Colegio de Postgraduados

Opportunities for territorial development in the transisthmic corridor; baseline diagnosis in the region of the Isthmus of Tehuantepec, Oaxaca

Morales-Guerra, Mariano[1]; **Maldonado-Méndez, José de J.**[2]; **Cadena-Iñiguez, Pedro**[3*]; **Ariza-Flores, Rafael**[4]

[1] Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias. Central Valleys of Oaxaca Experimental Field. Melchor Ocampo No. 7, Santo Domingo Barrio Bajo, Etla, Oaxaca. C.P. 68200 morales.mariano@inifap.gob.mx

[2] Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias. Rosario Izapa Experimental Field. Km. 18 Tapachula – Cacahoatan highway. Tuxtla Chico, Chiapas. C.P. 30870. maldonado.jose@inifap.gob.mx

[3] Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias. Experimental Field Center of Chiapas, Km. 3 Ocozocoautla-Cintalapa highway, CP 29140 cadena.pedro@inifap.gob.mx

[4] Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias. Central Valleys of Oaxaca Experimental Field. Melchor Ocampo No. 7, Santo Domingo Barrio Bajo, Etla, Oaxaca. C.P. 68200 ariza.rafael@inifap.gob.mx

* Correspondence: cadena.pedro@inifap.gob.mx

ABSTRACT

Objective: The main objective was to know the current situation of livestock production, problems and potentialities, in the municipalities of Matías Romero, Santa María Petapa and San Juan Guichicovi, Oaxaca, located in the transoceanic corridor of the Isthmus of Tehuantepec.

Design/methodology/approach: The diagnosis was made in eight communities in the municipalities of Matías Romero, Santa María Petapa and San Juan Guichicovi, located north of the Isthmus of Tehuantepec region, Oaxaca. To determine the sample size, the formula suggested by (Snedecor and Cochran, 1967 and Rojas, 1979) was used. It indicates that the elements must be selected through a random draw with replacement, to define the population, the list of production units registered in the Ministry of Agriculture and Rural Development, whose universe is 215, from which, a sample of 41 units was taken.

Results: 36% of the interviewees indicated that the ownership of their land is ejidal, 34% is communal and 30% is small property. The interviewed livestock producers develop their livestock activities on an average of 37 hectares. The production units with the smallest area are 8.5 hectares and those with the largest area are 140 hectares. Of the total number of interviewees, 78% provide themselves with water for cattle in the pasture or corrals, coming from rivers and streams, other sources are springs with 12% and dams with 10%. It is considered that the characteristics described provide adequate conditions for livestock. A problem that afflicts livestock in the tropics in the presence of *Ixodoida* spp, in addition to other types of Mites, the options and alternatives to combat the tick in the PRODETER territory are through the bathroom, regularly it is done by using spray backpack, also the use of Pour on (loin) and tick-killing baths. The misuse of tick control products has generated resistance and problems for farmers (Piña *et al.*, 2017). More than half of the farmers do not participate in animal health campaigns, only 36% do participate. The animal health campaigns in which farmers participate in PRODETER are bovine tuberculosis and paralytic rabies, 24% respectively, tick control 20% and finally brucellosis with 16%. Leos-Rodríguez, (2008) in the work of economic and productive characterization of bovine cattle producers that make up the list of PROGAN beneficiaries in Mexico, observed that the percentage of producers that participated in campaigns against ticks, tuberculosis and brucellosis is above 91%. What is superior to what was found in this diagnosis.

Limitations on study/implications: One of the main limitations was that the PRODETER Program was financed by the State for one year only and with that, in the first instance, it limited the intervention to see the effects and levels of adoption of the technological model in the Family Production Units.

Findings/conclusions: There is ignorance in the use of food supplements, so the development of calves, and the milk production and fertility of the cows, do not express the potential due to the lack of the necessary nutrients in the different productive stages. There is little use of the rangelands because the farmers ignore the practices to give maintenance, make divisions in the paddocks, so they do not rotate. Among the problems detected, the following stand out, among others: the lack of training, the lack of availability of technicians or

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experts to attend them, the cost of artificial insemination technology and the long periods between births, which causes calf production to decrease. Therefore, the lack of training in artificial insemination, stallion evaluation and crossbreeding systems for genetic improvement, limit the development of livestock with better quality standards in the region of the Isthmus of Tehuantepec, Oaxaca. The diagnosis as such provides elements for the territorial development of livestock in the transoceanic corridor, since it offers areas of opportunity throughout the production process and can satisfactorily help livestock in that region.

Keywords: PRODETER, Dual purpose, training, Isthmus of Tehuantepec.

INTRODUCTION

The geographical, environmental, and social characteristics of the Isthmus of Tehuantepec Region create a rich tapestry of culture, ecosystems, natural resources, and diverse productive activities. It is also one of Mexico's regions with conditions of accentuated poverty and a high degree of marginalization. The Government of the Mexican Republic, based on the Sustainable Rural Development Act among others, proposed the Development Program of the Interoceanic Corridor of the Isthmus of Tehuantepec, whose main objective is to contribute to the growth of the regional economy with full respect for history, culture and traditions of the Oaxacan and Veracruz Isthmus. The Interoceanic Corridor plan, in addition to providing first-world infrastructure, aims to interconnect the ports of Coatzacoalcos, Veracruz and Salina Cruz Oaxaca by land. In addition to the comprehensive consolidation of primary activities, the plan encompasses the consolidation of rural economic activities, the development of the Corridor of primary, peripheral and marginalized areas, as well as the development of the primary distribution, collection points and value-added centers. This plan aims to contribute to generating the social, economic, environmental and food security well-being of the rural population, increasing production, productivity and the integration of producers into the value chain, through more inclusive agriculture and livestock, responsible and sustainable, and generating differentiated policies that contribute to the development of the main productive activities of the Region. The Interoceanic Corridor Plan of the Isthmus of Tehuantepec considers four transversal axes of attention: I. Capacity Development, Extension and Rural Consulting; II. Health and Safety Services; III. Water and soil Capture, Conservation and Management; and IV. Access to Financing Services; as well as the Economic Integration component of the Productive Chain…" (SIC), (DOF Gobierno de México, 2020).

The public policy in the Mexican Republic for the 2018-2024 administration was issued and, in the general provisions and operating guidelines of the rural development program of the Ministry of Agriculture and Rural Development, it is stated that the support of the Rural Development Program will be aimed at small producers in areas of high and very high marginalization, applying criteria of social inclusion and gender equity. The Family Production Units (UPFs —in Spanish), are defined as: "…a group of producers who associate to achieve a common objective, without legal formality or constituted as associative entities under the national legal regulations." To achieve this, efforts from three parties were combined: extension services, research, and the productive sector, in order to create synergies and be able to manage innovation. (Avalos *et al.*, 2021; de la O *et al.*, 2021; Cabrera *et al.*, 2022).

The Ministry of Agriculture and Rural Development conceptualized territorial development as an action where two segments converge: investment in infrastructure and investment in knowledge, an aspect widely documented in (Avalos *et al.*, 2021). The aim is for farmers, agricultural workers, producers or livestock farmers (for the purposes of this document, the management of the three concepts will be considered as synonymous with each other and make a differentiation with livestock farmers, due to the activity they undertake, drawing on concepts by Chayanov (1974); Wolf (1975); Galesky (1997) and the pro-peasant concepts of Armando Bartra, cited by Boltvinik (2009), etc. be regarded as subjects and not as beneficiaries and recipients of government programs that contribute to the well-being of them and their households. The Ministry of Agriculture and Rural Development of Mexico conceptualizes three interrelated actors: Producers, Extensionists, and Researchers. Regarding the aforementioned, in the knowledge segment, the National Institute of Forestry, Agriculture, and Livestock Research (INIFAP) has a direct influence where it is committed to having three fundamental actions: Taking the available technologies to the producer, providing technical accompaniment to UPFs already grouped into functional organizations to achieve or manage innovation; conducting a territorial diagnosis through the characterization of UPFs, prioritizing the identified issues, and intervening with a differential working model in the selected territories.

The main objective was to know the current situation of livestock production, problems, and potential in the Oaxacan municipalities of Matías Romero, Santa María Petapa and San Juan Guichicovi, located in the Transoceanic Corridor of the Isthmus of Tehuantepec.

Technical-productive diagnosis of the Family Production Units: which consisted of the following sections or activities:

a. Technological characterization of Family Production Units.
b. Identification of the productive issues.
c. Definition and estimation of productive indicators, baseline diagnosis to contrast the annual advances of technological intervention.
d. Proposal of a technological model based on the technologies available by INIFAP or other higher education/research institutions.

Technology transfer proposal

a. Establishment of demonstrative modules (on producers' lands) and hosting demonstrative events.
b. Implementation of a program for the development of technical skills for extensionists and producers.
c. Sessions for the exchange of experience and knowledge among producers.

Technical Support Strategy

The objective was to provide feedback to producers and extensionists in the application of the technological components, which allowed direct interrelation in the field between

extension agents, producers, and the researcher. Technical support was provided on the plots and/or farms of the agricultural and livestock producers. The researcher designed a program of visits to the territory, considering: the phenological stages of the crop, the physiological stages in the animals, the recommended technological components, and other specific aspects. The present diagnosis on livestock farming is part of the National Territorial Development Project (PRODETER), developed between 2020 and 2021 in the Mexican Republic.

In this framework, field activities were conducted in different regions of the country. One of the undertaken activities was the baseline study, for which a diagnosis of production was conducted in a territory characterized by its vocation and background in livestock production, in the municipalities of Matías Romero, Santa María Petapa and San Juan Guichicovi, located to the north of the Isthmus of Tehuantepec region, Oaxaca. This region has gained special interest for being a trans-isthmus corridor in two development poles: the port of Coatzacoalcos, Veracruz in the Gulf of México, and the port of Salina Cruz, Oaxaca in the Mexican Pacific. The diagnosis was conducted to understand the current situation regarding the technological management of livestock in the aforementioned municipalities, addressing aspects related to nutrition, feeding and product marketing. The information was obtained through the application of a pre-coded questionnaire, field trips, as well as interviews with key stakeholders. A diverse set of issues was identified, of which the following stands out: differentiation of potential across production unit areas, the availability of forage throughout most of the year, but also the limited use of technologies to improve aspects of health, nutrition and added value.

MATERIALS AND METHODS

The diagnosis was carried out in eight communities in the municipalities of Matías Romero, Santa María Petapa and San Juan Guichicovi, located north of the Isthmus of Tehuantepec region, Oaxaca. To determine the sample size, the formula suggested by (Snedecor and Cochran, 1967 and Rojas, 1979) was used. It indicates that the elements must be randomly selected with replacements. The definition of the population was based on the list of production units registered in the Ministry of Agriculture and Rural Development, with a total universe of 215. From this, a sample of 41 units was selected.

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

The mathematical equation is detailed as follows based on a hypothetical universe:

Where: Z=Confidence level; d=Precision level; pn=Proportion of the population that belongs to the interest group; q=$(1-p_n)$; N=Population size; n=Sample size.

The information was obtained by applying a pre-coded questionnaire with sections on social issues, elements for production, and technological characterization, including reproductive and productive parameters, as well as field trips and interviews with six key actors (stakeholders). The information from the questionnaires was captured in the Excel © database, and analyzed in a program for social sciences, from which the results were obtained and are described later.

RESULTS AND DISCUSSION

Socioeconomic aspects. Regarding gender, 80% of the participants are men and 20% women, which clearly demonstrates the predominance of men in this activity. This situation is similar in other branches of countryside activities (León *et al.*, 2002). The average age of participating producers is 46 years; this represents a productive age, with the presence of young individuals, which is attributed to the economic orientation of livestock farming that prevents migration and abandonment of the activity (Chávez *et al.*, 2019).

Concerning education, 95% of those interviewed can read and write, 5% lack this skill. Those who cannot read or write are in the age range of 69-76 years. Among those who have education, 51% completed elementary education, 43% the secondary level and 7% the high school or equivalent. The data from the working area differ from the results of other studies in indigenous areas, where it is common to find higher percentages of people who cannot read or write (León *et al.*, 2002; Bautista 2018).

46% of those interviewed identify themselves as indigenous, belonging to the Zapotec ethnic group, the remaining 54% do not recognize themselves as indigenous.

Regarding membership in organizations, 71% of those interviewed do not belong to any organization, while 29% indicated that they belong to an organization. The above illustrates that the work, in general, has been individual, and the organizational potential has not been taken advantage of for the development of the activities, although it must also be considered that on many occasions the negative experiences in the organizational aspects, limits new efforts due to associativity and willingness to undertake new productive entrepreneurships.

Regarding how they obtain information for production, 49% of the producers stated that they receive advice or information from other producers, 36% receive advice from a technician or researcher, 12% obtain information from the supply store, and 3% mentioned other sources. These data show that producers have greater trust among themselves, based on the experience that is shared, even though a significant amount of them receive information from technical personnel (Amaro-Rosales and Gortari-Rabiela, 2016). Similar research was conducted by Zambada *et al.* (2013) and Cadena *et al.* (2018), in which they found that information flowed from three actors in the region or territory: an Agronomy professional, the manager of a veterinary store, and a government institution and on a smaller scale among peasants. Regarding the source of resources to develop their productive activity, 90% indicated that they use their own resources, while other sources indicated they used loans (10%). The low proportion of producers who prefer loans is attributed to distrust of credit institutions, the risk of high interest, as well as lack of confidence in credit

institutions, and the poor dissemination of financing opportunities to the countryside (Serrano, 2021).

Elements for production

36% of those interviewed indicated that their land ownership is *ejidal*, 34% is communal, and 30% is small property. The livestock producers interviewed develop their livestock activities on an average of 37 hectares. The production units with the smallest area are 8.5 hectares and those with the largest area are 140 hectares. Of the total interviewees, 78% obtain water for livestock in the pasture or corrals, sourced from rivers and streams; other sources include springs with 12%, and dams with 10%. It is considered that the described characteristics provide suitable conditions for livestock farming.

Predominant cattle breed

There is not a single record of pure and Creole breeds in any of the three municipalities. Farmers prefer to crossbreed bovines of European breeds, *Bos taurus*, with zebu, *Bos indicus*, selecting animals for their racial conformation, rather than for their milk or meat production characteristics. Similar results were found by Aguilar (1992), who, in a diagnosis in Venezuela, observed that the phenotypic characteristics of the animals correspond to the hybrid type, a product of continuous crossbreeding of Creole animals with purebred animals, due to the continuous change of sires since every three or four years, those who have greater possibilities are introduced. The phenotypic characteristics of purebred animals have not been fixed, as these crossbreeds have not been conducted. In the cattle population, there is a higher presence of breeding cows, calves, and heifers. This situation denotes a low percentage of annual extraction and a low reproductive efficiency of the wombs. Quiroz *et al.* (2014), found a similar situation in the herd structure in Tabasco. The number of replacement heifers accounts for 15% of the total herd, as an attempt to increase the number of breeding females; the livestock farmers retain all the females (Medina *et al.*, 2009).

The number of calves, although high, represents only 40% of the total, which reflects a low reproductive capacity of the herd. It means that there are wombs with reproductive problems with the usual decrease in the number of offspring. The maintenance of wombs that are not pregnant after two consecutive mating periods and those that give birth late represents an unnecessary expense and are candidates for culling (Rivera and Quintal, 2011). Some livestock farmers who have sufficient resources to meet the nutritional needs for grazing bulls raise the possibility of taking advantage of the potential for meat production at a local level, preventing calves from being sold at low prices. To address the demand for training, technologies for fattening grazing bulls and feeding systems based on protein and energy banks using cut grass have been developed, which can be transferred to producers (Maldonado *et al.*, 2012a; Maldonado *et al.*, 2012b).

Supply of forages and concentrates

The climate and soil conditions are favorable for livestock farming in the Matías Romero PRODETER, the animal load that livestock farmers handle in relation to the

range area means that they do not feel the need to make silos, produce hay or any method of conservation of forage. Only a few that have exceeded the limit or have faced prolonged draught conditions due to climate change have found necessary to construct silos primarily to support breeding stock and calves, which are of utmost importance to them. 62% of producers indicated that they had supplied silage for livestock, mainly for breeding stock and developing calves. Similarly, mineral blocks (48%) were supplied for breeding stock and calves, although it is not a routine practice (Amaro, 2001).

The supply of vitamins and mineral premixes for livestock is common in Matías Romero PRODETER; 64% of the livestock farmers provide such supplements for animals, including both breeding stock and calves. Most of livestock farmers are accustomed, by tradition, to providing salt to their cattle. However, they do so empirically, without having a precise understanding of the nutritional needs of the livestock. In general, they lack criteria regarding the quantity and quality of mineral salts and vitamin premixes they purchase to offer to their animals (Jiménez *et al.*, 2014). It is important to underscore that concentrates, maize grains and protein pastas are not provided. Some limitations that expressed relate to the cost of concentrates and minerals, as well as the lack of knowledge of how to prepare balanced diets for livestock.

Rangeland Management

It is important to mention that livestock farmers in the communities of Matías Romero PRODETER, given the extensive land areas at their disposal, can place all livestock heads in that area while simultaneously dividing it into lots to effectively manage the available pasture. However, often the livestock tends to scatter in a manner that cannot be entirely controlled by the farmers. For this reason, pasture subdivision (62%) is implemented, leading to the practice of rotational grazing. The use of electric fencing was minimal, with only two cases reported throughout the entire territory, similarly to the adjustment of stocking rates. González (2013) in Tuxpan, Veracruz, observed a similar situation where animals graze freely with minimal or no management, receiving little attention from an ecological perspective, resulting in an impact on biodiversity and ecosystem integrity (Maldonado *et al.*, 2015). The lack of knowledge about new forage species to improve the quality of the feed was also mentioned; likewise, reference was made to the dry season period from March to June (48%).

Reproductive practices management

Regarding reproductive management practices carried out by livestock farmers in Matías Romero PRODETER, the only practice identified is free mating (92%). Issues were identified, including the low number of calvings per year (32%), abortions at 16%, and the fact that females take a long time to conceive again after giving birth (36%).

External and Internal Livestock Health Management

A problem affecting livestock in tropical regions is the presence of *Ixodoida* sp., as well as other types of mites. The options and alternatives for tick control in the PRODETER territory include bathing, commonly done using backpack sprayers. Additionally, the use

of Pour-on (on the loin) and tick-dipping baths are employed. The misuse of tick control products has led to resistance issues and challenges for livestock farmers (Piña *et al.*, 2017). More than half of livestock farmers do not participate in animal health campaigns, only 36% do participate. The zoosanitary campaigns where PRODETER farmers participate include bovine tuberculosis and paralytic rabies, 24% respectively, tick control 20%, and finally, brucellosis with 16%. Leos-Rodríguez (2008) in the work of economic and productive characterization of the cattle producers that make up the registry of PROGAN beneficiaries in Mexico, observed that the percentage of producers who participated in campaigns against ticks, tuberculosis and brucellosis is above 91%, which surpasses what was found in this diagnosis. Regarding the vaccination program, 86% of the livestock farmers indicated that they do have a vaccination program.

The vaccination programs established among the farmers of Matías Romero PRODETER are for pneumonia (72%), Leptospirosis (68%), Clostridiosis (60%), derriengue (56%), and finally, the triple vaccine (48%).

Regarding the sample size in this study, it was found that 92% do not perform any hygiene practices during milking. Only 4% engage in udder washing, and the use of teat sealants is also at 4%. This indicates that there are no good management practices in obtaining milk, which could represent a potential public or industrial health risk depending on the destination of the milk. On the other hand, the most frequent health problems in the livestock are mastitis 68%, peripartum issues and diarrhea 48%, foot rot 44%, abortions and rabies with 9 cases 36%, septicemias and respiratory diseases 24%, ocular diseases 16%, and finally, 8% are parasitic conditions associated with ticks. The diagnosis of subclinical mastitis is not carried out in any of the communities or municipalities within Matías Romero PRODETER. Lack of training for disease control (80%) and the absence of information recording (60%) were identified.

Marketing of Livestock Products

Livestock farmers in PRODETER Matías Romero, when it comes to marketing, respond based on the capacity of their pastures to sustain the number of animals they own, as well as their economic needs and the opportunities they have to sell at a better price. Following these criteria, they sell weaned calves first, and then heifers that can be offered at a better price, followed by fattening calves and finished steers, and finally cull cows. The latter are sold last because they have a lower price per kilogram, and they can be sold at any time to meet local demand. The common practice is the sale of live cattle. The method of sale is centered around intermediaries, so it is likely that, in this business relationship, producers do not fully benefit, as they do not have a direct connection with the final link in the marketing chain.

Villate and Martínez (2011), in a diagnosis conducted with producers in a province in Colombia, mention that the data found suggests that the operations belong to small and medium-sized producers who work in isolation. This isolation hinders their access to appropriate technologies for production and specialized markets that could improve the income and social well-being of the community.

Definition and Estimation of Reproductive and Productive Indicators

A critically important fertility indicator is the age at first calving, with an average value of around 36 months of age. This suggests a low growth potential and deficient strategies in replacement management. The average percentage of females calved in Matías Romero PRODETER is 64%. Although the calving percentage is relatively high, the proportion of breeding females to the total is low. The average time between one calving and the next for a female is 443 days (15 months) in PRODETER. After a 12-month calving interval, $1/9^{th}$ of a gestation calf is lost (280 days). If the average is 15 months, $3/9^{th}$ or a third of a calf is lost for each non-pregnant cow. The average age at first birth in PRODETER is 33 months. When records are not available, predicting this data becomes difficult, however, these data reflect a good level of productive efficiency according to the environmental conditions, given the availability of pasture during most of the year. However, a drawback in the system is the lack of productive and reproductive records.

With the characteristics of pasture or rangeland management, as well as the cattle and nutritional values, we can indicate that, due to the climatic conditions and access to natural resources in this territory, livestock farming is potentially an alternative for economic development in the Isthmus of Tehuantepec. Although there are many areas of opportunity in each of the points described, it is essential for farmers to approach government institutions to request constant and/or permanent guidance to improve the described parameters and enhance with good livestock practices. PRODETER, as such, fulfilled its objectives of facilitating access to knowledge through technologies and the presence of the extension technician in the territory. However, it is understandable that any technology, no matter how simple, requires resources, whether human for development, economic, or material, depending on the magnitude of the issues and the proposed technologies within the technical support strategy provided to the producers.

Based on the technical-productive diagnosis, the implementation of a technological model was prepared and proposed to producers based on the technology generated and available by INIFAP. The proposed model was implemented through training courses with the Field Schools method, a concept that academics and researchers in Mexico have extensively developed and described, among others: Morales *et al.* (2006); Morales (2007); Morales *et al.* (2015); Morales *et al.* (2016); Chain (2016); Martinez *et al.* (2019) and Morales *et al.* (2022) aimed at producers in the participating communities.

The main activity, in which a significant amount of time and resources were invested, was the technical-productive diagnosis, which allowed the identification of the problem, which translates into opportunities to improve the production process, of livestock farming in the Isthmus of Tehuantepec. The same diagnosis facilitated the integration of the technological model, which was implemented, along with the technical support, with the particularity that the application period, both of the model and the support, was very short in time. Regarding the possible effects of training and technical support, these may be little or none. Likewise, the usefulness of the diagnostic information transcends the operation of PRODETER, since this territory coincides with the scope of the interoceanic corridor, contemplated in the program for the development of the Isthmus of Tehuantepec, which requires technical-productive information for its operation.

CONCLUSIONS

There is a lack of knowledge in the use of nutritional supplements, so the development of the calves, and the milk production and fertility of the cows, do not express their potential due to the lack of the necessary nutrients in the different productive stages. There is little use of the pastures because livestock farmers ignore the practices to maintain them, and make divisions in the pastures, so they do not rotate them. Of the problems detected, among others, the following stand out: the lack of training, the low availability of technicians or experts to address them, the cost of artificial insemination technology and the long periods between births, leading to a decrease in calf production. Therefore, the lack of training in artificial insemination, evaluation of breeding bulls, and crossbreeding systems for genetic improvement limits the development of livestock with higher quality standards in the region of the Isthmus of Tehuantepec, Oaxaca. The diagnosis as such provides elements for the territorial development of livestock farming in the transoceanic corridor, since it offers areas of opportunity throughout the production process and can satisfactorily help livestock farming in that region.

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