at improving working conditions, preventing occupational accidents and diseases, and ensuring compliance with legal and sectoral standards. Several mills also have doctors, engineers, physiotherapists, psychologists and other specialists working to institutionalize OSH across various operational areas.

Research and technical assistance on agronomic and industrial issues conducted by CENICAÑA, contributes to the improvement of OSH conditions at the source. This is pivotal for developing industry best practices and ensuring that OSH is prioritized throughout the sugar cane supply chain.

ASOCAÑA also plays a significant role. It has a dedicated commission for dealing with OSH issues that organizes sector-specific meetings and seminars to address OSH challenges, sharing experiences and good practices.

The fact that work in the mills is permanent, rather than seasonal, contributes to better working conditions and reduced OSH risks in Colombia. Many mills have specific work plans to improve the relationship with the communities where they are located, including actions related to improving the quality of life of the surrounding communities, as well as their overall health and safety. These measures play a role in reducing public risk.

2.1.4 Trade union organizations and collective agreements

In the focus groups discussions, trade union organizations were said to be actively engaged in:

- **Collective bargaining processes within the sector.** This enables unions to negotiate OSH prevention and protection measures, ensuring they are enforceable. For example, measures such as the use of reflective shirts or bucket hats to protect workers from occupational hazards related to sun exposure or hazardous conditions have been successfully implemented. Compliance with collective agreements, which often include provisions on OSH and for improved emergency medical care, benefits both workers and companies by ensuring safe working conditions and fostering a more productive working environment.
- **Joint OSH committees within the workplace.** These committees serve as platforms for dialogue and collaboration between workers' representatives and the company. They encourage workers to voice their OSH concerns and needs, and, in line with legal and regulatory standards, allow them to participate in the design and implementation of preventive measures.

2.1.5 Productivity indicators and recognition

Mills measure productivity to ensure efficiency and competitiveness using a variety of indicators. These indicators include "traditional" metrics, such as the amount of cane cut and processed per day and the efficiency of sugar extraction. They help assess performance across the supply chain and clarify OSH indicators, such as the occupational accident rate, severity rate, occupational illness rate, reporting and control of unsafe conditions as well as compliance with safety regulations. This

data allows for an analysis of the hidden costs associated with occupational and non-occupational accidents. Some stakeholders have implemented non-monetary recognition strategies to promote workplace safety. These include congratulating workers for improvements, reporting hazards, and taking photos for internal publications to showcase these efforts.

The implementation of these performance management systems includes financial incentives for workers who meet productivity targets. They also include non-monetary recognition for meeting OSH targets, such as OSH certificates of excellence or opportunities for continuous training. Recognizing strong OSH performance helps workers feel valued and motivated, as their contribution to maintaining a safe working environment and the company's successes are acknowledged. This fosters engagement and job satisfaction, which in turn boosts talent retention and enhances the company's reputation.

2.1.6 Strengthening, capacity and individual and professional competences of supply chain participants

Strengthening the individual and professional skills and competencies of those involved in the sugar cane supply chain is key to boosting efficiency and quality at every stage of the process. A notable example is the inter-institutional collaboration between SENA and the mills, which focuses on training technologists and developing sector-specific skills.

This strategic collaboration allows for the design of training programmes tailored to the real needs of the sector, ensuring that participants acquire the skills and knowledge necessary to effectively perform their roles. From skills certification, to training in farm mechanization and cane cutting, the aim is to offer a comprehensive set of tools to improve the sector.

Beyond technical training, access to up-to-date educational programmes and materials is also essential. In this sense, initiatives such as those developed by the ARLs play a key role in providing quality educational resources that address sugar cane production, from agricultural techniques to sustainable practices and business management.

Joint public-private initiatives that focus on innovation, development, education and worker welfare as well as supporting culture, sport, and personal development for workers, address employment barriers and contribute positively to the socio-economic development of the community.
These initiatives also focus on providing decent working conditions, with formal contracts and corresponding social benefits. In addition, continuous training is promoted. Through strategic alliances with sugar mills, cutting companies and other key actors, the social fabric of rural communities is strengthened, contributing to the sustainable development of the sugar agro-industry in Colombia.

This comprehensive approach to strengthening individual and professional skills through initiatives such as skills certification and access to specialized educational programmes represents a holistic and collaborative approach to increasing employability and sustainable growth within the sugar cane supply chain. It benefits workers and enterprises by improving productivity and the quality of work, as well as encourages the development of farming communities within the sector.

2.1.7 Continuous strengthening of the inspectorate[22]

Ensuring compliance with OSH legal requirements is a top priority for both companies and government authorities. In this regard, OSH training for Ministry of Labour inspectors plays a key role in ensuring compliance and worker protection.

Training Ministry of Labour inspectors equips them with the necessary knowledge and skills to carry out effective workplace inspections. This includes identifying potential safety hazards and deficiencies in the sector, implementing corrective measures, and addressing cases of non-compliance.

In addition, OSH training of inspectors has a positive impact by ensuring compliance with safety regulations and reducing the risk of occupational accidents and diseases, which in turn can improve the efficiency and profitability of organizations.

The sector has also been working to strengthen these processes through the construction of tools for inspection, supervision and monitoring, under the leadership of the Ministry of Labour with a sectoral approach. These include a checklist for the evaluation of critical occupational safety and health risk controls in the sugar cane sector.

2.1.8 Existence of a health surveillance system at sectoral level

The implementation of an epidemiological surveillance system in the sugar sector contributes to monitoring and controlling health-related risks for workers across all stages of the sugar cane supply chain. This system, implemented by various actors in the sector, makes it possible to identify and analyse potential adverse health effects resulting from exposure to biological, chemical or physical agents present in the work environment.

By implementing an epidemiological surveillance system and using tools such as OSH assessment checklists, the sugar cane sector can significantly improve the health protection of its workers and reduce the risk of work-related diseases. In addition, this proactive approach to occupational safety and health management can also contribute to improving the productivity and reputation of companies within the sector.

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22 In the Direct Request (CEACR) - Adoption: 2023, Publication: 112th ILC Session (2024), the Committee requests the Government to provide information on the measures adopted to increase the work of labour inspection services in rural areas of the country, including information on the implementation of the Mobile Labour Inspection strategy and its impact on compliance with legal provisions in agriculture. It also requests the Government to provide detailed information on the number of reactive and preventive inspections carried out in this sector. Similarly, the Committee requests the Government to provide information on the number of measures ordered by labour inspectors (modification and prohibition measures) to ensure the safety and health of workers in agriculture. It also asks the Government to continue providing information on the number and nature of OSH violations detected in agricultural enterprises, the number of sanctions imposed, as well as the number of occupational accidents and diseases recorded in this sector.

The Committee takes note of the information provided by the Government regarding the training courses delivered to labour inspectors in 2022, including the number of participants (1,261) and the topics covered, which include inspection protocols applicable to the palm and sugar cane cultivation sectors, floriculture, prevention and protection against occupational risks and gender-based violence in the workplace, administrative sanctioning procedures, the grading of sanctions, among others.

2.1.9 Incorporation of technology in production processes

Applying technology to work processes has become essential for controlling operational risks and improving OSH in the sugar cane sector. Process automation in boilers, alcohol plants and sugar production in industrial plants has proven to be effective in mitigating risks. For instance, automation of packaging lines significantly reduces biomechanical hazards to operators. Similarly, the use of robots in warehousing and distribution centres for finished products reduces the risks associated with these activities.

In the agricultural sector, automation of cane cutting has led to a significant reduction of accidents and occupational diseases among workers who previously performed this task manually. Planting machines have also reduced exposure to biomechanical hazards. In addition, technological advances in irrigation systems, such as drip irrigation, pivot irrigation and buried pipe systems, have not only contributed to the reduction of water consumption in cane crops, but they have also minimized biomechanical and accident hazards for irrigation workers. During the focus groups discussions, participants suggested other technologies, such as the use of drones, could be implemented for the application of ripening agents and other substances.

The growth and adoption of new technologies, including artificial intelligence and process automation positively impacts workers' safety, reducing their vulnerability to various occupational hazards. This makes it a valuable area for the sector to explore and further develop.

2.2 Constraints to OSH improvement

This section identifies the underlying constraints that limit OSH improvement and/or compliance with the relevant provisions in the sugar cane value chain.

2.2.1 Awareness and design of OSH legislation adapted to the sector

A lack of knowledge regarding OSH legislation among workers and some trade union organizations in the sugar cane supply chain in Colombia poses a significant obstacle to improving OSH. This knowledge gap prevents trade unions from effectively representing workers' interests and advocating for better working conditions. It also limits workers´ ability to correctly identify and manage occupational hazards, leading to unsafe workplace practices.

While Colombia has extensive OSH legislation, including specific regulations for high-risk activities, there are gaps in addressing critical risks such as work in confined spaces and work at heights. These are key hazards in the sugar cane sector, and the absence of regulations for these activities highlights broader concerns affecting all economic sectors.

Moreover, there are no standards or guidelines on the application of legislation, with a focus on prevention rather than punitive measures. Some existing guidelines are outdated, such as the Guidelines for Integrated Occupational Health Care (GATISO).

2.2.2 Climate change and worker vulnerability

Climate change poses significant challenges for OSH in the sugar cane supply chain. The combination of rising temperatures, extreme weather events and changes in rainfall patterns

increase the vulnerability of workers, as well as the risk of workers affected by heat stress, dehydration and heat-related illnesses. These conditions can reduce workers´ physical work capacity, increase fatigue and decrease productivity. By addressing these factors, the sector can reduce errors and accidents, fostering a safer and more efficient work environment

In the focus groups discussions, PPE was highlighted as an issue impacted by climate change requiring a sector-wide response. Participants highlighted the lack of appropriate equipment adapted to new climatic conditions, as well as increased disease vectorand concerns over changing soil conditions.

Changes in rainfall patterns have also had a significant impact on the sector. Irregular or torrential rains can cause flooding, destroy crops, damage agricultural infrastructure, and increase the risk of insect-borne diseases such as dengue fever. Ground conditions become unstable and slippery, increasing the risk of falls and other occupational accidents. Prolonged droughts also affect the availability of water for irrigation, affecting sugar cane production and increasing the workload required to maintain plantation productivity.

Finally, it is important to highlight a paucity of research in this field. Additional research would allow for a better understanding of the impacts of climate change on the health of sugar cane workers in Colombia.

2.2.3 Public safety (conditions in the region)

In the sugar cane supply chain, particularly in the Cauca and Valle del Cauca region, public risk and region-specific conditions have a significant impact on OSH. Public risk in some areas of this region is related to the presence of armed groups and criminal activity. This presence can increase the risk of violence in the workplace, which endangers workers both physically and affects their mental health and well-being. Safety concerns can also make it difficult for workers and emergency teams to access work areas in case of incidents or accidents.

The topography of the region and the inadequate infrastructure in some areas can make it difficult to implement effective safety measures. To address these challenges and improve OSH, a comprehensive approach that considers both occupational risks and external factors of the region is needed. This includes:

1. Implementing additional security measures in areas of higher public risk to protect workers from potential violence;
2. Offering regular OSH training addressing public risk;
3. Improving infrastructure and access to health services to ensure a rapid and effective response in case of emergencies or occupational accidents; and
4. Promoting a culture of prevention and safety at work, involving workers, employers and local authorities in identifying and mitigating risks.

2.2.4 Generational change

Social change, driven by generational shifts and demographic transitions, is significantly transforming the sugar cane supply chain.

Unlike previous generations, who often remained in the same job for extended periods, today's young workers are continually looking for new opportunities and challenges.[23] This is driven by increased mobility and flexibility in the labour market. Traditional social benefits, often an incentive for job stability, no longer serves to attract or retain younger employees. In the sugar cane supply chain, this high turnover of young workers can be a challenge for companies who rely on a consistent workforce to ensure productivity targets. A new or constantly changing workforce can also impact organizational culture as well as a sense of stability and cohesion within the organization.

Additionally, focus group discussions revealed that young workers in the sector often have a low perception of risk, underestimating the hazards associated with certain work activities. This mindset increases the likelihood of accidents and health problems. This perception may be shaped by experience, a culture of immediacy, and reduced risk aversion, which is concerning in an agricultural environment where working conditions can be hazardous. A lack of policies encouraging young people to participate in agro- and OSH programmes compounds these risks.

2.2.5 Technical and specialized OSH education with a focus on the agricultural sector

In the sugar cane supply chain, the lack of specialized technical education represents a significant challenge affecting both the operational efficiency and sustainable development of the sector. This has a significant impact on the sugar cane supply chain, limiting innovation and the adoption of sustainable practices. In addition, the absence of OSH professionals, with expertise in agriculture, perpetuates knowledge and skills gaps for the sector.

This problem is further exacerbated by the training of OSH technicians and technologists without a specific focus on the agricultural sector, leading to a lack of in-depth understanding of the specific needs and complexities of the sugar cane industry. Widespread technical educational programmes do not yet provide the skills and expertise needed to effectively address challenges in the supply chain related to cultivation, weed control, manual cane cutting, harvesting, processing and waste management.

Additional challenges to implementing training courses is the large distances between the agricultural unit / workplaces and the training centres. Sugar cane plantations are usually located in rural areas and far from urban centres where educational institutions and technical training centres are often located. This geographical distance makes it difficult for workers to regularly access continuous training and programmes designed to upgrade skills.

Therefore, it is essential to design specific education and training programmes for the agricultural sector. This involves developing curricula that integrate advanced agricultural OSH practices and technologies, and implementing mobile or online training programmes to overcome geographical barriers and promote the continuous participation of workers in specialized learning processes. Additionally, it includes generating specialized training programmes for priority hazards or high-risk activities for the agricultural sector and particularly, throughout the sugar cane supply chain.

In addition, focus group participants suggested educational institutions expand business practices and OSH-related curricula.

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23 Between 2018 and 2019, the ILO implemented a country project of the Global Programme SafeYouth@Work in Colombia promoting OSH among young people, with a special focus on workers aged 15 to 24. This initiative strengthened capacities through a diploma course in OSH, labour formalization, and strategic planning for compliance. It also involved designing tools for managing risks in the workplace.

3. Suggested intervention models

Intervention models are based on research and consider a **series of interventions that can effectively improve OSH outcomes in the supply chain under study**. It is important to note that a single intervention is unlikely to have a significant impact, thus, a combination of policy and market interventions should be considered.

This section presents intervention models derived from the study. **The implementation of these models requires a collective action approach.** The aim of collective action is to ensure that all relevant parties, such as government organizations, employers, workers and other actors, contribute to addressing the root causes of unsafe and unhealthy working conditions in the supply chain. They do this by committing to work collectively to ensure a supply chain free of fatal or serious accidents, injuries and illnesses.

Intervention model 1: Generate knowledge about OSH conditions in the sugar cane supply chain.

Understanding OSH conditions in the sugar cane supply chain requires knowing the socio-demographic conditions of workers, OSH knowledge and practices, as well as the hazards associated with the production of sugar and its derivatives, such as the panela.

The sugar sector and the panela sector, although both produce products derived from sugar cane, present key differences in their production processes, technology and tools used, and working conditions, among other variables impacting occupational health and safety. Therefore, it is important to continue to analyse OSH risks, working conditions as well as and the general health and well-being of workers in both sectors.

Climate change was identified as a limitation for OSH improvement because the frequency, prevalence or incidence of the climate change on the health of people in the sugar cane supply chain is not yet fully known. Understanding the impact of increasing temperatures, humidity or greater sun exposure for workers will support strategies that reduce risks and promote a healthier working environment.

Institutionalizing good practices and replicating innovative actions within the sugar cane supply chain, such as by using new technologies and applying effective methods towards the prevention of occupational accidents and diseases, will contribute to greater impact and sustainability in the sector.

Intervention model 2: Strengthen the capacity of ILO constituents and other key actors in the supply chain on OSH.

Considering the current OSH knowledge gap among the stakeholders involved in the sector was identified as a limitation, a beneficial next step would be to strengthen the capacities of ILO constituents and other key actors in the sugar cane supply chain.

Creating materials on applicable regulations, hazards, possible control or prevention measures, among other OSH topics could support capacity development. In addition, to strengthen knowledge building and awareness, targeting materials by age groups as well as by gender, focusing on critical workplace activities and workers at higher risk, such as agricultural and harvesting workers, should be considered.

Activities to be prioritized include developing a training of trainers' programme for workers' and employers' representatives, utilizing andragogic, adult education tools for adult learners, with an aim of recognizing and addressing early warnings based on workplace inspections. These training programmes could highlight the differences in agricultural and harvesting work, as well as activities carried out in the production plants. Such programmes will institutionalize these concepts, further build the sector, and strengthen an awareness of the roles and management of trade union organizations.

The design and implementation of a training process for labour inspectors with tools and a focus on rural areas will allow for the recognition of sector-specific OSH challenges. This awareness is a fundamental consideration for developing and strengthening the inspection process throughout the sugar cane supply chain.

This intervention model promotes self-care, self-management and a culture of prevention with the different actors in the sugar cane supply chain. It supports awareness and builds a community of practice in the sector, which helps encourage a proactive culture of OSH risk prevention.

Intervention Model 3: Strengthen the institutional capacities of actors through education and training programmes specific to the sugar cane sector and its priority hazards.

Hazards in the workplace are diverse, with the level of risk influenced by various factors such as activities, processes, and human resources, among other considerations. Evaluating and assessing these risks is essential to identify the most critical ones to be addressed.

Developing and implementing a specialized training process on priority hazards and activities in the sugar cane supply chain would support institutional capacity building.[24] The training focus could include new technologies, types of operations or activities in the sector, situations where specific skills or in-depth technical knowledge are required, or any situation where workers are exposed to high risks. Tools or instruments could also be created to monitor and control OSH conditions in workplaces, by highlighting specific indicators and developing checklists.

A training programme with a specialized approach to the priority hazards and activities in the sugar cane supply chain might include some of the following issues: safety hazards when working at heights, hooking and unhooking tasks, use of tools or equipment, chemical hazards from agrochemicals or biological hazards, psychosocial risks, and public hazards due to regional conditions. The programme should align with existing regulations in other issues impacting workers` safety, for instance, the road safety plan, which highlights the importance of integrating with the OSH management system.

Transferring the trainings to institutions such as SENA, ASOCAÑA , global platforms, ARL, among others, will be key towards ensuring the long-term sustainability and relevance of the activities and its results.

24 Example: Safety hazard related to working at heights, in confined spaces, or using of tools or equipment; psychosocial hazard due to organizational management; chemical hazard due to the use of agrochemicals or biological hazard.

Intervention Model 4: Promoting a culture of occupational risk prevention in the sugar cane sector

The promotion of health and the prevention of occupational risks in the activities carried out by the workers in the sector requires the use of awareness-raising materials. Such materials should facilitate the understanding of concepts, tools, methodologies, priorities, among other relevant aspects of OSH.

Activities could also include creating awareness-raising materials on health promotion and prevention, social security benefits and measures to mitigate occupational risks using graphic pieces, videos, radio campaigns or other strategies. The wide dissemination of these materials will increase community awareness of specific risks and how to avoid them, which empowers people to engage in individual and collective risk strategies, inducing short- and long-term behavioural changes.

Additionally, given the strong commitment of stakeholders in the sugar cane supply chain, it will be crucial to establish a collaborative strategy or agreement (collective action) that effectively aligns efforts and resources. This will ensure a meaningful and lasting impact on promoting a culture of occupational safety and health within the sector.

Intervention model 5: OSH regulatory analysis for the rural sector

Colombian supply chain stakeholders emphasized the extensive range of existing legislation governing OSH. However, they highlighted the critical need for dialogue processes that address the unique challenges of rural areas, particularly in high-risk activities such as working at heights, in confined spaces, and other agriculture-specific working conditions. Strengthening tripartite dialogue—engaging workers, employers, and government representatives—is essential for ensuring that agricultural regulations are both relevant and practical.

In line with the obligation to respect and promote the right to a safe and healthy working environment there is a clear need to foster social dialogue among the government, employers, and workers. Dialogue should focus on reaching an agreement for the ratification of ILO Convention No. 155 on Occupational Safety and Health (1981) and ILO Convention No. 187 on the Promotional Framework for Occupational Safety and Health (2006), as well as conventions addressing rural issues, such as Convention No. 184 on Safety and Health in Agriculture. Furthermore, with the ongoing process of ratifying ILO Convention No. 190 on Violence and Harassment in the country, it will be crucial to adopt measures that address existing gaps in the legislation and engage in activities that help understand any changes and how to effectively comply with their requirements.

The technological and social impacts that may be occurring in the country, such as changes in the structure of employment, the growth of remote work or the impact of climate change on working conditions should be reflected in legislation. In this way, governance and harmonization of national policies can be strengthened.

In conclusion, strengthening sectoral regulatory analysis will be essential to ensuring that labour policies are appropriately reflect the realities and challenges of each sector. This would not only contribute to OSH but also towards boosting economic development, sustainability and competitiveness in each sector.

Intervention Model 6: Coordination of initiatives and spaces for OSH improvement

Stakeholders or stages linked to certifications, sustainability seals or customer demand for compliance with labour standards, including OSH, promote overall compliance. Therefore, the creation of synergies and collaborative programmes with global platforms and private initiatives to advance compliance or sustainability seals will make it possible to leverage resources, knowledge and individual capacities to improve the health and working conditions in this supply chain.

Linking these efforts to tripartite dialogue at the local and regional levels in Colombia, and with the OSH commission for the agricultural sector, will further support the needs of the sector and address sector-specific OSH risks.

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