

## PRODUCTIVITY IN TRADITIONALLY DEVELOPED CROPS: THE BLACKBERRIES CASE IN THE MUNICIPALITY OF ENVIGADO, ANTIOQUIA-COLOMBIA

LA PRODUCTIVIDAD EN EL DESARROLLO TRADICIONAL DE LOS CULTIVOS: EL CASO DE LA MORA EN EL MUNICIPIO DE ENVIGADO, ANTIOQUIA-COLOMBIA

Mauricio López González<sup>1</sup>; Carlos Méndez Restrepo<sup>2</sup> and Lina Montoya Llano<sup>3</sup>

**Abstract.** A vast area of the Municipality of Envigado, Antioquia-Colombia, is considered a rural zone. In this zone, the districts of Perico and Pantanillo stand out for their traditional production of blackberry crop. In the past few years, blackberry producers have encountered new major competitors due to elements that have strengthened the competition. Factors such as: the technification of crops, urban infrastructure improvements, and the establishment of competing productive chains in adjacent municipalities. Nevertheless, despite still being developed with very traditional techniques, the blackberry crop is still profitable for local producers. Therefore, the objective of this work is to calculate the actual level of blackberry productivity and to identify some of the principal determinants of said productivity. For this purpose, strategic information from a representative number of blackberry producing farms was collected. The research shows that some factors have become determinant differentiators of blackberry production. Among these factors are: the use of inputs, soil qualities and level of associativity.

**Key words:** Agricultural productivity, blackberry, soils, value chain.

**Resumen.** Una extensa área del Municipio de Envigado en Antioquia; Colombia; es considerada como zona rural. En dicha zona, las veredas de Perico y Pantanillo, se destacan por la producción tradicional del cultivo de mora. En los últimos años, los productores de mora han encontrado mayores competidores, siendo la tecnificación de los cultivos, las mejoras en infraestructura urbana y el montaje de cadenas productivas competidoras en municipios aledaños, algunos de los elementos que han fortalecido la mayor competencia. Sin embargo, pese a ser un cultivo desarrollado con técnicas aún muy tradicionales, el cultivo de mora continua siendo rentable. Así, el objetivo de este trabajo, consiste en calcular el actual nivel de productividad de la mora e identificar algunos de los principales determinantes de dicha productividad. Para tal fin se compiló información estratégica de un número representativo de fincas productoras de mora. En tal sentido, la investigación demuestra como algunos factores se han convertido en elementos diferenciadores, determinantes de la productividad de la mora, entre los cuales se destacan: los fertilizantes, las características del suelo y el grado de asociatividad.

**Palabras claves:** Productividad agrícola, mora, suelos, cadena productiva.

Agricultural production in the districts of Perico and Pantanillo, rural area of the Municipality of Envigado, Antioquia-Colombia, has traditionally centered on blackberry (*Rubus glaucus*) crops. Nevertheless, the last few years have been active with the presence of new crops and productive processes which represent alternatives for the residents of this region and for entrepreneurs.

However, blackberry remains as the main line of production in the area due to reasons such as the large number of families involved and the amounts of land cultivated that certify its importance. The aforesaid, supports conducting a detailed analysis of the sector through various studies which provide information about the crops structure, cultivated soil

qualities, crops productivity, mid-term potentials, and other aspects which may improve conditions for farmers in the region.

For this purpose, this article aims at calculating the productivity of blackberry crops in the area departing from information gathered through two different mechanisms: the first is a survey of a representative number of blackberry producers which captured information regarding production and commercialization qualities; and the second deals with the physical and chemical conditions of the soil.

An analysis of support policies orchestrated by the municipal administration, in addition to the conditions in which blackberry is grown in the region – still

<sup>1</sup> Profesor Auxiliar. Universidad de Antioquia. Facultad de Ciencias Económicas. Calle 67 No. 53-108, Oficina 13-110. Medellín, Colombia. <malopez@economicas.udea.edu.co>

<sup>2</sup> Zootecnista. Universidad de Antioquia. Facultad de Ciencias Económicas. Calle 67 No. 53-108, Oficina 13-110. Medellín, Colombia. <mendez@agronica.udea.edu.co>

<sup>3</sup> Economista. Universidad de Antioquia. Facultad de Ciencias Económicas. Calle 67 No. 53-108, Oficina 13-110. Medellín, Colombia. <Immontoyal@gmail.com>

Recibido: Febrero 25 de 2009; Aceptado: Octubre 19 de 2009.

Rev.Fac.Nal.Agr.Medellín 62(2): 5145-5156. 2009

traditional to a certain degree, – allow deducing that the crop has good levels of productivity. In this way it is profitable for small producers to destine their lands to plant blackberries. Field information, gathered through soil analysis and surveys of local producers, was analyzed in a manner that could provide the necessary information to evaluate such statement.

Therefore, the work is comprised of four sections besides this introduction. The first one, describes the analytical framework in which blackberry production takes place, including generic terms and specific terms for the districts of Perico and Pantanillo in the Municipality of Envigado. The second section, describes the analytical framework through which information was gathered and analyzed. The third section, contemplates an analysis of the productivity of the blackberry crop for the districts themselves; and finally, conclusions and recommendations are presented.

## MATERIAL AND METHODS

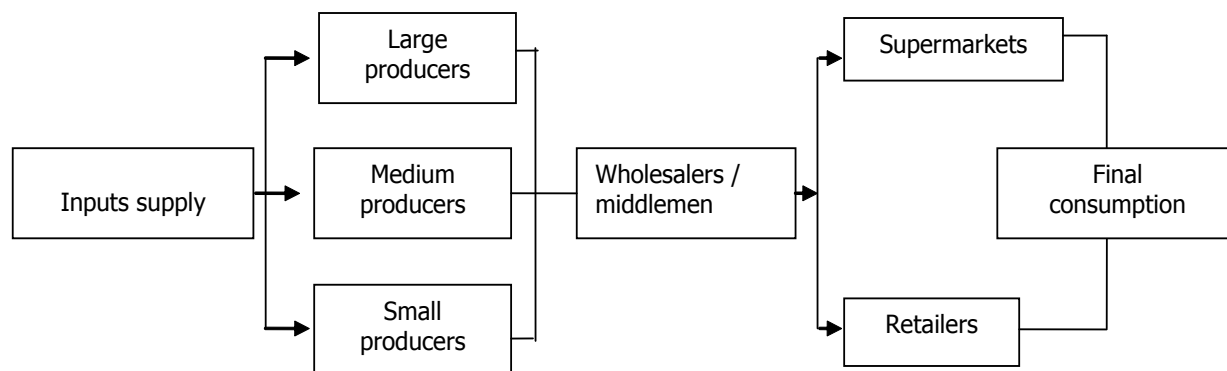
### *The structure of a blackberry productive chain.*

A productive chain consists of the coordination of the different phases and processes of a product, connecting supply with demand, and producers with consumers. In particular the agrifood chain of blackberries is made up of basic and support activities

such as: primary production, industrial transformation, commercialization and consumption. According to Molina (2003), analyzing production chains permits measuring the economical activity of a product in different phases.

- Primary production, in which agricultural raw goods are cultivated and harvested
- Agro-industrial transformation. This pertains to processing activities to transform agricultural raw goods into their form for final consumption.
- Commercialization of agrifood and agro-industrial products. It is based on basic pre-commercialization functions (activities conducted to prepare products), transportation, storage, distribution and sales.
- Consumption. This refers to direct consumption (fresh edible products) and the consumption of transformed products (industrialized products consumed locally and exported).
- Support activities (inputs and services), are those activities which contribute to the development of the agrifood system through the supply of inputs and the provision of services for production and transformation.

The Figure 1 schematizes the parts of an agrifood chain<sup>4</sup>. It details basic activities and activities that act as support of the productive system.



**Figure 1.** Productive chain of blackberry crops in Envigado, Colombia. Source: Self-developed.

Besides, blackberries have vitamins A, B and C, and calcium, iron, copper, etc. Some health problems where its fruits and leaves can be applied include: rheumatism, gout, throat inflammations, mouth and vocal cord infections, hoarseness, fevers,

diabetes, parasites, arthritis, diarrhea, typhoid and cholesterol (Asohofrucol, 2009).

**Primary production.** A variety of blackberry known as Castillian Blackberry is grown in the districts of

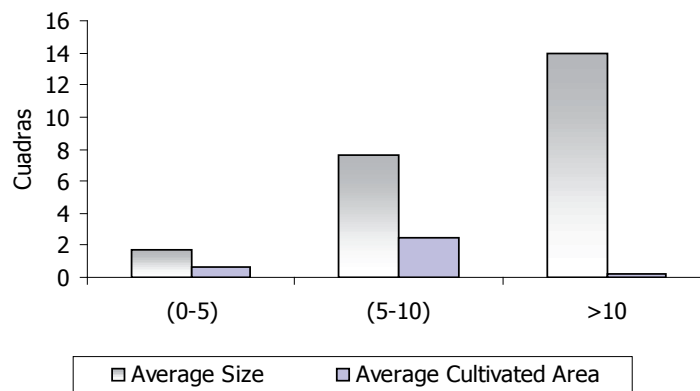
<sup>4</sup> A description of the agro-industrial chain of blackberries is presented by the Centro Internacional de Agricultura Tropical –CIAT– (2002). [International Tropical Agriculture Center].

Perico and Pantanillo. As part of the primary production of this product there is an indispensable phase to guarantee the crops productivity and economic yield: the post-crop, a stage that to a great scale determines the product's good quality, which in turn translates into better sale-prices and competitive advantages with respect to other producers. Blackberries grown in the Municipality of Envigado are recognized in the local markets by commercializers, and consumers, for their good quality and characteristics.

Three types of producers can be defined according to the extension of their productive units: Large, medium and small. According to the survey conducted, in the districts of Perico and Pantanillo most, 73.3%, blackberry producers

can be considered small as their productive units are considered less than two cuadras (a land measurement equivalent to 6,400 square meters). The remaining percentage is equally comprised by medium and large producers<sup>5</sup>.

An important problem of the blackberry production process in the districts of Envigado, is the sub-utilization of productive land. This is evidenced in the fact that the bigger the lot, the smaller proportion of this lot being used to cultivate blackberries. In this manner we observe that the owners of plots with an average size of 1.71 cuadras allocate approximately 37% of the plot for cultivating, while bigger plots with an average size of 14 cuadras only allocate 1.86% for cultivating (Figure 2)<sup>6</sup>.



**Figure 2.** Average cultivated area in different products vs. average size (cuadras). Source: Self developed with data from the blackberry producers survey. Municipality of Envigado, Colombia.

Another conclusion drawn from the survey is that blackberry production in the districts of the Municipality of Envigado is a labor-intensive activity and it is based on a family-structured farming economic system. This can be determined after observing that 71.21% of the labor used by blackberry producers in their crops comes from relatives. Only 28.79% of the personnel is independent and receives payment for their work on the crops. This result is congruent with observations made in other blackberry producing areas in the region.

Regarding the level of technification of the crops, it was discovered that only 36.4 % of the producers incorporated some type of machinery to their

production process, while more than half (63.3%) of the population surveyed denied acquiring any type of machinery for their production. Machinery is understood as instruments, or tools, necessary to plant, maintain and harvest the crops. This item can explain the reason why a large percentage of blackberry producers in the area, have productivities and yields, although they fall inside acceptable levels, below standards in comparison with other regions<sup>7</sup>.

Technical assistance received by produces is another fundamental determinant of the productivity levels and yields, as it gives producers the necessary tools and knowledge to implement proper practices in the processing of blackberry crops. On this matter,

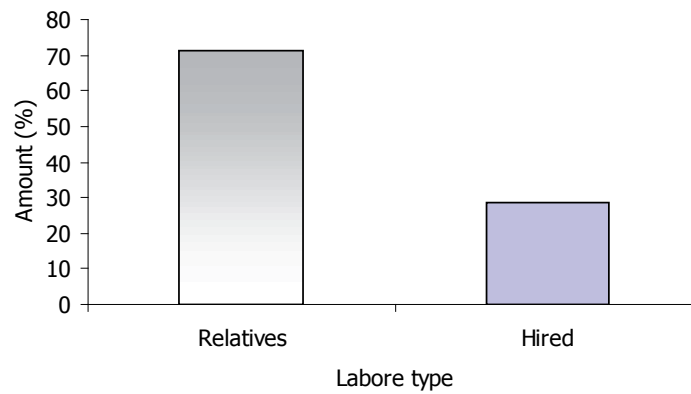
<sup>5</sup> According to information collected from interviews made of 27 of the 105 blackberry producers formally registered in the Municipality. The sampling was random and classified producers according to their size (large, medium, and small).

<sup>6</sup> A significant number of farms is destined for leisure recreation activities, cattle, and to other crops such as tamarillo (*Solanum betaceum*) and a few vegetables.

<sup>7</sup> An analysis of the productivity observed in blackberry crops in the districts of Envigado will be conducted in the next section.

most producers (63.6%) denied receiving any type of technical assistance. This presents an important problem for blackberry producers and calls for an urgent intervention by the proper authorities to design, and carry on, assistance and training plans

on topics the community deems indispensable for the handling of blackberry crops. In this way, the production activity can be turned into a successful business, and an important source of income for farmers in the area.



**Figure 3.** Types of Labor. Source: Self developed with data from the Strawberry Producers Survey. Municipality of Envigado.

A fundamental element for the success of a productive activity is the level of associativity among the different agents involved in such activity. If we analyze this aspect with regards to blackberry produces in the districts of Perico and Pantanillo, we observe that the level of associativity among them is low. Along these lines we find that only 40.9% of producers surveyed said that they belonged to a blackberry producers association. A worrying fact taking into account all the advantages, mainly opportunities to better confront challenges that arise in the trade, that belonging to an association may offer to producers. The key point is to inquire about the reasons for producers do not have interest in associating and demolishing obstacles that block their interests and those of the community. The task is for municipal administrators who, through the design and implementation of policies and incentives, can promote the strengthening of The Blackberry Producers Association of Envigado (ASPRMOEN for its initials in Spanish) in the area. In the same manner, having a strong associative organization lays on the commitment of the producers who see themselves identified by this group and who recognize the benefits that a closer cohesion among blackberry producers can produce.

Along these lines and based on the information gathered through surveys, the following can be remarked as benefits of associativity:

- Productivity improvements in the crops as it has been proven that the more divided the land is, the lower its yield and productivity.

- Sharing of knowledge and techniques for handling crops, allowing an appropriation of good cultivating practices by those with low productivities from those who have better results.
- Better negotiating conditions for acquiring raw material and inputs necessary in the production process. For instance, better prices can be obtained when buying fertilizers through an association in bulk volumes.
- An association can enable its members to compete more efficiently and capture a larger market segment.
- The creation of a group to represent common interests can create pressure and result in better negotiating conditions in front of blackberry purchasers (commercializers), this in turn can represent higher prices and higher incomes for its associates.
- More participation in municipal administrative decisions concerning the blackberry sector. And also, easier access to benefits such as training and technical assistance.

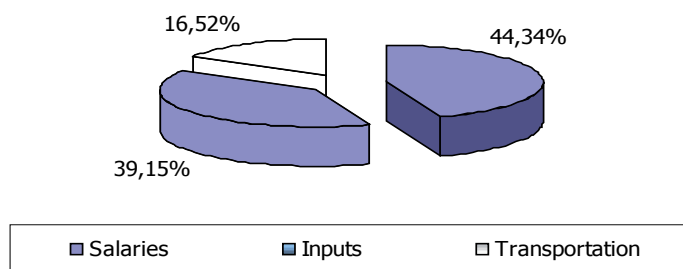
**Production costs.** The subject of production costs in the primary sector has certain limitations as the productive structures that do not control the matter appropriately. However, to understand the economic handling of this crop, two types of production costs can be defined: direct/operation costs and indirect costs. The first type comprehends costs related to direct and indirect labor used throughout the process, from the

preparation of the soil to the placement of the fruit in baskets upon harvests. It also includes inputs such as plants, fertilizers, direct materials such as baskets used for transporting the fruit, and transportation costs which refer to the transportation of inputs and materials to the crop and the transportation of the harvested fruit to points of distribution. The other type of costs, indirect, concern costs regarding training, technical assessment, basic services, administrative personnel and capital costs. However, because of the presence of a significant percentage of small producers in the area, this last type of expense was deemed not relevant.

In this manner, in agreement with the information collected through surveys and as illustrated in Figure 4, the most representative area in the total of production costs for blackberry producers in the Districts of Perico and Pantanillo is labor fees (44.3%). Next on the list are inputs with 25% while transportation costs represent 16.5% of the total. The previous information agrees with the conditions faced by blackberry producers in these districts. As previously mentioned, the activity is labor intensive and transportation costs are reduced as municipal administrators provide support by renting, for a moderate fee, a vehicle to transport the end product to points of commercialization, and transport inputs for the production and groceries for themselves.

If compared with the production costs of other blackberry producing regions, it is observed that the cost percentage destined to labor fees is relatively higher. For instance, this percentage in blackberry areas in Ecuador is 30% and for the Valle del Cauca Region in Colombia, is also 30% (García, 2003). At first sight one might think that the cost for producers in the Municipality of Envigado is high, and that this factor represents a drawback for competitiveness. However, it is important to point out that the blackberry production system in the area is strictly family structured, an estimate was made including wages to family members that participate in the blackberry production process, who, after all, are the principal production factor in the Envigado blackberry crops. It is necessary to stress that cost calculation included the participation of family members.

**Productivity.** Agricultural productivity has been a topic of interest for scientists, agronomists, economists, administrators, accountants, sociologists, etc. This has led to the development and availability of studies that enable accounting for such important matter. Colombia national environment has not been the exception; for instance, Galvis (2001) concludes that the availability of natural resources and climate are the most important factors explaining the differences in agricultural production in the different Colombian departments.



**Figure 4.** Cost distribution. Source: Self developed with data from the Strawberry Producers Survey. Municipality of Envigado.

Particularly concerning blackberries, Contreras (2006) presents an average blackberry yield from eight to 10 tons per hectare for 2006. Likewise, the Ministry of Agriculture and Rural Development (2006) through its program Apoyo a Alianzas

Productivas [Support Productive Alliances] cites yields of 11 tons per hectare for 2004 in regions, where the program was present. These references represent the scenario for the study presented in this paper.

## METHODOLOGY

**Agro-environmental conditions.** In terms of geography, the districts of Perico and Pantanillo are situated on a latitudinal range between 2,400 and 2,800 meters above sea level. Their average temperature is 16 degrees Celsius, lower in the higher elevations (15 degrees Celsius) and higher in the lower elevations (17 degrees Celsius). Additionally, they have a relative humidity average of 75% and rain precipitation is calculated at 2,100 mm per year.

On the other side, the Zone 12 territory is conformed by a high percentage of large land parcels, and by a high population proportion proprietor of small parcels, on which pan coger (self-consumption products), and blackberry are principally cultivated. On this regard, according the Agricultural Census of 2004, there are a total 861 plots of which a high percentage, almost half, is large extension parcels. Regarding land ownership, statistics reveal a high concentration of ownership. While 72% of the population in the district have plots smaller than a hectare, only 4% of the population own plots of more than 10 hectares, which represent 45% of the total Village area. This phenomenon of land concentration is no so marked in the other two districts. However, the principal problem that this situation implies, is the limiting factor that it presents for expanding the agricultural borders in Zone 12.

**Soil analysis.** In order to obtain the principal soil qualities, more than 100 samples were collected from the 27 surveyed plots. A highly significant number given the geographical and parcel conditions. The samples were sent to the soil analysis lab of the Universidad Nacional de Colombia, Medellín, *Campus*, after an analysis, a report detailing the pH, organic material, major elements, and minor elements, was produced. These results, in conjunction with the agro-climatic conditions of the area, have the objective of determining the aptness of the region for the cultivation of blackberry.

**Survey.** Production volumes are also explained by elements related to techniques, farmers, production and distribution methods, and other important elements typical of traditional crops. This information was obtained through direct surveys of the producers. A representative sample of approximately 20% of the blackberry producers in the area was taken. Survey

results were analyzed through an SPSS Program and questions regarding production costs, inputs, transportation, storage centers and sales, among others, were developed.

Both in the soil analysis and in the conducted surveys, the results correspond to those of descriptive statistics including correlations among variables. Additionally, the study includes an important bibliographic revision through which identifying the productive chain of blackberries, and other general characteristics of the crop, was possible.

## RESULTS AND DISCUSSION

**Analysis of blackberry productivity.** Field observations and information collected in the surveys indicate that blackberry crops in the districts of Perico and Pantanillo, despite not being technologically developed, have important productivity levels. Although most farmers are aware of the importance of fertilizing and to a certain extent employ macro and micronutrients, plants do not receive the adequate amount of these elements. The previous statement can be observed through analyses of the soils and crop extraction rates. Nevertheless, as previously mentioned, the performance of productivity is fine.

On this topic, in order to compare productivity by hectare it is necessary to keep in mind certain conditions. First on line, is the sowing density<sup>8</sup>. Logically, a moderately technified crop with a planting density of one plant for every three square meters, will have a larger yield than a crop with a planting density of one plant for every four m<sup>2</sup>.

Second, a precise estimation of the projected annual production must consider the different climatic and harvest states during the year, given the effects both have on the crop throughout the year. In order to solve this problem a control group is required, which in other words, means to implement a data collection program in pre-established periods and, in this manner, elaborate an analysis of production performance.

However, an exercise by which an approximation of the productivity given by blackberry crops in the districts of Perico and Pantanillo is presented next. The analysis divides the data in three groups according to

<sup>8</sup> See also Dámaso (1977)

production per plant: Low production ranges between 0.00 and 0.49 kg per plant, medium production ranges between 0.50 and 0.79 kg per plant, and high production is 0.8 kg or more per plant (Table 1).

**Table 1.** Blackberry production classification in the districts of Pantanillo and Perico. Envigado, Colombia.

<b>Blackberry Crop Productivity</b>		
<b>Range kg/plant/month</b>	<b>Type</b>	<b>Producers (%)</b>
0 - 0.49	Low	47,4
0.5 - 0.79	Medium	26,3
More than 0.8	High	26,3

Source: Self developed based on data from the Blackberry Producers Survey.

Blackberry production in Colombia is concentrated in the departments of Cundinamarca (34.7%); Santander (16.5%); Antioquia (12.9%) and Huila (7.3%). These zones concentrate a slightly more than 70% of the total production<sup>9</sup>.

Besides, crop productivity, meaning the number of tons produced by hectare per year, has been traditionally higher in the zone with the highest production: Cundinamarca. Nevertheless, mid levels of productivity, at a national level, have also increased productions in recent years (Table 2).

**Table 2.** Blackberry production in Colombia.

<b>Item</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>
t/ha/year National Total	7.782	8.374	9.059	8.901	9.615
t/ha/year Cundinamarca Total (a)	10.677	10.692	11.548	10.746	12.235

Source: Ministry of Agriculture and Rural Development 2008.

Note: (a). Principal producer in Colombia

Again, after making the necessary conversions, it was observed that even for low productivity cases in Envigado, production there reaches levels that are quite acceptable. In fact, although it is necessary to keep in mind the different time

periods being considered (information from Envigado corresponds only to the year 2007), we have that the lowest production range in Envigado can reach an average of 14.7 tons per hectare per year (Table 3).

**Table 3.** Yield of blackberry crop according to productivity type in Envigado, Colombia.

<b>Productivity t/ha/year (Density of 1 plant per 4 m<sup>2</sup>)</b>		
<b>Range</b>	<b>Minimum</b>	<b>Maximum</b>
0 – 0.49	0,0	14,7
0.5 - 0.79	15,0	23,7
More than 0.8	24	

Source: Self developed based on data from the Blackberry Producers Survey

<sup>9</sup> According to information from Anuario de Frutas y Hortalizas; 2003-2007 (Yearbook of Fruits and Vegetables, 2003-2007); edited by the Ministry of Agriculture and Rural Development.

In other words, given the soil qualities which were analyzed in a previous section, the "traditional" qualities of crops, the climate and the altitude, it is possible to affirm that blackberry in Envigado is a crop with good productivity. In this sense, recommendations focus on two factors: In first place to continue blackberry production in these areas, and in second place, to conduct the proper

monitoring of the crops in order to increase even more said productivity.

Furthermore, it is possible to conduct a productivity analysis that refers to the profits that a blackberry-cultivated hectare can yield, at a density of one plant per every three square meters, and compare said profits to profits obtained if said extension was rented (Tables 4 and 5).

**Table 4.** Approximate profits per plant of blackberry in Envigado, Colombia.

Product	Average Monthly Production	Production Value (Colombian pesos)	Monthly Costs per kg <sup>1</sup>			Profits (Colombian pesos)
			Labor	Inputs	Transport	
1 Plant	1 kilogram	1.349	338.34	285	100	625.65

Source: Self developed based on data from the Blackberry Producers Survey

1. Labor costs were increased by 50%, with the purpose of covering imbalances that arise from excluding labor services performed by the proprietors themselves. It was observed in the surveys that an average of two people worked in farms, one of whom was a family member.

The previous analysis relays an average profit of approximately \$626 Colombian Pesos per blackberry plant annually. Now, this profit can also be compared with the profits that would be reported if the land were used in another

production activity, or if it were rented. Along these lines, we will now report, as in a case in which the plot was rented, the profits that would be made compared to those relayed by blackberry production.

**Table 5.** Approximate profits per plant of blackberry in a renting plot of Envigado, Colombia.

Renting Costs			
A cuadra with similar characteristics in the area rents for an average \$1,000,000 Colombian pesos			
Area m <sup>2</sup>	Rent	Price per meter	Price for renting the plot per plant <sup>1</sup>
6,400	1,000,000	156.25	468.75

Source: Self developed based on data from the Blackberry Producers Survey

1. Calculations were made at a density of one plant per three m<sup>2</sup>.

As a result, for the owner of a plot in the districts of Perico and Pantanillo who currently owns a blackberry crop, it is more profitable to continue with the crop than to rent the plot. It is important to point out that calculations were made per hectare, a smaller extension would imply to take the fixed and sunk costs to a smaller area which affects profitability. In other words, dividing the crops causes profitability drops<sup>10</sup>.

the area indicates 4.2 animals per hectare and a daily production of 10 liters per animal.

In a similar manner, it is possible to make comparisons between blackberry crops and other productive systems, such as the specialized bovine dairy industry. Using the same productive parameters of

Comparing profits from blackberry production and the dairy industry a considerable difference can be seen. Because, as previously stated having plants that occupy three square meters and produce the indicated profits, blackberry yields of more than COP\$2 million per year. Nevertheless, in order to analyze both results we must always consider the size of the plots of most blackberry producers, the initial investment in each productive system, and the non-productive period while the system begins to produce and becomes stable.

<sup>10</sup> Some of the special characteristics concerning Castillian Blackberry producers are developed by Tobón and Vásquez (1998).



**Table 6.** Approximate profits in the dairy industry in Antioquia, Colombia.

Number of cows per hectare	Production liters per year	Income annual	Costs	Profits by hectare
4.2	15,330	10,731,000 COP	9,964,500 COP	766,500 COP

Source: Self developed based on data from the Blackberry Producers Survey  
Prices and costs are an average for the department of Antioquia. Calculated with information from the Banco de la República (2007).

Now an obliged question arises concerning the factors currently generating the differences, which in turn translate into higher or lower productivity levels, among blackberry producers in the districts of Perico and Pantanillo. In this sense, the conducted soil analyses, and the information gathered on the field, account for some important differences that could determine said differences.

In the first aspect, soil analysis, there are various important elements to be considered. The first one,

deals with the precautions that must be taken with the conclusions produced by the exercises conducted, as they come from a limited number of producers in which, as shown in Table 7, the standard deviation is relatively high.

The second aspect, refers to common elements in the soil for all three cases: High, medium and low productivities. It is observed that the three categories have the same sandy loam soil type and that the three categories also have a moderately acid pH, of 5.2 - 5.6.

**Table 7.** Soil elements and blackberry productivity in Envigado, Colombia.

Productivity	Name	Texture (%)			pH Class	M.O. %	Al	Ca cmolc kg <sup>-1</sup>	Mg
		A	L	A					
LOW	Average	61	30	10	5,4	21,7	1,4	5,6	1,4
	Standard Deviation	8,06	6,73	3,00	0,74	5,87	0,99	5,29	1,24
	Coefficient of Variation	13,3%	22,4%	31,6%	13,8%	27,1%	70,7%	94,0%	87,0%
MEDIUM	Average	67	26	7	5,2	24,9	1,2	4,8	1,2
	Standard Deviation	2,68	2,00	1,79	0,15	6,72	0,91	2,62	1,17
	Coefficient of Variation	4%	8%	25%	3%	27%	79%	55%	95%
HIGH	Average	62	29	9	5,6	21,7	0,6	7,5	2,9
	Standard Deviation	7,21	3,05	4,16	0,27	4,45		5,20	2,23
	Coefficient of Variation	12%	11%	45%	5%	21%		70%	78%

Source: Self Developed based on soil analysis.

In that sense, the last aspect deals with the differentiating elements among high, medium and low productivity.

Therefore, in high productivity crops a larger quantity of calcium, a macro-element added to the soil, is observed

in larger quantities. Phosphorus and potassium which are added to the soil by fertilizers such as "triple 15" or "10-20-10" among others are also observed in larger percentages in high productivity crops (Table 8).

**Table 8.** Soil elements and blackberry productivity in Envigado, Colombia.

Productivity	Name	K	CICE	P	Fe	Mn	Cu	Zn	B
		cmol	kg <sup>-1</sup>						
LOW	Average	0,4	8,2	10,5	126	9,8	1,5	8,3	0,1
	Standard Deviation	0,18	6,05	7,04	53,59	6,65	1,00	5,50	0,11
	Coefficient of Variation	49,1%	74,3%	67,1%	42,7%	68,2%	66,7%	66,7%	116%
MEDIUM	Average	0,4	7,6	9,8	147	17,2	2,4	14,0	0,1
	Standard Deviation	0,09	3,14	5,97	68,8	5,71	0,89	4,30	0,11
	Coefficient of Variation	25%	42%	61%	47%	33%	37%	31%	141%
HIGH	Average	0,5	11,0	11,0	110	12,7	3,0	17,3	0,3
	Standard Deviation	0,15	7,14	13,0	22,5	9,86	1,73	23,1	0,31
	Coefficient of Variation	31%	65%	118%	20%	78%	58%	133%	105%

Source: Self Developed based on soil analysis.

Regarding the differentiating elements derived from the field work, four important common factors stand out in the high productivity cases, and are present at a lower scale on the remaining cases. These factors deal with:

- Higher productivity cases showed higher expenditures in inputs. This factor is of vital importance once traditional practices, which on occasion support the belief that the use of inputs such as pesticides is not so necessary, are detected in the crops.
- This same high productivity cases also presented lower costs for labor. On this regard, labor represents a smaller cost in comparison with the low and medium productivity cases. In addition, all the high productivity cases reported having 100% social security coverage for its employees, unlike the other two cases. This indicates that despite representing a smaller percentage of the overall costs, there are no threats upon the conditions of hired labor.
- Another important factor regarding the higher expenditures in inputs, which is present at a higher

scale in high productivity farmers, deals with the presence of plagues. Indeed, it is this producers group the one that presents the lowest percentage of plagues in their blackberry production.

- A crucial factor is that high productivity farmers have the highest levels of associativity. Moreover, 60% of these blackberry producers said that they belonged to an association. In the low and medium productivity cases, the percentages of farmers that belong to an association are much lower.

### CONCLUSIONS AND RECOMMENDATIONS

One of the principal results of this study revolves around the efficiency of blackberry crops in economical terms. A cost-benefit analysis certainly demonstrated that the crop is profitable, even more than other activities suited for the area such as: dairy farms, flower farms, the cultivation of other products and renting the land. Therefore, the recommendation for those that already have their crops is to continue producing blackberries, to prepare the soils with the

needed elements, to continuously monitor production, and to imitate the practices of those who have higher levels of productivity.

On another front, an aspect to improve is associativity. According to the tools used, more than 50% of the blackberry producers do not belong to an association. This element turned out to be a key determinant at the moment of seeking better prices for the products, of assuming production costs such as machinery, and of looking for new commercialization sources. On this regard, it is viable to explore the ink and fruit pulp<sup>11</sup>, markets among others. These alternatives would enable a higher added value to the product, which would in turn significantly increase the profitability of the crop.

A worrisome factor is the subdivision of land which is occurring in the area. According to the tools employed, everyday this is becoming a more frequent phenomenon and it is a result of a lack of land deeds (titles) and of the wish that proprietors may have to distribute the land among their descendants. In any case, this fact obviously affects crop productivity and therefore profitability. As a result, we recommend taking measures to prevent this process of subdivision to continue. This could be linked to the phenomena of associativity mentioned above: if associativity increases, it will contribute to reducing land subdivision.

The study indicates an inverse relationship between the size of the plot and the proportion of its blackberry cultivated area. We have that the owners of plots with an average size of 1.71 cuerdas allocate approximately 37% of the plot for cultivating, while the bigger plots with an average size of 14 cuerdas only allocate 1.86% for cultivating. A permanent demand for larger zones to develop condominiums and residential areas may be the reason for the lack of motivation from the large-lot owners, while the owners of the smaller lots have no other option but to continue with their crops. Besides, blackberry production in districts in the Municipality of Envigado is based on a family-structured farming economic system. This can be determined after observing that 71.2% of the labor used by blackberry producers in their crops comes from relatives and that only 28.8% of the personnel is independent and receives payment for its work on the crops. In a similar manner those who use labor

from relatives employ an average of two people, while producers who hire their labor force employ an average 1.8 people. This result is congruent with observations made in other blackberry producing areas in the region.

A high percentage of blackberry producers in the area have productive and profitability levels in their crops below normal standards. Similarly, a significant number of producers, more than 60%, expressed that they had not acquired any type of production machinery in the previous year.

Regarding blackberry plants, although most farmers are aware of the importance of fertilizing, and that to a certain extent they contribute macro and micronutrients to the soil, the crops do not receive the adequate amount of these elements. The previous statement can be observed through analyses of the soils and crop extraction rates. Nevertheless, as previously mentioned, the performance of productivity in the area is fine.

Finally, the study disclosed evidence of a positive relation between productivity and aspects such as: i) the costs of using inputs, as producers are more aware of the need to fertilize and, ii) belonging, or not belonging, to an association (60% of producers in the high productivity category said that they belonged to an association). On the other hand, there is evidence of a negative relationship between productivity and labor, which represents a smaller percentage of the total costs in the cases in which productivity was determined as high.

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<sup>11</sup> Just as recommended by the University of Antioquia (2007)

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