ISSN Electrónico: 2500-9338
Volumen 23-N°1
Año 2023
Págs. 211 – 225

SOCIO-FINANCIAL FUNCTIONING OF SUGARCANE (SACCHARUM OFFICINARUM L.) PROCESSING FOR THE PRODUCTION OF PANELA: THE CASE OF THE BELLAVISTA VILLAGE.

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Fecha de Recepción: 21 de Enero de 2023
Fecha de Aprobación: 27 de Abril 2023

SOCIO-FINANCIAL FUNCTIONING OF SUGARCANE (SACCHARUM OFFICINARUM L.) PROCESSING FOR THE PRODUCTION OF PANELA: THE CASE OF THE BELLAVISTA VILLAGE.

Abstract:

The cultivation of sugarcane for panela production has been an economic and social alternative to diversify farm income. Thus, in the study site, this crop has been grown for more than forty years, and there needs to be clarity on the social and financial aspects of the sugarcane-producing farms, which could account for groups of farms by social and financial arrangement. The paradigm that guided the research was the analytical, empirical one, with a descriptive type of research. As a result, it was obtained that the main determinant of the similarity groups in the sugarcane producers' farms is the production expenses; however, the Ebidta margin has a differential behavior by a social and financial arrangement identified.

Keywords: farmers, economy, panela, production, rurality.

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FUNCIONAMIENTO SOCIOFINANCIERO DEL PROCESAMIENTO DE LA CAÑA (SACCHARUM OFFICINARUM L.) PARA LA PRODUCCIÓN DE PANELA: EL CASO DE LA VEREDA BELLAVISTA

Resumen :

El cultivo de caña para la producción de panela ha sido una alternativa económica y social para diversificar los ingresos en los predios. Así pues, en el lugar de estudio, este cultivo lleva más de cuarenta años, y no se tiene claridad sobre los aspectos sociales y financieros de los predios productores de caña, que pudieran dar cuenta grupos de fincas por arreglo social y financiero. El paradigma que guio la pesquisa fue el empírico analítico, con un tipo de investigación descriptiva. Como resultado, se obtuvo que el principal determinante de los grupos de similitud en las fincas de los paneleros son los gastos de producción; sin embargo, el margen Ebidta tiene un comportamiento diferencial por tipo de arreglo social y financiero identificado.

Palabras Claves: campesinos, economía, panela, producción, ruralidad.

FUNCIONAMENTO SOCIOFINANCEIRO DO BENEFICIAMENTO DA CANA-DE-AÇÚCAR (SACCHARUM OFFICINARUM L.) PARA PRODUÇÃO DE AÇÚCAR MASCAVO: O CASO DO POVOADO DE BELLAVISTA

Resumo:

O cultivo da cana para produção de rapadura tem sido uma alternativa econômica e social para diversificar a renda nas propriedades. Assim, no local de estudo, esta cultura existe há mais de quarenta anos, não havendo clareza sobre os aspectos sociais e financeiros que determinam as tipologias. O paradigma que norteou a pesquisa foi a pesquisa empírica analítica e descritiva. Como resultado, verifica-se que os principais determinantes dos grupos de fazendas são os custos de produção; no entanto, a margem Ebidta tem um comportamento diferenciado por tipo de arranjo social e financeiro identificado.

Palavras-chave: camponeses, economia, panela, produção, ruralidade.

1. INTRODUCTION:

According to Gutiérrez-Mosquera et al. (2018), India holds the top position in the production of non-centrifugal sugar (NCS), followed by Colombia, which also leads in per capita consumption with an average of 24.7 kg year^-1. Regarding sugarcane areas, the National Agricultural Survey (ENA) (DANE, 2019) reported that there are 205,614 hectares planted in the country, spread across 29 departments nationwide, of which 90.1% are in the productive stage and produce 1,098,206 tons of panela annually.

As per FEDEPANELA (2019), this crop benefits 350,000 families who operate on 69,980 estates and 18,473 panela mills. The cultivation tasks include planting, plantation management, harvesting, and post-harvesting and involve around 40,895,268 workdays per year; hence, it is the second-highest activity in rural employment generation. In this regard, Ramírez and Rodríguez (2019) specify that the juices are obtained and processed in artisanal mills, involving 12.8% of the economically active rural population.

Despite the significance of this agro-industrial activity, there are constraints, such as climatic conditions, which do not allow for 100% optimization; However, sugarcane is a crop that adapts to various conditions. Its yield and productivity are highly affected by excessive rainfall and prolonged drought periods (Volverás-Mambuscay et al., 2020).

In the department of Caquetá, the panela agro-industry represents a vital economic sector for dozens of families who rely on it for their livelihood. However, in this territory:

> ....harvested 5,097 hectares with a production of 27,957 tons, which represented a participation of 2.43% of the national production, being this the best production report since 1990; these values are still insufficient since the supply of this product does not compensate for the demand needs, and this leads to the need to transfer products from various regions of the country (Ruíz, 2020, p.35).

Specifically, in the San José del Fragua municipality, there are 868 hectares of sugarcane, and 5,432 tons of panela are produced in the year, benefiting more than 150 households that depend on this productive activity. While the productive issue is somewhat clear in some areas, it is not so in yield and much less about the profits generated by the exercise (Alcaldía de San José del Fragua, 2018).

In the specific case of the panels of the Vereda Bellavista in the Municipality of San José del Fragua, they are unaware of the behavior of the profitability of their productive activity while considering it important to analyze their socio-financial reality and identify neighbors with similar conditions and thus design strategies to address the problems, collectively and move forward with their crop and the generation of their finished product. Therefore, this research aimed to characterize socio-financially the panela-producing families of the participating village.

2. THEORETICAL FRAMEWORK

Characterization of production systems

Characterization is a descriptive study built from quantitative and qualitative data to approach the knowledge and understanding of the systems and dynamics related to an object of interest (Surichaqui, 2022).

In the case of production systems, these are understood as a conglomerate of technical, social, economic, and institutional aspects that cooperate to achieve the generation of an agricultural product (Orjuela, 2020), which subsequently, when the articulation is achieved from the field of production to the consumer, oriented towards the final destination, where there is economic integration of activities, we speak of agribusiness (Castañeda et al., 2018).

Thus, to configure an agroindustrial system, four basic situations are required: supply of inputs to agriculture, livestock production, processing, and the market.

ISSN: 1794-9920 Impreso / Electrónico 2500-9338
January - April.. Volumen 23 Número 1, Año 2023 Págs. 211-225

Institutionality

It corresponds to the regulatory and cognitive agreements and norms defining social behavior. This research refers to all possible formal and non-formal socio-financial arrangements that have allowed a collective to function and maintain itself over time (Appendini and Nuijten, 2002). In this order, the:

> Formal institutions are those that refer to written rules or duly organized structures. And informal ones are unwritten rules that, over time, are incorporated and assimilated by society as part of its customs (Pimienta and Suarez, 2014, p.14).

EBITDA ratio

Earnings Before Interest, Taxes, Depreciation, and Amortization (EBITDA), according to Universidad EAFIT (s.f.):

> It is a financial indicator that allows the approximation of a company and can be obtained through the income statement; it shows the adjusted profit without taking into account interest, taxes, depreciation, and amortization; for this reason, EBITDA allows to obtain a clear idea of the operating performance of companies, and it is possible to compare the profitability, in itself, and relation to other companies, how well or poorly they do in the operational area (p. 1).

The calculation of EBITDA is derived from the information in the Income Statement, using the formula: EBITDA Margin = Gross Profit - Production Expenses + Depreciation Costs + Amortization Costs. Regarding the formula above, the following should be considered:

- The difference between Revenues and Production Costs determines gross Profit.
- *Production Expenses:* consolidate administrative expenses (personnel, services, among others) and sales expenses (personnel, transportation, among others).
- *Depreciation Costs:* are transferred from the accounting system. If they do not exist, the straight-line method is used, as it is the most commonly applied.
- *Amortization Costs:* when present, will be based on the information provided by the accounting system.

Regarding the indicator above, Bonmatí (2012) has stated that:

> EBITDA has the advantage, therefore, of eliminating the bias of the financial structure, the fiscal environment (through taxes), and 'fictitious' expenses (amortizations). In this way, it provides a clear idea of the operational performance of companies. It allows for a more appropriate comparison of how well or poorly different companies or sectors perform purely operational (p. 19).

3. METHODOLOGY

The Bellavista village is located on the slopes of the eastern mountain range in the Amazonian Andean piedmont, the jurisdiction of the municipality of San José del Fragua, department of Caquetá - Colombia (Corporación RECONOCER, 2009; CORDESPA, 2018). It comprises 37 rural families, of which 15 are the population participating in the study, with sugarcane panel crops in an area of 28 hectares.

This research is based on the analytical, empirical research paradigm since it assumes reality as a whole, which can be studied from the fragmentation of its parts, and the result is of interest because there is only one truth (Gutiérrez, 2014). The type of study is descriptive since, through investigating the behavior of some variables, the studied reality is known (Sampieri et al., 2014).

The method

Description of the technical process of sugarcane processing for the production of panela (sugar cane sugar)

Field visits and accompaniment were made during the milling process, from the preparation of the complex and raw materials to the packaging of the finished product.

For this purpose, the participant observation technique was used, with a written and photographic recording guide, with basic statements to direct the observations:

activities developed, places, actors, roles, times, and materials; this information was systematized and ordered chronologically in the development of the activity.

Characterization and socio-economic typification of sugarcane-producing households

A socio-economic questionnaire was carried out to 100% of the population participating in the study, including questions such as planting areas, ages, frequency of cutting, yield, pest and disease management, labor, etc. This information was processed in Excel and Infostat, where the respective output diagrams were generated.

Ebidta margin analysis

Through field visits, informal dialogues with the community, and to avoid difficulties or errors in the estimates, the terminology was unified around: bundles, loads and bundles and a checklist of activities, inputs, and labor performed by the paneleros during the entire transformation process were designed, accompanied by a financial questionnaire, which was verified through on-site observation.

The following data were taken: income and production costs: raw material costs (fuel, motor oil, plastic bags, paper bags); labor costs (cane cutting, firewood collection, pailero, hornero, prensero, bagacero, banquero); indirect manufacturing costs (valvulina), production expenses, transportation - crop - complex, complex transportation - point of sale, drainage, cleaning of infrastructure and depreciation expenses: With this information and using the EBITDA calculation methodology, the respective EBITDA margin was calculated for each particular case.

4. RESULTS:_

Description of the technical process of sugarcane processing for the production of panela (sugar cane sugar)

Description of the technical process of sugarcane processing for the product the preparation of the sugarcane to be taken to the "complex" - as the place where the cane is processed is called - usually begins on Monday and lasts until Thursday. If the quantity to be processed is small, the family unit carries out this activity, so there is no need to hire external labor. However, even if the amount of sugarcane is smaller, this process takes the same 4 days as if there were a larger quantity requiring the hiring of external personnel.

Once the sugarcane is cut, it must be taken to the complex, as it cannot be exposed to the sun. Stalk by stalk, they are organized and formed into bundles tied and transported by animal-drawn carriage or on the back of a beast to the complex facilities. The exact time it takes for this transport is still being determined; this was estimated considering the time taken for each trip and the number of trips made.

Activities in the complex generally start on Thursday evening or early Friday, depending on the number of panela bundles to be produced. When production exceeds 15 bundles, the engine is started at ten or eleven on Thursday night, and when it is less, around one in the morning on Friday.

In the Bellavista district, there are three complexes for sugarcane processing; one is community-based – the infrastructure belongs to the community – and two are private complexes – the infrastructure belongs to an individual. However, the technology and machinery they use are similar, consisting of a diesel engine and a mill where the sugarcane is "pressed" to produce the juice; steel pools where the juices are collected; settling tanks where the juice is cleaned; a cooking battery, and a molding room.

The process consists of milling the sugarcane in the mill to extract the juices; then, through a pipe, the juice is led to the settling tanks, where it is cleaned. Then the sugar-rich liquid goes to the cooking battery, where there is an oven with two large round basins, two square boilers, and a final basin where the syrup is finished before finally going to the molding room.

Generally, from the moment the engine is turned on until the first panela batch is produced, it takes about 2 hours, and from then on, a new panela batch comes out every half hour. It's worth mentioning that these times depend on the skill and knowledge of the oven

operator and the boiler operator, who play the most significant roles in the process.

In addition to this, the size of the basins in each complex determines the amount of panela produced in each batch. For the complexes in the Bellavista district, this production ranges between 120 and 130 pounds of panela, that is, approximately one bundle of 30 bundles or slightly more.

At the end of the process, the basins and boilers are filled with water to prevent burning and left this way for about two days. Once they are completely cool, the cleaning tasks of the complex are carried out.

According to the information provided by the families, no chemical products are used in this district to improve the presentation of the panela. Only cooking oil is used in the leading basin to prevent it from burning due to the high temperatures (+/- 127 °C) managed for the setting of the panela (sugar cane sugar)

Roles in the processing of sugarcane: the labor force in the complex always exceeds five or six people in the roles of:

-*Pailero*: is the person in charge of stirring the guarapo between the bottoms and boilers and, at the end of the cooking process, giving the melado and then molding the panela.

-*Hornero:* is in charge of supplying the fuel to the burner and maintaining the temperature at the appropriate levels.

-*Prensero:* is in charge of introducing the canes into the mill for the extraction of the juices.

-*Bagacero:* is the one that receives the bagasse that comes out of the mill and stacks it in the spaces destined for that purpose.

-*Banquero:* is the person receives the molasses from the pailero, performs the cooling process in the tacha, and then passes it to the molds where the panela is shaped.

Characterization and socio-economic typification of panel households

Panelero households comprise an average of four people, with most families consisting of fathers, mothers, and children. The highest number of children per household is 4, and the lowest is 0. The average was 2 children, and the most frequent was 3. The average area under sugarcane cultivation per farm was 1.8 hectares, with the highest being 3 hectares - owned by only three producers - and 0.25 hectares, the lowest.

- *Frequency of sugarcane processing for panela production*

According to CORPOICA (1999), the timing of the sugarcane harvest is determined by its maturity level. This maturity is influenced by temperature, altitude, and flowering. Therefore, the intervals between harvests can be shortened or extended. Notably, the lower the altitude, the less time it takes to achieve the required maturity level for harvesting. Sugarcane can be harvested uniformly—cutting all at once—or selectively, cutting only the stalks that are ready. In this case study, it was identified that harvesting is done selectively. The frequency of this method was one of the most diverse practices observed among the properties. Some producers were uncertain about their harvest frequency, claiming they rely on intuition, cutting "when the cane is about to be wasted" (p. 61).

CORPOICA (2000) states that one of the advantages of selective sugarcane harvesting is that "it is a suitable system for small areas where the farmer uses sugarcane merely for subsistence" (p.59). However, even though the farmers in this study have small planting extensions, the production is for more than self-consumption but also surplus sales. They argue that with this technique, there's less cane to process and, thus, less molasses output. It is because the spacing between their crops is very narrow, allowing less light penetration and non-continuous shoot germination. It makes the effort seem unrewarded, as operational costs are higher while production is lower.

Despite these perceived disadvantages, the farmers don't risk uniform harvesting. Since the areas are small, the first batch harvested wouldn't reach maturity by the end of all harvests, meaning they wouldn't have sugarcane ready for processing. Technically, the ideal harvest time is when the sugarcane shows maturity symptoms like a change in internode color, reduced distance between them, decreased leaf count, and a chlorotic appearance. However, these factors are highly variable among the individuals in a batch. Therefore, when the "panelero" mentions they decide "by eye" "when it's about to go to waste," they're referring to these symptoms present in most of their sugarcane stalks. Due to the narrow spacing, light distribution at the stalk base is unequal, leading to uneven maturation and affecting molasses' quality and output (CORPOICA, 2000).

By analyzing harvest frequency concerning the crop's age, there was a direct relationship. Older crops had shorter intervals between harvests, meaning older crops produced molasses more frequently—although not necessarily at a higher yield. This frequency is closely related to the sugarcane hectares on each property. Larger areas result in more consistent harvesting.

Reviewing statistics of sugarcane areas planted in the Caquetá department in 1998, there were 3,960 hectares with a yield of 5.4 tons per hectare per year (ICA, 2011). By 2014, the area had increased to 5,445 hectares but had a reduced yield of 4.20 tons per hectare (MINAGRICULTURA, 2014). In 2019, 5,271 hectares were planted, but only 4,746 were harvested, yielding 5.27 tons per hectare, making it the fifth lowest in the country (MINAGRICULTURA, 2019).

From the above, sugarcane cultivation areas in the department have declined in the past five years, along with harvested areas and production yield. These cultivation areas are owned by small farmers, usually at most 3 hectares. Since 2014, no new plantings have been reported, suggesting current crops are at least seven years old, consistent with most properties in this study case processing for panela production.

- Panela production performance about cutting and processing frequency

Panela production perforIn line with the above, it was analyzed whether cutting frequencies could become a determining factor when obtaining more or less panela production per year; however, no significant correlation values were found between these variables. For instance, property #1 has the highest yield in ton.ha.year, among all the properties, with a value of 3.9 ton.ha.year, whereas the yield of property #11 was the lowest at 0.6 ton.ha.year. Nonetheless, both properties have similar cutting frequencies—30 and 60 days, respectively. Later, it was examined if the yield in ton.ha.year was related to the age of the crops, and no relationship was found either.

Similarly, there is a relationship between production frequency and bundles of panela produced per grinding. One would expect that plantations harvested with a longer maturity would have a higher yield; alternatively, those similar in area and cutting interval would also have similar production. However, as seen in Table 1, plots 8 and 14 cut sugarcane and produce panela every 60 days, yet, their yield differs considerably. Plot 8 produces 6 bundles of panela, whereas plot 14 produces 12 bundles, having the same cultivated area. Properties 1 and 7 have a high cutting and processing frequency—every 15 days—though with different areas, 1.5 hectares and 1, respectively, they have the same production regarding the total number of bundles generated (Table 1).

This scenario suggests that what determines the yield in panela tons per hectare is neither the crop's age nor the area itself nor the production frequency. Moreover, it can't be attributed to low or high yields in processing as correlating sugarcane loads per grinding and produced panela bundles; 80% of the study properties show a 3:1 ratio. In comparison, 15% have a 4:1 ratio, and only 5% have a 2:1 ratio.

Returning to the data from ICA (2011), MINAGRICULTURA (2014), and MINAGRICULTURA (2019), presented in the previous paragraph, regarding the yield in ton.ha.year, it is evident that this variable,

in the study properties, is below the departmental average. Moreover, this yield doesn't show a significant relationship with cutting frequency or crop age, as seen in Table 1. Hence, cutting frequency wouldn't be a determining or significantly impacting factor in this result.

Therefore, the yield of panela in tons per hectare per year would be determined more by the crop's agronomic conditions than by age, cutting frequency, or the relationship between sugarcane loads and the amount of panela obtained. It is confirmed in the case of farms #4 and #14, with 1 hectare of established sugarcane, cutting frequencies of 120 and 60 days, respectively. They had nearly the same number of sugarcane loads to process, and the yield in tons per grinding was equal to 0.72. However, the difference in ton.ha.year yield is significant, with farm #14, the one with lower performance, doubling farm #4 (Table 1).

While cutting frequency and crop age are not strong determinants of ton.ha.year production yield, they do influence the variables of the finished product. Following Mosquera et al. (2007), product variables directly affect its quality or presentation. The number of cuts in a plot determines the quality of the panela produced; an older crop, i.e., with more than five cuts, will produce finished products with issues, especially with color.

Another factor affecting panela production yield beyond the cutting method is the identification of maturity, which, as mentioned, is done by eye without using technical measures such as estimating upper and lower Brix degrees. Both immature and overripe canes, which contain a high amount of reducing sugars that damage the grade of the panela, make it to the processing site. It also complicates juice management and lowers yields (CORPOICA, 2000)

Table 1. Production of panela according to crop age and frequency of cutting

Property #	Area in Cane (Has)	Crop Age (Years)	Production Frequency (Days)	Tons in milling	Tons / Hectare per year.
1	1,5	5	15	0,16	3,9
2	1	2	180	0,36	0,7
3	1,5	9	30	0,2	2,4
4	1	5	120	0,72	2,2
5	3	30	20	0,18	3,3
6	3	15	30	0,16	1,9
7	3	30	15	0,08	1,9
8	1	7	60	0,36	2,2
9	6	40	20	0,15	2,7
10	0,25	7	180	0,96	1,9
11	2,5	10	60	0,096	0,6
12	1	4	60	0,36	2,2
13	1	15	30	0,18	2,2
14	1	10	60	0,72	4,4
15	1	8	100	0,6	2,2

Source: own elaboration

Although the cutting and production frequencies vary considerably across the board, when calculating the annual yield in tons per hectare, it tends to stabilize at 2 ton.ha.year. There are outliers, such as plot #14 and plot #1 which reported 4 tons.ha.year, and the ones with the lowest yields, in this case, plots #11 and #2, which reported 0.7 and 0.6 tons.ha.year, respectively. This yield is significantly below the average for the Caquetá department, which, according to ICA (2017), ranges between 4 and 5 tons.ha.year.

It's worth noting that while the cutting frequency doesn't show a significant difference in the number of sugarcane loads obtained per cut, at an annual level, there were notable differences. In periods with longer intervals between cuts, a lesser quantity of sugarcane is utilized. It is because an extended duration results in

a significant percentage of stalks exceeding their optimal maturity, reaching Brix degrees higher than 1. When processing occurs under these conditions, there are anticipated challenges in achieving the ideal texture and color for the final product (Mosquera et al., 2007)

-Costs associated with the transformation process

Among the costs associated with transformation processes, those generated by the following activities were characterized: the preparation and cutting of the sugarcane, its transportation from the field to the complex, the setup of the complex, operations within the complex, "trenaje" (a specific processing stage), packaging, and finally, the transportation of the panela to the sales location.

Considering that, in the studied fields, the areas designated for sugarcane cultivation range between 1 and 3 hectares—with a minimum of 0.25 hectares and a maximum of 3 hectares, cases which occur only on two fields—the number of daily wages utilized per field for each of the specific transformation activities are found to be similar.

In this context, for the preparation of raw materials, panela-producing households invest between 3 and 4 daily wages for $35,000 per day. Similarly, for the transportation of sugarcane from the fields to the processing complex, the average is around 3.5 daily wages, with the cost being lower for fields where the complex is located. This cost relationship aligns with reports from the interior of the country, specifically in Villeta, where the number of daily wages for sugarcane cutting is similar to those used for lifting and transportation—counting both person-hours and hours using mule transportation—and stacking the sugarcane. In this case, the ratio per hectare is 38 daily wages for cutting and 37 for lifting and transportation (SIPA, 2018).

The "trenaje" cost, which depends on the number of bundles processed, varies based on whether the sugarcane is processed in a specific panela complex or a community one or if certain materials required for processing are brought in. Thus, some fields pay $5,000 for "trenaje" per bundle of produced panela, while others reported costs up to $14,000. Additionally, during processing in the complex, one must pay for the labor of the "pailero," the "hornero," the "prencero," the "bagacero," and the "banquero," with the first three charging $6,000 per bundle and the latter two $4,000 per bundle.

It follows that out of the $1,468 per kilogram, which on average a sugarcane farmer must pay for the transformation process of sugarcane into panela, including its sales and marketing costs, 30% goes to transformation costs, encompassing exclusively the milling work in the complex. Next are sugarcane preparation costs, such as cutting and load organization at 23%, and closely following are the transportation costs of this raw material to the manufacturing site. Other costs like "trenaje" complex setup and marketing make up 9%.

According to DANE (2017), in the department of Antioquia, the highest post-harvest costs for panela are labor, accounting for 55.18%, followed by other expenses at 31.14%, inputs at 13.00%, and transportation at 0.68% respectively. If one narrows down to only processing costs for analysis, the highest costs are again in labor (SIPA, 2018). It aligns with the findings in the study farms, where only 9% of processing costs are related to warehousing and packaging issues for marketing. At the same time, activities like sugarcane preparation, complex setup, sugarcane transportation to the complex, transformation, and "trenaje" are costs generated by labor payment.

Thus, whether processing in a community or private complex, the panela production costs in the study area are quite high, hovering around 30%. This leads to a low level of competitiveness in the agro-industrial exercise. This situation is similar across the country where cultivation areas are less than 5 hectares, as the processing infrastructure could be more efficient, and the economic conditions of producers are low, preventing them from accessing investment loans. Furthermore, there are weak organizational and

associative processes, causing many farmers not to view panela as a significant economic activity for their income (Mojica & Paredes, 2004).

-Involvement of Family and Hired Labor in the Process

During the transformation process, both family and hired labor are utilized. On average, 53% of the labor is hired, and 46% is from the family. In 6 out of the 15 households, the participation of family labor in processing activities exceeds that of hired labor, with two fields where family labor accounts for 100% of the workforce. Similarly, hired labor surpasses family labor in 9 households, and in two fields, the hired labor comprises almost 100%. According to FAO (2004), this situation demonstrates how panela production becomes a strategy for income diversification in rural areas.

Kinship ties, neighborly relations, and identities among local actors, which allow for essential monetary and non-monetary exchanges facilitating the movement of labor, land, and capital, are a key element for the survival of the family unit and the economic and social stability at the local and regional levels (FAO, 2004, p.25).

Types of households identified

Once it was verified that neither the age of the crop, the number of hectares, nor the cutting and transformation frequency showed a significant difference in determining similarity groups, the variables of the type of complex in which they process, range of transformation costs per kg of produced panela, percentage of employed family labor, and percentage of hired labor were correlated.

Type of complex in which they process: In the village, there are four panela complexes for transforming sugarcane into panela. One is communal and was donated by USAID, while the other three are private, owned by panela-producing peasants. These owners allow their neighbors to use their infrastructure for processing. In return for this activity, the raw material owners must pay the complex owner a "trenaje" fee. In line with this, FAO (2004) suggests that, in Colombia, in the case of small sugarcane-producing units for panela, it is common to rent mills or, failing that, to arrange milling in partnership and/or sharecropping, as well as the high employment of family labor and the hiring of temporary workers for milling tasks.
In this context, three types of processing were identified: communal, private, and own. "Own" refers to situations where the sugarcane owner is also the complex's owner, where they process their raw material.

Of the fifteen properties studied, it was found that 6 producers process in the communal complex, 7 in private complexes, and 2 in their complexes. It should be noted that although three private complexes exist, one of these properties does not have established sugarcane. Thus, it is only used for renting to other peasants in the village.

Relation of the participation of family and hired labor in the process: Concerning the participation of family labor (MOF) and hired labor (MOC), the situation is very heterogeneous. In some properties, MOF predominates, while in others, MOC does, so it's also not a variable that determines the constitution of the types of socio-financial arrangements.

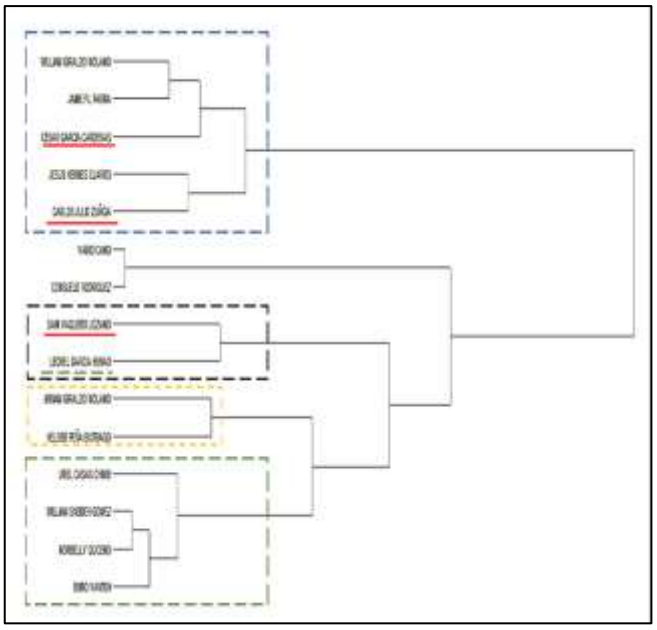
*-Transformation Costs***:** The transformation cost per kg of produced panela, though it varies significantly from one property to another, with minimums of $880 and maximums of $1996/kg of panela produced, is one of the main determinants of similarity groups, along with the types of processing. These figures align with the statements made by the commercial director of Fedepanela, Carlos Guerrero, who indicated that the production costs of panela depend on the region, but the average stands at two thousand pesos (Salazar, 2019). However, what Salazar mentions considers the entire process: establishment, maintenance, harvest, and post-harvest. Meanwhile, the costs assessed in the current study only concerned the post-harvest phase, which would undoubtedly place them above this national average.

Given this, through cluster analysis with a cophenetic correlation of 0.602, 5 similarity groups were identified, which we termed socio-financial arrangements. These were determined by variables related to transformation costs, and the percentage relationship between family

labor determined 2 groups and hired labor employed (Figure 1):

Type 1. Community socio-financial arrangement -high transformation costs-: In this type of arrangement, there are 5-panel producers, which are the ones that appear in the box in blue spacing. In this group are located, underlined in red, the producers of rank 3, which are those whose transformation costs are in the range of $1,608 and $1,650, and those without underlining, are producers of rank 4, which correspond to a transformation cost above $1,650. These 5 producers are then those who have the highest costs of transformation/ kg of panela obtained, between $1500 and $2000, respectively; at the same time, they have the lowest drainage than all the others, being this a canon of $5,000/bundle of panela generated. In this type of arrangement, the cane owner places the materials to be processed, and they are also in charge of the preparation of the complex and its readiness, both at the beginning and end.

Figure 1. Types of socio-financial arrangements of panel households



Source: own elaboration

Type 2. Private Socio-financial Arrangement - Medium Transformation Costs: This pertains to those properties (4 in this case - highlighted in a green dashed box) that process in private complexes, and their processing costs range between $1,200/kg and $1,400/kg of produced panela. In this scenario, producers carry out the processing labor in the rented complex, but the lessor provides all the materials.

Type 3. Own Socio-financial Arrangement - Low Transformation Costs: This arrangement includes 2 producers who own their infrastructure and process on the same property; their production costs are below $1,100 - highlighted in a yellow dashed box. In this case, the variable that determined the group's similarity was again the processing cost, and the type of labor used was also irrelevant.

Type 4. Socio-financial Arrangement with High Participation of Family Labor: In this kind of arrangement, the group's similarity is determined by the labor variable, regardless of the production cost range. The 2 producers in this group - outlined in a black dotted box - fall within the second and third cost ranges, respectively; one processes in a community complex, the other in a private one. They are the only two cases where family labor exceeds 95%.

Type 5. Socio-financial Arrangement with High Participation of Hired Labor: This arrangement comprises two properties – without any specific highlight - that process in private complexes with processing costs ranging between $1,411 and $1,425. They are characterized by the fact that the hired labor employed in their operation exceeds 95%.

EBITDA Margin Analysis

As established in the theoretical section, the EBITDA margin allows the evaluation of the business's operational results without considering additional outlays. In other words, it provides an x-ray of the purely structural conditions of production. However, for this specific analysis, it is crucial to mention that the cost structure does not consider the main raw material of panela, sugarcane. It is because the consulted

ISSN: 1794-9920 Impreso / Electrónico 2500-9338
January - April.. Volumen 23 Número 1, Año 2023 Págs. 211-225

stakeholders do not keep records of their investments, nor do they quantify their labor (in economic terms). Additionally, being a traditional crop, historical records could be more useful. Therefore, to avoid biases in the information analysis, one must consider that the EBITDA indicators described in the following tables also encompass the value of sugarcane, which is not accounted for in the production costs.

While the above is a limitation regarding handling financial data, its impact is mitigated since it's widespread. All the consulted stakeholders operate under the same conditions, meaning that the indicators can be compared since they all have the same constraints. While this scenario could be better, it exemplifies the informality encompassing the primary sectors of the region, especially in the types of arrangements studied, where tradition and custom are far from an economic culture.

- Relationship between Ebitda margin and type of socio-financial arrangement

Table 2 shows the results obtained in the EBITDA margin and also relates the type of socio-financial arrangement it has. These results show that there is no pattern of condensation of the results, i.e., there is no trend in terms of EBITDA in the population consulted. Thus, with the evidence collected, it is not possible to affirm that a certain arrangement generates higher economic performance indexes since the results are dispersed, as can be seen below:

Table 2. *Relationship between producer Ebitda Margin and type of socio-financial arrangement*

Nº	EBITDA margin	Type of socio-financial arrangement
1	71%	Type 2. Private socio-financial arrangement - medium transformation costs.
2	56%	Type 1. Community socio-financial arrangement - high transformation costs.
3	66%	Type 1. Community socio-financial arrangement - high transformation costs.
4	70%	Type 5. Socio-financial arrangement with high participation of hired labor.
5	61%	Type 3. Own financial partner arrangement - low transformation costs.
6	50%	Type 1. Community socio-financial arrangement - high transformation costs.
7	54%	Type 1. Community socio-financial arrangement - high transformation costs.
8	62%	Type 4. Socio-financial arrangement with high family labor participation.
9	61%	Type 3. Own financial partner arrangement - low transformation costs.
10	68%	Type 2. Private socio-financial arrangement - medium transformation costs.
11	53%	Type 4. Socio-financial arrangement with high family labor participation.
12	63%	Type 2. Private socio-financial arrangement - medium transformation costs.
13	54%	Type 2. Private socio-financial arrangement - medium transformation costs.
14	77%	Type 2. Private socio-financial arrangement - medium transformation costs.
15	64%	Type 5. Socio-financial arrangement with high participation of hired labor.

Source: own elaboration

However, as mentioned in the initial considerations of this section, on this EBITDA index, it is necessary to consider the non-expenditure for raw materials, a situation that could generate variations on the results, allowing, in future years, to have more clarity on the operating conditions of the sector. Notwithstanding the above, it is imperative to highlight that all the results are above 50%, that is to say, that, operationally, the profits are attractive, at least from the indicators.

5. DISCUSSION AND CONCLUSIONS

In most cases, Panela production complements the incomes of the families in the study rather than being a productive activity that allows families to live solely from it. The transportation costs of the sugarcane to the

complex and from the complex to the sales point significantly consume the potential profits that could be gained from the process.

The yield in the ton.ha.year is not determined by the cutting frequency or the age of the crop. It is defined by how the sugarcane is cut and the proper selection of the stems.

Regarding the financial evaluation of the arrangements conducted through the EBITDA margin, it's essential to emphasize that the raw material's costs were not subtracted since such information is unavailable among the producers. They employ artisanal methods, making obtaining data for this purpose impossible. Therefore, the results account for a benefit without this deduction. As mentioned in the text, since everyone shares the same bias, it's possible to establish comparisons and analyses based on their data. For instance, all are above 50%, indicating a positive operational activity that has likely sustained the production tradition.

However, when comparing the obtained indicators, no relationship was found between the EBITDA margin and the type of arrangement. It means the latter doesn't condition the operational results of panela production in the analyzed territory. On the contrary, the results are scattered and lack any behavioral pattern.

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