

Agroclimatic and management factors affecting milk production in the municipality of Catatumbo, Zulia State, Venezuela

Factores agroclimáticos y de manejo que afectan la producción de leche en el municipio Catatumbo, estado Zulia, Venezuela

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Abstract

Introduction— Milk production is a basic trait in the efficiency of production systems and the best way to evaluate the productive behavior of the herd; this production is closely related to several factors, among which the breed stands out, feeding, environmental conditions, facilities, number of deliveries and, in general, the production system.

Objective— Describe the agro-climatic and management factors that affect milk production on a dual purpose cattle farm.

Methodology— The study was developed from the positivist paradigm with a quantitative approach, being descriptive research with nonexperimental and longitudinal field design. Records of milk production and agro-climatic factors were taken into account through the livestock software and the meteorological station, respectively, available on the farm, and a structured survey with 57 closed questions was considered to observe the management factors carried out.

Results— The highest records in temperature (38°C - 39°C) correspond in those where milk production is lower (between 13.181 l and 16.926 l). Simultaneously, the highest precipitation values are where milk production decreased significantly. In the production unit supplements are not provided to animals, they only perform rotating grazing, making a cut after this. The movement of the herd do it in all phases of the productive cycle of the animal; according to the weight of the same. Also, there is almost always rotation of staff, and the reasons would be inappropriate behaviors and other job offers towards the subordinates. On the other hand, the monthly milk production and the average production per lactation was between 64.29 l/month and 173 l/month; and 73.79 l/days of lactation and 209, 86 l/days of lactation, respectively. The mortality rate in calves was between 0% and 2.88%; and in adults from 0% to 1.29%. As for the weight of hatchlings and of weaned calves, the averages were between 26.27 kg and 35.97 kg; and 162 kg to 182 kg, equally; while the liters of milk per hectare were between 35.15 l/ha and 90.88 l/ha.

Conclusions— Of the agro-climatic factors evaluated, temperature is one of the most important factors affecting milk production; regarding management, supplementation in feeding as well as fertilizing pastures and increasing rest days are considered necessary practices of inclusion in farm management. It is also suggested to take into account within its management plan, practices to mitigate heat stress generated in animals and thus reduce the effect of this on milk production.

Keywords— Agroclimatic factors; Management factors; Milk production

Resumen

Introducción— La producción de leche es un rasgo básico en la eficiencia de los sistemas de producción y la mejor manera de evaluar el comportamiento productivo del rebaño; esta producción tiene estrecha relación con diversos factores, entre los que destacan la raza, la alimentación, las condiciones ambientales, las instalaciones, el número de partos y, en general, el sistema de producción.

Objetivo— Describir los factores agroclimáticos y de manejo que afectan la producción de leche en una finca ganadera doble propósito.

Metodología— El estudio se desarrolló desde el paradigma positivista con enfoque cuantitativo, siendo una investigación descriptiva con diseño de campo no experimental y longitudinal. Se tomaron en cuenta registros de la producción de leche y factores agroclimáticos a través del programa ganadero y la estación meteorológica, respectivamente, disponible en la finca, y se consideró una encuesta estructurada con 57 preguntas cerradas para observar los factores de manejo llevados a cabo.

Resultados— Los registros más altos en temperatura (38°C - 39°C) corresponden en aquellos donde la producción de leche es menor (entre 13.181 l y 16.926 l). Simultáneamente, los valores de precipitación más altos, es donde la producción de leche disminuyó de una manera importante. En la unidad de producción no se le proporcionan a los animales suplementos, solo realizan pastoreo rotativo, realizando un corte después de este. El movimiento de rebaño lo hacen en todas las fases del ciclo productivo del animal; de acuerdo al peso del mismo. Asimismo, casi siempre existe rotación del personal, y las razones serían conductas inapropiadas y otras ofertas de trabajo hacia los subalternos. Por otra parte, la producción de leche mensual y el promedio de producción por lactancia se ubicó entre 64.29 l/mes y 173 l/mes; y 73.79 l/días de lactancia y 209, 86 l/días de lactancia, respectivamente. La tasa de mortalidad en becerro estuvo entre 0% y 2.88%; y en adultos de 0% a 1.29%. En cuanto al peso de crías nacidas y de becerros destetados, los promedios se ubicaron entre 26.27 kg y 35.97 kg; y 162 kg a 182 kg, equitativamente; mientras que los litros de leche por hectárea estuvieron entre 35.15 l/ha y de 90.88 l/ha.

Conclusiones— De los factores agroclimáticos evaluados, la temperatura es uno de los que mayor incide en la producción de leche; en cuanto al manejo, la suplementación en la alimentación así como también fertilizar los pastos y aumentar los días de descanso se consideran prácticas necesarias de inclusión en el manejo de la finca. También se sugiere tomar en cuenta dentro de su plan de manejo, prácticas para mitigar el estrés calórico generado en los animales y así reducir en su mínima expresión el efecto de este en la producción de leche.

Palabras clave— Factores agroclimáticos; Factores de manejo; Producción de leche



I. INTRODUCTION

Milk production is a basic feature in the efficiency of production systems and the best way to assess the productive performance of the herd [1], [2]; so the profitability of a production unit is largely determined by milk income and feed costs [3].

The development of milk production evolved with the growth of the human population, for which more productive breeds were selected, to the detriment of the rusticity and adaptability of the animals, making them more dependent on environmental conditions [2]. In tropical countries this adaptive process presents greater problems, mainly due to many adverse climatic factors or the meteorological changes that occur [4], among them: high temperature and relative humidity, as well as precipitation, in which they have an effect on the production and composition of milk, reducing its persistence and level of production [2]. Similarly, they state that productivity in dairy cattle is closely linked to a number of factors, including breed, feeding, environmental conditions, facilities, number of deliveries and, in general, the production system [5]; within climatic factors or environmental conditions, temperature is one of those that can limit or condition a number of biological processes, this is how cows eventually increase food intake to meet the increased energy demand for increased milk production [6].

The determining influence between these factors or climatic conditions, altitudinal floor, agrotechnical factors and management such as fertilization, irrigation, grazing, exert a variation on the nutrients of the forage and its production, in addition, the quality and quantity of food influences milk production levels [7]. In this sense, differences in milk production have been observed according to the handling and feeding routine provided to the animals [8]. Given the above, it is considered necessary to carry out this research, which sought to describe the agro-climatic and management factors that affect milk production in a double-purpose cattle farm, located in the municipality of Catatumbo, Zulia State (Venezuela).

II. LITERATURE REVIEW

The volume of milk produced is the result of the combination of cow factors, environment and handling by man. From the factors coming from cows, age and physiological maturity greatly influence the amount of milk harvested; but climatic conditions infer in the amount of milk obtained in different ways. One is by altering the metabolism of the animal by high temperatures; the other by determining the seasonality of forage production [9]. They therefore indicate that the various technological practices carried out, such as: food, health, reproduction and pasture management, have an impact on the productive variables, mainly on milk production and weight gains [10].

In a study carried out by UEA (Ecuador) [11] they identified a group of variables: number of cows, females to reproduction, cows in milking and milk production, which defined a first factor (called herd and production) determinant in milk production with 38.7% of the variance.

Also, there are factors that interfere with animal productivity, such as: genetics and nutrition, so-called bioclimatology require special attention from scientists, because the climatic characteristics of each region can cause stress and thermal discomfort in animals during periods of high temperatures, resulting in production losses due to reduced voluntary consumption, reduced weight gain and in extreme cases death [12]. Indeed, it is estimated that up to 10% of the variability in milk production is the result of climatic factors such as: temperature [13].

The region of warm climates or “Tropical Belt”, in which Venezuela is located, is located between latitudes 30° North and 30° South, and is characterized by: having climatic conditions that influence, directly or indirectly, negatively on agricultural and livestock production, especially on milk production, some of which: high ambient temperatures (T°); high relative humidity; High Temperature - Humidity (ITH); direct incidence of sunlight; low production and food productivity, being therefore production-deficit and dependent on exports; low level of economic, cultural and social development; and low capacity and industrial development.

It is important to note that Venezuela has climatic characteristics, given its geographical location, affected by latitude or altitude, which influence both the quantity and quality of milk produced, this effect by latitude or altitude, is shown as a factor of variation according to the time of year and the area of origin or production of milk [14].

On the other hand, energy is indicated as the first limiting nutrient for high production, when comparing cows that consume only high quality pasture with those that consume a balanced nutrition in a mixed total ration, where they obtain lower milk production [15].

Thus, the availability and variety of food resources are necessary to ensure the food security of dairy systems in the tropics [16], the same authors indicate that the quality and management of pastures and fodder resources, may have an impact on animal production. In addition, the complexity of animal production systems based on the use of grazing grass requires knowledge of the effect of each of the management variables on the productivity of the system from technicians and farmers [17].

Despite being widely known the incidence of agroclimatic and management factors on milk production in cattle farms in other latitudes; currently in Venezuela for several reasons: economic, social and even political issues were outdated in many livestock production issues, where these edges are no exception; adding that production units have not been assisted by technicians and researchers in the area.

III. METHODOLOGY

A. Description of the study area

The present investigation was carried out in the Terranova estate, via km 33 towards Guayabo, camellón km 43, Parroquia Udón Pérez, municipality Catatumbo, Zulia State (Venezuela), during the year 2020 and the second and third quarter of the year 2021. This area has a temperature of 39°C maximum and 34°C minimum, altitude of 5 meters, relative humidity between 75 and 81%.

B. Type and design of research

As for the type of research, they perform a classification, although not exclusive, or detailed according to certain criteria, namely: For the purpose or purpose; according to the type of means used to obtain data; according to the level of knowledge acquired; according to the nature of the information collected to respond to the problem of the research; according to the field of knowledge in which it is carried out; according to the method used; according to the number of researchers performing it [18].

In looking at the conceptualizations of the authors of each classification criterion and its relation to the type of research, we consider for our study, field research, in this regard it is mentioned that: It consists of the collection of data directly from the subjects investigated, or from the reality where the facts occur (primary data), without manipulating or controlling any variable, that is, the researcher obtains the information but does not alter the existing conditions. Hence its character as an experimental research [19].

Based on the proposed classification, the type of research is also conceived according to the level of knowledge acquired, which are: exploratory, descriptive, explanatory: correlative and experimental. In particular, the type of descriptive research was taken into account since: “by observation emphasis is placed on the specification of the characteristics of individuals, groups, communities or a phenomenon under analysis” [18, p. 10].

In the same way, the research design refers to “the strategy adopted by the researcher to respond to the problem, difficulty or inconvenience raised in the study. For didactic purposes, they are classified as: experimental design, non-experimental design and bibliographic design” [20, p. 95]. Additionally, it classifies field designs into “experimental design, post-facto design, survey design, panel design and case study” [21, cap. 6].

Consequently, the present study was based on a non-experimental field design, in which information will be collected directly from the object of study (production parameters) without any manipulation or control of variables. An example of this is: “survey studies (polls, opinion

polls), where evidence is collected on various topics in order to quantify the study event and formulate conclusions about it” [18, p. 10].

Simultaneously, the frequency with which the data are taken was considered, thus classifying them into transectional designs and longitudinal designs, for this research was evaluated within the second design, in which “comprise more than one measurement made to the study group over time. Commonly used in natural science research” [18, p. 10].

C. *Study population*

The population is known as “the set of beings that possess the characteristic or event to be studied and that are framed within the criteria of inclusion” [22, p. 152].

It is also stated that the “elements or units that integrate it... can be a simple entity (a person) or a complex entity (a family) that is called a unit” [23, p. 7]. According to the number of elements the population can be considered finite or infinite.

In this sense, it is pointed out that the finite population: “...as that group in which the number of units that integrate it is known” [19, p. 83]. Certain selection criteria were taken into account by the researchers: accessible population, available information on agroclimatic and management factors taken into account in the production unit and information on production parameters in 2020 and from January to August 2021; the population of the present research was formed by the Terranova production unit, where the production data were taken; as well as the agroclimatic and management factors present in that production unit.

D. *Data collection techniques and tolos*

There are various data collection techniques and instruments. The most common research techniques are observation and survey [18], the first: considered to be the oldest research technique and, in turn, the most relevant for its wide utility, it consists in the investigation of a specific phenomenon or fact through the use of the senses (mainly sight and hearing) in order to capture facts and realities about various social events.

For the survey, they state that an investigation by this technique is characterized by “the recording of the information which is made directly in writing, either under formats previously encoded or generated by the respondent himself” [24, p. 580]. The authors also point out that the survey is defined as “the technique of obtaining data by interrogating subjects who provide information related to the area of reality to be studied” [24, p. 500]. The instrument through which this inquiry is conducted is known as a questionnaire which is used to gather information on a specific topic [24], [18].

Within this framework, considers the questionnaire “as the type of survey that is carried out in writing by means of an instrument or paper format containing a series of questions” [19, p. 74]. Thus, in the present work, the survey was used as a technique and as a data collection instrument the questionnaire with closed questions of fifty-seven (57) questions, making the direct delivery to the respondent (responsible for the production unit), all to describe the management factors; in the case of agroclimatic factors these were obtained from a meteorological station DAVIS Vantage PRO 2 located in the same production unit; and for the production parameters, the indicators were acquired from the manual registers and systematized through the program GanSoft (version 7.2.3.2653) [41].

E. *Statistical analysis*

The fundamental statistical analysis in field investigations with a quantitative approach “lies in the elaboration of a distribution table of absolute and relative frequencies or percentages, to then generate a graph from that table” [19, p. 136].

In this sense in the present investigation, the data were projected in graphs for the agroclimatic factors and the production parameters, in the latter some indices were determined and these were related to these agroclimatic factors; and also presented some tables, specifically tables, where the indicators and indices for the case of management factors were detailed. The aggregation of these phases was carried out under the office tool Microsoft Office Excel (version 2010).

IV. RESULTS

The agroclimatic factors obtained corresponded to temperature (°C), humidity (%) and precipitation (mm), so we observed that the first factor mentioned was between 34 °C and 39°C, in the same way, the humidity values were between 75% and 81%; and for the case of precipitation a minimum record of 1.8 mm and a maximum record of 308,4 mm (Fig. 1). Similarly, the highest records in temperature (38°C - 39°C) correspond in those where milk production is lower (between 13 181 and 16 926 liters) (Fig. 2). Similarly, the highest recorded precipitation values, as in the case of August 2021, show that milk production decreased significantly (Fig. 3). The highest milk production was recorded in January 2021 with 34,080 liters, and agroclimatic values of 35°C, 75% and 69.4 mm (Fig. 1, Fig. 2 and Fig. 3).

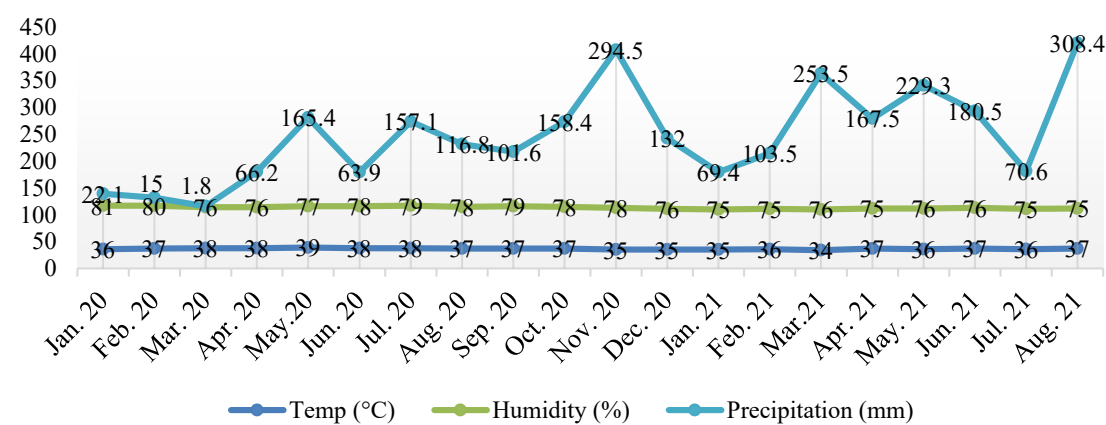


Fig. 1. Agroclimatic factors: temperature (°C), humidity (%) and precipitation (mm) present in the farm Terranova, municipality Catatumbo, state Zulia.
 Source: Authors.

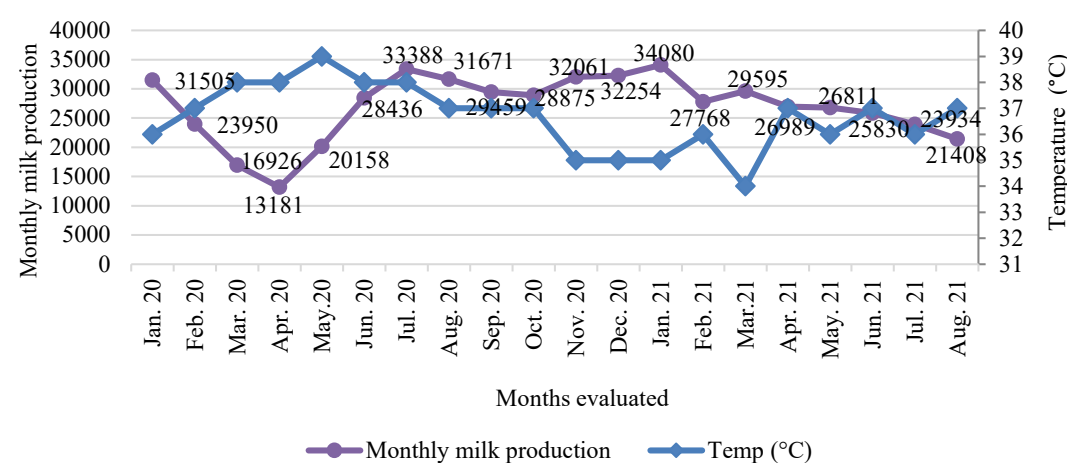


Fig. 2. Monthly production of milk and temperature recorded in the farm Terranova, municipality Catatumbo, state Zulia.
 Source: Authors.

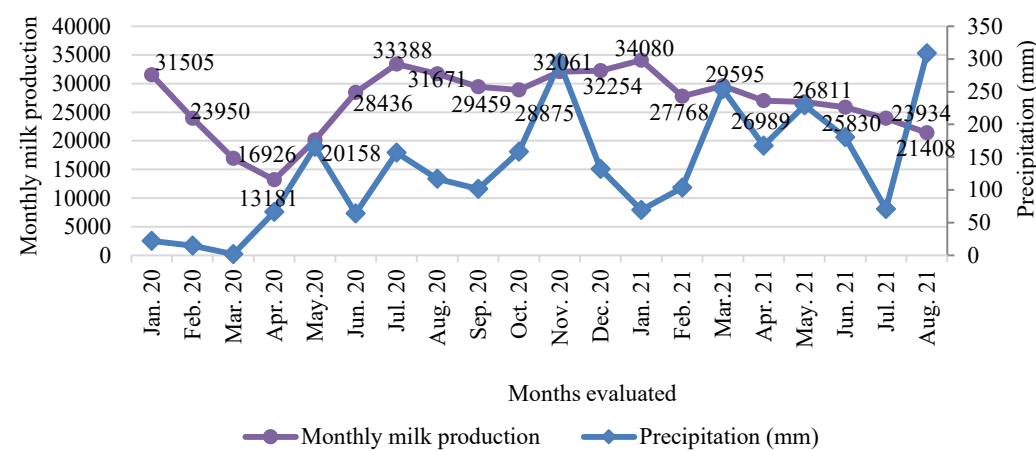


Fig. 3. Monthly milk production and precipitation recorded on the Terranova farm, Catatumbo municipality, Zulia state.
 Source: Authors.

In [Table 1](#), it is observed that in the Terranova farm are not provided to the animals supplements, they only carry out rotating grazing, making a cut after this; where the predominant species correspond to: tanner grass (*Brachiaria arrecta*) and guinea grass (*Panicum maximum*), the manager says that no improved pastures have been included; and that the existing pastures are not fertilized even applying some amendment (agricultural lime, dolomitic lime). Obviously, the paddocks are divided with barbed wire, they are given 18 to 24 days of rest to the paddocks, they also express that the carrying capacity is 1.6 animal unit per hectare (UA/ha).

TABLE 1.
MANAGEMENT FACTORS SUCH AS: SUPPLEMENTATION AND ROTATION OF PADDOCKS CARRIED OUT ON THE TERRANOVA FARM, CATATUMBO MUNICIPALITY, ZULIA STATE.

Dimension	Indicators	Items	Answers alternative												
			A		AA		S		EH		N				
			Af	Rf	Af	Rf	Af	Rf	Af	Rf	Af	Rf			
Management factors	Supplementation	1										1	100		
		2	Grazing only												
		3											1	100	
		4	In none, they do not provide supplements.												
	Paddock rotation	5	60% Grass tanner (<i>Brachiaria arrecta</i>). 40% Grass guinea (<i>Panicum maximum</i>).												
		6	They have not included improved pastures on the farm.												
		7	There is a division of paddocks.												
		8	Barbed wire is used for the division of paddocks.												
		9	Rotational grazing system is used.												
		10	Between 18 and 24 days of rest are considered for the paddocks.												
		11	The carrying capacity of the paddocks is 1.6 AU/ha.												
		12	If the grass is cut after grazing.												
		13												1	100
		14	No amendments are applied in the paddocks.												

Legend: A: Always; AA: Always almost; S: Sometimes; EH: Ever hardly; N: Never; Af: Absolute frequency; Rf: Relative frequency (%); items: 1. Do you provide any supplements to animal units?; 2. ¿Which supplements, select one or more of one: Forages and cereals; Concentrated foods; Grazing only; All of the above (indicate the percentage or proportion of each)?; 3. ¿How often do they provide supplements to animal units?; 4. ¿In which lactation phase of your animals do you provide supplements, select one: First third of lactation (0 - 100 days); Second third of lactation (100 - 200 days); Third third of lactation (200 - 300 days)?; 5. ¿ Which are the plant species of grass that predominate in your paddocks? Indicate their proportion; 6. ¿Have you introduced any improved grass, mention which one or which ones?; 7. Is there a division of paddocks in the production unit?; 8. ¿Is there a division of paddocks in the production unit?; 9. ¿What material do you use to divide the paddocks?: Barbed wire; Electric fence; Mixed?; 9. ¿What grazing system do you use: Rotational grazing; Continuous grazing?; 10. ¿How many rest days are given to the paddocks: Between 18 and 24 days; Between 28 and 35 days; More than 35 days?; 11. ¿What is the carrying capacity of the paddocks of the production unit?; 12. ¿Do you carry out any practice after grazing, such as cutting the grass to make the land uniform?; 13. ¿How often do you fertilize your paddocks?; 14. ¿Do you apply any amendments to your paddocks? If your answer is positive, indicate one: Agricultural lime; dolomitic lime; Other?

Source: Authors.

The movement of the herd is done in maternity, milking, drying, weaning, service, grazing, milking-escotero and escotero-proximo, that is, in all phases of the productive cycle of the animal; these animals occupy the paddocks for two days; such herd movement is made according to the weight of the animal, carrying out the weighing every 3 months, in addition the animals are fattened and these are moved to slaughterhouses when they have a weight of 450 kilograms, taking into account that females are carried according to certain criteria such as: reproductive (prolonged open days, infertility diagnosed, empty at the time of drying) and sanitary (foot lesions, mastitis, old age, uselessness) every 4 months. To select the females that go to escotero consider weighing the milk, doing this on a monthly basis; they do milking 2 times a day, with support of the calf and weaning along with drying the mother ([Table 2](#)).

It is necessary to emphasize that in the Terranova farm the natural mountain is carried out, also every 5 years change the breeding males and place 25 cows per male.

They keep records of the animals through inventories that they make monthly; the animals perform all the productive cycles in the same production unit and do not have stable animals (Table 2).

TABLE 2.
 HERD MOVEMENT CARRIED OUT ON THE TERRANOVA FARM, MUNICIPALITY CATATUMBO, ZULIA STATE.

Dimension	Indicators	Items	Answers alternative			
			YES		NO	
			<i>Af</i>	<i>Rf</i>	<i>Af</i>	<i>Rf</i>
Management factors	Herd movement	15	1	100		
		16	The animals occupy the paddocks for two days.			
		17	The herd movements are made in: Maternity; Milking; Dried; Weaning; Service; Herding; Milking-Escotero and Escotero-Next.			
		18	Herd movements are made according to the weight of the animal.			
		19	Animals are transferred to slaughterhouses when they weigh 450 kg.			
		20	If they fatten the animals.			
		21	Body weighings are carried out every 3 months.			
		22	The selection of females for scouting according to the weighing of milk.			
		23	Drying is carried out by weighing milk, doing the latter on a monthly basis.			
		24	They wean along with drying off from the mother.			
		25	-----			
		26	1	100		
		27	They do 2 milkings a day.			
		28	Breeding males change every 5 years.			
		29	They place 25 cows per breeding male.			
		30	Natural riding takes place.			
		31	-----			
		32	1	100		
		33	The inventory of the animals is done monthly.			
34	The criteria used to send females to slaughterhouses are: reproductive (long open days, diagnosed infertility, empty at the time of drying) and health (foot lesions, mastitis, old age, and uselessness).					
35	The females are sent to the slaughterhouse every 4 months.					
36			1	100		
37	They carry out all the production cycles in the same production unit.					

Legend: *Af*: Absolute frequency; *Rf*: Relative frequency (%); items: 15. ¿Do you move the herd? If you answer no, indicate why?; 16. ¿How long are your animals occupied in the paddocks: One day; Two days; Three days?; 17. Herd movements are made in: Maternity; Milking; Dried; Weaning; Service; Herding; Milking-Escotero; Escotero-Next?; 18. The movement of the herd is done according to: The weight of the animal; Age?; 19. ¿At what age or at what weight are the animals sent to the slaughterhouse?; 20. Of not fattening the animals that they do with the male offspring?; 21. If they rotate by weights, how often do they do body weighings?; 22. The selection criteria of females for clerks do them empirically or by milk weighings?; 23. When carrying out drying by weighing milk, how often do you weigh milk?; 24. Do they wean together with drying from the mother or do they wean after?; 25. If they wean later, then where do these calves go, whose mothers were dried up?; 26. Do they milk with the support of the calf?; 27. ¿How many milkings do you do per day?; 28. ¿How often do breeding males change?; 29. ¿How many cows do you place per breeding male?; 30. ¿Is artificial insemination carried out, controlled mating or natural mating?; 31. If it is controlled mating or artificial insemination, ¿how do the bellies and males move?; 32. ¿Do they make an inventory of animals, if your answer is negative, why don't they do it?; 33. ¿How often do they do animal inventories?; 34. ¿What are the criteria used to send females to slaughterhouses?; 35. ¿How often do they send females to slaughter?; 36. ¿Do you have stabled animals?; 37. Do you move animals to other farms or carry out part or all of the production cycles in the same production unit, explain?

Source: Authors.

In the following Table 3, we see how the manager says that there is usually rotation of staff, and the reasons would be inappropriate behaviors and other offers of work towards the subordinates. The wage of the workers equals 2.4\$/ day, being considered good; it is highlighted that this is one of the best in the area when comparing them with other dairy farms, even when comparing it with other parts relatively close geographically.

Likewise, workers are provided with a good portion of balanced food, including proteins such as: grains, eggs and red meats; in the case of bedrooms used by them, the manager considers them comfortable, because they have good infrastructure and have air conditioning,

however, they do not have individual bathrooms. Workers are not provided with uniforms or work permits; but the location of entertainment spaces within the farm for their employees is highlighted (Table 3).

The daily working day is 8 hours, so the manager indicates that there is no overload in that day, there is also good communication between the administrator and the workers; and between the latter mentioned. The manager says that workers are usually assigned efficiency and productivity bonuses equivalent to \$2.4 per programmed activity; but also inappropriate behaviors within the day, such as theft, drunkenness, and obscene words (Table 3).

TABLE 3.
ROTATION OF PERSONNEL CONSIDERED IN THE TERRANOVA ESTATE, CATATUMBO MUNICIPALITY, ZULIA STATE.

Dimension	Indicators	Items	Answers alternative											
			A		AA		S		EH		N			
			Af	Rf	Af	Rf	Af	Rf	Af	Rf	Af	Rf		
Management factors	Staff turnover	38			1	100								
		39	The reasons for staff turnover according to the manager are inappropriate behavior and other job offers.											
		40	The salary of the workers is \$2.4/day.											
		41	The manager considers that the salary of the workers is good.											
		42	The manager considers that if a balanced diet is provided to the workers.											
		43	The manager considers that if a good portion of food is offered to the workers.											
		44	The proteins provided in the food ration to the workers are grains, eggs and red meat.											
		45	The manager considers that the infrastructure of the dormitories used by the workers is comfortable.											
		46	The dormitories used by the workers have air conditioning.											
		47	The dormitories used by the workers do not have an individual bathroom.											
		48	They do not provide uniforms for the workers.											
		49	There are entertainment spaces within the production unit, such as soccer field, environments for table games (dominoes).											
		50	The daily work shift of each worker is 8 hours.											
		51	The manager considers that there is no work overload during the workday.											
		52	The manager states that the workers are not granted a work permit.											
		53	There is good communication between the manager and the workers.											
		54	There are good interpersonal relationships among the workers.											
55	The manager states that the workers are assigned efficiency and productivity bonuses.													
				1	100									
		57	The workers at some point have been observed inappropriate behaviors											

Legend: A: Always; AA: Always almost; S: Sometimes; EH: Ever hardly; N: Never; Af: Absolute frequency; Rf: Relative frequency (%); items: 38. ¿Do you think there is a high rate of staff turnover? 39. ¿What do you think is the reason for staff turnover? Select one or more than one: Salaries; Feeding; Labor conditions (dormitory, uniforms, spaces for entertainment); Labor exploitation (work overload, rest restrictions); Interpersonal relations between staff; and between them and you; Labor incentives (efficiency and productivity bonuses); Innapropriate behaviours; Other job offers?; 40. ¿What is the salary of the workers?; 41. ¿Do you think the wages of the workers is?; 42. ¿Do you consider that they provide a balanced diet to the workers?; 43. ¿Do you think they offer a good portion of food to the workers?; 44. ¿What kind of proteins are provided to the workers, select one or more than one: Grains; Eggs; Red meats; White meats; Others?; 45. ¿The infrastructure of the dormitories used by the workers; do you consider it comfortable?; 46. ¿Do the bedrooms have air conditioning?; 47. ¿Do the bedrooms have individual bathrooms?; 48. ¿Do they provide uniforms to the workers?; 49. ¿Are there entertainment spaces within the production unit? If your answer is positive, which one or which ones?; 50. ¿How many hours a day does a worker work in the production unit?; 51. ¿Do you consider that there is work overload in the work day?; 52. ¿Are the workers granted a work permit?; 53. ¿Is there good communication between the person in charge and subordinates?; 54. ¿Are there good interpersonal relationships between workers?; 55. ¿Are workers assigned efficiency and productivity bonuses?; 56. ¿How often are efficiency and productivity bonuses assigned to the workers?; 57. ¿Have the workers ever been observed to behave inappropriately during the working day (theft, drunkenness, obscene words)?

Source: Authors.

On the other hand, the monthly milk production and the average production per lactation was between 64.29 liters/month and 173 liters/month; and 73.79 liters/days of lactation and 209, 86 liters/days of lactation, respectively. The mortality rate in calves was between 0% and 2.88%; and in adults from 0% to 1.29%. In terms of the weight of hatchlings and of weaned calves, the averages were between 26.27 kg and 35.97 kg; and 162 kg to 182 kg, equally; while the liters of milk per hectare were between 35.15 liters/ha for the month of April 2020 and 90,88 litres/ha in January 2021 (Fig. 4, Fig. 5, Fig. 6 and Fig. 7).

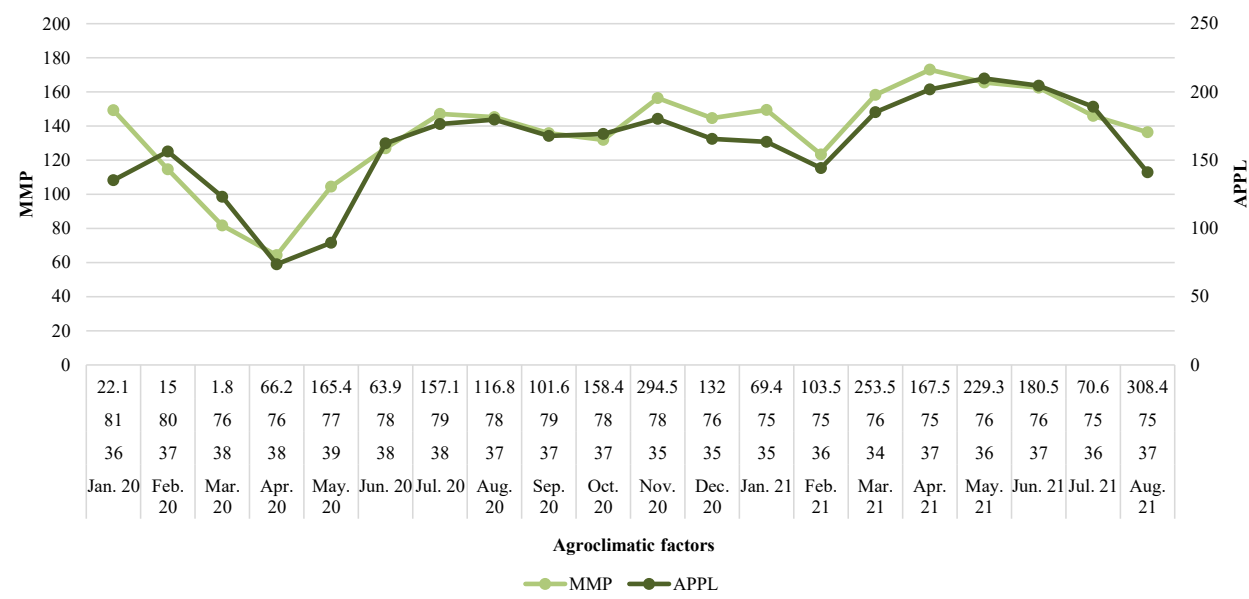


Fig. 4. Monthly milk production, average production by lactation and agroclimatic factors (precipitation (mm), humidity (%), temperatura (°C)), in the farm Terranova, municipality Catatumbo, Zulia state (Venezuela). Source: Authors.

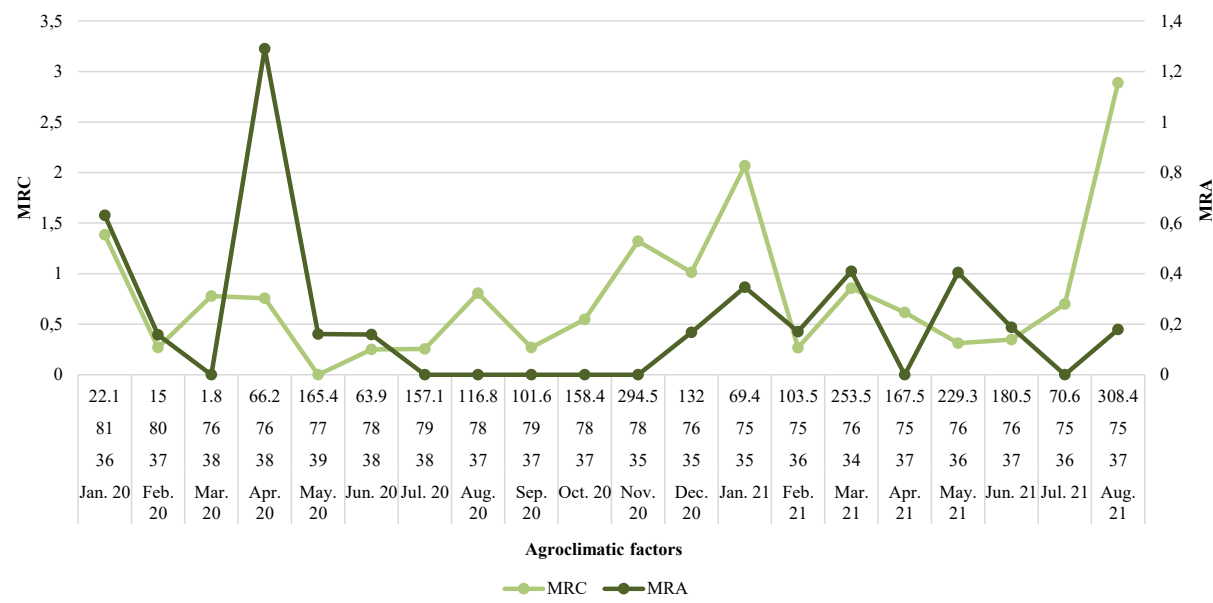


Fig. 5. Mortality rate in calves (MRC), mortality rate in adults (MRA) and agroclimatic factors (precipitation (mm), humidity (%), temperatura (°C)) in the farm Terranova, municipality Catatumbo, Zulia state (Venezuela). Source: Authors.

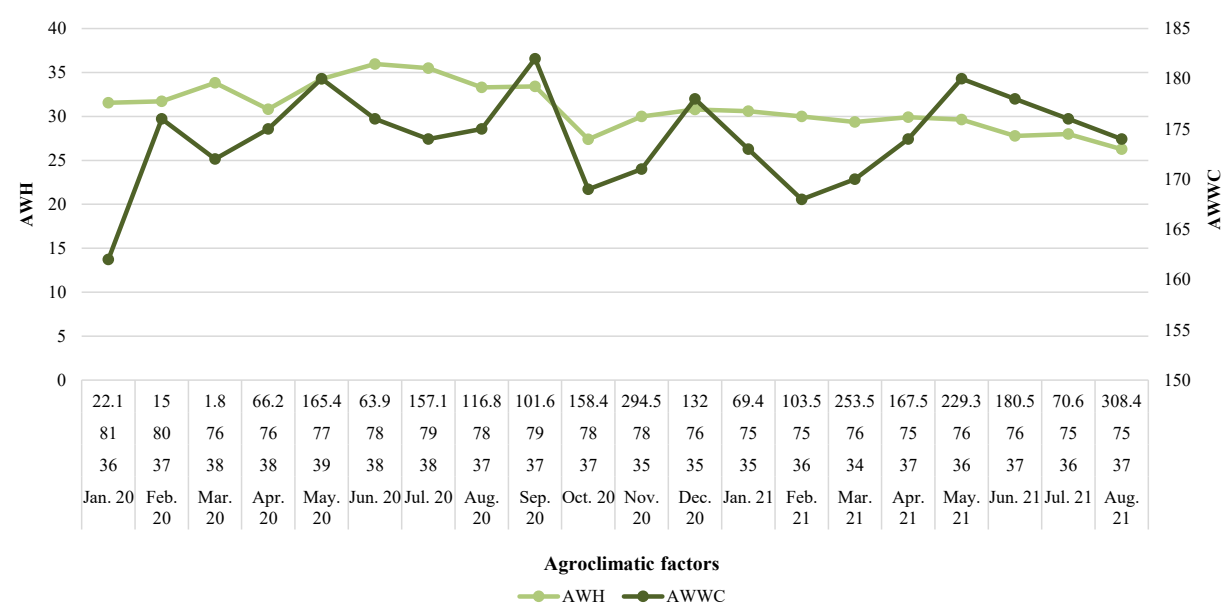


Fig. 6. Average weight of hatchlings (AWH), average weight of weaned calves (AWWC) and agroclimatic factors (precipitation (mm), humidity (%), temperatura (°C)) in the farm Terranova, municipality Catatumbo, Zulia state (Venezuela). Source: Authors.

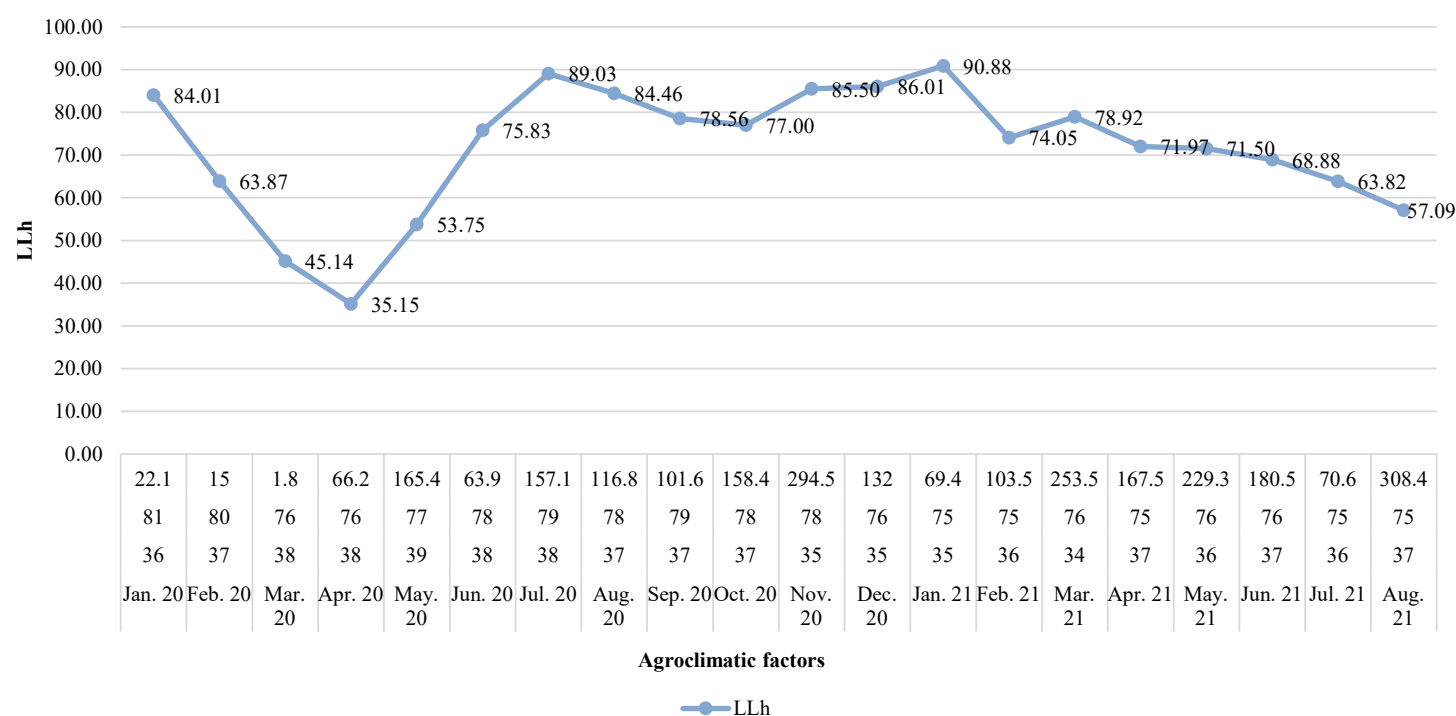


Fig. 7. Liters of milk per hectare (LLh) and agroclimatic factors (precipitation (mm), humidity (%), temperatura (°C)) in the farm Terranova, municipality Catatumbo, Zulia state (Venezuela).
Source: Authors.

V. DISCUSSION

It is indicated that when the ambient temperature is 24°C or higher, food consumption is reduced with decreased milk production. On the other hand, at approximately 27 °C, food consumption increases and milk production decreases. For this author temperature represents an important factor in Mexico, for its double action on grass and animals [25]. Thus the decrease in milk production depends on several factors including the ambient temperature [26]. An inverse relationship between ambient temperature and voluntary food consumption has also been highlighted [27].

For their part, producers on dairy farms in the area say that the ideal precipitation to stabilize milk production levels correspond to 150 mm per month. Regarding humidity, UCR (Costa Rica) researchers obtained an increase in milk production (average production of 15.34 ± 3.3 l.dia⁻¹) when the relative humidity value (RH) was less than 80% [28]; whereas said production was reduced by 1.08 l.dia⁻¹.animal⁻¹ when the RH was > 80% but < 87%; and in the range > 87% but < 95% the loss in production was counted at 1.19 l. The animals stopped producing 1.75 l on average when the daily HR was > 95%.

Coincidentally, the racial characteristic of the cattle located on the farm under study is mestizo Carora, in this respect, it is noted that the agricultural activity of those countries located within the tropical belt (specifically Venezuela) has generated the need to have a dairy cattle breed that produces enough milk, in adverse tropical weather conditions, without compromising normal physiological functions; that is how Venezuelan farmers have achieved this goal, Carora cattle being a genuine expression of this effort [14].

For management factors such as: supplementation and rotation of paddocks, they indicate that food supplementation is positively correlated with milk production [10]. At the same time, studies by CIESTAM and UACH (Mexico) observe how the use of concentrated food has a direct and expected relationship on the production of milk [29]. The estimated value expresses that those producers who supplement the diet of their herd with concentrated food obtain higher yields (about 2.25 liters per cow per day).

The production of forages in quantity and quality is variable in the course of the year, as manifested in the Mexican tropics [30], which in the winter time there is a low availability of forage, and the maturity of this in the summer, does not allow to meet the requirements of cows in milk production, so they recommend supplementing with concentrates at these times to reduce variations in milk production during the year; although they recommend offering nutritional supplementation in strategic physiological stages of cattle, independent of the climatic time which could result in a greater increase in productive and reproductive efficiency [31].

It is important to consider that the chemical composition of tropical pastures and the voluntary consumption of these, does not allow covering the demand of nutrients of cattle in specific physiological stages of high demand of nutrients, for example, the last third of gestation and the first months of lactation [32]. Thus, INIFAP (Mexico) reaffirm that those animals subjected to better handling conditions during the breeding period, managed to produce more milk in their first lactation than those that were developed in systems with lack of food, shelter and health [33].

Moreover, the practice of fertilization in pastures must be incorporated to obtain high yields, maximum quality and good economic return; this is essential for the production of higher quality fodder, and thus have a complete and balanced nutrition of livestock [32]. As for rest time, it is noted that brachiarias, guineas and pangolas are of average growth so require between 28 and 35 days of rest. Other species such as the African star, bermuda, humid, are fast-growing plants, whose rest period must range between 18 and 24 days [34].

In this sense, the proper management of guinea grass and tanner grass in the basin of Lake Maracaibo is expressed; for this first indicates that the grazing used in this species is rotational not systematic or alternate, with paddocks between 5-15 ha. Rotations every 28-35 days and 2-7 days of occupation in high rainy period, while in the dry period they make rotations and short occupations of 12-15 days of rest and 2-3 of use, without lowering the residual height of 40 cm, and driving between 1-2 AU/ha. For tanner grass, the soil moisture requirement is indicated, in addition to being adapted to intensive management and tolerant of poor drainage; the grazing that should be used for this species is systematic rotational, although this tolerates intense grazing and loads between 4-5 AU/ha. Rotations are between 28-35 days and occupation periods of 1-3 days [35].

Similarly, it is indicated that if a dairy cow is going to produce regular amounts of milk it should not remain in the paddock for more than three days. The maximum production is obtained if it remains in the paddock for a single day [34].

On the other hand, it is evident that animals in the tropics are exposed to high environmental temperatures, which act negatively on reproductive efficiency. In general, high temperatures are accompanied by strong droughts that affect the quality of pastures, placing on the animal in addition to caloric stress, nutritional. At certain times, high temperatures are accompanied with high humidity, which also causes discomfort and alterations of animal metabolism. In the situation the animals decrease their physical activity, do not search for females in heat, do not graze, eat less, their libido is reduced and in some cases they can even succumb [36].

All milk producers know the effect of rain and wind on their production; given this situation, it is advisable that during the winter the animals are kept indoors throughout the day, or at least overnight [25]. In terms of management of feeding and breastfeeding, it is indicated that the frequency of the latter and the presence of breeding involve a strong external stimulus that modulates ovarian activity in postpartum cows of milk, meat, in mixed cows and in zebra cattle, delaying the resumption of zeal and ovulation, lengthening postpartum periods and increasing anaesthetic and ovarian atrophy [37].

Similarly, unsupported milking and breastfeeding is characterized by P4 profiles that demonstrate a delay in hormonal discharge, even in cows undergoing nutritional improvement. Due to a likely indirect effect of negative energy balance, pulsatile frequency and Luteinizing Hormone (LH) discharge or follicular LH receptors may be blocked. However, early weaning would eliminate the blockage, releasing pulsatile LH and increasing the number of follicular LH receptors. It is indisputable if the inhibitory effect is exerted only by breastfeeding, the presence of the calf or both, and the findings are contradictory; continuous breastfeeding delays heat and ovulation, although the bioestimulant importance of breeding is deduced, due to the similarity between calving and mating intervals in cows that breastfeed with intact udders, but wider than in cows that do not breastfeed [37].

Herd management is the traditional type of milk production in the Zulia region, where milking is done manually 2 times a day, the calf being tied to the mother's leg as a stimulus to milk loss [38].

On the other hand, it is indicated that field workers must be well paid and have adequate living conditions to produce the expected changes, so as to guarantee their permanence on the farms, even considering the characteristic of this workforce, foreign, floating and unstable; this undoubtedly represents the “crux” of the modernization of Zulian livestock, or training and improving the living conditions and wages of labor force or production, or productivity will remain stagnant [38].

It should be noted that the southern area of the lake is still the one with the best milk production indices, which is related to the higher animal load that this area presents, which in turn is due to the availability of grass produced by rainfall during the year [38]. However, the average production per lactation and the duration in days of lactation are lower than those indicated by LUZ studies (Venezuela) [39]; the mortality rate in calves and adults is favorable, which is low when compared with those obtained by LUZ [40], [39]. As for the average weight of weaned calves, the referred values are higher than those indicated by LUZ [40].

VI. CONCLUSIONS

- Temperature is the agro-climatic factor that greatly affects milk production on the farm under study; mostly the breed of animal unit present conserves production.
- The absence of food supplementation and fertilization of the pastures, as well as the number of days of rest of the pastures could have a significant impact on milk production.
- Lower monthly milk production levels coincide with higher temperatures (38°C) and one of the minimum amounts in precipitation; Coincidentally, the highest values in monthly milk production is where temperatures are located between 34°C and 37°C and precipitation amounts between 167 mm - 253.5 mm; being the highest when compared with the rest of the months evaluated.

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