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Caracterización de sistemas de producción artesanal de caña panelera y algunas perspectivas para mejorar su sostenibilidad

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ABSTRACT

Key words:
Panela
Economic
sustainability
Rural emigration

Sugarcane used for the production of "panela" (unrefined cane sugar) is a crop of great importance for Colombia's rural economy. Additionally, it serves a fundamental role in the food security and sovereignty of the Colombian population and daily consumption. However, the small production system presents problems of sustainability, as a direct consequence of its technological arrears and loss of interest in this crop. In this study, a characterization of 30 small productive units located in three municipalities in Antioquia was performed with the objective of identifying the problems associated with this production system and stablish the causes associated with loss of area dedicated to this crop in the study area. The results demonstrate that in the region of study, this production system and its associated agro-industry have problems associated with low technological level, poor infrastructure, deficient agro-industry processing and low levels of associativity and marketing. This situation has generated a low economic solvency for the farmers, leading many to abandon this activity and migrate towards other economic sectors. The findings of this study indicate the need to reengineer this production system, for which they could make technological adaptations that improve productivity and product quality and generate added value. On the other hand, must the rural countryside attractive to avoid the loss of labor and make young people become interested in this economic activity. As strategies to improve productivity, we suggest the effective use of information technologies, improve rural living conditions, increase associativity and value added, involve the consumer in the production chain and design development policies for the entire chain of value.

RESUMEN

Palabras claves:
Panela
Sutentabilidad
economica
Emigracion rural.

La caña de azúcar para la producción de panela es un cultivo de suma importancia para la economía del sector rural, además de su papel fundamental en la seguridad y soberanía alimentaria de la población colombiana. A pesar de esto, los pequeños sistemas productivos en algunas regiones del país presentan problemas de sostenibilidad, consecuencia directa de los rezagos tecnológicos y la perdida de interés por este cultivo. Con el fin de identificar la problemática de este cultivo, se realizó la caracterización de 30 pequeñas unidades productivas ubicadas en tres municipios de Antioquia. Los resultados encontrados demuestran que este sistema productivo y su agroindustria en la zona de estudio presentan grandes problemas asociados a bajos niveles tecnológicos, deficiente infraestructura para el procesamiento agroindustrial y bajos niveles de asociatividad y comercialización. Esta situación ha generado una baja solvencia económica de los productores, generando el abandono de esta actividad y la migración hacia otros rubros económicos. Basado en lo encontrado en este trabajo se hace necesaria la reingeniería de este sistema productivo mediante la utilización de adaptaciones tecnologías que mejoren la productividad y calidad del producto además de generar un mayor valor agregado. Por otra parte hay que buscar estrategias para volver más atractivo el sector rural y atraerlo hacia los jóvenes evitando la perdida de mano de obra y garantizando el relevo generacional. Como estrategias para mejorar la productividad se sugiere el uso efectivo de las tecnologías de información, mejorar las condiciones de vida rural, aumentar la asociatividad y valor agregado, involucrar al consumidor en la cadena productiva y el diseño de políticas de desarrollo para toda la cadena de valor.

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The cultivation of sugarcane used for the production of "panela" (unrefined sugarcane) in Colombia is concentrated in the departments of Cundinamarca, Antioquia, Boyacá, Santander, Nariño and Caldas, representing 70% of the national total. These regions are also responsible for 72% of panela production in the country (FAO, 2004; Castellanos *et al.*, 2010). In the country it is considered that about than 83% of the land area planted with this crop, the production system is made up of small plots that have undergone artisanal transformation processes, located in high mountain zones, with natural soil fertility limits, low mechanization, a family-based labor force and very low levels of technology or investment capital, In addition to presenting quality problems by low levels of incorporation of good practice from manufacture (GPM) (Castellanos *et al.*, 2010). This situation forces families involved in this industry to complement their income with other agricultural or ranching activities (FAO, 2004; Rodríguez, 2005; M.A.D.R, 2005; Velásquez *et al.*, 2006; Osorio, 2007). Meanwhile it is reported that small producers of panela in the country present low technological levels, regardless of the region to which it belongs (Castellanos *et al.*, 2010).

This production system is of great socioeconomic importance for the rural sector, Rodríguez (2005) and Castellanos *et al.* (2010) propose that it serves multiple functions, not only from an economic point of view, but also from social, environmental, cultural, food security and nutritional perspectives. Additionally, it has a revitalizing effect in these territories, as it contributes to other non-agricultural sectors of the local economy, such as manufacturing workshops, infrastructure and machinery maintenance, production of packaging and financial activities linked to transport and distribution.

The characterization of production systems are very important as it sheds basic information for the design of state policies, basic input of various investigations, in addition to achieving identify technological constraints and to implement strategies that lead to the sustainability of agro-ecosystems (Martinez, 2013; Cariño *et al.*, 2012; Moreno *et al.*, 2012) .

Donmatías, Barbosa and Girardota are municipalities located in the Altiplano Norte (Northern High Plateau Region), close to the Aburrá Valley of the Antioquia department. The economy of these towns is based on various economic activities. In the rural sector, livestock farming plays an important role, marked by the production of hogs, milking cows and beef cattle, and poultry. In regard to the agricultural sector, production is focused on tree tomato and garden tomato crops, and to a lesser extent, potatoes, beans, garden vegetables, sugarcane, coffee, plantains and yucca, among others. These crops are produced under a peasant economy system (Anuario Estadistico de Antioquia, 2014).

Among these agricultural activities, sugarcane production has been an important economic sector in these three municipalities. However, in recent years it has lost a great deal of importance as a result of multiple problems, leading to this land being taken over by extensive livestock farming, indicating a decrease in the area dedicated to this crop in the study region (Anuario Estadistico de Antioquia, 2010.

Considering the importance of this crop in the country's socioeconomic sphere, this study had the objective of characterizing the production system for the aforementioned region, in order to determine the reasons why growers have abandoned this economic activity and thus to be able to propose concrete strategies that would improve the economic situation of this farmers.

MATERIALS AND METHODS
Collection of samples and characterization of production system
The sampling and collection of information was performed in 30 production systems (10 in each municipality), which were located at random throughout the area dedicated to the cultivation of sugarcane for the production of panela. The number of samples was obtained by a simple random sampling, using the formula of maximum variance (Cochran, 1976). In each production unit, a survey was carried out with questions related to socioeconomic factors, planting, maintenance, harvesting, transport, agro-industrial transformation and the marketing system. The methodology for the characterization of production systems was participatory Diagnostic Checks, where producers responded to a survey of descriptive type, with structured and unstructured questions, plus extra contributions that these generated during the interview and visit lots cultivated. The participatory diagnosis was

made with producers and processors of sugarcane and within these included his family. In the design of the survey was seeking to cover all activities associated with the production and processing, but it was not very technique in order to achieve a better approach to the producer.

For the group of related socioeconomic factors, the following parameters were considered: area dedicated to cultivation, associated economic activities, land ownership, labor force used and age, economic system and significance of the crop. For the section dedicated to planting, maintenance, harvesting and transport, a characterization was performed of the following factors: the planting system, origin of the seed, cultural practices performed during the crop's life cycle, field yield in biomass and transformation process, varieties planted, time until harvest and transport to a processing center. Additionally, in each production unit, stem and leaf samples were taken from 15 plants at random, with the goal of identifying the existing phytosanitary problems and the varieties planted. For the agro-industrial transformation and marketing system factors, the parameters associated with the infrastructure of the sugar mills were determined and the various links in the marketing chain were identified.

Problems perceived by the growers and economic and financial information regarding cultivation

Based on the information obtained in the field and from the growers, the most significant limiting factors were identified and an analysis of the principal problems associated with the production system for panela sugarcane in the region of study was performed. Additionally, an economic analysis was performed using the absorption costing method (Álvarez and Sánchez, 2010). This analysis was performed on two production systems located in the municipality of Donmatías, Antioquia that had similar parameters in regards to the production stage, such as area (5 ha) and agronomic practices performed. However, in one of the systems agro-industrial processing was performed using a traditional sugar mill, while the other used a more modernized one. Using this information, the cost/benefit relationship was determined and the capacity of the infrastructure used for each system was identified. Later, the financial indicators of gross profit margin (GPM), operating profit margin (OPM) and return on assets (RA) were determined.

Processing of the information

The information compiled in the field and in the laboratory was systematized. For each qualitative variable evaluated the absolute frequency (AF) was determined and with the sample size (SZ) relative frequency was determined (RF) (RF=AF/SZ). Posterior relative frequency was converted in percentage (%), to multiply this value by 100 (%= RF*100). A schematic representation was made. The test statistic used was chi square, with a significance level of 95%. Statistical tests were run on the R program.

RESULTS AND DISCUSSION
Characterization of the production system related socioeconomic factors

One hundred percent ($P<0.05$) of the small farms evaluated corresponded to areas planted with less than 5 hectares of sugarcane (Figure 1A), which were supplemented by other agricultural and livestock activities such as the cultivation of coffee, plantain and subsistence crops; cattle ranching; and the farming of pigs and minor species (Figures 1B and 3A). In regard to land ownership, the majority of the land was owned by the farmers, with a small percentage rented or communally owned ($P<0.05$) (Figure 1C). This production system in many cases utilizes a family-based labor force ($P<0.05$) (Figure 1D), and the most common economic model is of family agro-industry, followed by sharecropping and, to a lesser extent, communal businesses ($P<0.05$) (Figure 1E). Although the latter system was the most common, not legally constituted associations were found. Another situation found is that the work force associated with the production system panela, is made up of 80% of male and 20% female, where 75% have more than 50 years of age, 17.5% in the range of 40-20 years and 9.5 are under 20 years.

These results do not differ much from those reported for Colombia as a whole and it is thought that thanks to these characteristics, the cultivation of sugarcane for panela production has a very heavy socioeconomic weight in the country. It is considered an important rural agro-industry, based on the number of production centers, planted area, the size of the associated workforce and, most importantly, its relationship with the small farmer and family industry (FAO, 2004; M.A.D.R, 2005; Rodríguez, 2005; Osorio, 2007; Tarazona, 2008). These systems are the most common throughout the country, but there are some exceptions which have been termed food industries (Castellanos et al., 2010).
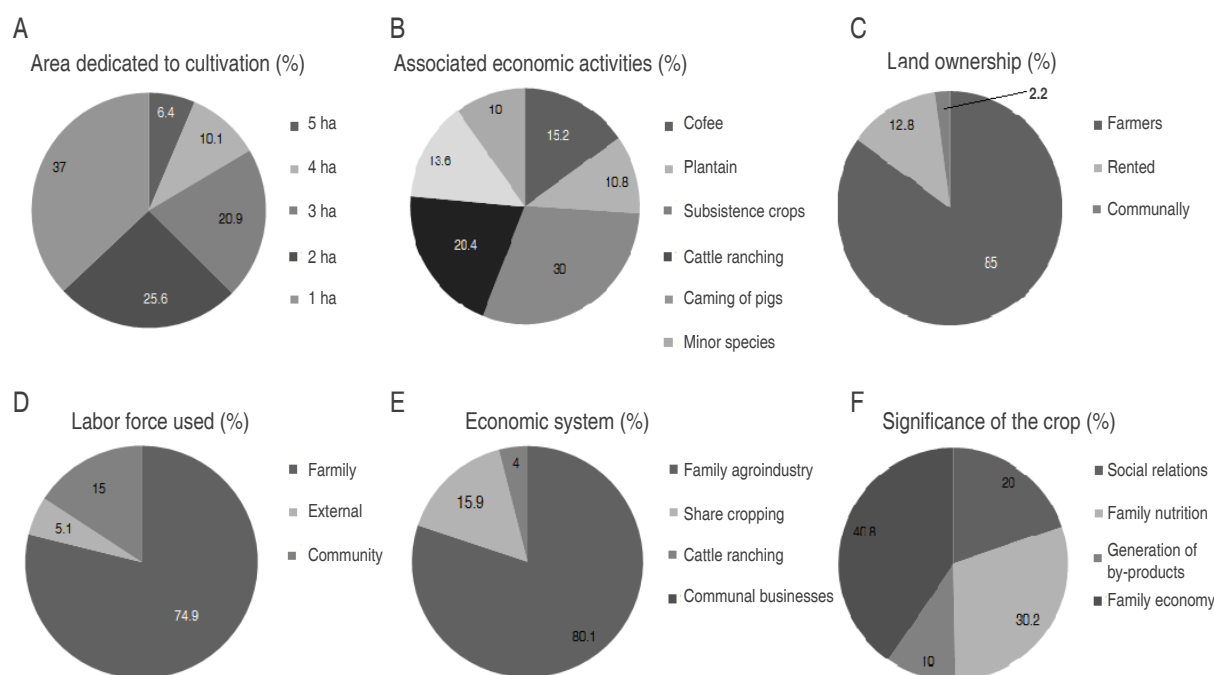
Figure 1. Features associated with socio-economic component sugarcane for panela production in the study area. The values are represented by the relative frequency.

In regard to the significance this activity represents for the farmer (Figure 1F), the results obtained show the importance of this agro-industry in aspects associated with the family economy, nutrition, generation of by-products and, particularly, social relations within the community (P<0.05).

An aspect that is just as important as panela's economic contribution is its role in nutrition in the country. The benefits are not limited to the farmers, but are also experienced by the consumers, since Colombia is the biggest *per-capita* consumer of panela at a global level (FAO, 2004; Osorio, 2007; Osorio and Restrepo, 2007; Tarazona, 2008; Castellanos *et al.*, 2010). Moreover, as the M.A.D.R. (2006) notes, panela is a low-cost sweetener that forms part of the family food basket in low-income sectors, due to its caloric and nutritional value. Another important contribution is the by-products produced, which are utilized in animal and human nutrition, and which provide multiple benefits for the family economy by decreasing the need to buy high-cost nutritional supplements at the market (Osorio and Restrepo, 2007; Tarazona, 2008).

The social impact of panela is also invaluable, given the relationships that are generated and sustained through its production chain. The FAO (2004) and Rodríguez (2005) propose that these can be economic in nature, but that family and community relationships and nonmonetary exchanges are still prevalent. These elements help increase circulation and the access of various production agents to resources such as a labor force, land and capital, all of which are important factors for the subsistence of the family unit and social and economic stability in the local and regional sphere.

Planting, management, harvest and transport
The planting of sugarcane for the production of panela in the area of study was characterized by the adaptation of the land through the removal of soil and the formation of furrows. The planting distances ranged between 1-1.2 m, and the seed was produced at the same farm through plant reproduction, and planted in a system of regular intervals or in furrows. During the growth and management stage, agronomic labors were greatly reduced, with weed control the principal activity (*P*<0.05) (Figure 2A). Harvesting is performed using a system of selective cutting or suckering,

using visual parameters including changes in the color of the bark of the sugar cane stalk and the shortening of the internodes of the interior of the plant, which occurs over distinct periods of time, usually in periods greater than 20 months (*P*<0.05) (Figure 2B). This late harvest largely affects the quality of the final product (Mosquera *et*
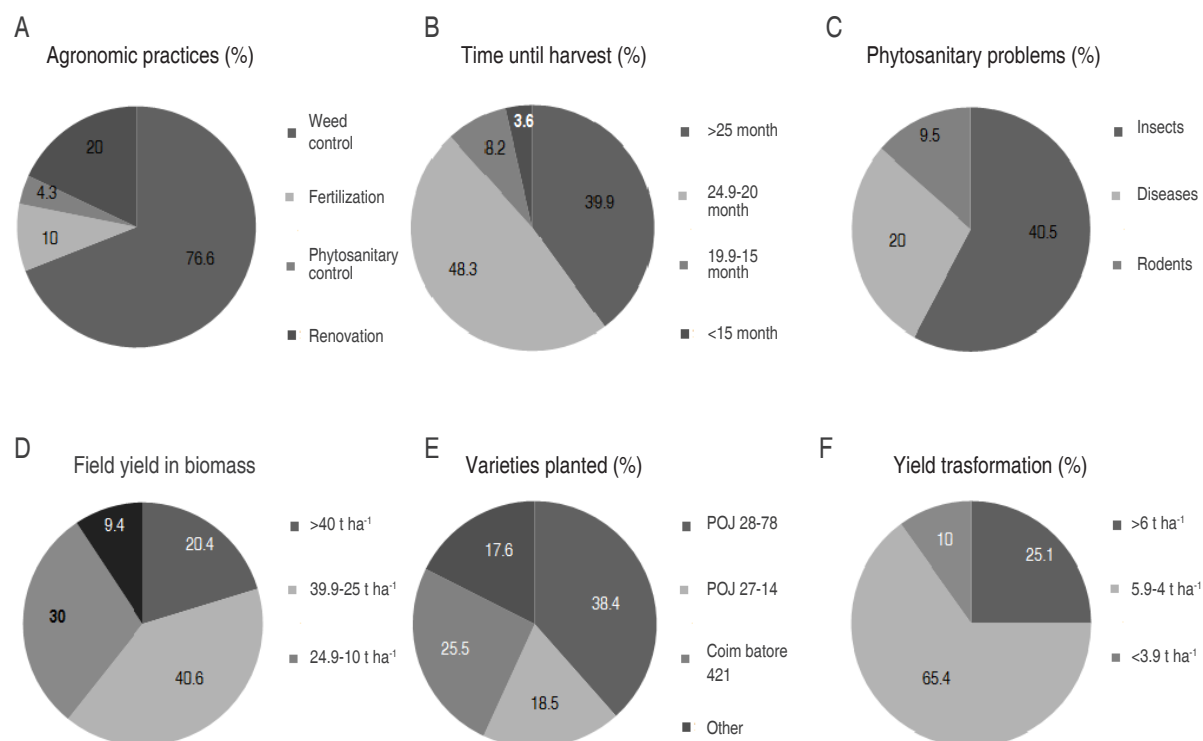
Figure 2. Features associated with cycle sugarcane for panela production in the study area. A: importance for each one. Insects**:** *Diatrea* sp. (60%), *Paratrechina fulva* (Mayr) (20.3%), *Aeneolamia* sp. (10.5) and *Mahanarva* sp. (9.2). Diseases: *Puccinia melanocephala* H. Sydow y P. Sydow (64.6 %), and *Ustilago scitaminea* Sydow (35.4 %). Rodents:*Mus musculus* L. (55.3 %) and *Sciurus vulgaris* L. (44.7%). The values are represented by the relative frequency.

al., 2007). None of the labors associated with this stage are performed using agricultural machinery, and transport to agro-industrial processing centers is completed using mules. The low number of agronomic practices performed (Figure 2A) results in multiple agronomic problems, among which are a high incidence of insects (*Diatrea* sp., *Paratrechina fulva, Aeneolamia* sp. And *Mahanarva* sp.), diseases (*Ustilago scitaminea* and *Pucciniam elanocephala*) and rodents (*Mus musculu s*and *Sciurus vulgaris)* (Figure 2C).

This situation coincides with that found in this and other production systems, where technological lags are common, leading to multiple agronomic and sustainability problems. Are common where high incidences of pests and diseases and their inadequate management, which

is based almost exclusively on chemicals (Mosquera *et al.*, 2007; Martínez, 2013; Ramirez *et al.,* 2014).

These lead to low yield in the field (*P*<0.05) (Figure 2D), where the varieties planted (P.O.J. 27-14, P.O.J. 28-78 and Co 421) are also very old (Figure 1E), and, according to Osorio (2007) are not the best option, given that currently there are other varieties that perform better in terms of agronomic factors and yield (Garcia *et al.,* 2007). These situations affect the performance of the final product (*P*<0.05) (Figure 1F).

For many of the problems identified above, there is report of technological tools that could improve crop productivity (Lopez, 2015), but exist a problem, which is associated with the unknown of technology or your using, which

implies a lack of coordination between the generation of technological processes and those conducting their transference.

Agro-industrial processing and marketing system

In 90% of cases ($P<0.05$), the agro-industrial processing of sugarcane is performed with artisanal sugar mills, and consists in the extraction of juices, pre-cleaning, clarification and liming, evaporation of the water and concentration of the honeys, tapping and shaking, molding, cooling, packaging and baling (Figure 3B, C, D and F). The other 10% ($P<0.05$) is performed with more technologically advanced sugar mills, which comply with the requirements listed in Resolution 779 of 2006 (FEDEPANELA, 2008; INVIMA, 2009).

In regard to installations, artisanal sugar mills have dirt floors, no walls, are not divided into rooms, do not have sanitary services, the utensils used in the process are made of copper, the channels for conduction and storage and the pre-cleaning containers for the juices are made of cement, the water is taken from natural sources and is not pretreated, the facilities lack adequate infrastructure for the final disposal of the waste, and the employees do not use the appropriate attire. In regard to the mechanical infrastructure, the grinder has an internal combustion engine (diesel), with a grinding capacity of less than 0.5 t h^{-1}, the capacity of the furnaces is between 41-49 kg of panela $hour^{-1}$, and the percentage of juice extraction by weight of the machines varies between 47% and 50%. This value is considered low, since the minimum value should be 58% (Osorio, 2007). The fuel necessary for the furnaces is supplied almost entirely with sugarcane pulp, but on some occasions it is necessary to utilize firewood, a circumstance which, according to Velásquez *et al.* (2006) is due to the inefficiency of these artisanal furnaces, and has a negative impact on the environment.

Figure 3. Sugarcane for panela production and agro-processing. A: typical agroecosystem B: area planted to sugarcane for the production of panela. C, D, E y F: basic infrastructure for the processing of panela.

The above description does not comply with the requirements put forth in Resolution 779 of 2006 by the Ministry of Social Protection, which establishes technical regulations regarding the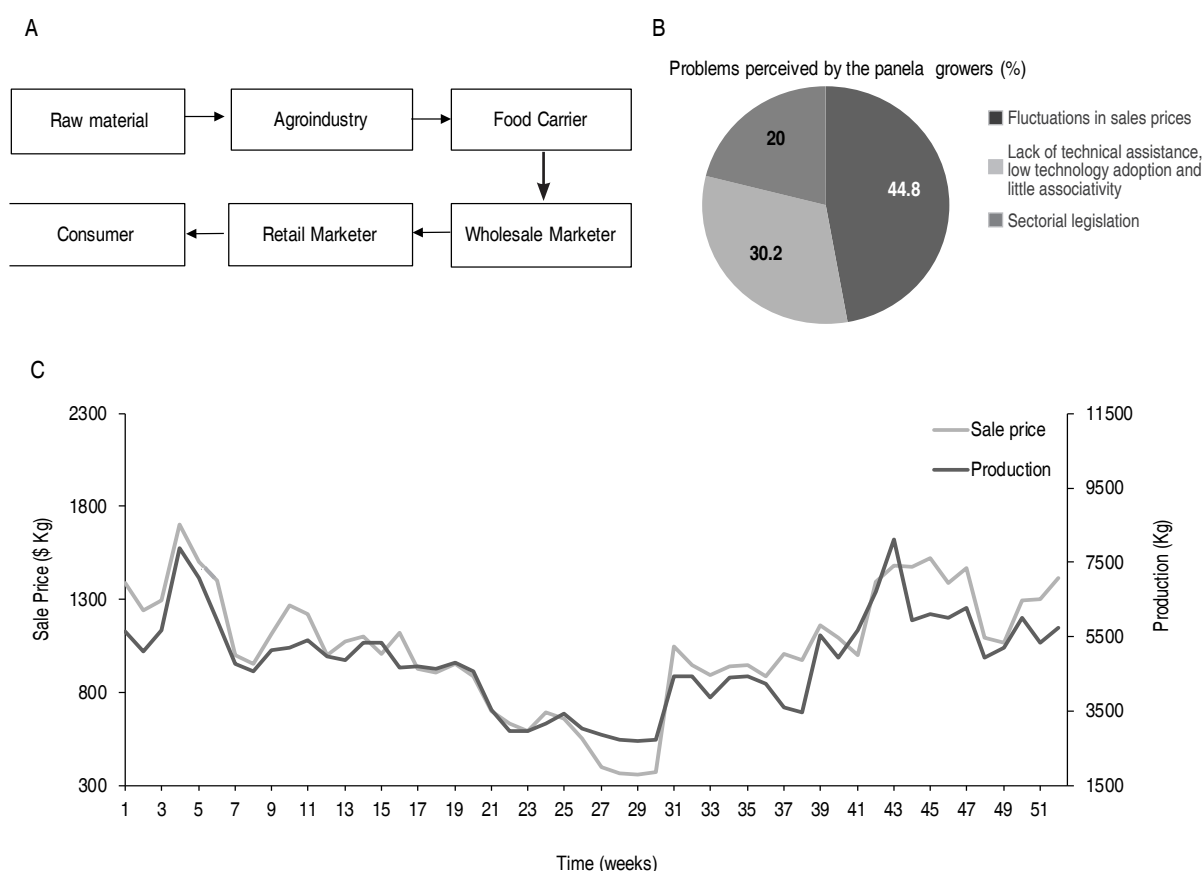 sanitary requirements that should be complied with in the production and sale of panela for human consumption (FEDEPANELA, 2008; INVIMA, 2009). Moreover, Velásquez *et al.* (2006) propose that the infrastructural conditions and machinery described

are obsolete and inefficient, coinciding with that found in other regions production systems (Mosquera *et al.*, 2007). The inefficient practices used in agro-industrial processing, in addition to the harvesting of overripe sugar cane and the long time lapse between cutting and processing (Figure 2B) leads to major losses due to the reversion of glucose (Larrahondo and Torres 1990; Mosquera *et al.*, 2007). When combined with low levels of extraction by obsolete machinery (Figure 3D), this results in a low yield of panela (Figure 2F). The marketing stage is completed via multiple intermediaries, as shown in Figure 4A. This phenomenon will be discussed further below.

Problems identified by small farmers of sugarcane in regard to the panela production system
For all of the farmers analyzed in the region of study, there was a consensus that fluctuations in sales prices ($P<0.05$)

(Figure 4B and 4C) was one of the problems that had the most negative impact on sugarcane farming. These direct relationship is observed as increased purchase prices lead to increases in production, leading causes saturation in the market, which reacts and lowers purchase prices. They identified this as the cause of the low profit margins that currently exist (Table 1). This phenomenon is a direct consequence of the inefficient sales process, little incorporation of aggregated value, lack of homogeneity in quality, low levels of associativity and very poor crop planning. Osorio (2007), Rodríguez (2005), M.A.D.R. (2006) and Castellanos *et al.* (2010) have noted that the panela market involves innumerable intermediaries, which generates significant dispersion and inefficiency, as well as additional transaction costs. This situation favors the wholesalers who store the merchandise in urban settings, to the detriment of the farmer.

A

B

Problems perceived by the panela growers (%)

- Fluctuations in sales prices
- Lack of technical assistance, low technology adoption and little associativity
- Sectorial legislation

44.8
30.2
20

C

Figure 4. Marketing chain and main problems identified system of sugarcane for panela production in the study area. A: Marketing chain of panela sugarcane production. B: Problems perceived by the panela growers. The values are represented by the relative frequency. C: Dynamics of the sales price and production of panela systems evaluated.

Meanwhile, Rodríguez and Gottret (1998), M.A.D.R. (2005), Osorio (2007), FEDEPANELA (2009) and Castellanos *et al.* (2010) attribute the fluctuations in sales prices in the panela sector to multiple factors. These include: the commercial schemes of the merchants; the existence, in some cases, of long sales chains that lead to a rise in prices for the consumer; the use of sugar in the manufacturing of panela by illegal producers, a practice that is performed particularly when the price of panela is high and that of sugar low, and which leads to excess supply and price decreases; deficiencies in the packaging, transport and storage systems of the panela, which lead to considerable losses due to the deterioration of the product; and the false expectations of resolving these problems by constructing, in some panela producing regions, distilling plants for ethanol and honey plants that use up some of the sugarcane planted. Those long chains of marketing are identified in Figure 4 A, in which the large number of processes and links involved observed is evaluated production systems. Production costs are increased each and are part of a link off the previous one and that is part of groups of different people, resulting in an expensive product to the consumer, but with very low profit margin for the producer raw material or farmer.

A lack of technical assistance was the second problem identified in the present study (Figure 4B). None of the farms evaluated had received such assistance for the production stage, while in the case of agro-industrial processing, only the growers with contacts in the technologically advanced sugar mills had received it. This situation is reflected in the scarcity of agronomic labors performed (Figure 2A) and the underdevelopment of this crop in the production stage, as well as at the level of agro-industrial processing for the growers-transformers who use traditional sugar mills (Figures 3B, C, D and E). This is a common problem not onlyin the Antioquia department, but in most of the country, where low productivity is constant for this production system as a direct consequence of various problems, among them a lack of integral technical assistance (Osorio and Restrepo, 2007; Anuario Estadistico de Antioquia, 2010, 2014). It is believed that this production system has only made some advancements in regards to the modernization of all links in the production chain, rather than just the processing end, in a few regions of the country (FAO, 2004; M.A.D.R 2006; Osorio, 2007).

A third situation that the producers evaluated identified as limiting (Figure 4B) was the sectorial legislation. This refers to the issuing of Resolution 003462 of 2008, which sets forth the minimum requirements for the agro-industrial processing of panela, based on compliance with the sanitary conditions mentioned in Article 9, Number 1, Letters C and D; Number 2, Letters A and B; Number 8, Letter B; and Number 9, Letters A, B and C of Resolution 779 of 2006 (FEDEPANELA, 2008; INVIMA, 2009). The above situation is of significant concern, due to the high number of sugar mills within the regional and national production system that do not comply with the current technical requirements described in the legislation for the honey and sugar sectors (Tarazona, 2008). This problem does not appear to have a quick solution given the current dynamics of the sector, with the producers lacking the economic capacity to assume the high construction costs of facilities that comply with the regulations mentioned.

Economic aspects and financial indicators associated with two farms

Table 1 shows the results for two farms with different agro-industrial processing technologies. The results indicate that the traditional sugar mill has a 1.1 cost-benefit relationship, meaningthat the earnings are low but allow the farmer to assume the costs of production and have some margin of profit. This was not the case with the producer that had transformed his sugar mill into a more technologically advanced one, and was working for a loss. These results are supported by the indicators G.P.M and O.P.M. While for the farmer who uses a traditional sugar mill, both of these are positive, for the technologically advanced sugar mill, both are negative. These differences can be clearly explained by observing the indicator R.A, which is positive for the artisanal sugar mill and negative for the technologically advanced one. This is due to the fact that the fixed costs for the latter are very high, because the installed capacity is very superior to the capacity used. This means that the small amount of production obtained assumes all of the fixed costs (Table 1). These results coincide with those found by Arango (2006), who reported that the small producers of panela in the Guatape municipality (Antioquia) had negative profit margins, indicating that they were unable to compensate for production costs with sales prices.

Table 1. Income statements and financial indicators for two sugarcane for panela production systems in the study area.

Parameter	[1,2]Traditional	[1,3]Modernized
(+)Net Sales (NS)	24,486,302	25,500,000
(-)SoldCost of production	21,500,302	32,725,456
(=) Gross Profit (G P)	2,986,000	-7,225,456
(-)Administrative Expenses	1,201,305	1,305,505
(=)Operating Profit (UO)	1,784,695	-8,530,961
(+)OtherIncome	0	0
(=)Income Before Taxation and Interest (IBTI)	1,784,695	-8,530,961
(-)Interest	0	0
(=)Income Before Taxation (IBT)	1,784,695	-8,530,961
(-)Taxation	535,408	0
(=)Net Income(NI)	1,249,287	-8,530,961
Capacity of the Infrastructure Used (%)	92	10
Cost-benefit relationship	1.1	0.77
Gross Profit Margin (%)	12.1	-28.3
Operating Profit Margin (%)	7.28	-33.5
Return on Assets (%)	26.3	56.8

[1]Values are in constant Colombian money for 2012. [2]Infrastructure without modernization, the cost of infrastructure use and the costs associated with production and processing stage is assumed. [3]Infrastructure that meets regulated in resolution 779 of 2006, the cost of infrastructure use and the costs associated with production and processing stage is assumed.

The precarious and underdeveloped primary production system contrasts with the high levels of investment in agro-industrial processing facilities on the part of the state, generating an negative returnssince in many cases not even 10% of productive capacity is used (Table 1). This situation is the result of low levels of associativity, the small number of farms in the areas where processing units are constructed (Figure 1A) and the low yields per hectare (Figure 2D).

The low levels of technology, negative profit margins, inefficient marketing processes, lack of business or union organizations and misplaced state assistance, among many other problems, have relegated this economic sector to a second tier in the region of study. This has caused the land dedicated to panela cane production to be reallocated to other production systems, with a preference for monoculture dedicated to the production of animal feed. In the worst of cases, it has led to migration towards the cities, a phenomenon that is not foreign for the country (M.A.D.R., 2005; Osorio, 2007; Tarazona, 2008). Faced with this dynamic, the production of panela by small farmers is seriously threatened.

The above situation points to the need to redefine the strategies and programs financed by the state, with a look towards improving the production systems for panela sugarcane in order to increase the productivity and profitability of the entire production chain. At the same time, the farmers are in large part responsible for this situation, since they have very little culture of adopting preexisting technologies for this crop, including the use of more productive varieties and more appropriate agronomic practices (García et al., 2007).

Strategies to improve the sustainability of small sugarcane production systems for the production of panela

Many of the problems listed above have been associated with small producer of panela throughout the country (Castellanos et al., 2010) and there are alternatives to improve many of these technological delays and it is used in some production systems with good results. (Lopez, 2015). This could be due to multiple causes, where the most potential are given as a result of a break between who makes the technological developments and those in

charge of the transfer or non-adoption by the producer.This implies the first strategy that could pose to improve system productivity, which should be associated to establish direct communication mechanisms among all players in the chain with goals and targets for each one, where the researcher can generate alternatives adapted to the conditions and needs of the producer and there is a dynamic and effective mechanism to ensure the transfer of these technologies. Meanwhile the producer is willing to make changes leading to improve their sustainability. In addition to making innovative advertising tools to improve the perception by farmers to system more sustainable, which involves the use of information technologies are included to achieve an educational revolution in which we look for farmers to access new technologies. An important aspect that should be sought is the generation of technologies that meet specific needs of different production systems and not from the premise of general technological packages, this mechanism would involve a great effort from the entire chain, but generate strategies more integrated into territory where the community perceive them closer and there may be a greater appropriation.

As a second strategy should be avoided migration of the young population to the cities and the loss the generational change, put at serious risk the production of panela. This situation could counteract by an entire rural restructuring associated with greater safety, better infrastructure, health centers, sports and cultural scenarios, better wages and working conditions, should also ensure access to quality education and to new information technologies.

As a third component is necessary to strengthen the social base and to enhance and create associative processes that could help improve the production stage of the crop, as well as profits and marketing. This involves combining the available technology with a permanent integrated technical accompaniment that would improve the competitivity and sustainability of this subsector in the country. In this regard, the M.A.D.R (2006), Osorio (2007) and Tarazona (2008) have noted that the panela farmers' lack of business or union organizations is one of the major problems hindering and preventing the adequate development of the sector. From this can be generated cooperative production systems, involving greater ability to offer products on the market and access systems technical assistance, credit, among others.

Under these production systems can generate greater value added, seeking to offer other kinds of products whose raw material is the panela (Castellanos *et al.*, 2010). Where this alternative is considered the most appropriate to avoid the drop in sales prices for periods of over-supply (Álvarez and Sánchez, 2010). This part should identify successful cases and associated factors, in addition to identifying errors in unsuccessful processes. Moreover in partner process to generate added value must be integrated to the final consumer, which you may be charged on the production cycle of the same, where the strategy to implement serious that you can know who and how the food they consume is produced, this could create direct links between urban and rural.

As fourth aspect arises that is fundamental to keep in mind when making a private or public investment that this should not be limited only to one link in the chain, but rather, should take into account the entire production model in order to avoid using technology in an isolated and disjointed way. As this study clearly showed, setting up infrastructure just for the processing of the sugarcane failed to resolve the problems of the panela growers.The fifth and final aspect that arises is the need of a product of excellent quality, which should be based on good manufacturing practice, this implies the need to adapt the small plants, so it is proposed that no infrastructure become very large and expensive, but small functional units according to the production capacity of raw materials in the area. This require technological adaptations inexpensive and easy and fast implementation, which would generate a high impact because much of the production of panela is made by small producers.

CONCLUSIONS

The traditional panela production system evaluated showed great technological lags in each of the stages of its production system. This production system requires a restructuring, which must come from the producer's needs as fundamental to the productivity and sustainability of the system, where it manages to incorporate the technological solutions adapted to each particular situation, which would ensure that resources seen well channeled. Meanwhile is necessary the cohesion of all players in the chain of production system in order to improve their economic expectations and avoid the loss of this activity in areas of artisanal production.

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