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Typology of sheep farmers benefited by the Program for the Improvement of indigenous Production and Productivity

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ABSTRACT

Objective: To identify the typology and describe the sheep farmers benefited by the Programa para el Mejoramiento de la Producción y Productividad Indígena (PROIN: Program for the Improvement of Indigenous Production and Productivity) of the Instituto Nacional de Pueblos Indígenas (INPI: National Institute for Indigenous Peoples), in Campeche.

Design/Methodology/Approach: One-hundred ninety-nine sheep farmers registered as beneficiaries in the Program were interviewed. They belonged to 27 sheep farms (SF), located in seven municipalities. A questionnaire including socioeconomic and technical questions and 15 quantitative and qualitative variables was conducted. Variables were correlated and a principal components analysis was carried out to define types of farms. The variables that explained the highest variability in the data set were number of sheep, number of sheep sold per year, annual income from sheep sales, productive purpose of the sheep farming, and feeding system. These variables were then used to perform a cluster analysis in order to identify and cluster the sheep farms.

Results: Three groups of farmers were identified: Conventional (C, 74%) with 70 sheep and annual sales for $10,109.00; Transitional (T, 15%) with 169 sheep and annual sales for $36,680.00; and those in business (B, 11%) with 142 sheep and annual sales for $48,443.00. All the producers (100%) carry out extensive grazing. The breeds used by C and T are Pelibuey × Black Belly (78%), while B uses Pelibuey × Kathadin (21.7%).

Study Limitations/Implications: Implemented support strategies must differentiate according to the type of farm.

Findings/Conclusions: Three types of sheep farmers were identified: Conventional, Transitional, and Enterprise. Farmer types were differentiated by the number of sheep, sales, income, sheep production system, and feeding system they use.

Keywords: Management, sheep production, flock, production system, Farm types.

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INTRODUCTION

In Campeche, support programs for sheep farming are based on optimal agroecological conditions, the easy management of sheep, and the presence of Pelibuey and Black Belly breeds. These breeds are considered easy to raise because of their prolificity, rusticity (which makes them resistant to internal and external parasites), and adaptability to precipitation and high temperature conditions, these hair breeds are an alternative for production of food for self-consumption and commercialization (Calderón-Cabrera *et al.*, 2022).

The classification of sheep farmers enables their distribution into groups for their analysis and contributes to the decision-making process in the sector (Vázquez-Martínez *et al.*, 2018). In the case of small-scale sheep farming in private production systems, differences among the systems should be delineated to develop strategies for their development (Calderón-Cabrera *et al.*, 2022). Although Pérez-Bautista *et al.* (2021a) characterized the sheep farms benefited from the Comisión Nacional para el Desarrollo de los Pueblos Indígenas (National Commission for the Development of Indigenous People) in Campeche, there is still a lack of information about the socioeconomic and technological parameters under which they are grouped. The availability of the said information will contribute to the use of appropriate technology and the design of strategies suited to their socioeconomic characteristics. This information helps to improve productivity and encourages sheep farming. It can also be the basis for future research. Therefore, the objective of this research was to carry out a typology and characterize the types of sheep farmers benefited by the INPI, in Campeche.

MATERIALS AND METHODS

The study was carried out from October to December 2015 with the participation of 199 farmers from 27 sheep farms, with farms located in seven different municipalities of Campeche. The study area is located between parallels 19° 14' and 20° 00' N and 89° 50' and 90° 42' W, at 260 m.a.s.l. The climate is warm sub-humid with rainfall in summer (García, 1988), a mean temperature of 30 °C, and an annual rainfall of 1200-2000 mm.

Statistical analysis included data from all the 27 farms receiving funds from the INPI during 2014 and 2015, the data was provided from the database by the Comisión Nacional para el Desarrollo de los Pueblos Indígenas (CDI: National Commission for the Development of Indigenous Peoples) in the state of Campeche.

To characterize the farmers, a questionnaire with semi-structured questions was designed to gather information of the socioeconomic and technical status of farms. Socioeconomic characteristics included: number of members managing the farm, indigenous language, age, education, years of experience in sheep farming, importance in sheep-related activities, land tenure, sales, income from sheep farming, number of sheep owned, total farm area, area dedicated to sheep raising, breeds used, production purpose of the farm, characteristics of the job, facilities, and equipment related to sheep farming. Technical characteristics included the production focus of the farm, reproductive management, feeding management, health management, technical assistance, and water use. The questionnaires were performed throughout interviews. Direct observations were also made to describe the management and available equipment and infrastructure in the farms. The variables of the socioeconomic characteristics were used to classify the farms.

Pearson correlations were performed among all variables, to obtain the most associated variables and include them in a principal components analysis (PCA). The PCA was then performed to obtain the most significant variables and total variances that contribute to the total number of components. Subsequently, a cluster analysis was carried out through an average grouping based on Euclidean distances. The most relevant variables identified in the PCA (sheep sales, income per sale, number of sheep in the farm, production system, and feeding system) were taken into consideration to determine similar groups of farmers and define their characteristics. All analyses were carried out with the Infostat software version 2020 (Di Rienzo *et al.*, 2020).

RESULTS AND DISCUSSION

The sheep sale and income by sales variables recorded the highest correlation in the analysis (r=0.99), followed by the total number of sheep and sales income (r=0.54), and number of sheep and sheep sale (r=0.51). The PCA included two components: the first accounted for 53% and the second 29% of the total variance (together they represent 82% of the variance in the data). These components show the relationships that exist between the socioeconomic and technical variables: the most important variables in component 1 were sale of sheep and the income, while component 2, was the negative weight of the purpose of the production system opposed to the positive weight of the feeding system (Table 1).

Typology of Sheep farms

The three types of farmerss found had different socioeconomic and technical characteristics (Figure 1). Conventional (C) farmers represent 74% of the total and on average they have a maximum of 70 sheep, sell up to eight sheep per year, and their annual income is $10,109.00. Fifteen percent of the producers fall into the Transitional (T) category; on average they have 169 sheep, they sell 31 sheep per year, and they obtain an annual income of $36,680.00. Finally, 11% of the producers belong to the Business (B) category, they on average have 142 sheep, sell 40 sheep per year, and their annual income is $48,443.00 (Figure 2).

Socioeconomic characteristics of the types of sheep farms

Most sheep farmers (90%) in Campeche are literate and went to school during 2 years in average, similarly to farmers in the neighboring state of Yucatán (Góngora-Pérez *et al.*,

Table 1. Variables with the greatest influence on the two main components defining sheep farmer groups in Campeche, Mexico.

Variable	Component 1	Component 2
Number of sheep	0.41	−0.26
Sheep sales	0.55	−0.28
Sales income	0.56	−0.26
Productive purpose of the farm	−0.33	−0.62
Feeding system	0.33	0.63

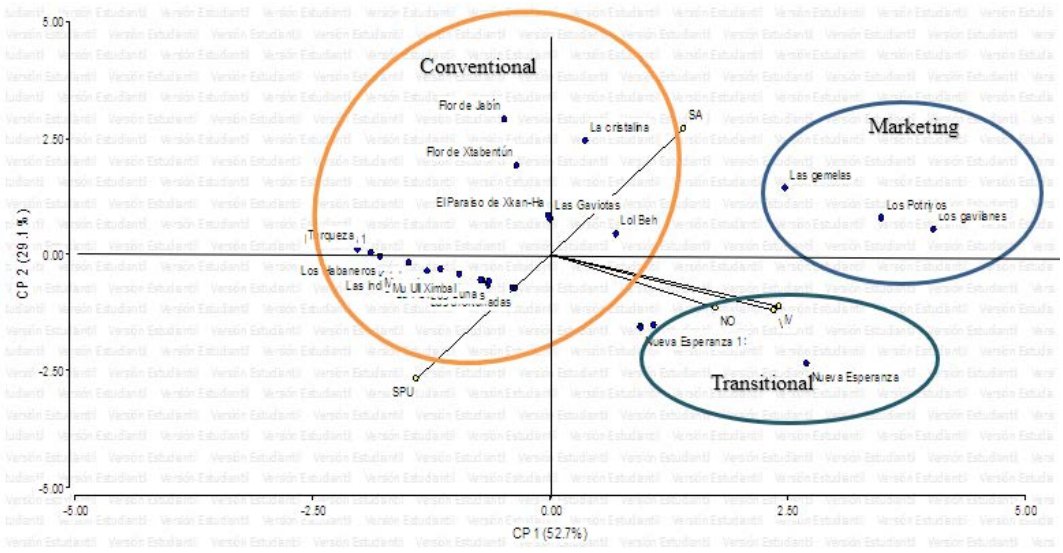

Figure 1. Values of the components 1 (PC 1) and 2 (PC 2) that identify the location of sheep farms into three groups, based on socioeconomic and technical variables.

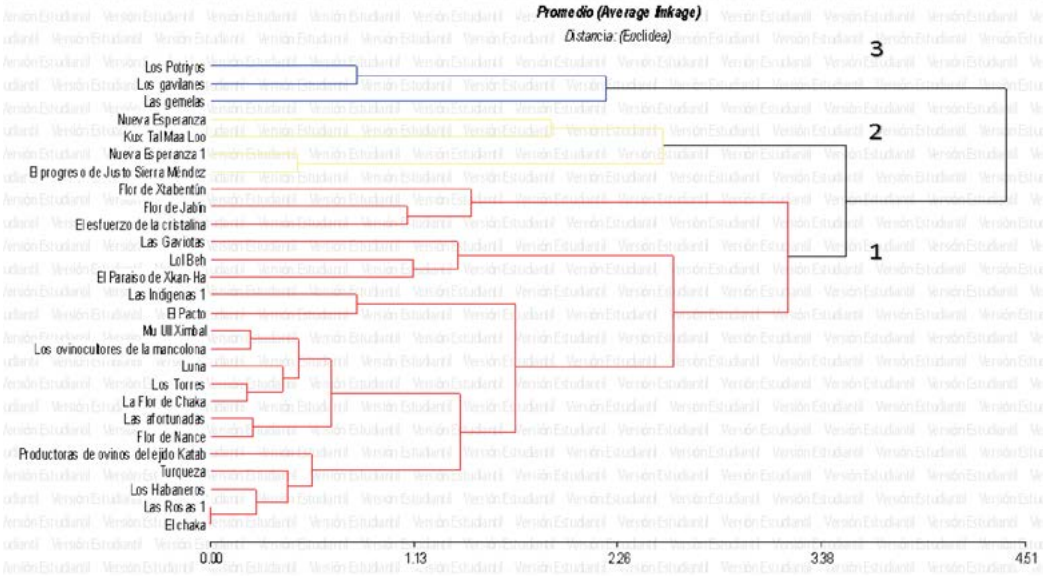

Figure 2. Dendrogram of the groups formed with similar characteristics in sheep production in Campeche, Mexico.

2010). Therefore, non-traditional training of this type of farmers must be implemented to understand and assimilate training regarding sheep farming.

The average age of the farmers was 37.5 (C), 38.4 (T), and 40.5 (B) years and they owned 70, 169, and 142 sheep, respectively. Candelaria-Martínez *et al.* (2015) reported similar results in eastern Yucatán, while Vázquez-Martínez *et al.* (2018) and Calderón-Cabrera *et al.* (2022) recorded lower values in the Puebla and Tlaxcala region and in the northeast-central areas of the State of Mexico, respectively. Candelaria-Martínez *et al.* (2015) sustains that this age range is appropriate for the adoption of technology and innovation.

Seventy-eight percent of the members of groups C and T use the Pelibuey × Black Belly sheep breed. The area dedicated to sheep production was 15 (C), 22 (T), and 24 (B) ha, which are sown with grasses of genera *Pennisetum* and *Briachiaria* and native grasses. Given that the support has only been granted in recent years, producers had 1-2 year experience in sheep farming (no more than 3 years). This time span is lower than those previously reported in Campeche (Dzib-Can *et al.*, 2006), less than 4, 6, and 7 years were recorded, depending on the level of technology (high, medium, and low, respectively). The three groups exclusively use family labor, and they have basic infrastructure and equipment: the barn, pens, drinkers, and feeders are built with native material, just like producers in Yucatán (Candelaria-Martínez *et al.*, 2015). Farmers in T and B groups have more equipment and infrastructure for flock management, while farmers in C lack enough equipment and infrastructure (Table 2). Therefore, they need support for the construction of basic infrastructure, which is key for the promotion of this type of production units (Martínez-González *et al.*, 2011).

All three groups lack the infrastructure required to produce or store forage and consequently animals lose weight during the dry season. This situation, coupled with the low number of trees and shrubs observed in the grazing areas (resulting from the establishment of exotic pastures), provides the opportunity to develop agricultural, forestry, and grazing systems with locally available tree resources, such *Guazuma ulmifolia* Lam (Partida-Hernández *et al.*, 2019) or breadnut (*Brosimiun alicastrum* Swarth (Rojas-Schroeder *et al.*, 2017). Likewise, it is proof that producers need to receive information that allows them to recognize this vegetation as a highly nutritious forage source.

Table 2. Infrastructure and equipment (%) owned by the groups of sheep farmers receiving financial support by the Instituto Nacional de Pueblos Indígenas, in Campeche, Mexico.

Infrastructure and equipment	Producers		
	Conventional (C) (n=20)	**Transitional (T) (n=4)**	**Marketing (E) (n=3)**
Backpack fumigator	30	43	75
Electric irrigation pump	10	10	20
Scale	14	20	50
Forage chopper	14	33	40
Chainsaw	14	28	40
Basic first aid kit	0	40	50
Feeders, water troughs and mineral feeders	100	100	100
Cyclonic wire mesh	20	30	50
Artesian well	20	25	43
Sheep individual pens	15	20	26
Sheep large pens Subdivided pastures	80	85	100
Sorting shuttle	20	20	20
Shelter	100	100	100

Most B and T farmers (80%) sell sheep and use their animals to increase their flock, while 75% of farmers in C are focused on the breeding and reproduction of their flocks, which indicates that they farms are growing. As in sheep farms in the State of Mexico (Calderón-Cabrera *et al.*, 2022), 90% of the sheep are sold directly at the farmers' homes. Sheep dealers and "*barbacoyeros*" (people who prepare and sell barbacoa) trade live sheep. This is considered an advantage, since farmers do not incur in transportation costs; however, the trading prices are low (Calderón-Cabrera *et al.*, 2022).

Technical characteristics of the sheep farm types

The reproduction system of studied farms involves natural mating throughout the year, with a 1:40, 1:55, and 1:65 male:female ratio for C, T, and B, respectively. These results fall within the ratio recommended by Cruz-Espinoza *et al.* (2021). Animals are allowed to graze (100% in C, 90% in T, and 70% in B) and are fed commercial balanced feed (25% in B and 10% in T) as well as crop residues (in C). Similar results have been reported by Dzib-Can *et al.* (2006) in Campeche and by Góngora-Pérez *et al.* (2010) in Yucatán. The stocking rate (animal units per hectare: AU ha^{-1}), is low in the three groups (0.14, 0.18, and 0.25 for B, T, and C, respectively), indicating the importance of training producers to improve the production, use, and conservation of forages.

Parasites are the main health problem faced by the three types of producers (Table 3), similar to what happens in Yucatán (Candelaria-Martínez *et al.*, 2015) and Hidalgo (Pérez-Bautista *et al.*, 2021b). Farmers do not follow the recommended calendars and doses of the medications. Therefore, technical assistance and training must be provided regarding this aspect of production.

A recently established slaughterhouse (with the capacity to slaughter 10,000 sheep per year and export carcass meat) may promote sheep meat production. The activity of sheep producers benefited by the INPI of the CDI in Campeche is incipient. Therefore, government programs, including technical assistance and training strategies —which are key for the consolidation of support programs— are needed to promote sheep farming (Martínez-González *et al.*, 2011).

Table 3. Primary health issues (%) detected in sheep flocks from farms supported by the Instituto Nacional de Pueblos Indígenas in Campeche, Mexico.

Health problem	Producers		
	Conventional (C) (n=20)	**Transitional (T) (n=4)**	**Marketing (E) (n=3)**
Keratoconjunctivitis	14	0	0
Hoof Rot	0	20	50
Parasitosis	71	60	75
Respiratory	0	0	0
Contagious ecthyma	0	0	25
Digestive	0	20	0
Other	28	0	0

CONCLUSIONS

The sheep farms of the groups benefited by the INPI in Campeche are differentiated by the size of the flock, total annual sales, and total annual income. In the classification, three types of farmers were identified: Conventional, Transitional, and those in Business. The Conventional group includes most farmers, followed by Transitional and Business. The characteristics of the available infrastructure and general management of the flocks show that, provision of sheep to farmers was not accompanied by training and adequate infrastructure support and that the effects of technical assistance are not yet perceptible.

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