Article

Characteristics of coffee producers and plantations in the northern region of the state of Chiapas

Patricia Vázquez-López[1]
José de Jesús Espinoza-Arellano[1§]
Apolinar González-Mancilla[2]
Liliana Angélica Guerrero-Ramos[1]

[1]Faculty of Accounting and Administration-Autonomous University of Coahuila-Torreón Unit. Boulevard Revolution 153 East, col. Centro, Torreon, Coahuila, Mexico. ZC. 27000. Tel. 871 7124514. (vlopezpatricia@hotmail.com; dralilianaclases@gmail.com). [2]Faculty of Agriculture and Zootechnics-Juarez University of the State of Durango. Highway Gómez Palacio-Tlahualilo km 35, ejido Venecia, Durango. ZC. 35170. Tel. 871 7118875. (apolinar.gonzalez@ujed.mx).

[§]Corresponding author: jesusespinoza_612@yahoo.com.mx.

Abstract

Coffee is one of the most consumed agricultural products in the world. Mexico has a planted area of 710 431 ha and a production volume of 953 682 t. Despite its importance, in Mexico there is a lack of regional studies on the characteristics of coffee producers and plantations that serve as a basis for public policy decision-making. The objective of this work was to identify the characteristics of coffee producers and plantations in the municipality of Pantepec, Chiapas. A questionnaire of 76 questions was applied, which was divided into six blocks: informant data, plantation data, labor, financing and commercialization. The sample consisted of 61 producers from five localities of the municipality of Pantepec, Chiapas. The results indicate that producers are on average 41 years old and have low schooling. They have an area of less than two hectares, so the producers have to supplement their income with other activities. Eighty percent produce the landrace variety with renewed plantations, finding that 34.4% replanted two years earlier and 97% used between 100 and 600 new plants. Ninety-five percent of producers obtain yields between 0 and 600 kg ha^{-1}. Coffee cultivation is an activity that generates roots in the population, however, it requires options that give it added value to generate employment and income in the region of study.

Keywords: *Coffea arabica* L., added value, family roots, Pantepec.

Reception date: December 2021
Acceptance date: March 2022

Introduction

Agriculture is one of the most important activities for humanity as it provides foods for the population and raw materials for agribusiness. Among agricultural activities, coffee farming stands out in importance because, in addition to generating employment and income, it contributes foreign exchange to the country as it is the main agricultural export item of Mexico, only surpassed by petroleum exports and remittances from migrants (FIRA, 2016). Coffee is considered the most consumed agricultural product in the world, with a market that generates more than 90 trillion dollars annually (Damatta and Rodríguez, 2007). In Latin America, the cultivation of Arabica coffee (*Coffea arabica*) plays an important role in the lives of rural producers due to biodiversity, conservation and contributions to sustainable development (Harvey *et al*., 2021).

Coffee is one of the most important tropical crops in the world both in terms of the gross value of its production and the number of families that depend on it for their livelihood (Chain-Guadarrama *et al*., 2019). In 2020, 11 million hectares of coffee were harvested in the world, in which more than 10 million tons were produced. Brazil ranks first in world production with 3.7 million tons, followed by Vietnam with 1.76 million. Mexico, in that same year, ranked 13th with 175 555 t (FAOSTAT, 2022). At the national level, in 2020, Mexico had a planted area of 710 431 ha, of which 636 003 ha were harvested. The production volume was 953 682 t of cherry coffee, having an average production yield of 1.5 t ha^{-1} and a value of 5 135 835 thousand nominal pesos (SIACON-SAGARPA, 2022).

In Mexico, more than three million people who participate in its production depend on coffee cultivation. One hundred percent of coffee production is obtained in 14 states of the Mexican Republic, which include Chiapas, Veracruz, Oaxaca, Puebla, Guerrero, Hidalgo, San Luis Potosí, Nayarit, Jalisco, Colima, State of Mexico, Morelos, Querétaro and Tabasco. The state of Chiapas ranks first in planted area (253 318 ha) and harvested area (237 656 ha), followed by Veracruz (144 598 planted ha and 126 254 harvested ha) and Oaxaca (134 647 planted ha and 111 296 ha harvested) (SIACON-SAGARPA, 2022).

The average price of a tonne of cherry coffee, nationwide, between 2013 and 2020, fluctuated between $4 797.00 and $5 872.00 in nominal terms, reaching a maximum price in 2017. In 2020, the price of cherry coffee nationwide was $5 385.00. The state of Chiapas has reached prices between $4 572.00 and $5 269.00. In 2019 and 2020, coffee in Chiapas reached prices between $4 696.00 and $4 839.00, lower levels compared to previous years (SIACON-SAGARPA, 2022). In 2020, the municipality of Pantepec, Chiapas registered an area of 325 ha planted with coffee, of which 317 ha were harvested with a production of 234.6 t and an average yield of 0.75 t ha^{-1}. The price per ton on average, was $4 334.00 pesos (SIACON-SAGARPA, 2022).

In the study area, coffee cultivation is characterized by being carried out by smallholder producers, many of them Indigenous. Its cultivation is a complementary economic activity, producers diversify their activities in other sectors, which allows them to obtain additional income to meet the basic needs of the family. Coffee cultivation is of great environmental importance, contributes to carbon sequestration and is effective in stabilizing soils. The cultivation of coffee is associated with other forest species that provide it with shade, which also provide a service to the environment by reducing pollution from high concentrations of carbon dioxide, allowing the conservation and restoration of forests and jungles.

Despite the economic, social and environmental importance of coffee, in Mexico there is a lack of regional studies on the characteristics of producers and plantations that serve as a basis for making public policy decisions in relation to strategies to develop their productivity and profitability. The objective of this work was to identify the most important characteristics of coffee producers and plantations in the municipality of Pantepec, Chiapas. It was hypothesized that coffee production in the study area is for subsistence, of low productivity, but constitutes a factor of rootedness in the localities of origin by generating employment and income for day laborers, producers and their families.

Materials and methods

The research was developed in the localities of Canelar, Buenos Aires, El avellano, El Limón and Santa Cruz, belonging to the municipality of Pantepec, in the north of the state of Chiapas, Mexico. These localities are the ones with the largest area with coffee in the municipality of study. The geographical location of the study area is 17° 06' 27.72" north latitude and 92º 57" west longitude, with an altitude of 1 462 m. The total population of the municipality is 12 266 inhabitants (INEGI, 2020).

The research was descriptive with a mixed approach (Hernández *et al*., 2010). The collection of information was carried out in 2019 through a questionnaire aimed at small producers who have coffee farms. The questionnaire consisted of 76 questions divided into six blocks: I) informant data; II) plantation data; III) labor; IV) financing; V) commercialization; and VI) organization. Responses were analyzed by frequency.

The statistical sample was calculated based on a list of 163 coffee producers in the municipality. A simple random sampling was applied, with an error of 10% and a reliability of 95%. The formula for the calculation of the sample was as follows $n=\frac{NZ^2_{\alpha/2}\ p\ q}{Nd^2+Z^2_{\alpha/2}+p\ q}$ (García *et al*., 2014). Where: n= sample size; N= population size (163 producers); Z= critical value; obtained from statistical tables; d= level of maximum error admitted; $Z_{\alpha/2}$ at 95%= 1.96; *p*= 50% = 0.5; q= 1 - p= 1 - 0.5= 0.5; d= error at 10% (0.1). The calculations were performed as follows: $n=\frac{NZ^2_{\alpha/2}\ p\ q}{Nd^2+Z^2_{\alpha/2}+p\ q}=\frac{(163)(1.96)(0.5)(0.5)}{(163)(0.1)^2+(1.96)^2(0.5)(0.5)}=\frac{156.5452}{1.63+0,9604}=61$. The selection of the producers that made up the sample was completely random. The data obtained were encoded and captured in the editor of the Statistical Package for the Social Sciences (SPSS) Version 22. The results are shown below.

Results and discussion

Characteristics of coffee producers

The producers engaged in coffee activities in the study region are people between 20 and 75 years old; of these, 26% are between 20 and 40 years old; 48.9% between 41 and 60 years old and 24.6% between 61 and 75 years old. In relation to gender, 60.7% are men and 39.3% women. Women who grow coffee do so because their husbands work outside the municipality or are widows. In addition, they take care of children and carry out other activities outside the home that help them to complement the economy of their families. As for marital status, 69% are married, 16% are in a consensual union, 3% are single and 11% are widowed.

The older children of the producers have emigrated to other places such as Campeche, Cancún, Villahermosa, Tuxtla Gutiérrez, Ciudad del Carmen, Veracruz, while some others go to nearby municipalities. Only 38% of the children are engaged in the cultivation of coffee, while 62% carry out other activities. In a similar study in the state of Guerrero, Tablas (2021) found that most of the producers' children have also migrated to places such as Tlapa de Comonfort, Acapulco, Mexico City and the United States of America. Eighty-four percent of producers use exclusively family labor; while 16% hired external day laborers to carry out the tasks of the crop.

This indicates that, in the region, coffee is a crop where the family finds employment and roots for its members, but also scarcity of economic resources of the owners of the plantations to hire external workers. As for the level of schooling, only 1.6% of producers have completed a bachelor's degree, 13.1% have high school education, 8.2% have primary education and junior high school education, 42.6% have incomplete primary education and the rest, 26.2% are producers who do not have any schooling (Figure 1). The level of education of producers is very low, which could be an adverse factor for the modernization of coffee plantations of the region.

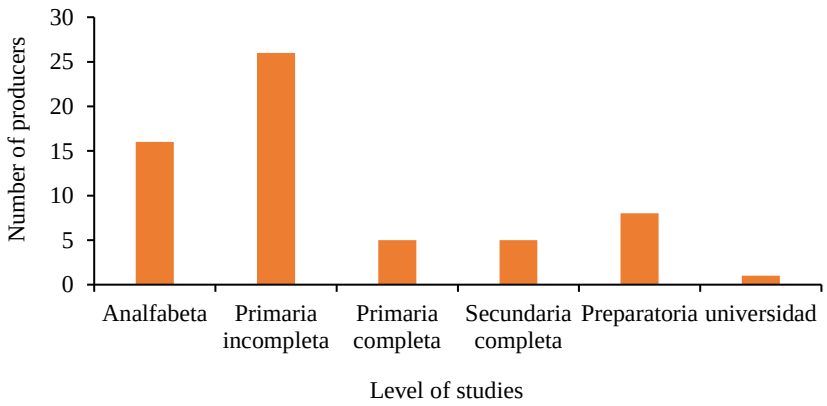

Figure 1. Level of schooling of coffee producers in the municipality of Pantepec, Chiapas.

Most of the producers in the study area are people who speak the Zoque language. According to Aguirre *et al*. (2018), in Mexico more than 60% of coffee producers are Indigenous, who belong to 32 ethnic groups. Of the almost three million people involved in coffee farming, 1.5 million are Indigenous people, who are directly involved in production.

In relation to the experience of producers in coffee farming, the results indicate that 18% have a range of 0-10 years working in this activity; 36% have 11-20 years; 23% have 21-30 years, 13% have 31-40 years, 8% have 41-50 years and 2% have 51-60 years (Figure 2). As can be seen, producers have the necessary experience to manage the crop, although they do not always have the necessary economic resources to acquire the inputs that allow them to increase productivity. Vázquez *et al*. (2017), in a study conducted in the state of Veracruz, found similar results with coffee producers with an experience that fluctuated between 8 and 65 years, concluding that this factor is one of the most important for the cultural maintenance of the crop and its productivity.

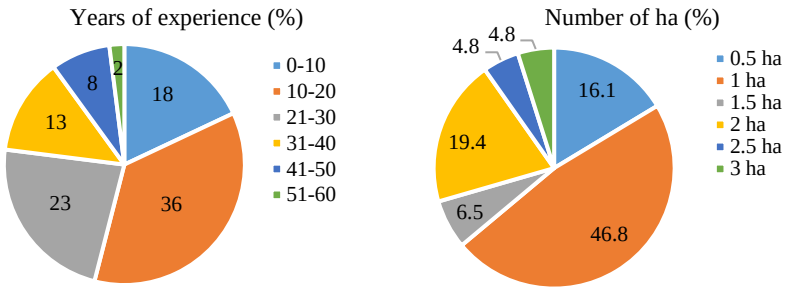

Figure 2. Stratification of experience in years (%) and number of hectares (%) in coffee production in Pantepec, Chiapas.

Tablas *et al*. (2021), in a study conducted in the state of Guerrero, found that 63% of producers have more than 20 years as coffee growers; 9% from 1 to 5 years; 22% from 6 to 15 years and 6% from 16 to 20 years, which indicates that, like Chiapas, there is experience in coffee production. In the study area, it was found that 45.9% of coffee producers have their plots compact and 54.1% have them scattered; likewise, it was found that 16.1% of producers have 0.5 ha, 46.8% have one ha, 19.4% have two ha and 4.8% have 2.5 and 3 ha, respectively, concluding that it is a smallholder activity (Figure 2).

According to Medina-Meléndez *et al*. (2016), the density of coffee plants in the state of Chiapas ranges from 3 334 plants ha^{-1} to 4 444 plants ha^{-1}. Coffee producers from the study region diversify their activities within and outside agriculture, which allows them to obtain additional income in order to meet the needs of the family. Quiroz (2006) mentions that the diversification of activities allows producers to reduce market and production risks, as well as maximize land use and remain in production activities throughout the year. This increases their gross sales, reduces their fixed costs per individual crop and provides continuous employment.

In addition to coffee cultivation, 97% of respondents are day laborers, 23% are also engaged in other trades (mason, carpenter, plumber, electrician, photographer, baker, etc.), 6% poultry farming, 3% housewife, 18% livestock farming, 8% other crops, and 20% other trades such as traders and various jobs (Figure 3). Diversification of producers' activities is an important strategy to strengthen food security and improve the standard of living of coffee-producing families (Anderzén *et al*., 2020).

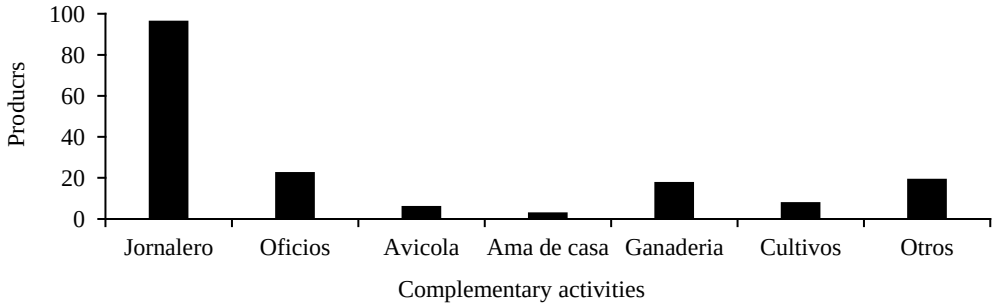

Figure 3. Complementary activities to coffee cultivation of producers of the study region. Note: trades= mason, carpenter, plumber, electrician, photographer, baker, etc. Others= traders and various jobs.

Characteristics of the plantations

The coffee varieties that predominate in the study area are Criolla or Typica (*Coffea arabica*) with 80% of the area, but other varieties such as Caturra, Mundo Novo, Garnica, Oro azteca, Catimor, Bourbon, Robusta and Costa Rica are also grown. The planting of other varieties is one of the strategies they have followed to improve productivity and obtain greater production. A similar situation, in terms of varieties, occurs in the state of Guerrero, where the main coffee grown is *Coffea arabica* with the varieties Typica, Caturra, Mundo Novo, Garnica and Bourbon (Tomas *et al*., 2018).

On the other hand, 60% of the world's production is of the Arabica variety, which is sold at better prices for the quality of the drink (Van der Vossen *et al*., 2015). In a study conducted in the state of Veracruz, López-García *et al*. (2016) it was found that the main varieties harvested were Typica, Bourbon and Caturra. In the state of Chiapas, it was found that the coffee grown is *Coffea arabica* with the varieties Typica (30.27%), red Bourbon (13%) and yellow Bourbon (29.07%) (Medina-Meléndez *et al*., 2016). From the above, it is observed that the varieties that have been recently planted in the municipality of Pantepec are similar to those of other states.

The approximate age of coffee plantations of the region indicates that 27.8% are from 0 to 10 years old, 8.1% are from 11 to 15 years old, 27.8% are from 16 to 20 years old and 35.9% are from 21 to 40 years old (Table 1), so the existence of young plantations but also mature plantations can be observed. To obtain a greater production and increase profitability, it is important to invest in new plants and the renewal of old plantations. According to Romero and Camilo (2019), it is important to follow strategies for the renewal of coffee farms: renewal of old plants by new plants and restoration of the old culture with pruning of the plantation. The results of Fithriyyah *et al*. (2020) indicate that the productive age of coffee plants starts from four years; and they usually reach a maximum of production when the plant is between 10 and 15 years old.

Table 1. Age of coffee plants, percentage and number of producers according to different strata in the municipality of Pantepec, Chiapas

Strata (age of plants in years)	(%)	No. of producers
5-10	27.8	17
11-15	8.1	5
16-20	27.8	17
21-25	4.8	3
26-30	23	14
31-35	3.2	2
36-40	4.9	3

The date of replanting of coffee plants and the number of plants replanted in the study area are shown in Table 2. Most of the replantings have been in the last five years; 23% of producers mentioned having replanted their farms a year ago, with an average of 388 plants; 34% replanted two years ago, with 257 plants; 18% mentioned replanting three years ago, with 227 plants on average; 8% four years ago, with 330 plants on average and 5% five years ago with an average of 250 plants, respectively (Table 2).

Table 2. Last time the producer replanted their plantation, percentage and number of coffee plants replanted.

Date of replanting (years)	(%)	Replanted plants
1	23	388
2	34	257
3	18	227
4	8	330
5	5	250
7	2	50
10	3	175
Not applicable	7	0

A study conducted in the Sierra Madre area of Chiapas mentions that the cause of the renewal is the death of plants due to the coffee rust disease of 2012 (Casiano and Paz, 2019). In the study area, one of the factors for which they have decided to replant is also due to the rust disease and the advanced age of the plantations. The renewal of plants brings greater productivity by changing old or diseased trees, which allows improving the yield of coffee plantations (Morales and Adame, 2021).

Harvest expenses in coffee cultivation, Pantepec, Chiapas

For the collection or harvesting of cherry coffee, three cuts per year are usually made. The first cut (early) is made in January and February; the second (intermediate) from March to May; and the third (late) from June onwards. In cut one (early) of cherry coffee the producers spend on average $372.00, for cut two (intermediate) they spend on average of $323.00 and for cut 3 (late) they spend on average $169.00, having an average total expense per hectare of $700.00 (Table 3). In cut three the expenses are lower since the production is lower and they use family labor in what they call the ‘rebusca’ (collection of fruits from the first flowerings).

Table 3. Value and percentage of harvest expenses for cuts 1, 2 and 3 of cherry coffee.

Harvest expenses (strata $)	Producers		
	Cut 1	Cut 2	Cut 3
0-200	26.2	36.1	68.8
201-400	32.8	36.1	24.6
401-600	37.7	22.9	4.9
601-800	0	1.6	0
801-1 000	1.6	1.6	0
1 001-1 200	1.6	1.6	1.6

The variations in the expenses for cutting coffee in the three stages are due, among other factors, to: 1) some make greater or lesser use of family labor; 2) they depend on the number of hectares that the producer has; and 3) production varies in the three stages of harvest, being lower in the late. Some producers in the study region reported only two cuts or harvests. Medina- Meléndez *et al*. (2016) found that, in the region of La Frailesca, Chiapas, 74.1% of producers make only two cuts of coffee, while 25.9% make only one.

Annual operating expenses for cleaning, pruning, clearing, and replanting in coffee cultivation averaged $2 288.00 (Figure 4). The operating expenses for carrying out these activities vary according to the number of hectares. It is worth mentioning that the expenses reported here refer to contracted workers, family labor is not included. López and Caamal (2009) found that producers invest $6 205.70 ha^{-1} for the maintenance of coffee cultivation.

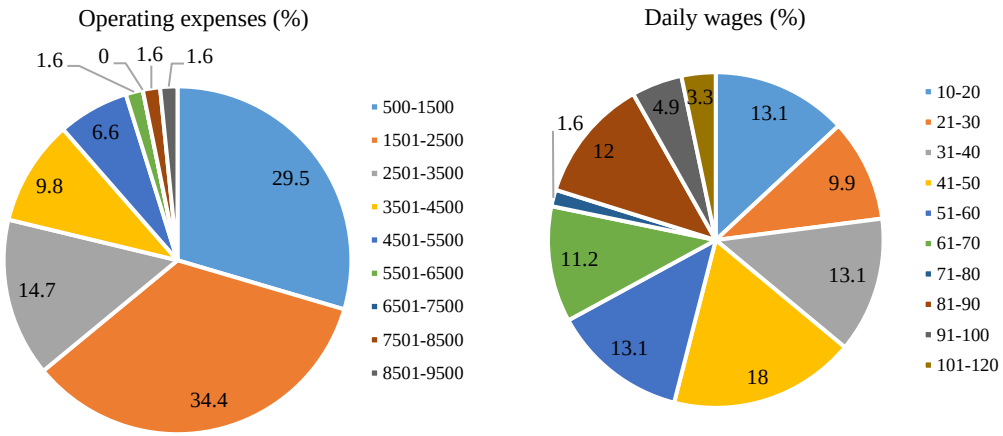

Figure 4. Operating expenses and number of daily wages (%) for coffee cultivation in the municipality of Pantepec, Chiapas.

In the study area, producers mentioned that coffee cultivation requires an average of 44 daily wages per ha throughout the year (Figure 4). In relation to the payment of labor, it was found that 3.3% pay $70.00 day^{-1}; 21.3% pay $80.00; 65.6% pay $100.00 day^{-1}; 1.6% pay $110.00 and 8.2% pay $120.00 day^{-1}; that is, more than 90% of the producers paid below the general minimum wage, which in the year of study was $102.68 pesos day^{-1}, national minimum wage commission (CNSM, for its acronym in Spanish). Low wages are explained by the fact that producers are small-scale and do not have enough capital to offer better wages, to which is added that employment options for workers are minimal.

Coffee production, commercialization and prices

The production obtained per producer in the study area was in a range of 100 to 1 000 kg of parchment coffee per producer (Table 4). It is worth mentioning that this production is in all their plantation, not per unit of area. In unit terms, the production in the study area was on average, 186 kg ha^{-1}, while the economic yield per hectare was $4 492.00. The price paid to producers in the study area for parchment coffee fluctuated between 25 and 30 pesos kg^{-1}. Producers in the municipality mentioned that the best price of coffee was recorded during the second cut and decreased during the third.

According to official statistics, in the municipality of Pantepec, Chiapas, a production of 234.6 t of cherry coffee was obtained, with an average yield per hectare of 0.75 t ha^{-1} (SIACON-SAGARPA, 2022). The yields per hectare in this municipality are equivalent to almost 50% of the national average of 1.43 t ha^{-1} (SIACON-SAGARPA, 2022), which reflects the low productivity of the plantations of the municipality of Pantepec, northern Chiapas.

Table 4. Harvest of parchment coffee (kg) per producer in the municipality of Pantepec, Chiapas.

Harvested kilograms of parchment coffee	No. of producers	(%)
0-100	29	47.6
101-200	9	14.7
201-300	12	19.7
301-400	5	8.2
401-500	1	1.6
501-600	2	3.3
601-700	0	0
701-800	1	1.6
801-900	0	0
901-1 000	2	3.3

As for commercialization, 78.7% of producers sold their coffee in the form of parchment, 18% in cherry form and 3.3% ground. This reflects the low processing with which the product is marketed. Some of the problems that producers face in the commercialization of coffee are: very low prices, lack of transportation and buyers who can offer better prices. Producers consider that it is of the utmost importance to have their own brand to differentiate themselves from other regions since the coffee of this region is high-grown coffee and is produced in a traditional way and not in a conventional way.

Conclusions

The results of this study confirm the working hypothesis that coffee in the municipality of Pantepec is of subsistence and low productivity. The area cultivated with coffee, in 80% of the producers, is equal to or less than two hectares, insufficient to support a family, so they carry out complementary activities to coffee farming to improve their income. In addition, given the insufficiency of economic resources, there is still high migration among the children of producers. Productivity is also low, with yields per hectare fifty percent lower than the national average, which together with low prices generate low incomes. It is necessary to reduce the gap in yields to improve the income of producers.

Something relevant to mention is that almost 40% of the producers are women, which generates strong family roots in the plantations and strengthens their position within the family structure. The fact that 84% of the labor used in the production process comes from the family reflects the importance of coffee plantations in the municipality of Pantepec in the rooting of the population to their localities. The low schooling and advanced age of producers can be adverse factors in modernizing plantations. A plan of technical training in the main components of the production process can contribute to reducing the productivity gap.

It is necessary to carry out more specific studies to identify the technological components that are most slowing down productivity and focus training on them. It is proposed that the training of producers be subsidized by the state because they are smallholder producers, without the economic capacity to pay for training or private technical assistance. The high migration of the young population and the low income make it necessary to look for options to generate more employment

and income in their localities. One possibility is to give greater added value to their crops, to move from the sale of cherry and parchment coffee to roasted and ground coffee. It is necessary to carry out technical, financial feasibility and market studies to make some proposal for the industrialization of coffee in the study region.

Cited literature

Anderzén, J.; Guzmán, L. A.; Luna, G. D. V.; Merril, S. C.; Caswell, M. V.; Méndez, E. V.; Hernández, J. R.; Mier, M. and Giménez, C. T. 2020. Effects of on-farm diversification strategies on smallholder coffee farmer food security and income sufficiency in Chiapas, México. Rev. J. Rural Studies. 77:33-46.

Aguirre, C. J. F.; Ramírez, V. B. L.; Trejo, T. B. I.; Morales, F. F. J. y Juárez, S. J. P. 2018. Producción de café en comunidades indígenas de México: beneficios sociales y ambientales. Rev. Agro Productividad. 5(2):34-41.

Casiano, D. M. and Paz, P. F. 2019. Opportunity costs of organic coffee production systems in the Sierra Madre de Chiapas, Mexico. Rev. Elementos para Políticas Públicas. 3(3):257-266.

Chain, G. A.; Martínez, S. A.; Aristizábal, N. and Ricketts, T. H. 2019. Ecosystem services by birds and bees to coffee in a changing climate: A review of coffee berry borer control and pollination. Rev. Agriculture, Ecosystems Environment. 280(1):53-67. https://doi.org/10.1016/j.agee.2019.04.011.

Damatta, F. and Rodriguez, N. 2007. Producción sostenible de cafetales en sistemas agroforestales del Neotrópico: una visión agrnómica y ecofisiológica. Agron. Colomb. 25(1):113-123.

Fithriyyah, D.; Wulandari, E. and Sendjaja, T. P. 2020. Knowledge Level of Farmers and the importance of coffee seedling attributes and accessibilities in Bandung regency, West Java, Indonesia. Rev. Pelita Perkebunan (una revista de investigación sobre café y cacao). 36(3):249-263.

FIRA. 2016. Fideicomisos Instituidos en Relación con la Agricultura. Panorama Agroalimentario. Café 2016. Dirección de investigación y evaluación económica y sectorial. 36 p. https://www.gob.mx/cms/uploads/attachment/file/200636/Panorama_Agroalimentario_Caf_2016.pdf.

FAOSTAT. 2022. Food and Agriculture Organization of the United Nations. https://www.fao.org/faostat/es/#data/QCL.

García, H. J. L.; Zapata, M. E.; Valtierra, P. E. y Garza, B. L. 2014. El microcrédito como estrategia para atenuar la pobreza de las mujeres, ¿cuál pobreza? Estudios Fronterizos, nueva época. 15(30):97-126.

Harvey, C. A.; Pritts, A. A.; Zwetsloot, M. J.; Jansen, K.; Pulleman, M. M.; Armbrecht, I.; Avelino, J.; Barrera, J. F.; Bunn, C.; Hoyos, G. J.; Isaza, C.; Munoz, U. J.; Pérez, A. C. J.; Rahn, E.; Robiglio, V.; Somarriba, E. and Valencia, V. 2021. Transformation of coffee-growing landscapes across Latin America. A review. Rev. Agron. Sustainable Develop. 41(62):2-19. https://doi.org/10.1007/s13593-021-00712-0.

Hernández, S. R.; Fernández, C. C. y Baptista, L. M. P. 2010. Metodología de la investigación. Mexico. (Ed.). Quinta edicion. McGraw-Hill / Interamericana Editores, SA de CV. 656 p. https://www.icmujeres.gob.mx/wp-content/uploads/2020/05/Sampieri.Met.Inv.pdf .

INEGI. 2020. Instituto Nacional de Estadística, Geografía e Informática. https://www.inegi.org.mx/app/buscador/default.html?q=pantepec+chiapas.

López, G. F. J.; Escamilla, P. E.; Zamarripa, Colmenero, A. X.; Cruz, C. J. G. 2016. Producción y calidad en variedades de café (*Coffea arabica* L.) en Veracruz, México. Rev. Fitotec. Mex. 39(3):297-304.

López, L. É. C. y Caamal, C. I. 2009. Los costos de producción del café orgánico del estado de Chiapas y el precio justo en el mercado internacional. Rev. Mex Ec. Agric. Rec. Nat. 2(1):175-198.

Medina, M. J. A.; Ruiz, N. R. E.; Gómez, C. J. C.; Sánchez, Y. J. M.; Gómez, A. G. y Pinto, M. O. 2016. Estudio del sistema de producción de café (*Coffea arabica* L.) en la región Frailesca, Chiapas. Rev. CienciaUAT. 10(2):33-43.

Morales, R. E. I. y Adame, M. S. 2021. Caracterización de los agros ecosistemas de producción de café orgánico en cuatro municipios de Chiapas. Agric. Soc. Des. 197-223.

SIACON-SAGARPA. 2022. Sistema de Información Agroalimentaria y Pesca-Secretaría de Agricultura, Ganadería, Pesca y Alimentación. https://nube.siap.gob.mx/index.php/s/Nt0tHGfxl21vkl5.

Tablas, G. I.; Guerrero, R. J.; Aceves, R. E.; Álvarez, C. N. M.; Laínez, L. E. y Olvera, H. J. I. 2021. El cultivo de café en Ojo de Agua de Cuauhtémoc, Malinaltepec, Guerrero. Rev. Mex. Cienc. Agríc. 12(14):1031-1042.

Tomas, T. A.; Delgado, A. A.; Herrera, C. B. E. y Vargas, L. S. 2018. Sistema de producción de café (*Coffea arabica* L.). Rev. Agroproductividad. 11(10):157-163.

Vázquez, L. P.; Hernández, R. O.; Vivar, M. R. y González, M. A. 2017. Producción del café a pequeña escala (*coffea arabica*) en Chiconquiaco, Veracruz, México. Rev. Agroproductividad. 10(3):37-42.

Van, V. H.; Bertrand, B. and Charrier, A. 2015. Next generation variety development for sustainable production of arabica coffee (*Coffea arabica* L.): a Rev. Euphytica. 204(2):243-256. https://doi.org/10.1007/s10681-015-1398-z.