v. 4, n. 6, 2024

International Journal of Biological and Natural Sciences

RELEVANCE OF SUSTAINABILITY IN DAIRY PRODUCTION SYSTEMS IN THE STATE OF VERACRUZ, MEXICO

Elizabeth Zavala Martinez

Jorge Eduardo Vieyra Durán
https://orcid.org/0000-0001-7205-2772

Jaime Rangel Q
https://orcid.org/0000-0003-3631-0222

Juan Manuel Vargas Romero
https://orcid.org/0000-0003-1837-3959

Erika Patricia Gallaga Maldonado

Cindy Emily Gomez Vergara

Abstract: The objective of this study was to evaluate Dual Purpose Livestock Systems (SGDP) in the municipality of Tlalixcoyan, Veracruz. In order to identify risks to address environmental, social, economic and governance impacts, the data were analyzed using descriptive statistics. From the above, it was found that the systems have low use of technology and external inputs and that they lack knowledge of regulations to produce safe food; that this type of system takes advantage of market opportunities, selling milk or meat according to the prices of the supply chain and market offers. Currently, there is a tendency to recover and innovate in conventional practices of small-scale systems, considering this system as the engine of the economy of vulnerable populations, which is why it is essential to ensure its survival over time in a competitive manner and contribute to its sustainable growth.
Keywords: Governance, environment, climate change, economy, rural development.

INTRODUCTION

The demand for food has increased, especially that of animal origin, as a consequence of population growth, rising incomes, as well as changes in food preferences (LEAD, 2006; FAO, 2018). The above represents an opportunity for the development of livestock activities, on which a large part of the rural population depends. However, livestock systems have been considered harmful to the environment due to greenhouse gas emissions, soil erosion, contamination of water bodies, deforestation and their contribution to climate change (Steinfeld *et al.*, 2006; Urdaneta *et al.,* 2008; FAO, 2009; Herrero *et al.*, 2010). In Mexico, 37% of methane emitted comes from enteric fermentation (93.7% from cattle) (Castelán et al. 2019; GHGSat*, 2020*).

In the state of Veracruz, the predominant livestock system is the dual-purpose system. It is an activity of great importance in the generation of family employment. In addition, these systems have proven to be resistant to social, economic and environmental changes. In this sense, the importance of cattle raising from the productive point of view is evident, as well as in the impact it has on the environment. This has led to international agreements for sustainable development, especially with the creation of the 2030 agenda by the UN (United Nations) and the integration of the Sustainable Development Goals (SDGs).

Therefore, livestock systems are highly fragmented and have a trend marked by the SDGs, which seek to intensify actions aimed at mitigating climate change by reducing carbon emissions. In this sense, the dual-purpose system is presented as a model of recovery and revaluation of conventional agricultural strategies coupled with innovation and new production practices to evaluate their contribution to the environment (Arriaga *et al*., 2022). Therefore, the objective of this study was to evaluate and describe processes carried out in Dual Purpose Livestock Systems (SGDP) in the municipality of Tlalixcoyan, Veracruz. In order to identify risks to address environmental, social, economic and governance impacts using ESG criteria.

METHODOLOGY

The study was conducted in the municipality of Tlalixcoyan, located in the center-south of the state of Veracruz, in the Sotavento region, at coordinates 18° 48' north latitude and 96° 04', west longitude at an altitude of 10 meters above sea level. It has a warm sub-humid climate with summer rains, higher humidity (72%) and warm sub-humid with summer rains, medium humidity (28%). The agro-ecological characteristics of the municipality have allowed both livestock and

forage production to develop. This can be seen by the fact that 34% of the municipality's land is used for agriculture and 62% for pasture. Accordingly, Tlalixcoyan has stood out as one of the most important milk producers in the state of Veracruz. However, the Secretaría de Desarrollo Municipal does not have a registry that can provide data on the number of producers in the area.

On the other hand, it is interesting to mention that when we talked to the state officials about this situation, they did not know that the municipality is ranked as one of the first places in milk production, according to the census of the Secretariat of Agriculture and Rural Development (SADER, 2020). It is worth mentioning that the predominant crops in this area are corn, sugar cane and some leguminous plants such as beans and rice, among others, and that the main livestock activities include raising cattle, pigs, sheep, goats and poultry. In addition, it is important to note that 44% of the population is engaged in livestock sector activities.

In order to carry out this study, interviews were conducted (a copy of the interview instrument is attached) with cattle producers in the municipality of Tlalixcoyan in the State of Veracruz. The selection criteria were: a) *cooperating producers*, those who were interested in participating in the research and acted as informants for locating other cooperating producers, b) *cattle producers* and c) *producers who marketed milk*. In order to be included in the research, they had to meet the three criteria mentioned above, since they were indispensable to classify them as SGDP. Such systems were characterized by being small-scale; grazing and the sale of milk as part of the family's economic income predominate in the diet; the systems that do not sell milk are composed of one or two production animals and the milk is for self-consumption. In addition, the evaluation of sustainability in the production units (UP) was carried out through the following indicators: a) socioeconomic characteristics of the producer (age, sex, schooling, main economic activity, income, expenses, among others), b) environmental (use of external and internal inputs, management of natural resources, biodiversity and environmental impacts), c) social (equity and livelihoods) and d) governance (participation, succession plan, accountability and efficiency). The sample consisted of 47 UPs that met the aforementioned criteria. The data were entered into Excel spreadsheets and analyzed using descriptive statistics.

RESULTS

The results show: 1) identification of producers according to their socioeconomic characteristics, degree of schooling, experience in the activity, family structure, among others, 2) average production of milk and meat, as well as the average selling price, 3) characteristics of the systems and of the production unit, 4) environmental indicators, use of internal and external inputs, natural resource management, biodiversity and environmental impacts, 5) social aspects of equity, livelihoods and 6) governance, participation, succession plan, accountability and efficiency. Data were entered into Excel spreadsheets and analyzed using descriptive statistics.

SOCIOECONOMIC CHARACTERISTICS OF THE PRODUCER

Table 1 shows the responses of 42 farmers and shows that 88% of the farmers surveyed were male and only 12% were female, with an average age of 53 and 52 years, respectively. In terms of schooling, the farmers had 7 years of schooling and 26 years dedicated to agricultural production. The average number of economic dependents was three, one man

and two women. In terms of marital status, 53% of the farmers reported being married, followed by 24% who reported living in a free union and 21% who reported being single.

Variable	Male	Female
Sex (%)	88	12
Age (years)	53	52
Schooling (years)	7	14
Average experience as producer (years)	26	19
Average family members (N°)	4	3
Average number of economic dependents	3	1

Table 1. General characteristics of the producer

Source: Own elaboration

MAIN SOURCE OF ECONOMIC RESOURCES

87% of the farmers reported that the ranch was their main source of income, 9% mentioned commerce as their main source of income (Figure 1).

Average daily milk production per cow was 6 liters in the dry season and up to 12 liters in the rainy season. Milk prices fluctuated during the dry season, reaching their highest value ($0.50 USD) during the dry season. The sale of milk represented the immediate income for the producers, whose clients were local cheese makers (92%), distributors or boatmen (7%), and only 3% went to a state company (*Liconsa*).

Producers reported that the average weight of calves at birth was 35 kilograms (kg), the average weaning was done at 7 months with an approximate weight of 166 kilograms, and that calves were sold through intermediaries. Only 16% reported selling calves at 9 months of age with an average weight of 347 kilograms, selling calves by kg live weight, at a price of 2.5 USD per kg. These systems, unlike specialized milk or meat production systems, base their production on environmental opportunity.

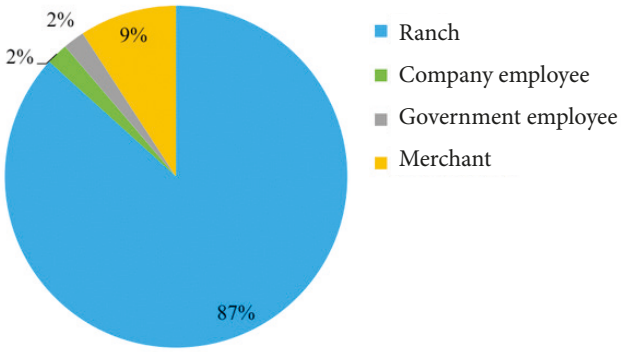

Figure 1. Main source of economic resources

Source: Own elaboration

GENERAL CHARACTERISTICS OF THE PRODUCTION UNIT

Regarding the land regime (rural property management), 81% reported small property, 12% ejido and very few 2% communal. Land tenure (land administration) was 86% owned, 12% borrowed and very few (2%) rented. The average total area was 16 hectares, of which 12 were grazing pastures and 4 with fodder crops.

The average number of total cows was 25, of which 12 were in production. In addition to these, the herd had 3 replacement calves and 3 calves for sale at weaning. Seventy-four percent of the UPs had their own stallion for direct breeding and 26% reported having borrowed one. The predominant crossbreed in the UPs was Swiss X Zebu (65%), the rest reported having undetermined crosses. The prevailing method of reproduction was direct mating and only 5% used artificial insemination.

Variable	Percentage (%)
Land regime	
• Own	86
• Loaned	12
• Rented	2
Land trend	12
• Small property	81
• Ejidal	12
• Communal	2
Herd composition	Average
• Total cows	25
• Cows in production	12
• Calves	3
• Calves	3
Race	Percentage (%)
• Swiss / Cebu	65
• Undetermined crosses	35
Reproductive method	
• Free riding	95
• Artificial insemination	5

Table 2. General characteristics of the UP

Source: Own elaboration

SERVICES PROVIDED BY THE UPS

50% mentioned having electricity and their main source of water supply is from a well (98%). In addition, 86% mentioned having at least one rustic corral made of wood (varenga) and wire. The UPs studied did not have animal records or accounting records and usually only kept approximate records of daily milk production in order to be able to charge the buyer.

ENVIRONMENTAL INDICATORS

USE OF EXTERNAL INPUTS

In 98% of the UPs, the type of feeding system that prevails is grazing on native and induced pastures, among which predominates the Star of Africa (*Cynodon nlemfuensis Vanderyst*), llanero (*Brachiaria dictyoneura*), Pangola (*Digitaria eriantha Stent*) and Pará *(Brachiaria mutica (Forssk.) Stapf)*, to name a few. On the other hand, 31% of the producers offered silage in the dry season, 70% of which was produced by themselves, while 22% supplemented with purchased concentrate feed, mainly locally. In addition, 98% of producers reported offering mineral salts.

Use of fertilizers, herbicides and pesticides and waste management 21% of the farmers reported chemical fertilization, the type of fertilizer container was plastic and 90% of the farmers mentioned that the containers were washed and reused. The use of pesticides and herbicides was only used by 26% of the farmers and on average is applied once a year during the rainy season. On the other hand, 95% mentioned that the material of the containers was plastic, while 72% reported throwing them directly in the garbage. Finally, 10% reported that they were burned.

ENVIRONMENTAL IMPACTS

In terms of environmental impacts, Figure 2 shows that 68% of the producers reported the drought season as the most critical period of the UP, while 17% indicated that the rainy season had negative effects, followed by 14%, who mentioned the nortes season. During the months of October to May there are strong winds from the north, known as "nortes", which occur on average every ten days, with wind speeds of 45 to 70 km/hr and in the coastal areas can reach 90 to 120 km/hr).

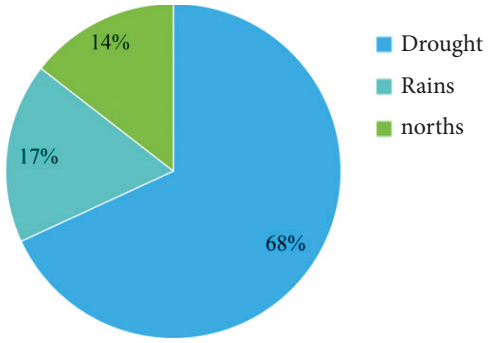

Figure 2. Percentage of environmental impacts by season

Source: Own elaboration

ANIMAL HEALTH AND WELFARE

The main diseases that occurred in UP animals were mastitis (77%), pneumonia (30%), scabies (38%), rabies (35%), anaplasmosis (34%), piroplasmosis (22%) and stomatitis (11%). Most producers used antibiotics to treat livestock diseases. In this regard, it is important to mention that, according to producers, veterinary care is only requested when calving is required or when the animals present symptoms that are not well recognized by them. In addition, 98% reported internal and external deworming.

Soil conservation practices

Among the main soil conservation practices, it was found that 60% carried out pasture maintenance (weeding and fertilization), followed by 55% who reported having a diversity of pastures and 31% emphasized the importance of using electric fences for pasture conservation. On the other hand, only 28% of the farmers carried out stocking rate control

SOCIAL INDICATORS

Among the main social indicators, equity was taken into account, as well as the livelihoods of producers and the organization of the UP.

ORGANIZATION

The type of organizational structure in the UPs was simple (Figure 4), the most prominent form of communication was farmer-wife, farmer-manager, wife-manager, and on rare occasions they considered the opinion of a professional (veterinarian or agronomist).

EQUITY

According to the results obtained from the instrument, the majority of the producers answered that decision making follows a hierarchical process as shown in Figure 1. In the UPs, it was observed that the participation of women in decision making was mainly in the purchase and sale of animals, while the selection and hiring of personnel is carried out by the owner himself without considering the wife's opinion.

On the other hand, 88% of producers reported having a preference for hiring only men, as they consider field work to be heavy.

LIVELIHOODS

For the evaluation of livelihoods, variables such as food, health, security, education and training were determined. 60% of the farmers mentioned having access to sufficient food; 52% reported having training; 23% reported having security and very few, 12%, had access to education.

GOVERNANCE INDICATORS

PARTICIPATION

Table 3 shows that the type of labor that prevailed in the UPs studied was family labor (98%). However, in 10% of the UPs, family members received wages, since they are considered workers or employees. At least two family members participate in different activities such as animal handling and care, feeding, operational processes and marketing. Temporary workers are mainly in charge of planting, harvesting, fertilizing and arranging corrals. On the other hand, permanent workers are in charge of activities such as milking, livestock management, and farm labor support.

77% of the UPs generated jobs ranging from two to five people from outside the family, which represents 66% of temporary

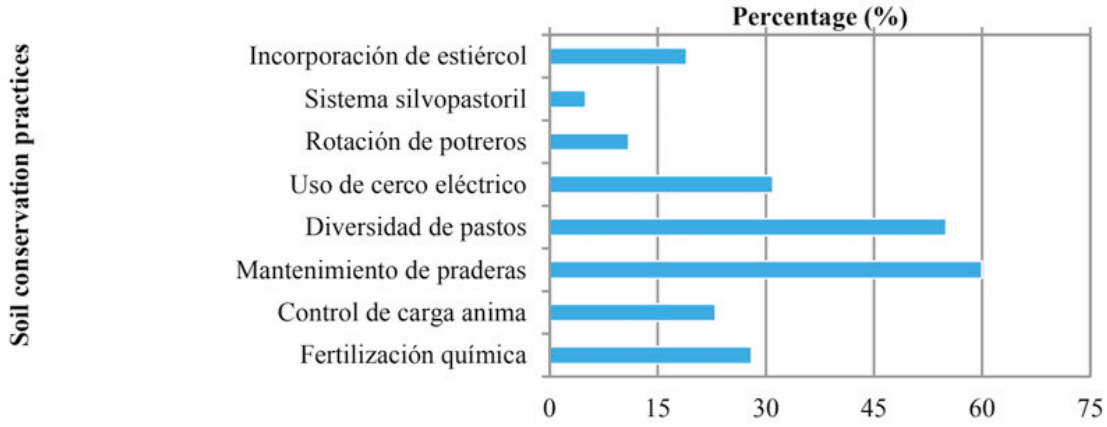

Figure 3. Soil conservation practices
Source: Own elaboration

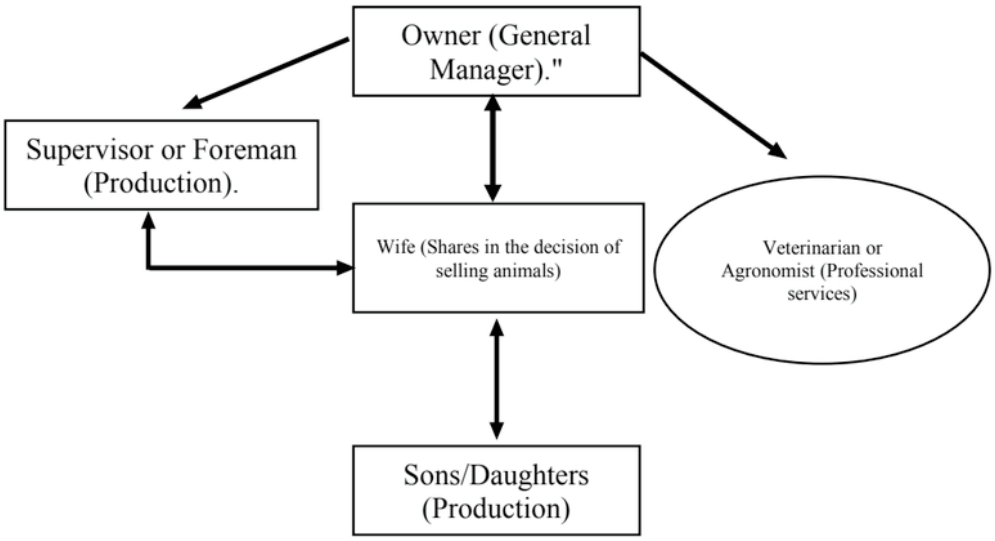

Figure 4. Governance organization chart in the UPs
Source: Own elaboration

jobs, mainly doing field work, while 11% had permanent workers in charge of activities such as milking, general livestock management and field work. The average pay per day was $13.15 USD and the type of pay was weekly.

71% of the employers considered that their workers were happy with their jobs, among the main reasons were good treatment (56%), no employee complaints (15%) and good pay (10%), to mention a few. The main incentives found were; support for medical expenses (57%) and meals (40%). However, 89% of the producers mentioned that it is increasingly difficult to obtain local labor.

Variable	Percentage (%)	Activities in which it participates
Family	**98**	
- Unpaid family members	88	All activities
- Paid family members	10	Milking, general herd management
External workers	**77**	
- Temporary workers	66	Farm work
- Permanent workers	11	Milking, general livestock management, field work, etc.

Table 3. Participation and type of labor force in UPs
Source: Own elaboration

SUCCESSION PLAN

79% of respondents mentioned that their father was a rancher, while 21% reported being first generation. On the other hand, 50% reported that their children were taught to farm, while 30% help or are interested in the activities.

It was reported that in 53% of the cases, the foreman or caporal is the one who makes decisions in the absence of the employer, 30% of the children participate in decision making and in 17%, the wife or another member of the family.

Regarding the support of the children in the ranch activities, it was found that only 33% of them are interested in livestock activities, with an average age of 23 years, with an age range between 10 and 45 years.

ACCOUNTABILITY

As mentioned above, most of the milk is sold to the *cheesemaker*, who is the one who carries out the processing. This means that it is a short channel marketing. In some cases (41%), this relationship is strongly established through trust, which guarantees a secure demand for the product, even in times of oversupply, without the need to sign contracts. In the same way, the producer guarantees product availability during the dry season. However, 90% of the producers mentioned having the possibility of marketing their product to the highest bidder. In another aspect, 97% of the producers mentioned that payment for quality or composition of the product is not considered.

In terms of complaints, it was found that the majority of producers (95%) had no problems with the management of their ranch; only 5% reported that the complaints received were focused on damage caused by animals that were moved to neighboring plots. Nevertheless, the producers mentioned that they always tried to reach a good agreement. In terms of marketing, no complaints were reported from buyers, but producers had some displeasure because the worker did not report the increase in milk payment.

EFFICIENCY

With respect to the governance of the system, from the point of view of coordinated interaction between the different actors, resources and institutions, it was observed that 67% of the producers do not have access to support and incentives for their production, while 27% of the producers who had access participated in state programs and 6% obtained support from the same company to which their production is destined (Figure 5).

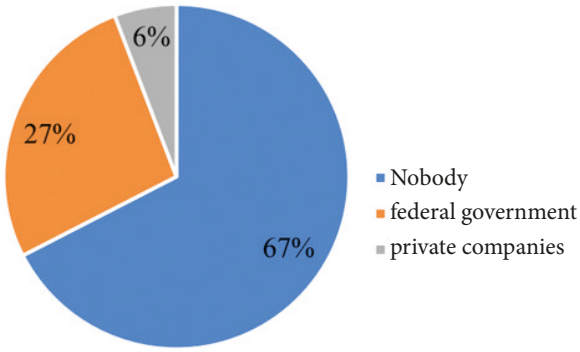

Figure 5. Access to support

Source: Own elaboration

DISCUSSION

Most of the UPs were found to be in charge of men, this is similar to what was reported in other studies on the typification of dual-purpose systems in the state of Veracruz (Vilaboa *et al.,* 2009; Juárez *et al.,* 2015), in which they reported that 91% of the UPs were found to be in charge of men. From the above, it is possible to clearly observe that the raising of large livestock continues to be a sector in which male labor predominates. Although there is a particular case, Torres *et al.,* 2016, which highlighted the role of women in dual-purpose livestock farming in Ecuador and its

existence lies in a strong relationship between social and biological beliefs regarding the role that women should play in the field and a low participation of women in the care of larger species.

On the other hand, the average age of the people who participated in the study was 53 years old, with a low level of schooling (which, it should be noted, coincides with what is reported at the state and national levels). Likewise, they had an average of more than 25 years of experience in livestock production and this has allowed them to overcome climatic and economic phenomena and changes in public policies. As mentioned by Torres, *et al.* 2015, this was similar to what was reported in dual-purpose systems in the province of Manabí, Ecuador and in the south of the State of Mexico. Granados *et al*., 2018; Solano *et al*., 2001 mention that the age of producers influences the incorporation of new practices and technologies, so the appropriation of these generates a complicated situation.

The relevance of these systems within the local, state and national economy is that they are an essential part of the family's livelihood. Therefore, these systems should be supported, since they contribute 70% of the family budget. According to Sánchez *et al.,* 2014 and Ravallion *et al.,* 2007, about 75% of the world's population living in rural areas obtains income from agricultural activities.

Regarding the main source of income, the largest number of producers mentioned the ranch. However, this is not directly related to the sale of milk; in addition to cattle raising, they reported that they also produce papaya and lemons, among others. On the other hand, 9% mentioned commerce as their main source of income. This means that the farmer has to attend to different tasks during the day, transforming him/her into a multi-tasking person. In other words, a farmer is dedicated to livestock activities in the morning and later works in the office of the municipality or as a shopkeeper. For De Janvry *et al.,* 2000, the lack of economic assets has pushed the individual to depend on a wide variety of activities for his or her livelihood. In this sense, there is growing evidence that agricultural activities are no longer part of the main income of the rural population. Nevertheless, milk represented an immediate economic income for producers, followed by the sale of calves, which is considered as savings and is sold to cover unexpected expenses. In this same sense, Nava (2005) commented that animal husbandry in rural areas represents an important source of economic resources for families that allows for diversification of activities, both in terms of sales and self-consumption.

The average herd size was 31 animals, of which 12 were in production; these 12 animals are the main source of income. In addition to these, there were six animals, including replacement calves and calves for sale at weaning; the rest were dry cows. This distribution of the herd was due to the production needs originated by the demand for milk by cheese producers. The animal genetics found in the area come from the crossbreeding of *Bos Taurus* and *Bos Indicus* species and the F1 is mainly used. This is similar to that reported by Vilbao, J *et al.,* 2009. In addition to the aforementioned crosses, undetermined crosses were found, since producers sometimes request borrowed bulls that have a history in the area of being good milk producers. Such crosses are practiced by cattlemen in order to contend with climatic conditions (Toledo, H *et al.,* 2015; Gómez, R *et al.,* 2016).

Although it is true that reproduction is important in this type of system, the use of assisted animal reproduction is not accepted in part due to custom and the costs it represents, so the predominant reproductive mode was direct mating. The above was similar to that reported in other studies of characterization

and typification of dual-purpose livestock systems in the tropics (Vilbao *et al.,* 2009; Gómez *et al.,* 2016).

The UPs had rustic facilities (corrals made of wood and wire). In addition, they lacked machinery and equipment for field activities, milking and livestock management. Only 50% had electricity and their main source of water supply was from artesian wells (98%), which was used for the fields. According to Dussán, J. A (2017), in order to obtain quality or safe food from these systems it is necessary to have adequate infrastructure conditions.

On the other hand, it is important to have records of the activities that take place in production systems. Although for PDS producers it is not very relevant, since they claim to keep in their memory the names of the animals they have (Florecita, Gertrudis, Pancho, etc.) and their status in the UP (amount of milk of Florecita, age of Pancho, etc.). However, some producers have taken courses and advice on this subject. Most of the UPs studied did not have animal or accounting records and usually only kept approximate records of daily milk production in order to be able to charge the buyer. According to Granados *et al* (2018), the lack of records prevents knowing the critical points of the UP for decision making to improve production processes. In addition, a study conducted in dual-purpose systems in Venezuela indicated that planning and decision making in the management of the system by producers is done in an improvised manner and according to the experience of previous years (Urdaneta et al., 2008).

The reported production level was between 6 and 12 liters of milk per cow per day on average during the dry and rainy seasons, respectively, which is similar to that reported in dual-purpose systems in the state of Chiapas, Mexico (Gómez, *et al.* 2002). In addition, the dry season was the season in which milk had the highest market value. Therefore, the level of production was strongly determined by environmental conditions and the cyclical quality of the milk. Thus, during the rainy season, production increased due to the abundance of pasture and in the dry season, production eventually decreased due to feed shortage. This is similar to what was reported by Gómez, *et al.* 2002 where most of the ranches presented a marked decrease in forage biomass in the dry months, so that the producer is forced to look for alternatives to help in the nutrition of the animals.

The chain of sale and transportation of milk was short, so that it was the predominant destination of the agribusiness for the production of local cheeses without quality requirements, where the density was the only valued factor of the milk characteristics. According to SIAP 2020, small-scale systems at the national level contribute 37% of the milk demand for dairy production and are thus recognized as the third most important activity within the food industry. Cheesemakers are an important part of the social relationship in the chain, mainly due to their organizational system for milk collection, since in 69% of the cases the collectors or "boteros" are in charge of going to the UP to collect the milk. This is considered an important benefit for the producers. These data were similar to those reported in small-scale cattle herds in the central valleys of the state of Querétaro, Mexico (Gutiérrez, 2014).

The type of system that prevailed in the UPs was extensive, where grazing was carried out on native and induced pastures, with Star of Africa grass (*Cynodon nlemfuensis Vanderyst*) being the predominant one. On the other hand, it is important to note that only 31% of the producers used external inputs, mainly in the dry season, purchased locally. It should be noted that in the area it is common to use mineral salts, which is offered to the animals in most of the UPs.

The drought season was the most critical time of the UP, because animals are affected mainly by the shortage of pasture, which results in low productivity and low weight, followed by the rainy season due to flooding of the land, which is the main effect and consequence that generates problems of hoofs of animals due to humidity. In addition, FAO 2023 mentions that in tropical regions, problems of access to production sites are aggravated during the rainy season, as a result of damage to roads and bridges. Paradoxically, it is common that this is the season with the highest production.

On the other hand, the so-called nortes affect the animals' respiratory system. Therefore, the producer has to apply antibiotics to combat the infectious diseases suffered by cattle at this time of year (see Figure 2). Regarding animal health management, most producers used antibiotics to treat cattle diseases, mainly mastitis and pneumonia. It is important to mention that, according to the producers, they only request veterinary attention when they need to attend births or when the animals present symptoms that they do not recognize. Regarding the organization of the UP, it was found that decision making by the members is not strictly established, but is delegated to the next commander based on trust. In most cases, when the owner is absent, the wife is the second in the hierarchical order to make decisions, especially when it comes to the sale of animals (see Figure 1).

The prevailing type of labor in the UPs was family labor, and in most of them the family members did not receive a salary, since their participation was considered a contribution to the support and sustenance of the family economy. On the other hand, in very few of the UPs, family members were financially compensated for the services they provided, such as milking, cattle management and farm work (see Table 3). This is derived from the limited income that these UPs have, which is similar to that found by Arteaga *et al.,* 2021.

Historically, most of the cooperating producers mentioned that their father was a cattle rancher. This indicated that at least the last two generations have been involved in ranching, while one-fifth of them reported being the first generation. Likewise, almost half of them mentioned that their children were educated in farm work. However, few of the descendants showed interest in continuing these activities. The relevance of these responses by the farmers and the low interest shown by the next generation indicated a notorious generational break, which in the future will be a problem to be solved. According to Morales 2021, low yields, soil degradation and some socio-cultural phenomena are the causes that discourage young people from continuing farming activities.

The lack of guarantees or the lack of concern of those in power for these communities has prevented local economic problems from being solved, which is evident in the lack of public policies focused on land users; with support for production, but with no interest in making them efficient or industrialized, and with no possibility of maintaining sustainable production. It is worth mentioning that there is a high percentage of producers who are not paid for the quality or composition of their milk, which prevents the actors (producer-cheesemaker) from maintaining an interest in improving the quality of their product and thus being able to see the system from a "win-win" logic.

Regarding production for national or international companies, producers receive training and are constantly evaluated according to quality criteria and, as a result, they expect to receive a better price for their product (Gutiérrez, 2014; FIRA, 2007). However, even when in the municipality of Tlalixcoyan there was a collection of the national company,

Liconsa, the producers showed little interest in being suppliers of this, since they did not have the sanitary possibility of production or the quality requested of them, in addition to the transportation costs that would be borne by the producer.

Both the lack of economic support and the horizontal decision making by governments have weakened the governance of the UPs, since public policies are not focused on the needs of the producers; which is similar to what was reported by Álvarez, Montaño and Flores (2007), who mention that decapitalization prevents producers, especially small-scale producers, from having sufficient means to increase their efficiency and productive effectiveness. Furthermore, in a study conducted in San Martin, Huitzizilapan, Lerma, State of Mexico, it was reported that this lack of public policies focused on land users (without trying to make them industrialized and with the possibility of maintaining themselves in sustainable production) has not been a government priority (Vieyra *et al,* 2021). In addition, the erroneous idea that intensive systems are the model to imitate, without taking into account the environmental, social and governance consequences, has weakened the sustainability of livestock systems.

The low use of technology in these systems and the lack of appropriation of new technologies on the part of producers are accompanied by little knowledge of the regulations applicable to production and quality controls. It is therefore important to develop public policies that favor the dissemination of official Mexican standards, including training to adapt them to these production systems. The lack of labor was also evident, as producers had problems finding personnel to work in the UP. This was mainly due to the fact that people are becoming less interested in livestock activities. In addition, youth have now turned to jobs that offer social security (health, retirement, etc.) and economic security (benefits and profit sharing, to name a few). Several authors (García, *et al*., 2023; Olguín, M 2017) mention that the situation of the Mexican countryside has been worsening, mainly because it is a sector abandoned by the state and individuals.

Despite the above, employers felt that their workers were happy with their jobs. Among the most important reasons were: good treatment (56%), no employee complaints (15%), good pay (10%), among others. Several authors mention that workers' productivity increases when they have more dignified and fairer working conditions. Likewise, staff turnover is avoided (Villafan, B *et al.,* 2014; Becchetti, 2004). Therefore, in these systems, some producers mention supporting workers with food, transportation and when necessary with support for health services. However, the conditions in which producers find themselves hardly allow them to do so on a recurrent basis.

CONCLUSIONS

In the territory studied, in the dual-purpose livestock systems, positive environmental sustainability indicators were found, such as pasture diversity, low use of fertilizers, herbicides and pesticides. The use of external inputs for feeding was only used to cope with the dry season, which highlights that the lack of financing, technology, labor, among others, is unfavorable for their productivity, profitability and competitiveness. However, this system can be transformed and give added value to their product with the implementation of regulations and quality care. On the other hand, it is important to see the feasibility of convincing producers to form companies where they can join together to produce by-products (cheese, cream, etc.) and be able to meet the demands of consumers who demand quality.

The inappropriate administration of natural and economic resources, the lack of governance and the lack of interest on the part of governments and society have allowed these systems to produce without any control, which has caused the low prices of the product, which only partially support the producer without generating real profits. In another sense, it is important to recognize the lack of training for the administration of resources and the financial management of the family business without the producer considering the costs of production, investment vs. profits. This situation generates in the succession the feeling that this type of business is not appropriate to invest time or money in, which leads to a marked lack of interest that causes generational rupture.

Currently, there is a tendency to recover and innovate in the conventional or traditional practices of small-scale systems (Arriaga, 2022), considering this system as the engine of the economy of vulnerable populations. Therefore, it is essential to ensure not only their survival, but also their existence over time in a competitive manner, and thus be able to contribute to their sustainable growth. Therefore, the evaluation of sustainability indicators in their environmental, social, economic and governance dimensions allows the identification of critical points to implement measures that promote continuous improvement in the management of the dual-purpose livestock system, in order to reduce the environmental impact and guarantee sustainable development in a responsible manner.

ACKNOWLEDGMENTS

To the Universidad Autónoma Metropolitana and the financial support granted by the Consejo Nacional de Humanidades, Ciencia y Tecnología (CONAHCYT) (CVU/Scholarship 1167115) in the Postgraduate Program in Energy and Environment. As well as to the cooperating producers of the municipality of Tlalixcoyan, Veracruz who contributed to the realization of this research.

REFERENCES

Álvarez, A., Montaño, E. y A. Flores (2007) La estrategia de integración de cadenas agroalimentarias en México. Conferencia presentada en VI Congreso Asociación Mexicana de Estudios Rurales: la encrucijada del México rural, Contrastes regionales en un mundo desigual, Asociación Mexicana de Estudios Rurales, A. C. Veracruz, Ver., 22-26 octubre.

Arriaga, C. M. (2022). Nuevas tendencias para la producción de leche en pequeña escala a partir de los objetivos de desarrollo sustentable. 1er Simposio Departamento de Biología de la Reproducción 11 al 15 de julio 2022.

Arteaga, M., Sánchez, P., Romero, O., Ocampo, I., Rivera, A., Garcia, I, G., (2018). Diversificación de ingresos de la agricultura familiar durante 2018 en Tehuatzingo, Libres, Puebla. *Revista Mexicana de Ciencias Agrícolas.* Vol. 12 número 3, admin%2C+Editor%2Fa+de+la+revista%2C+3%29ArtiEsp+2170-20OK.pdf

Becchetti, L. (2004). The impact of Social Responsibility on productivity and efficiency of US listed companies. *XIII Tor Vergata Financial Conference.* Roma: University of Rome "Tor Vergata.

Castelán, O. A., Ku-Vera, J. C., Ángeles, J. C., M., Hernández, G. S., Molina., Ramírez, L., Castelán, S.V., Praga, A. R., Lazos, F., Montelongo, H., González, M., Vázquez, M. F., Cardoso, E., Aran, E., Villegas, D., Guadarrama, A. P. y Apodaca, G. (2019). Estado del Ciclo del Carbono en México: Agenda Azul y Verde. Programa Mexica. Ganadería. Capítulo 22. *pp. 492- 528*

De Janvry, A., Sadoulet, E. (2000). Rural poverty in Latin-America determinant and exit paths. Food Policy, 25 (4): 389-409

FAO and GDP. (2018). Climate change and the global dairy cattle sector – The role of the dairy sector in a low-carbon future. Rome. 36 pp. Licence: *CC BY-NC-SA- 3.0 IGO*. Recuperado de: https://www.fao.org/publications/card/en/c/CA2929EN/

FAO. (2023). Portal lácteo, Recogida y transporte. Diponible en: https://www.fao.org/dairy-production-products/processing/collection-and-transport/es/

FIRA. (2007). Evaluación externa de los programas que canalizan subsidios. *Grupo de Economistas y Asociados.* Disponible en: https://www.fira.gob.mx/Nd/Evaluacion_2007.pdf

García, L. I., Zavala, E., Vargas, J. M., Vieyra, J. E. (2023) El abandono del campo. *Congreso Internacional de Desarrollo Rural. Reto de la despoblación y emigración en el mundo rural. pp 78,* https://repositorio.uloyola.es/bitstream/handle/20.500.12412/4053/Libro%20de%20resúmenes.%20PDF.pdf?isAllowed=y&sequence=1

GHGSat. (2020). Monitorización de las emisiones de gases de efecto invernadero, https://login.ghgsat.com/create-account/

Gómez, C.H., Tewolde, M.A., y Nahed, T.J. (2002). Análisis de los sistemas ganaderos de doble propósito en el Centro de Chiapas, México. *Archivo Latinoamericano de Producción Animal 10: 175-183*.

Gómez, Raúl, & Saravia, H. (2016). Tecnología en sistemas ganaderos criadores de Sierras del Este: oferta disponible y toma de decisiones tecnológicas en el predio. *Agrociencia (Uruguay)*, *20*(1), 113-122, http://www.scielo.edu.uy/scielo.php?script=sci_arttext&pid=S2301-15482016000100014&lng=es&tlng=es.

Granados, L, D., Quiroz, J., Maldonado, J, A., Granados, L., Díaz, P., & Oliva, J. (2018). Caracterización y tipificación del sistema doble propósito en la ganadería bovina del Distrito de Desarrollo Rural 151, Tabasco, México. *Acta universitaria*, *28*(6), 47-57, https://doi.org/10.15174/au.2018.1916

Gutiérrez, L, O. (2014). Modelo de comercialización para la producción de lácteos funcionales como factor de competitividad en las empresas Queretana. TESIS DE MAESTRÍA. Universidad Autónoma de Querétaro, https://ri-ng.uaq.mx/bitstream/123456789/6595/1/RI000612.pdf

Herrero, M.T., et al. (2010) Climate Variability and Climate Change and Their Impacts on Kenya's Agricultural Sector. *ILRI, Nairobi*, https://cgspace.cgiar.org/bitstream/handle/10568/3840/climateVariability.pdf

Juárez, J. M., Herman, E., Soto, A., Ávalos, D. A., Vilaboa, J., & Díaz, P. (2015). Tipificación de sistemas de doble propósito para producción de leche en el distrito de desarrollo rural 008, Veracruz, México. *Revista Científica,* XXV(4), 317-323.

Morales, G. (2021). El acompañamiento técnico y el relevo generacional en el campo. Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT), https://idp.cimmyt.org/el-acompanamiento-tecnico-y-el-relevo-generacional-en-el-campo/

Nava, B. Y. (2005). Transferencia de tecnología - Estado de México - Villa Victoria; Industrias agropecuarias - Estado de México-Villa Victoria. Tesis de Maestría. *Universidad Iberoamericana,* México. CDMX. Disponible en: https://ri.ibero.mx/handle/ibero/880

Ravallion, M., Chen, S., Sangraula, P. (2007). New evidence on the urbanization. world bank. *Development Research Group, World Bank,* https://documents1.worldbank.org/curated/en/371511468314708097/pdf/wps419901update1.pdf

Ruiz C, Ávila C, García L, Brunett L. (2008). Sustentabilidad financiera: El caso de una empresa ganadera de bovino de doble propósito. *Revista Mexicana de Agronegocios.* https://agris.fao.org/agris-search/search.do?recordID=US2016206989

SADER. (2020). Panorama Agroalimentario 2020 Edición, 2020. Servicio de Información Agroalimentaria y Pesquera. Ciudad de México.

Solano, C., León, H., Pérez, E., & Herrero, M. (2001). Characterising objetive profiles of Costa Rican dairy farmers. *Agricultural Systems*, 67(3), 153-179, https://www.redalyc.org/journal/417/41751187003/html/#redalyc_41751187003_ref2

Steinfeld, H., Wassenaar, T. & Jutzi, S. (2006). Livestock production systems in developing countries: Status, drivers, trends. *Rev. Sci. Rech. Off. Int. Epiz., 25*(2). In press.

Torres, Y. G., García, A., Rivas, J., Perea, J., Angón, E., & De Pablos-Heredero, C. (2015). Caracterización socioeconómica y productiva de las granjas de doble propósito orientadas a la producción de leche en una región tropical de ecuador. caso de la provincia de Manabí. *Revista Científica, XXV*(4), 330-337.

Torres, Y.; Pablos, C., Morantes, M., Rangel, J., Espinosa, J.A., Angón, E.; García, A. (2016). El papel de la mujer en la explotación de ganado bovino de doble propósito en Ecuador *Archivos de Zootecnia*, vol. 65, núm. 251, septiembre, 2016, pp. 309-314 Universidad de Córdoba Córdoba, España.

Urdaneta de Galué, F., Peña, E., Rincón, P., Romero, J, & Rendón, M. (2008). Gestión y tecnología en sistemas ganaderos de doble propósito (taurus-indicus). *Revista Científica*, *18*(6), 715-724, http://ve.scielo.org/scielo.php script=sci_arttext&pid=S0798-22592008000600010&lng=es&tlng=es.

Vieyra, J. E., Zavala, E., Côrte-Real, J., Losada, H, R., Varga, J. M., Luna, L., Cortez, J. (2021). La vulnerabilidad de los sistemas agropecuarios: caso de las Rajas San Martin Huitzizilapan, Lerma, Edo. de México. *Brazilian Journal of Animal and Environmental Research, Curitiba,* v.4, n.4, p.5 304 -53 20 out./dez. 2021

Villafán Vidales, K. B., & Ayala Ortiz, D. A. (2014). Responsabilidad social de las empresas agrícolas y agroindustriales aguacateras de Uruapan, Michoacán, y sus implicaciones en la competitividad. *Contaduría y administración*, *59*(4), 223-251.