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Technical-Productive Diagnostic of Apiculture System in Felipe Carrillo Puerto, Quintana Roo

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Abstract:

The objective of this study was to carry out a productive technical diagnosis for the apiculture system in the Family Production Units (FPU) of Felipe Carrillo Puerto, Quintana Roo. The collected data were analyzed using descriptive statistics with the help of the RStudio software. Currently, 161 FPU participate in the apiculture chain which is the 10% of FPU that presented activities related to the apiculture system in this community. Furthermore, each one has approximately 19 colonies and 2 apiaries, 62% of the beekeepers carry out the harvest manually from March to June. Although beekeepers have a well-developed system, technological implementation could make their processes more efficient, improve quality and open up new export market opportunities.

Keywords **—apiculture, territorial development, family production units, economic development.**

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I. INTRODUCTION

In 2019 the federal government of Mexico, implement a program to help communities with extreme poverty.This program was called Rural Development Program (PRODETER by Spanish acronym). This program wasstructured by different activities, for instance: capacity development, rural consultancies and extension, economic integration of productive chains, strengthening of family production units (FPU), research and technology transference. The principal objective of this program was to improve the productivity of FPU by productive technical diagnostic, technology transference and technical support strategy.

Specifically, in Quintana Roo, Mexico, the program prioritized 409 rural territories, which were oriented in production of native corns, beans, coffee, cattle, apiculture, aquiculture, fishing among others (www.gob.mx, 2020). Felipe Carrillo Puerto is one of the municipally that is located in Quintana Roo,in which the apiculture chain was one of the products considered. This apiculture productive chain in this community is formed by 161 FPU.

In recent years, this community has focused the production of organic honey as principal product, furthermore they have been implemented tools to produce other products with quality standards to expand their market.

Honeybee is a solution supersaturated of sugars that contain small quantities of proteins, enzymes and amino acids, minerals, vitamins and aromatic components and polyphenols (Alvarez-Suárez*et al*., 2010). Nowadays, the annual world production is around 1.2 million of tons. The honey consumption differs from one country to another, furthermore, the demand is not always covered. The principal exporter of honey is China. This country produces from 0.1 to 0.2 kilograms per capita. In European Union the annual per capita consumption goes from

0.3 to 0.4 kilograms, in Italy, France, Great Britain, Denmark and Portugal the consume goes from 1–1.8 kg, while in countries such as the United States, Canada and Australia the average per capita consumption is 0.6-0.8 kg per year (Bogdanov *et al.*, 2008). Accord to SIAP (2016), Mexico is the 8th honey producer in world. In southeast of Mexico the apiculture is one of the activities that generates family income, this is because of low inversion and the availability of adequate vegetation in the region (Coh-Martínez *et al.*, 2019; Porter Bolland., 2003).

The objective of a technical-productive diagnostic is to obtain information from a community or region to analyse and take decisions to improve the economic processes that need to be improving. The diagnostic of FPU is a previous requirement to generate proposals for intervention and agricultural management, which are based on the availability of productive resources, traditional knowledge and local knowledge, as well as the aspirations and culture of the beneficiaries (Gómez *et al.*, 2015).

Accord to above mentioned, the objective of this study was to elaborate a technical-productive diagnostic of FPU in Felipe Carrillo Puerto in order to detect the principal problem of the agricultural activities in that region.

II. MATERIALS AND METHODS

Area of study

The area of study is located in Yucatan peninsula, in Felipe Carrillo Puerto, Quintana Roo at 19° 59' 48.06", -19° 57' 11.28" N and 88° 14' 33.66", - 88° 11' 16.01" O. The topography accord INEGI (2001) is formed with wide rocky plains with cemented floor hollows and presents an average elevation of 27 masl. The soil is Leptosols which are characterized to be thin and unattractive soils for agricultural activities (INEGI, 2013; IUSS-WRB, 2007). The vegetation is medium sub-evergreen forest (INEGI, 2015).The climate is Aw: warm Subhumid with a rainy regime in summer (Köppen modified by García, 2004) with short period of rain in February and March, the medium temperature is 24.3°C and the annual medium precipitation is 1,334 mm (Ramírez-Barajas, *et al.*, 2001).

Methodology to determine the Sample size for FPU

It was used the formula accord Snedecor and Cochran (1967). With this formula was obtained the value that indicate the number of samples to consider from a sample universe of FPU. To apply this formula, it was used a list of farmers from region to evaluate (obtained from a previous interviews), then values were changed by data in the next formula:

$$n = \frac{\frac{Z^2 p_n q}{d^2}}{1 + \frac{Z^2 p_n q}{N d^2}}$$

When the variables indicate: Z= Confidence level, d= Precision level, Pn=Population Proportion that belong to stakeholder group, q = (1 - Pn), N = Population Size, n= Sample Size

In this case, the values to calculate sample size were changed as follow: Z= 95 % (1.96) came from Z tables, d= 10 % (0.10), pn= 0.8 is the proportion of population that came from stakeholder group (from the first interview sample, 8 belongs to belongs to beekeepers), q= 0.2 (1 - pn), N= 161 FPU of beekeeper group of PRODETER. Values to p and q were calculated with number of interviewees that participated in the program more than two years. Finally, the result was 44 surveys that were carried out.

Process to carry out the surveys

The information was captured in a mobile application. This application was developed for smartphone in an Android Operative System 8.0. The application belongs to Servicio de Informacion Agroalimentaria y Pesquera (SIAP, by its Spanish acronym). Recorded data in app were farmer information, production unity, crops, infrastructure, equipment, commercialization and georeference.

Data Analysis

Data analyses were carried out accord quantitative and qualitative processing. This descriptive statistic was carried out to identify the principal characteristics of information and then represented in tables, graphics and figures. The analysis was carried out in RStudio® statistic software.

III. RESULTS AND DISCUSSION

Conformation of FPU in Felipe Carrillo Puerto

It was identified 276 farmers from 13 communities, which participate in apiculture. Those farmers are part of 161 FPU. Tepich was the community with more FPU represent while Cancepchen was the community with less FPU (Table1).

Table 1. List of communities, farmers and family production units of beekeepers in Felipe Carrillo Puerto, Quintana Roo.

Community	Total of farmers per community	FPU in apiculture chain	Average number of members per FPU
Cancepchen	18	1	18
San Felipe Berriozábal	38	22	1.7
San Francisco Aké	14	14	1
San José Segundo	21	21	1
San Ramón	35	7	5
Santa Rosa Segundo	34	34	1
Tepich	63	41	1.5
Tihosuco	30	4	7.5
Tuzik	22	17	1.3
Total	276	161	1.7

FPU: Family Production Units.

In Felipe Carrillo Puerto has been identified the diversification of productive activities. However, this diversification is part of the family income. This is important to consider because they can improve their activities with other goals. For example, they can conserve the Forestal resources in their zones in order to avoid changes in soils (Santos *et al*., 1998; Bray and Merino, 2004).

Socioeconomic characteristics

In respect tothe social characteristics, approximately 50% of farmers are from 20 to 50 years-old and the other 50% are older than 50 years, all of them belong to a Mayan ethnic group, speak Spanish and have as a second language the Maya. Regarding the level of studies, only 20% have elementary school or high school, however more than 60% of them can read despite not having had any degree of education.

Camacho *et al*. (2017) mention that education is an intermediation variable that is not necessarily directly associated with production, but influences other variables such as income, standard of living or investment capacity. On the other hand, Bragulat *et al*. (2018) explain that the level of education that is achieved in FPU depends on the type and characteristics of the family, the type of family relationships, the way of facing problems, intra-family communication difficulties and limited resources family members to face problematic situations. This leads us to conclude the importance of education for FPU to be able to consolidate and achieve take off as a micro-enterprise.

Regarding the economic characteristics, 100% of FPU have a kitchen, bathroom, drainage, drinking water service and electricity, however only 80% and 60% have a cement floor and ceiling respectively, 70% have a block housing. Not all families have telephone and internet services. It is worth mentioning that those services are currently necessary, especially in a world in which communication is very important.

To improve the economic income of FPU members, it is necessary to promote market knowledge. Cituk *et al*. (2018) mention that small producers in Felipe Carrillo Puerto have lack knowledge of the basic aspects in marketing. This lack knowledge has a negative impact because cause large losses in production. On the other hand, the levels of education in the communities will depend on both supply and demand factors, and the urban bias will affect each one in a forced way. Therefore, restricting rural investments means building fewer schools, reducing the supply of educational facilities in rural areas (Timmer, 2002).

Productive characteristics in apiculture

In Figure 1a, it can be seen that on average the FPU have 19 colonies and 2 apiaries, having a work effort (maintenance) dedicated to apiculture that goes on approximately every 10 days. 62% of beekeepers harvest from March to June, this activity is carried out manually by all beekeepers (Figure 1b).

For many activities carried out, beekeepers have to hire day laborers who constantly support their apiaries, in addition to acquiring machinery and equipment that allows them to carry out their activities, thereby minimizing time and improving processes. The costs of renting equipment, a day's wages and the wedge usually have an average cost of $ 150, brushes $ 100 and boxes and smoker $ 280 (Figure 1c). Regarding the work carried out by the producers, in addition to the production of honey, 60% of the beekeepers produce their own colonies and 70% produce wax which is usually processed with steam melters, 30% process it by knowledge inherited cultural (Figure 1d).

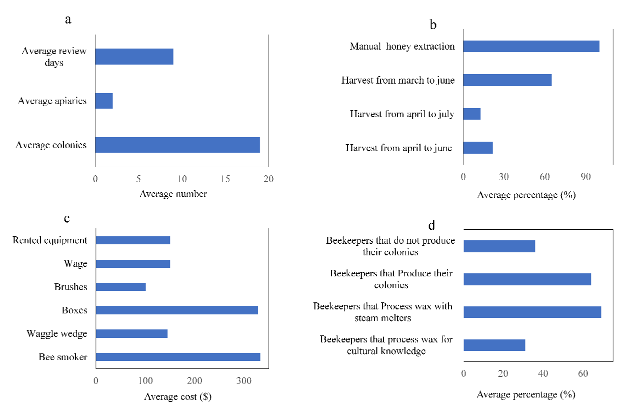

Figure 1. Productive characteristics in the apiculture system developed in the FPU of the municipality of Felipe Carrillo Puerto, Quintana Roo. a) Characteristics of hives, b) Characteristics of honey production, c) Production equipment costs and d) Average wax production.

In this analysis, it was observed that approximately 78% have been trained in control and use of apiaries and in organic production.

Furthermore, changes of honeycombs are carried out when they are useless, during honey production, every six months, every year or when are darken. On the other hand, it is known that the feeding of bees is very important, however, only 28% carry out the feeding properly. The activities that most producers carry out homogeneously are the change of queens with the purpose to renew their hives. In respect to the detection of diseases, 100% assured not to have serious problems, since, when detecting the plague or disease, producers eliminate or treat it. Beekeepers say that currently the biggest problem that they are facing is climate change (Table 2).

Table 2. Percentage of FPUthatcarry outactions in apiaries.

Apiaries actions	%
Beekeepers that maintain their apiaries in the same place	100
Beekeepers that change their apiaries because climatologic factors	77
Beekeepers that change their honeycombs for useless	9
Beekeepers that change their honeycombs in honey production	9
Beekeepers that change their honeycombs each six months	22
Beekeepers that change their honeycombs each year	4
Beekeepers that carry out feeding	28
Beekeepers that do not carry out feeding	72
Beekeepers that feed in critic season	28
Beekeepers that have divided their hives	72
Beekeepers that do not divided their hives	28
Beekeepers that do not divide their hives becauseabundant population	72
Beekeepers that do not divide their hives because honey provisions	28
Beekeepers that carry out swamp capture	9
Beekeepers that have joined hives	31
Beekeepers that have joined hives due to weak hives	28
Beekeepers that have joined hives due to queen lost	72
Beekeepers that change the queen to multiply their hives	78
Beekeepers that change their hives to renew them	75
Beekeepers that change the hives to avoid	25

consanguinity	
Beekeepers that change their hives once per year	100
Beekeepers that produce their own queen in their apiaries	100
Beekeepers that have had diseases in bee-colony	31
Beekeepers that have not had diseases in bee-colony	69
Beekeepers that eliminate all bee-colony due to diseases detected	100
Beekeepers that consider that climate change is affecting their honey production	100

It is necessary to consider different options, both from the traditional knowledge of the producers and incorporation of technological solutions in order to optimize the honey yield, for example, the use of rational boxes (wooden boxes of horizontal or vertical shapes) or produce organic products to guarantee the quality for human consumption (Villanueva Gutierrez and Colli Ucán, 2011; Sánchez *et al.*, 2019). The adoption of technology requires competent and updated personnel (Melak and Negatu, 2012).

Access to information related to apiculture knowledge is essential to develop the skills that producers need to maintain and increase their productivity (Pratiwi and Suzuki, 2017). Beekeepers in the municipality of Felipe Carrillo Puerto usually depend on information within their informal social network (Lyon, 2000; Boahene *et al.*, 1999). They transfer the apiculture knowledge through social interactions (Conley and Udry, 2001). Due to this method to obtain information, it is important to maintain communication and constant training through researchers or experts in processes related with apiculture. Pratiwi and Suzuki (2017) mention that people involved in training for farmers should have experience and advance knowledge in apiculture with the purpose of transmit better the information and minimize irrelevant information.

IV. CONCLUSIONS

Although apiculture producers have a well-developed system which has been obtained through generations, there are some flaws in their processes that could be improved and adopted. On the other hand,the organization of beekeepers in the municipality of Felipe Carrillo Puerto is very good, however, the education and migration of young people, endanger thefuture of apiculture in this region.Furthermore, it is necessary to implement periodic training programs and constant technical support by specialists with topics related with management and business administration, accounting and marketing.

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