

Raw sugar production: its diagnosis with a value chain approach

La producción de azúcar crudo: su diagnóstico con enfoque de cadena de valor

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ABSTRACT: This investigation focuses on the Agroindustrial Sugar Company Boris Luis Santa Coloma, belonging to the AZCUBA group. In recent years, this entity has experienced a decrease in its production, between 2019 and 2020 there was a decrease of 6.65% in sugar production and 3.44% in relation to honey. This decreasing trend raises concerns about the competitiveness and sustainability of the company, which is fundamental for economic and social development with an impact on local development, not only due to the high demand for its productions in the territory and the country, but also as crucial source of employment for the community. Based on the above, the objective of this research is to analyze whether the raw sugar production process at the EAA Boris Luis Santa Coloma complies with the value chain approach. To carry out this diagnosis, theoretical, empirical and statistical-mathematical methods were used, as well as tools such as the expert method, the Ishikawa diagram, brainstorming sessions and surveys. The results obtained reveal deficiencies in the value chain model proposed by Michael E. Porter, specifically in primary and support activities. Likewise, the analysis carried out on the production chain reveals irregularities that suggest that the company must address the existing deficiencies in its production process before being able to adequately optimize the cane sugar value chain.

Keywords: Cane Sugar, Productive Chain, Decreasing Trend.

RESUMEN: La presente investigación se centra en la Empresa Agroindustrial Azucarera Boris Luis Santa Coloma, perteneciente al grupo AZCUBA. En los últimos años, esta entidad ha experimentado un descenso en sus producciones, entre 2019 y 2020 se apreció una disminución del 6.65% en cuanto a producción de azúcar y del 3.44% con relación a las mieles. Esta tendencia decreciente genera preocupaciones sobre la competitividad y sostenibilidad de la empresa, el cual es fundamental para el desarrollo económico, social con impacto en el desarrollo local, no solo por la alta demanda de sus producciones en el territorio y el país, sino también como fuente de empleo crucial para la comunidad. Con base en lo anterior, el objetivo de esta investigación es analizar si el proceso de producción de azúcar crudo en la EAA Boris Luis Santa Coloma cumple con el enfoque de cadena valor. Para llevar a cabo este diagnóstico se emplearon métodos teóricos, empíricos y estadísticos-matemáticos, así como herramientas como el método de expertos, el diagrama de Ishikawa, sesiones de tormenta de ideas y encuestas. Los resultados obtenidos revelan deficiencias en el modelo de cadena de valor propuesto por Michael E. Porter, específicamente en las actividades primarias y de apoyo. Asimismo, el análisis realizado sobre la cadena productiva pone de manifiesto irregularidades que sugieren que la empresa debe abordar las deficiencias existentes en su proceso productivo antes de poder optimizar adecuadamente la cadena de valor del azúcar de caña.

Palabras clave: caña de azúcar, cadena productiva, tendencia decreciente.

INTRODUCTION

Optimizing resources in industrial and commercial environments is key to achieving efficiency and competitiveness (Abanin *et al.*, 2019). The responsible use of available resources is essential to maximize productivity and reduce waste, which, in turn, generates greater added value in operations (García *et al.*, 2024). This optimisation not only translates into economic benefits, but also a positive impact on the environment and on the sustainability of companies (Boscán, 2020).

This shows the need for coordination between actors in the productive sector to meet the needs of the demand for a specific product (Fernández y Bajac, 2018). In this context,

the production chain in the agri-food sector, with a value chain approach, proposes to improve the participation of these actors (Cayeros *et al.*, 2016). Effective collaboration between the different links in the chain ensures that each part of the process contributes to the final value of the product, allowing companies to offer unique products that customers perceive as such (Nova *et al.*, 2020). This is crucial to create value and properly segment potential customers, avoiding treating them as a homogeneous mass. As they point out Narváez *et al.* (2023) "the main challenge facing business organizations at this time is to face the challenge of changes in the environment and the needs of their customers".

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In addition, companies involved in value generation must modify their structures to integrate production processes with those of the companies with which they collaborate (Fernández & Sánchez, 1997). This coupling allows all parts to constitute a chain that creates value for both associates and end customers, strengthening their synchronous operation (Altman et al., 2019). This approach not only improves operational efficiency, but also fosters innovation and adaptability in the face of a changing market (Muñoz et al., 2024).

Taking into account the importance of adequate linkage for production processes, a novel issue in the Cuban agri-food sector, a diagnosis of the cane sugar value chain is carried out by the Boris Luis Santa Coloma Sugar Agroindustrial Company (EAA)

Given the growing need to innovate in the Cuban sugar sector to counteract the deficient reality that it presents today and promote the generation of value in the production of cane sugar, it is necessary to have a well-strengthened production chain that sustains the performance of the value chain, therefore, the general objective of this research is proposed: To analyze whether the raw sugar production process at the EAA Boris Luis Santa Coloma complies with the value chain approach; a component so necessary to revitalize the productive growth of the company, favoring territorial development under the care of the environment.

MATERIALS AND METHODS

In the course of this research, dissimilar methodological elements were used, which are expressed below:

- Documentary analysis of the information offered by the entity for the period: from January 2022 to June 2024.
- Application of a survey with an intentional or convenience non-probabilistic sampling with a focus on the value chain as expressed by Porter (2004). A sample of 20 respondents was taken between managers and process managers (Fernández & Bajac, 2018).
- Application of a survey regarding the production process with a non-probabilistic sampling, intentional or for convenience, to a total of 33 workers linked to the production process of obtaining sugar, which represents 35% of the workforce covered in said UEB. (Fernández y Bajac, 2018).
- An observation was made of the production process focused on the production chain from the entry of the raw material to the obtaining of the final product.
- A brainstorming session was held with the members of the board of directors.
- Noise measurements during the production process and mathematical analyses to determine noise and lighting levels.
- Application of an expert method, to define the most important effects on the deficient functioning of the sugar production chain than what is expressed in a weighted Ishikawa diagram.

RESULTS AND DISCUSSION

This research focuses on analyzing the functional value chain of a company dedicated to the production of cane sugar. To this end, a survey based on Michael E. Porter's value chain model (Porter, 2004; Quintero y Sánchez, 2006; Andaluza, 2015; Moreno et al., 2020; Riquelme, 2020; Laje et al., 2022). This study seeks to offer a comprehensive view of the behavior of the parameters that make up this chain (Ramírez et al., 2021).

An anonymous survey was conducted with a total of 20 managers and process managers involved in the raw sugar value chain, from the cane harvest to its commercialization (García et al., 2024). The evaluation focused on primary activities including: inbound logistics, operations, outbound logistics, marketing and sales, as well as after-sales service. In addition, support activities were considered: procurement, technological development and innovation, human resources management and infrastructure (Fernández y Bajac, 2018).

As for the *inbound logistics*:

It presents positive results in general because there is a permanent staff to receive the supplies that enter the warehouse, they use records to carry out a control at the time of receiving the supplies, the place destined to store and preserve the supplies is appropriate and the company distributes the product to customers in the requested time.

The need to improve the physical inventory of finished products remains a weakness.

Regarding *operations*:

The marketing of finished products is carried out immediately, and the company works on the continuous improvement of transformation processes. As a negative aspect, it is noted that the company almost always faces difficulties in transforming inputs into the final consumer product.

Regarding *outbound logistics*:

Upon delivering the products, customers pay for the product. Negatively, it should be mentioned that when distributing the products, a route plan to reach the customer is almost never made.

Regarding *marketing and sales*:

The company makes its products known through advertisements and promotions, sometimes incentivizes customers at the time of purchase, and almost always provides customers with information about product queries.

From *post-sale services*:

The company sometimes replaces products at the end of their validity period.

Regarding *supplies*:

The company evaluates suppliers before making purchases of raw materials. Negatively, it is known that the company almost never guarantees the supply of inputs for the production process and almost never has inventory to rotate product stocks.

Associated with *technological development and innovation*:

Negative aspects stand out here, as the company almost never uses the necessary technology for the transformation of inputs and is almost never focused on the innovation of products, services, or processes.

Regarding *human resources management*:

Favorable elements to consider include that the company sometimes seeks qualified candidates to fill positions within the organization, conducts training for workers, and cares about the development and growth of its employees.

Delving into *infrastructure*:

The company has a good structural organization, motivates workers to carry out their functions, performs periodic controls of the activities carried out, and there is availability of equipment to meet production needs.

As negative elements, the entity does not have a clear vision and mission, there is almost never an increase in revenue from the sale of goods and services, and there is almost never a decrease in costs per production unit.

The sugarcane value chain is a complex system that encompasses multiple stages, from the harvesting of the fundamental raw material, sugarcane, to the marketing and distribution to the final consumer. Currently, it has been identified that the chain in question does not comply with the value chain approach due to significant issues that prevent the fulfillment of the model proposed by Porter (2004). Irregularities have been detected in primary operations (deficiencies in the physical inventory of finished products, difficulties during the production process to obtain the final product, the absence of a customer-focused delivery route design) and in support operations (difficulties in ensuring the supply of raw materials during production, the use of inadequate technologies during the production process, as well as the entity's lack of clarity regarding its mission and vision).

In summary, it can be seen that the current value chain does not fully comply with the value chain approach, as there are disconnected links whether due to production, transformation, or marketing relationships, a lack of technical and economic linkages among the agents involved in the activities, and the absence of specific actors in supplier and customer links to optimize collaboration and generate competitive advantages and value in the chain. The localized networks of production companies' main management strategy focus on production management.

In mathematical terms, the company's performance in relation to sugarcane production (Figure 1), agricultural yield (Figure 2) and sales (Figure 3), is shown for the period from 2019 to 2024.

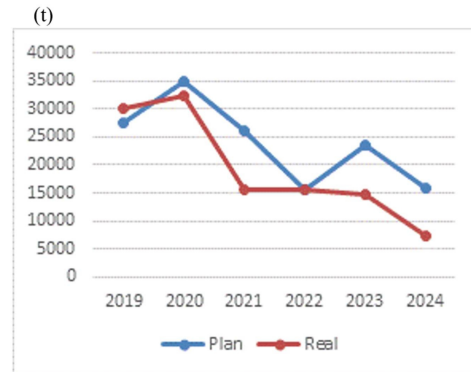


FIGURE 1. Sugarcane Production (t).

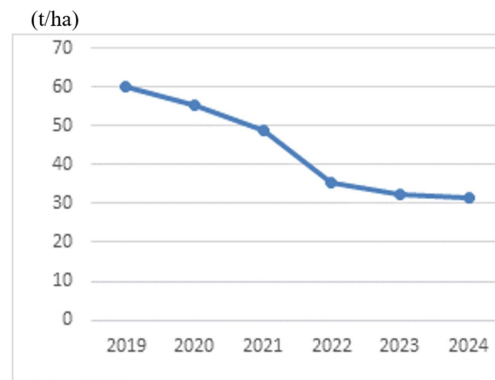


FIGURE 2. Agricultural Yield (t/ha).

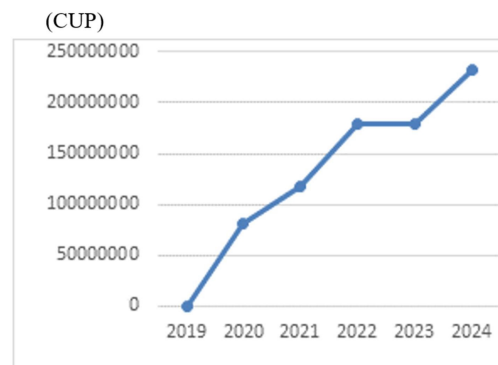


FIGURE 3. Sales Revenue (CUP).

The production of sugarcane has followed a downward trend, with a notable decline in 2022. Although there was a slight recovery in 2023, production decreased again in 2024. The decrease in production is mainly due to the reduction in agricultural yield. This affects the company's ability to meet its production plans.

Despite the fluctuations in production, sales revenue showed a significant increase until 2022, stabilizing in 2023.

However, the company has managed to maintain or even increase its revenue through optimized pricing strategies and efficient commercial management.

Noting that the weakest link is the industrial part, it was decided to delve deeper into the study of the productive chain, which encompasses everything from the entry of raw materials to their transformation into the final product.

Ensuring the success and sustainability of any value chain involves establishing a solid productive chain. This structure is fundamental for incorporating value into each of the links in the production process. Therefore, it is necessary to carry out an exhaustive analysis of the productive chain to determine its current state and propose improvements to optimize its functioning.

The analysis of the production process begins with the application of a survey designed to investigate key aspects related to the assurance of materials, raw materials, human resources, and technical equipment. The objective of this survey is to obtain a general perception of the current situation in these areas, applied anonymously to a sample of 33 workers, representing 35% of the workforce covered by UEB 1 Production and Service with 94 employees.

The results obtained from the survey reveal positive aspects in the planning of resources by the organization, offering professional development opportunities, and workers receiving adequate training for the tasks they perform, with 93%, 84%, and 89% respectively of affirmative responses (Always).

However, areas requiring attention were also identified. Among the less favorable aspects are the necessary material assurance for production, the availability of raw materials and their condition upon arrival at the company; as well as other parameters such as performance compensation, communication between colleagues, and the functioning of equipment, with 70%, 60%, 62%, 73%, 80%, and 74% respectively being factors that are in a regular condition and should be subject to more detailed analysis.

The most critical aspect identified in the results was health and safety in the workplace, with 68% unfavorable responses from the respondents.

Based on the guidelines established from the results obtained, an observation will be carried out in the production area focused on meeting production times, the technological functioning of the mill, and the identification of occupational hazards. There are delays in production times causing non-compliance with final deliveries/Delays in the arrival of the main raw material (sugarcane)/Unexpected breakdowns during milling. Problems in steam generation/Obsolete machinery technology/Inadequate maintenance due to lack of parts and lubricants.

Workers do not adequately use helmets in production areas/Poor lighting as only about 13 lamps are observed in the production area, some even with burnt-out lights/Loud noise from machinery/No signage in high-risk areas was observed.

A brainstorming session was held with the entity's management to identify the underlying causes of the

main problems previously detected. During this session, various concerns affecting operational performance were discussed, including:

Instability in the supply of the main raw material, which does not meet the required quality standards from suppliers.

Shortage of spare parts and lubricants needed for the maintenance of technical equipment.

Loss of software programs containing critical information related to the company's operations.

Absence of a clearly defined production chain, which hinders process efficiency.

The lack of identification of the limiting points within the production process.

Problems associated with the supply of 90W cool white lamps.

These weaknesses were among the key aspects highlighted during the brainstorming session. This technique facilitated the identification of other issues within the entity that had not been previously recognized, notably the loss of valuable information crucial for the center's operation.

As a result of the critical information loss, it was decided to conduct a thorough analysis of the operational flows within the company. This analysis allowed for the identification of various areas for improvement that are fundamental to optimizing processes and minimizing the risk of future information losses.

Systems Integration: Optimize the flow of information between different departments.

Process Automation: Automate repetitive tasks to increase efficiency and reduce errors.

Improve Information Security: Implement security measures to protect sensitive information.

Adopt New Technologies: Explore the implementation of new technologies, such as artificial intelligence or data analysis, to optimize the production process.

Once the deficiencies detected through the various methods and techniques applied were channeled, a triangulation process was carried out that revealed significant limitations in the proper functioning of the sugarcane production chain, namely:

Impacts on occupational health and safety; Inadequate equipment maintenance; Unexpected breakdowns during the production process; Deficiencies in material assurance; Delays in production times; Loss of critical software programs for operation. Based on the results obtained through the triangulation, an Ishikawa Diagram, **Figure 4**, was developed, applying a weighting approach. For this purpose, 8 experts from the center were selected.

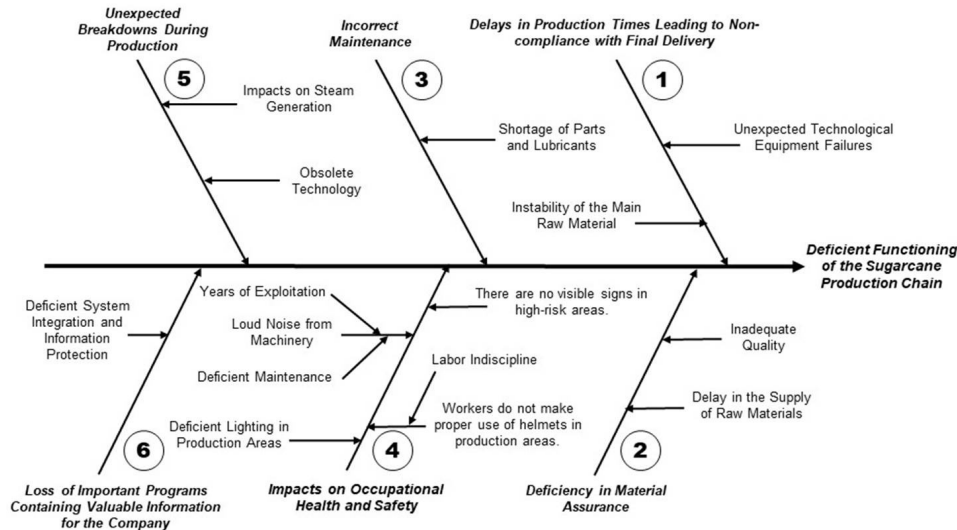


FIGURE 4. Weighted Ishikawa Diagram.

The identified deficiencies present a significant obstacle to the proper functioning of the production chain of the product under study, indicating that the chain is not in optimal condition. Before considering the implementation of a value chain, it is imperative to address and correct many of these issues, which hinder the fulfillment of the necessary requirements to establish an effective value chain.

Resolving these deficiencies is not only crucial for improving operational efficiency but also fundamental for ensuring the quality of the final product and customer satisfaction. Therefore, corrective actions should be prioritized to optimize processes and facilitate the development of a solid and sustainable value chain.

CONCLUSIONS

- The investigation into the sugarcane production process and its value chain at the Agroindustrial Sugar Company Boris Luis Santa Coloma has revealed deficiencies in its value chain, affecting its sugarcane production.
- Irregularities in primary and support operations, along with the disconnection of links in the production chain, have negatively impacted the competitiveness and sustainability of the company.
- To reverse this situation, it is crucial to implement improvements in the production process, increase agricultural yields, optimize the supply of raw materials, and strengthen coordination among the different actors.
- A solid production chain will allow the company to revitalize its growth and effectively meet market needs.

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