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Characterization of dairy production units in Tulancingo Valley, Hidalgo, Mexico

Caracterización de unidades de producción lechera en el Valle de Tulancingo, Hidalgo, México

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ABSTRACT

The aim of this study was to know the socioeconomic characteristics of dairy cattle producers, as well as to characterize the production units (PU) in the Tulancingo Valley, Hidalgo, Mexico. During the months of June and July 2020, a random survey was applied to 30 cattle producers. With the SAS statistical program, quantitative variables, percentages and absolute frequency tables were analyzed. Results of the study showed that 39.3% of producers are between 20 and 30 years old, 82.9% are male with primary education (28.6%) and 35.7% with higher education. The producers feed their cattle with forages and premixes (50%), and they agree that the main diseases that appreciate their cattle are mastitis (82.1%) and Brucellosis (10.7%). The data regarding technical advice where 60.7% of the producers have not received any kind of advice. In the case of social programs, 92.9% of the surveyed population specifies that they have not participated in this type of call. In turn, 71.4% do not know the requirements to participate in livestock programs. It is concluded that dairy cattle producers in the Tulancingo Valley, even if they are small-scale producers, require technical advice and information on different sources of support.

Keywords: Systems, Bovines, Holstein, Tulancingo.

RESUMEN

El objetivo del presente estudio fue conocer las características socioeconómicas de los productores de ganado bovino lechero, así como, caracterizar las unidades de producción (UP) en el Valle de Tulancingo, Hidalgo, México. Durante los meses de junio y julio del 2020 fue aplicada una encuesta aleatoria a 30 productores de ganado bovino. Con el programa estadístico SAS, fueron analizadas variables cuantitativas, porcentajes y tablas de frecuencia absoluta. Los resultados del estudio muestran que el 39.3% de los productores tienen una edad entre los 20 a 30 años, el 82.9% pertenece al sexo masculino con estudios de primaria (28.6%) y el 35.7% con estudios superiores. Los productores alimentan a su ganado con forrajes y pre-mezclas (50%), y coinciden que las principales enfermedades que afectan a su ganado son la mastitis (82.1%) y Brucelosis (10.7%). Los datos respecto a la asesoría técnica indican que el 60.7% de los productores no han recibido ningún tipo de asesoría. En el caso de programas sociales el 92.9% de la población encuestada especifica que no ha participado en este tipo de convocatorias. A su vez el 71.4% desconoce los requisitos para participar en programas ganaderos. Se concluye que los productores de bovinos de leche del Valle de Tulancingo, aunque sean productores a baja escala requieren de asesoría técnica e información sobre diferentes fuentes de apoyo.

Palabras clave: Sistemas, Bovinos, Holstein, Tulancingo.

INTRODUCTION

Cattle raising is one of the main activities of the agricultural sector in Mexico, due to the contribution of meat products and participation in the country's trade balance. Currently, bovine microenterprises face enormous challenges, among which are sources of financing, organization and scarce marketing channels (Carrera & Bustamante, 2013). In Hidalgo State, located in the central-eastern region of Mexico, milk production is one of the most important livestock activities. In the period 1996-2005, an average of more than one million liters per day were produced, which represented 4.2% of national production (SAGARPA, 2006; Cervantes-Escoto *et al.,* 2013).

In view of this situation, it is important to characterize production units, which is crucial for policy development, as it provides information on the composition of production systems, their technological components, potential and limitations with respect to other systems (Vilaboa & Díaz, 2009). Coronel & Ortuño (2005), point out that the appropriate classification of production systems helps to understand the development dynamics of a region or the design and management of development projects (Méndez-Cortés, 2019).

The challenges being faced by micro-entrepreneurs in dairy cattle production systems range from intense periods of drought, lack of liquidity and recently, reduced mobility (Lara-Rodríguez & Vázquez-Luna, 2020). Each of the dairy cattle production systems is distinguished by its productive heterogeneity, both in the forms of production and in different sizes of production units; milk is produced in the highlands as well as in tropical and arid zones, under very different conditions (Espinosa *et al.,* 2007), which is why it is important to continue with characterization studies in the different dairy production zones.

Research on the characterization of bovine PU is insufficient when considering the size of the unit or the amount of economic resources invested in it. It should consider the way the production system is managed, the rationality of the development of the activity, the conception in the use of resources and differences imposed by cultural patterns. Even when producers belong to the same state or region, they do not develop their activity under equal social, economic and technological conditions (Granados-Rivera, 2018; Vilaboa & Díaz, 2009). In the characterization of an "average livestock establishment", it is important to consider not only the productive conditions, but also the social, cultural, economic and/or environmental conditions of each region (Solano *et al.,* 2001).

In Hidalgo State, milk production plays a fundamental role as a means of income for producers, mainly in rural areas; three important dairy basins have been developed in Tizayuca, Tulancingo Valley and Mezquita states (Cervantes-Escoto *et al.,* 2013). However, given the variability of climatological conditions in the state, livestock farms acquire their own characteristics by region, additionally influenced by the idiosyncrasy, tradition and customs of the population (Arias *et al.,* 2008), which

makes it necessary to make greater efforts to understand the productive and commercial process of livestock farming in Hidalgo.

Therefore, the objective of this study was to know the socioeconomic characteristics of dairy cattle producers, as well as to characterize the production units (PU) in the Tulancingo Valley, Hidalgo, Mexico.

MATERIAL AND METHODS

General

The present study was carried out in the Tulancingo Valley, Hidalgo, Mexico. The site is geographically located between parallels 20°03' and 20°13' north latitude, meridians 98°14' and 98°31' west longitude and has an altitude between 2 200 and 2 700 m a.s.l. The region has average annual temperatures of 13.5°C and rainfall of 1669 mm.

The work was carried out with the participation of the "Local Livestock Association Specializing in Milk Producing Cattle of the Tulancingo Valley". Due to the fact that during the study period Mexico and the world were in a pandemic due to the effect of COVID-19, the following work protocol was established: a) Recognition, identification and acceptance of the producers, by telephone, each producer was called to request their authorization and participation in the study; b) previous elaboration of the questionnaire; d) application of questionnaires, using "GOOGLE" forms technology. A call was made on the day and time specified by each producer, the answers were entered directly into the forms individually by the interviewers, and e) descriptive analysis of the data.

All questions were recorded according to the consent of the producers. The enumerators, according to the guidelines for institutional ethics services responding to COVID-19, remained at home, because the survey was conducted during the pandemic period (Berlinger *et al.,* 2020).

Questionnaire design and survey application

During the months of June and July 2020, 30 dairy cattle producers scattered throughout the Tulancingo Valley were randomly interviewed. For the study, the formula proposed by Otzen & Manterola (2017) was applied, where the sample was delimited using simple random sampling and each Production Unit (PU) was considered as an experimental unit represented by each cattle producer. The questionnaire was constructed with 21 items and divided into five sections: owner data, production unit data, and description of current production and characteristics of the PU. The study variables were classified into: socioeconomic, technological and commercial, the type of variables used in this research were categorical and numerical (Agresti, 2013).

The numerical variables, analyzed were: producer's age (years), schooling (years), total cattle, total cows in production, milk price ($/liter), daily milk production, calf age at sale (months), calf weight at sale (kg), calf selling price ($ kg/1), calf selling price ($ kg/1), bull selling price ($ kg/1), heifer selling price ($ kg/1), cow selling price ($ kg/1), bull selling price ($ kg/1), and percentage of milk income (%).
Categorical variables included: land tenure, whether belonging to the association, government program received, municipalities, livestock production unit also facilities, other planting crops, breed, milking, main cattle diseases and sales problems.

Statistical analysis

Descriptive statistics were used for the analysis of the information; the percentage participation of each variable in the population was determined by means of frequency tables. The information collected was recorded in a Microsoft Excel (2016) spreadsheet for organization and control. The database corresponding to the identification of milk production systems was statistically processed through multivariate analysis (clustering) for grouping and classification. The statistical analysis of the information was carried out using SAS software version 9.0 (Copyright© 2002 by SAS Institute Inc., Cary, NC, USA).

RESULTS

Socioeconomic characterization of dairy farmers

The descriptive statistical analyses showed that the selected variables were independent and appropriate to explain the sets that were grouped. The first category corresponds to the age, sex, grade of schooling and years dedicated to PU of the producers (Table 1).

Producers in the Tulancingo Valley are between 20 and 40 years old, of which 82.1% are male and the rest are female. 28.6% have a university education and 28.6% have a college education. Some 28.6% have elementary school education and 35.7% have higher education. Forty-two point nine percent of the farmers have been involved in this activity for between 6 and 15 years.

The percentage of the type of property owned by the farmers was 57.1% private, with one to three hectares (57.1%), of which 42.9% of the land was planted with pasture and 67.9% had less than three people in charge of the barn (Table 2).

Table 1. General data of dairy cattle producers in the Tulancingo Valley

Variable	Category	Percentage
Age	Between 20 and 30 years old	39.3
	Between 31 and 40 years old	39.3
	Between 41 and 50 years old	10.7
	Over 51 years old	10.7
Sex	Femenine	17.9
	Masculine	82.1
Degree of education	No education	10.7
	Primary	28.6
	Secondary	25
	High school	0
	University (Superior)	35.7
Years dedicated to PU	Less than 5 years old	21.4
	Between 6 and 15 years	42.9
	Between 16 and 25 years	10.7
	More than 25 years old	25

Table 2. General characteristics of dairy cattle production units in the Tulancingo Valley

Variable	Category	Percentage
Type of ownership of the PU	Private	57.1
	Communal	42.9
Personnel in charge of the PU	Less than three people	67.9
	Between 4 and 6 people	32.1
Hectares of the PU	Less than one hectare	14.3
	Between one and three hectares	57.1
	More than four hectares	28.6
Pasture area	No pasture area	17.9
	Less than one hectare	25
	Between one and three hectares	42.9
	More than four hectares	14.3

Characterization of dairy cattle PU

It is observed that PUs have between 11 and 20 animals (32.1%), of which there are less than 10 males, cattle with Holstein crosses (46.4%); and 39.3% of the cows are in production and milked once a day in most of the PUs (85.7%) (Table 3).

Regarding the type of feed (50% fodder and pre-mix) and diseases (82.1% mastitis and 10.7% Brucellosis) that the cows present, 75% of the producers prefer to have their cattle under the care of a veterinarian (Table 3).

Table 3. Herd characteristics in the dairy cattle PUs of Tulancingo Valley

Variable	Category	Percentage
Number of animals	Less than 10	25
	Between 11 and 20	32.1
	Between 21 and 40	25
	More than 41	17.9
Cows in production	Less than 10	46.4
	Between 11 and 20	39.3
	Between 21 and 40	3.6
	More than 41	10.7
Males	Less than 10	85.7
	Between 11 and 20	14.3
Number of milkings per day	Once	85.7
	Twice	10.7
	Three times	3.6
Breeds	Holstein	42.9
	Crossbred with Holstein	46.4
	Jersey	10.7
Main diseases	Mastitis	82.1
	Brucellosis	10.7
	Other	7.2
Type of feeding	Forage mix	50
	Concentrate	17.9
	Silo	14.3
	Others	17.9

Regarding milking, 50% of the PUs use a milking machine and the rest milk manually, with between two and five workers responsible for this activity (57.1%) (Table 4).

The data also show that 60.7% of the farmers have not received any type of technical assistance. In the case of social programs, 92.9% of the surveyed population specifically stated that they had not participated in this type of call. In turn, 71.4% do not know the requirements for participating in livestock programs. The technical assistance received by the PUs studied made it possible to learn about the main diseases affecting cattle (Table 4).

The surveys applied in this study showed that the producers requested training related firstly to animal reproduction (39.3%) and secondly to animal medicine (35.7%) (Table 4).

Table 4. Management and requirements perspectives in dairy cattle producers for the Tulancingo Valley

Variable	Category	Percentage
Disease management	Consulted an MVZ	75
	Personal consultation	10.7
	Personally attends	14.3
Type of milking	Manual	50
	Machine	50
Personnel responsible for milking	One person	42.9
	Between two and five people	57.1
Receives technical assistance	No	60.7
	Yes	39.3
Receives support from social programs	No	92.9
	Yes	7.1
It has other businesses	Yes, but they are not farmers	25
	Yes, and they are farmers	17.9
	No	57.1
Training topics required by the PU	Reproduction	39.3
	Nutrition	14.3
	Animal medicine	35.7
	Other	10.7
It knows the requirements to participate in livestock programs	No	71.4
	Yes	28.6
It will continue for more years with the PU	No	11.1
	Yes	88.9

50% of the producers do not have other businesses besides PUs, which implies that their main activity is the sale of milk. On the other hand, 25% confirmed that they have other businesses but that they do not belong to the livestock sector, while 17.1% have livestock-related businesses.

Regarding the commercialization of the calves produced in the PU, producers affirm that the sale is not viable due to the low price and poor quality of the meat, so they keep them in the herd until another producer buys them; another study reports that this depends fundamentally on the participation of intermediaries (98%).

DISCUSSION

This study shows that the farmers are adults and have basic education (primary and secondary). Only 35.7% have higher education. Also, they indicate that they supplement their cattle and have identified the main diseases present in their PU, which indicates that a veterinarian should be in charge of the health of the cattle.

Socioeconomic characterization of dairy farmers

The results obtained, coincide with the study of PU characterization in Veracruz state by Méndez-Cortés (2019) who report that 97% were men and 3% women, with average age both of 58 years, higher than what was found in Sinaloa, and Veracruz (Juárez-Barrientos *et al.,* 2015). The age of PU producers was similar to that recorded in Morelos states (Chalate-Molina *et al.,* 2010), Sinaloa (Cuevas *et al.,* 2012) and Veracruz (Juárez-Barrientos *et al.,* 2015; Oros *et al.,* 2011). The age of the producer is important because older producers do not allow the adoption of new technological practices in PU (Fuentes *et al.,* 2012). Meanwhile, Granados-Rivera (2018) in his study for Tabasco State, mentions that the average age of producers was 54.5 years. In producers with advanced age, the probability that they will adopt new technologies in the PUs is reduced (Salas-González *et al.,* 2013).

In this research, 35.7% of producers in Tulancingo Valley had higher education, which was similar to that reported in Veracruz, where 22% had higher education for the schooling variable (Méndez-Cortés, 2019). Meanwhile, in Tabasco state it was reported that 52% of surveyed producers had a primary school level and 21% have bachelor's degree studies (Granados-Rivera, 2018), which coincides with the producers of Tulancingo Valley where 56.3% have primary and/or secondary education. The level of schooling directly influences the willingness of producers to adopt new technologies for production (Fuentes *et al.,* 2012; Galindo-González, 2001).

In the present study, 42.9% of producers who have been engaged in dairy cattle breeding were found to be between 6 and 15 years old. In this regard, Méndez-Cortés (2019) report an average age of farmers of 23 years, which shows that they are mostly producers with years of experience in cattle raising.

The 57.1% of Tulancingo Valley producers surveyed indicate that their land tenure is of private type, which does not coincide with the study by Granados-Rivera (2018) who reports a land tenure of district type in 74% and of private type in 26%. In other research, land tenure is mostly district type, while the PUs located in the region of Las Choapas, Veracruz and Central Chiapas, Mexico land tenure is mainly private (Díaz-Rivera *et al.,* 2011; Orantes-Zebadúa *et al.,* 2014). 67.9% of surveys in our study indicate that PUs have less than three people in charge of the stable, so there is no adequate administrative management, evidencing the lack of productive, reproductive and economic records.

In Tulancingo Valley it is reported that the PUs have one to three hectares (57.1%), Méndez-Cortés (2019) reports that the area dedicated to grazing on average was 74 hectares, in Tabasco surfaces of the PUs are 47 hectares on average (Granados-Rivera, 2018), so the PUs are small stables near urban areas. In our research 42.9% of the PUs in the Valley have a pasture area between one and three hectares.

Characterization of dairy cattle PUs

Producers have dairy cattle herds with around 20 animals in the PUs, which is lower than reported by Granados-Rivera (2018) where the averages in the number of total cows are 39.5 ± 24.7 animals. In the Tulancingo Valley, 39.3% of cows in production were recorded with Holstein cattle and different crosses with Brown Swiss or Jersey (46.4%). An interesting fact was that 85.7% of the PU kept less than 10 males in the PU. Milking is performed once a day in most of the PU (85.7%). Milking usually starts at 6:00 am, with an approximate duration of three hours. The average production per cow is 6.2 liters of milk per day, at the same time that the calf is weaned for sale or fattened on the farm. Similar data are reported by Magaña *et al*. (2006) for this type of system.

The main type of feeding (50%) of the PU of Tulancingo Valley is mixed forages, this may be due to the proximity to urban areas, compared to Tabasco where 98% of the PU cattle feeding is based on rotational grazing in grasslands with creeping and clumping type forage grasses (Granados-Rivera, 2018). The 73.3% of dairy cattle use alternate grazing on native and introduced grasses as a way of feeding the dairy herd. The rest (26.7%) combine traditional grazing with alternate strategies based on crop residues, agribusiness waste and mineral salt supplementation, a practice that becomes common in the critical forage and low water season. This is in general agreement with the feeding management for dairy cattle systems reported by Ruíz *et al*. (2008) and Magaña *et al*. (2006).

Regarding the sanitary status of the cattle in the present study, 82.1% of the producers agree that the presence of mastitis is one of the main prevalent diseases in the PU, followed by Brucellosis (10.7%). In this sense, in Tabasco it is reported that the main diseases recorded in PU cattle are diarrhea (64%), mastitis (52%) and pneumonia (43%), likewise, cases of rabies (26%), retained placenta (21%), abortions (12%), stomatitis (12%) and scabies (10%) are also present (Granados-Rivera, 2018). Several works have been conducted in other regions of the country on the frequency of diseases in dairy cattle (Rosete *et al.,* 2018; Segura *et al.,* 2010; Segura *et al.* 2003). A low frequency, with serological evidence, of the presence of Brucella has been found (Gutiérrez-Hernández et al., 2020). The results of the study and those reported for other States are similar to those reported by the National Service for Agrifood Health, Safety and Quality (SENASICA, 2014). In contrast, the prevalence reported by some authors in intensive dairy herds, located in endemic areas of this disease, are much higher, influenced by overcrowding, lack of exclusive calving areas, among others that favor the transmission of the bacteria (Milián *et al.,* 2016).

Regarding milking 50% of the PUs use a milking machine, which was exactly the same as reported in Tabasco, where also the result for the manual milking system was 50% and mechanical milking 50%, the difference lies in the fact that producers rely on the calf to stimulate milk ejection (20%) (Granados-Rivera, 2018). In the PUs of Tulancingo Valley, the number of people responsible for milking varies between two and five people (57.1%). Given that the relationship between the worker and the dairy cows has direct consequences on animal welfare and production, it is important to consider the characteristic traits of the operator's personality, the degree of job satisfaction and empathy for the animals; since these have been shown to be key in the type of interaction that is built (Hanna *et al.,* 2009), mainly when the number of people is low within the herd.

Regarding the technical assistance offered to producers in the Tulancingo Valley, they were similar in type to those detected in the PUs of Chiapas, but differed in their frequency (Orantes-Zebadúa *et al.,* 2014). In PUs with low levels of technical assistance, the frequency of diseases increases and their type and frequency are unknown (Juárez-Barrientos *et al.,* 2015; Vilaboa-Arroniz *et al.,* 2009). In Mexico, more than 70% of abortions are considered to be of unknown origin. In addition to these problems, there are health problems that compromise the efficient productivity of the animals (Gutiérrez-Hernández *et al.,* 2020; Escamilla *et al.,* 2007). Among the most important diseases are those that affect reproduction, jeopardizing the availability of calves; they also increase the cost of production due to treatment (Rojo *et al.,* 2009).

On average producers have 2.5±2.5 years of receiving technical assistance and training in the state of Tabasco (Granados-Rivera, 2018), it is important to incorporate this type of support to producers of dairy cattle production systems for the Tulancingo Valley. 90% of producers expressed in the survey conducted that they are in favor of receiving training, mainly in nutrition, reproduction and disease prevention topics.

The wide variation in the variables that determine the socioeconomic and technological aspects of the PUs explain that some producers spend part of their time in non-livestock productive activities, which allow them to obtain complementary economic income (Juárez-Barrientos *et al.,* 2015; Oros *et al.,* 2011). In the research conducted in Tabasco, 52% of producers are dedicated exclusively to livestock farming and the remaining 48% complement their income with activities inside and outside the PU (Granados-Rivera, 2018).

Finally, problems that producers have had during the last years due to the effect of droughts and in this last year due to the pandemic were detected. In Veracruz alone, from January to September 2019, more than 15 thousand head of cattle died due to drought (Ruiz *et al.,* 2008). Milk represents an important economic income in the studied PUs due to the fact that most of it is sold and allows having an income to cover daily expenses associated with the activities, a result that coincides with what has been reported in the states of Chiapas and Veracruz (Juárez-Barrientos *et al.,* 2015; Orantes-Zebadúa *et al.,* 2014). A similar situation has been reported in the PU located in Chiapas, evidencing the need to increase the producer's organizational capacity and improve the cattle commercialization process (Orantes-Zebadúa *et al.,* 2014).

CONCLUSION

The results of this study allow us to conclude that dairy cattle producers in the Tulancingo Valley have a medium socioeconomic profile, with a high level of schooling. The practices carried out by producers in the region are efficient, although they require technical advice and information on nutritional and reproductive aspects, as well as on the sanitary management of dairy cattle.

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