Article

Description and analysis of coffee producers from the Mixe region, Oaxaca

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Abstract

Diagnoses of the members of agricultural productive sectors provide information to generate strategies and public policies that strengthen them, according to their contexts. The objective of this study was to describe and analyze coffee producers based on social, productive, economic aspects and their perception of coffee farming. The information was obtained through semi-structured interviews conducted between November 2018 and March 2019 with producers (n= 40) from the Mixe region, Oaxaca, selected through a non-probabilistic sampling. The information was analyzed with descriptive statistics, hierarchical cluster analysis, Kruskal-Wallis test, Pearson χ^2 and principal component analysis. The results showed that producers carry out coffee farming with social, economic and productive disadvantages, where investment in coffee plantation renewal (χ^2= 0), area in production (χ^2= 0), sale of coffee (χ^2 =0), perception of coffee farming as a production option (χ^2= 0.001), age of producers (χ^2= 0), years of experience (χ^2 =0) and the degree of education (χ^2= 0) explain the conformation of dissatisfied (37.5%), undecisive (22.5%) and satisfied (40%) producers. Producers have social, productive and economic deficiencies that manifest themselves in a subsistence coffee farming, agroecosystems that tend to reduce their agrobiodiversity, with a partial strategy of pests and diseases, and deficient commercial structures that lead to a perception of this productive activity where the majority is dissatisfied and indecisive.

Keywords: coffee growers, organization, principal component analysis.

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Introduction

Agroecosystems are fundamental for the provision of food and key products for contemporary societies, among the most symbolic are shade coffee agroecosystems that represent the livelihoods of around 25 million small producers in the world (Valencia *et al*., 2016; Wagner *et al*., 2019). Coffee cultivation, like other crops, operates in scenarios of uncertainty due to extreme climates, low prices, pests and diseases, this situation was evidenced with the recent rust crisis (*Hemileia vastatrix* Berkeley and Broome) in Central America and Mexico. This, together with the characteristics of the producers, makes them vulnerable as they are in conditions of marginalization (Haggar *et al*., 2015; Läderach *et al*., 2017; Gerlicz, 2018; WCR, 2019).

Producing coffee in social contexts where resource scarcity prevails is a challenge addressed with different approaches such as inclusive innovation (Amaro-Rosales and Gortari-Rabiela, 2016), organizational strengthening (Espinoza *et al*., 2020), livelihoods (Alonso *et al*., 2019) and the promotion of cooperativism and fair trade (Arboleda *et al*., 2020; Ramírez and Nava, 2020). In Mexico, coffee production is an activity that occurs in 14 states and covers an approximate area of 712 000 ha. Currently, Oaxaca is the fourth largest coffee producer in the country with around 135 000 ha grown in marginalized indigenous regions (Ruelas-Monjardín, 2014; Bara and Pérez, 2015; SAGARPA, 2016; Fernández and Méndez, 2018; Henderson, 2019; SIAP, 2019).

A region little studied is the Mixe region located in the northeast of the state, which has 15 municipalities that practice this activity in a context of high marginalization and poverty (CONEVAL, 2018). In several regions, the characteristics of producers are unknown, even though this is a prerequisite for proposing strategies to promote agriculture (Borja *et al*., 2018). It is important to understand local contexts to generate appropriate strategies and public policies, for this reason, the present work aimed to describe and analyze coffee producers based on social, productive, economic aspects and the current perception of coffee farming.

Materials and methods

Study area

This descriptive and analytical study was conducted in four localities: Zompantle, San Isidro Huayapam, Santa Margarita Huitepec and Santiago Ixcuintepec (16° 56’ 05.7”/17° 00’ 58.0” north latitude and 95° 37’ 24.1”/95° 54’ 09.1” west longitude), located in the Mixe region northeast of the state of Oaxaca, Mexico (Figure 1).

The area is part of the Sierra Madre del Sur, and its rugged topography is typical of these mountain ranges with steep slopes (INEGI, 2016). It is located in one of the priority terrestrial regions of Mexico (RTP-130) that has a diversity of interconnected environments between tropical montane cloud forests and tropical rainforest (Arriaga *et al*., 2000). The inhabitants of the area belong to the Mixe culture and practice subsistence agriculture, coffee farming, extensive cattle farming, they are in a migratory category of strong expulsion and the product of greater commercialization in the region is coffee (INPI, 2017).

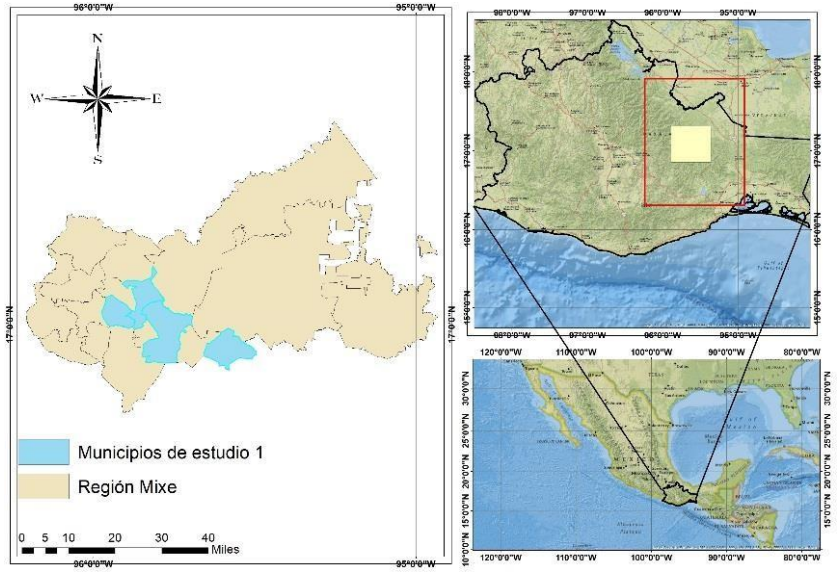

Figure 1. Study area (INEGI, 2019).

Since coffee boomed in the 1940s (Torres, 1997), coffee farming in this region has gone through different stages. Currently, there are approximately 5 420 producers organized in 16 groups and distributed in the four study municipalities (AMECAFÉ, 2020). The study was conducted in three stages: 1) non-probability sampling; 2) information collection; and 3) statistical analysis of information.

Probabilistic sampling. Field data were collected using a two-stage sampling technique. Firstly, a non-probabilistic sampling was carried out that led to the case of four groups selected for the willingness and approachable of the subjects. Secondly, 40 producers from a total of 108 producers that make up the four groups were randomly chosen to carry out the present study.

Information collection. A semi-structured interview was conducted with 25 questions organized into four sections: 1) social aspects (gender, age of the producer, number of members in the family, basic services in the home -water, electricity, drainage, cooking fuel), schooling, medical assistance service); 2) productive aspects (sales history, years of experience, total area of the plot, area in production, age of plantations (new-old), management or cultural practices, type of coffee plantation -composition by planted varieties, species for shade and other useful plantations); 3) economic aspects (family income, social programs, sources of income, coffee sales channels); and 4) perception of coffee farming (as a production option and reason for response) and problems.

Thirty-one men and nine women (n= 40) randomly selected were interviewed, these were carried out in their homes and plots during the period from November 2018 to March 2019. Statistical analysis of information. The information gathered was concentrated in a database. A descriptive analysis was made and subsequently the study subjects were classified into groups using a hierarchical cluster analysis using Euclidean squared distance and Ward's method in order to optimize the homogeneity of the clusters. Of the groups formed, the variables that influence this conformation were analyzed by means of the Kruskal-Wallis test and Pearson's χ^2. Finally, the

quantitative variables that showed statistical significance ($p \leq 0.05$) were subjected to a principal component analysis to explain the conformation of the groups. The analyses were performed in the SPSS V25.0 (2017) statistical package.

Results and discussion

Social characteristics

In organizational terms, it is highlighted that the coffee producers interviewed are made up of men (68%) and women (32%) organized in local working groups, this reflects the trend of inclusion and gender relations in power structures and economic benefits (Cárcamo *et al*., 2010; Paz, 2018); however, indigenous women continue to live in conditions of exclusion and marginalization (Muñoz and Vásquez, 2012). Regarding the sociodemographic aspects, the average age of the interviewees is 53.8 years, with families of 3.6 members on average and, according to their experience, there are three categories: 30% belong to the generation of older adults (≥ 61 years), 57.5% to the generation of middle-aged producers (36-60 years) and 12.5% to the generation of young producers (≤ 35 years).

The decrease in young producers threatens the continuity of coffee farming due to the lack of generational replacement, this coincides with other studies (Aguirre *et al*., 2016; Jiménez-Barbosa *et al*., 2018), and consequently, it entails the loss of the social, economic and environmental benefits provided by these systems recognized in other studies as sustainable (Haggar *et al*., 2017; Vanderhaegen *et al*., 2018; Ho *et al*., 2018; Morales *et al*., 2018).

The homes of the interviewees lack at least one basic service (100% drainage, 32.5% cooking fuel and 32.5% piped water at home), regarding electricity, all have this service. Government policies and programs for social care and those focused on the coffee sector have not been able to overcome these situations. Few initiatives have managed to improve the quality of life of small coffee growers and are considered success cases (Pacheco *et al*., 2019); however, the poverty conditions of small producers continue to reflect the few benefits they receive.

Eighty percent are considered illiterate (incomplete primary education and without formal education), this harms the initiatives related to capacity building those public policies or fair trade programs (Kudama, 2020) and in the reading and interpretation of instructions for the use of packaged inputs that social programs provide for the sector. All producers receive medical care in the rural medical units of the Mexican Institute of Social Security (UMR-IMSS, for its acronym in Spanish) and 57.5% resort to private doctors in cases of emergency.

Productive characteristics

Concerning production conditions, the record of sale of dried parchment coffee reflects a loss that reached 89% in the 2011-2012 cycle compared to the previous cycle (Figure 2). This devastation of coffee plantations due to the rust epidemic impacted at the national level and transformed the social, economic and ecological bases of coffee farming in the long term (Avelino *et al*., 2015; Renard and Larroa, 2017; Libert *et al*., 2019; Henderson, 2019).

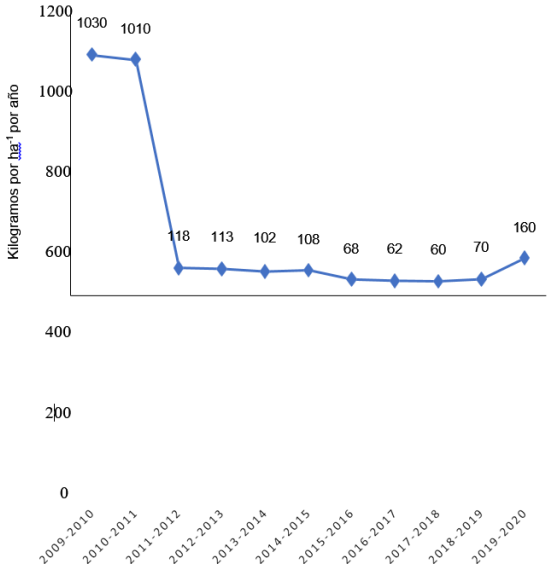

Figure 2. History of sale of dried parchment coffee of coffee growers surveyed (n= 40) in the Mixe region, Oaxaca, Mexico.

Currently, the producers surveyed have 1.2 ha of coffee plantation on average, which represents half of the production capacity. Renewal costs reach \$102 000.00 ha^{-1} carried out over an average period of three years and supported by practice (Table 1). The coffee plantations were renewed with their own work, eventual support from day laborers and the support of social programs to boost the sector (support program for small producers -PROCAFÉ component-). According to the above, the production characteristics of the respondents correspond to the category of small producers, given that they own less than five hectares of land, depend mainly on family labor and only hire workers occasionally (FAO, 2013; Bacon *et al*., 2014; Gómez *et al*., 2019).

Table 1. Current production aspects of coffee growers surveyed (n= 40) in the Mixe region, Oaxaca, Mexico.

	Mean	SD	Minimum	Maximum	CV (%)
Experience as a coffee grower (years)	35.8	13	5	60	34.8
Total area of the plot (ha)	2.3	1.3	1	5	55.8
Area in production (ha)	1.2	0.6	0.25	3	53.1
Age of plantations (years)	10.5	7.54	3	18	71.81
Renewal cost (\$ ha^{-1} 3 $years^{-1}$)	102 000	55 510	45 000	260 000	49.08

SD= standard deviation; CV= coefficient of variation.

Regarding the management of coffee plantations, this has been predominantly traditional with transition efforts towards organic production, in this sense, 85% of producers implement live or dead barriers in contour lines, cultivation of varieties resistant to rust, use of organic inputs for the contribution of nutrients to the soil and later to the renewed coffee plantations. All producers recognize that this type of management involves more work, they also expect a positive economic impact in the short term as has already been verified with other experiences (Calo and Wise, 2005; Rabanal *et al*., 2019; Rodríguez *et al*., 2019).

The coffee areas studied are classified as traditional polycultures. In the study areas, two subtypes are distinguished: 55% are considered highly diversified because there are between 14 and 32 useful plants, up to six varieties of coffee and six varieties of shade, although they currently have less quantity with respect to what was reported in other studies (Moguel and Toledo, 1999), producers indicate that they will continue to plant more species (Figure 3a) and 45% presents low diversification, where there are mainly one or two varieties of coffee, and banana and *Inga vera* sp., as the dominant shade with a slow diversification process and producers do not make it clear if they will follow that trend (Figure 3b).

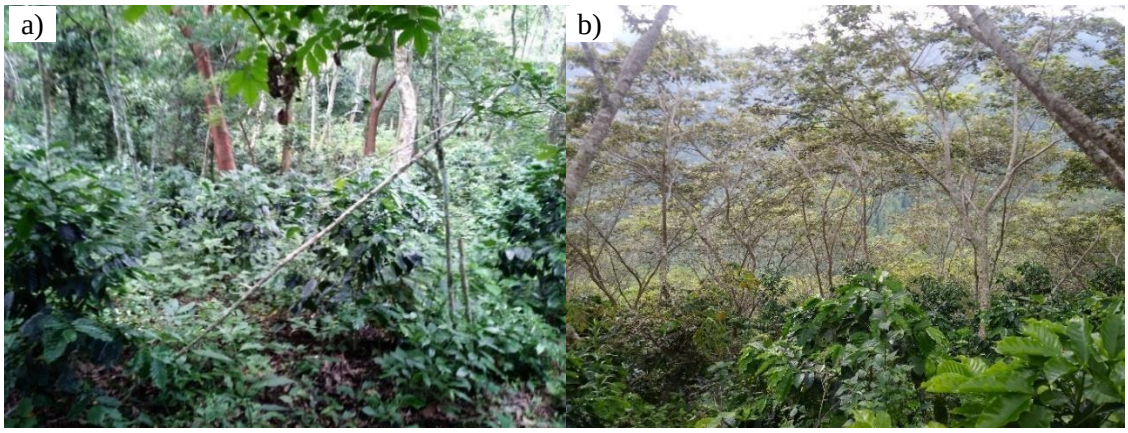

Figure 3a and 3b. Subtypes of coffee plantations based on the agrobiodiversity of small producers (n= 40) in the Mixe region, Oaxaca, Mexico.

Producers plant more than one variety of coffee according to their preferences and ease of acquisition, today they report that they have the following varieties of coffee: Marsellesa (97.5%), Garnica (87.5%), Costa Rica 95 (42.5%), Mundo Novo (40%), Caturra Amarrillo (30%), Bourbon (17.5%), Oro Azteca (15%) and Creole (7.5%). Within the plots, the Marsellesa variety is the one that currently predominates and covers on average 67% of the coffee plantations, the remaining 33% corresponds to the other varieties mentioned above. It is important to emphasize that previously the predominant variety was Creole or Typica that was devastated by rust.

The predominant shade species are: *Inga vera* sp. (100% -all producers have it planted-), followed by *Musa paradisiaca* L. (97.5%), *Persea americana* (50%), *Citrus sinensis* (47.5%), *Pouteria sapota* (47.5%), *Cedrela odorata* (32.5%). The average density of *Inga vera* sp., is 82 trees ha^{-1}, the other shade varieties have an irregular density that is not reported by producers, except the species *Cedrela odorata*, there are 6 trees ha^{-1} on average.

Economic characteristics

Producers have an average income of $2 432 pesos per month that comes from coffee farming and other income. Five percent of producers are supported by self-consumption agriculture, 62.5% by self-consumption agriculture and the sale of labor and 32.5% by self-consumption agriculture, remittances and social programs. The economy of the small producers interviewed corresponds to peasant forms of income diversification or the multifunctionality of family farming (Idárraga and Sánchez, 2016; Ticllacuri *et al*., 2020).

Regarding sales channels, producers belong to a limited liability rural production company (SPR de RL, for its name in Spanish) where they register to market the coffee produced and thus face situations of coffee crisis, but despite the effort, this structure has had a limited performance, largely attributed to the lack of professional management and involvement of the partners, this coincides with other studies (Rodríguez, 2020; Garduño and Ramírez, 2020).

Perception of coffee farming

Seventy percent of producers consider that coffee farming is the best production option in the region because the crop is adapted to the ecological and social environment and has a market, this perception has been built socially within the framework of a historical-social, local and regional context; from the experience and position of producers in the production chain that has finally been of subsistence and social reproduction rather than the accumulation of wealth (Ejea, 2009; Rosales *et al*., 2018).

At the other extreme is 30% of hesitant producers and consider small-scale cattle farming, mixed amaranth and cinnamon cultivation as better local options and migration to seek better income opportunities and quality of life (Figure 4). As for the perception of current problems, 67.5% consider that low prices generate greater distress for producers, for 17.5% they are pests and diseases and 15% consider that extreme climates represent a threat.

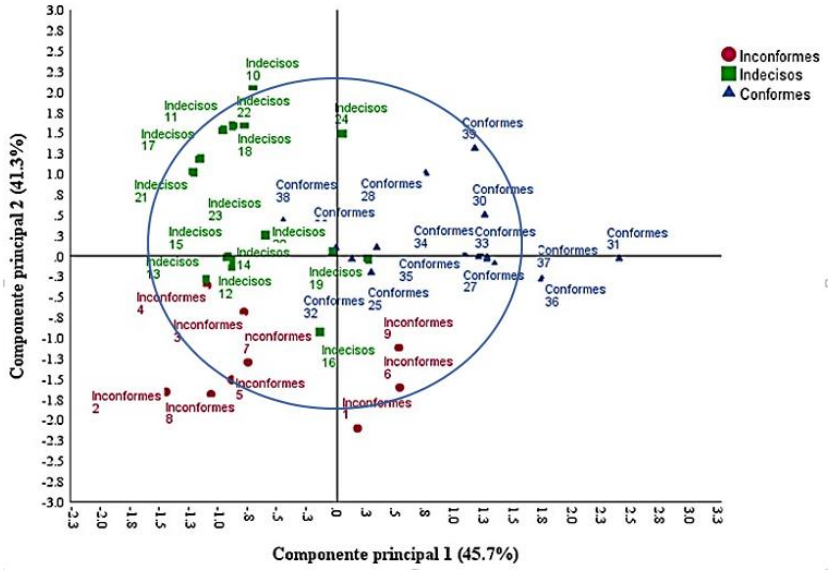

Figure 4. Dispersion of producers according to principal components.

Differentiation and analysis of producers

Three groups were identified through cluster analysis based on the social, economic, productive and social perception characteristics of coffee farming. Conglomerate I integrated 9 (22.5%) producers, conglomerate II groups 15 producers (37.5%) and group III is made up of 16 producers (40%) (Figure 5).

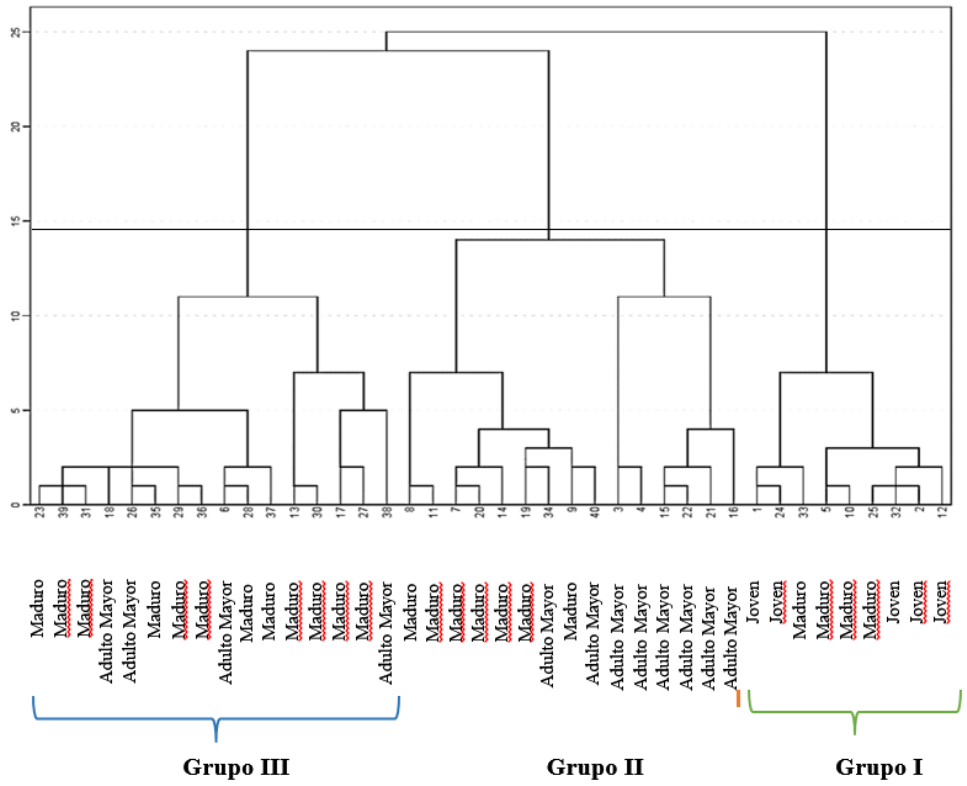

Figure 5. Grouping of producers using Ward's method.

Group I is made up of young producers who are on average 35.7 years old, can read and write, which represents a significant difference (χ^2= 0) with respect to groups II and III. Another contrast is that they consider coffee farming as an unattractive activity (χ^2= 0), this is reflected in the renewal of their coffee plantations, being 0.9 ha on average, of which 66.7% presents low diversification. The producers of group II are the ones that have invested the least in the renewal of their coffee plantation ($71 733.30 pesos) and have the lowest average area in production (0.7 ha) of which 86% of their coffee plantations are highly diversified.

A significant difference (χ^2= 0.001) is that they have three sources of income because they have decided to explore other options such as cattle farming or temporary migration for the sale of labor. Their perception of coffee farming is 'bad', it makes a significant difference (χ^2= 0.006) compared to the other groups, this is because they consider low prices to be the biggest problem. Group III is made up of elderly producers, with a lot of experience, a reduced workforce and they are considered illiterate.

They are the producers that have invested the most in the renewal of their coffee plantations, have the largest area in production in hectares, of which 75% are highly diversified coffee plantations, and registered the largest amount in sales of dried parchment coffee in the cycle 2019-2020. Their perception of coffee farming is very good, 93.8% consider that it is an ideal crop in economic, social and environmental terms (Table 2).

Table 2. Values (minimum, maximum and mean) and significance of the quantitative variables that make up group III.

Variable	Subgroup I (n= 9)	Subgroup II (n= 15)	Subgroup III (n= 16)	Significance (χ^2= p< 0.05)
Age of producer (years)	35.3 25 ±52	61.8 43 ±86	56.8 51 ±72	0.000
Coffee sales 2019- 2020 (kg)	117.2 45 ±260	94.4 40 ±210	247.8 112 ±360	0.000
Experience as a coffee grower (years)	17.8 5 ±35	40.8 20 ±60	36.8 25 ±55	0.000
Total area of the plot (ha)	2.1 1 ±4	1.9 1 ±4	2.8 1 ±5	0.154
Area in production (ha)	0.9 0.5 ±1.5	0.7 0.25 ±1.2	1.8 1 ±3	0.000
Renewal cost ($ ha^{-1} 3 years^{-1})	88 111.1 42 000 ±145000	71 733.3 30000 ±120 000	165 937.5 105 000 ±260 000	0.000
Family income ($)	2 333 1 500 ±3 600	1 980 1 500 ±3 200	2 912 1 500 ±5 000	0.059

Principal component analysis (KMO= 0.721 p= 0) generated two components that explain 87.1% of the group formed (Figure 4). Component 1 is defined by the variables of renewal cost of coffee plantation, area in production, sale of dried parchment coffee, cycle 2019-2020 and perception of coffee farming, component 2 is defined by the age of the producers, the years of experience as coffee grower and the level of education.

This explains and defines the groups of producers dissatisfied with coffee farming because they consider low prices as the biggest problem (37.5%), a group of producer's undecideds in maintaining this productive activity (22.5%) and producers who are satisfied with coffee farming (40%).

Conclusions

The social situation of the coffee growers interviewed is not favorable because most of the producers are elderly and do not have a relay to assume the challenges that the sector currently implies. They work with lack of at least one basic service in the home, illiteracy and basic medical service, this derives from social problems at the level of the municipalities, which are of low human development. In productive terms, coffee agroecosystems are impacted by rust and have been slowly renewed, the predominant management remains traditional with incipient efforts of transition towards organic production, but with a notable tendency towards reduction that can generate important changes in the structure and functioning.

There are producers dissatisfied with coffee farming because they consider low prices as the biggest problem, those undecisive in maintaining these productive activities and those who are satisfied with coffee farming are older adults.

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