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Technical-economic characteristics of bovine production systems of the Colombian creoles breeds Romosinuano and Hartón del Valle

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ABSTRACT

Objective. Identify and characterize bovine production systems based on Romosinuano and Hartón del Valle creole breeds in lowland Colombian tropical conditions. **Materials and methods.** A random sampling survey was conducted among producers in the departments of Antioquia, Bolívar, Boyacá, Córdoba, Cesar, Cundinamarca, Meta, Santander, Sucre and Valle del Cauca. The main socioeconomic characteristics of the producers were determined, and the production systems were classified according to their purpose; likewise, their respective technological levels and technical-economic performance indicators were established. **Results.** The average age of the producers was 58 years old, with a higher level of education and 20 years of experience in livestock farming. The main animal performance parameters estimated for the Romosinuano breed were birth weight 28.0 ± 1.3 kg, weaning weight 185.04 ± 45.5 kg, fertility rate $80 \pm 16.0\%$ and calving interval of 408 ± 43.0 days. Likewise, for the Hartón del Valle breed, the mentioned parameters were 28.1 ± 0.32 kg, 199.5 ± 8.3 kg, $82 \pm 9.0\%$ and 354 ± 13.0 days, respectively. The technological level of the systems was categorized as medium-high and their economic performance showed an annual profitability index of over 12%. **Conclusions.** The production systems based on creole breeds in the lowland Colombian tropics were characterized, mainly by a relevant technological level and differentiated parameters between breeds. The profitability was linked to both technical management and the producer's socioeconomic conditions.

Keywords: Animal performance; livestock; productivity; animal genetic resources; production systems; profitability (*Source: AGROVOC Multilingual Thesaurus*).

RESUMEN

Objetivo. Identificar y caracterizar los sistemas de producción bovina basados en razas criollas Romosinuano y Hartón del Valle en condiciones de trópico bajo colombiano. **Materiales y métodos.** Se realizó una encuesta por muestreo aleatorio a productores en los departamentos de Antioquia, Bolívar, Boyacá, Córdoba, Cesar, Cundinamarca, Meta, Santander, Sucre y Valle del Cauca. Se

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determinaron las principales características socioeconómicas de los productores y se clasificaron los sistemas de producción según su finalidad; asimismo, se establecieron sus respectivos niveles tecnológicos e indicadores de desempeño técnico-económico. **Resultados.** La edad promedio de los productores fue de 58 años, con escolaridad de nivel superior y experiencia en la actividad ganadera de 20 años. Los principales parámetros de desempeño animal estimados para la raza Romosinuano fueron peso al nacimiento 28.0 ± 1.3 kg, peso al destete 185.04 ± 45.5 kg, tasa de fertilidad $80 \pm 16.0\%$ e intervalo entre partos de 408 ± 43.0 días. Asimismo, para la raza Hartón del Valle los citados parámetros fueron 28.1 ± 0.32 kg, 199.5 ± 8.3 kg, $82 \pm 9.0\%$ y 354 ± 13.0 días, respectivamente. El nivel tecnológico de los sistemas fue categorizado como medio-alto y su desempeño económico evidenció un índice de rentabilidad anual superior al 12%. **Conclusiones.** Los sistemas de producción basados en razas criollas en el trópico bajo colombiano, se caracterizaron, principalmente por un nivel tecnológico relevante y parámetros diferenciados entre razas. La rentabilidad se vinculó tanto al manejo técnico como a las condiciones socioeconómicas del productor.

Palabras clave: Desempeño animal; ganadería; productividad; recursos genéticos animales; sistemas de producción; rentabilidad (*Fuente: AGROVOC Multilingual Thesaurus*).

INTRODUCTION

The world demand for products of animal origin for human feeding is growing. It is estimated that for the year 2050, the consumption of meats from ruminants will exceed in 200% the current figures. The causes giving rise to these increments differ between developed countries and those in the way of development; in the first mentioned countries an increase in family income of medium class highlights, as well as a change in the pattern of preference of the consumers and human migration toward development cities or poles. In the developing countries the main cause for the mentioned increase is associated to demographic growth; however, a higher demand of food is not reflected on the economic dynamism of the rural regions, and therefore, concerns related to poverty and feeding security exist.

The food demand has produced changes in global economy, which grant higher technical-productive demands to the agricultural ecosystems, resulting, among other relevant aspects, in the intensification of livestock farming at different parts of the world; a condition that is related to increases in the capacity of animal load per surface unit, the use of fodder and an improvement of the genetic merit of livestock (1). Currently, the livestock systems should not only assure production increases, but should also confront the challenges derived from climate change, such as the appearance of diseases, heat stress, water shortage or surplus, low amount and quality of fodders and the reduction of biodiversity (2, 3).

The phenomenon of livestock farming intensification has given rise to an intensive use of a reduced number of breeds considered as highly productive and, in turn, to the underutilization of the local zoo-genetic resources (4). To such respect, it is known that the creole bovine population in Latin America (animals of European origin that evolved in and adapted to the American continent since the times of conquest) has drastically reduced since the end of the 19th Century. Currently, in most of the countries, the inventories of these animals are not known and there is little information about their contribution, both to the economy and to the life means of rural communities. However, evidences exist about the outstanding fertility of creole breeds, their longevity, meekness, resistance to parasites and tolerance to caloric stress, as well as the highlighting organoleptic and nutritional quality of their meat and milk (5).

The above zootechnical characteristics of the creole bovines place them as a source of genetic diversity, useful both in their pure state and in plans of crosses with commercial breeds, as their genetic heritage could grant their descendants a capacity of adaptation to the surrounding and to the risks derived from climate change. Among the Latin American countries with a larger number of creole bovine breeds there is Colombia that has eleven racial types (Arhuaco, Blanco Orejinegro, Campuzano, Casanare, Caqueteno, Chino Santandereano, Costeño, Hartón del Valle, Lucerna, Romosinuano, Sanmartinero and Velásquez), and a precarious inventory estimated in 1% of the national bovine census (6). The livestock farming activity in general in this country performs an important role in national

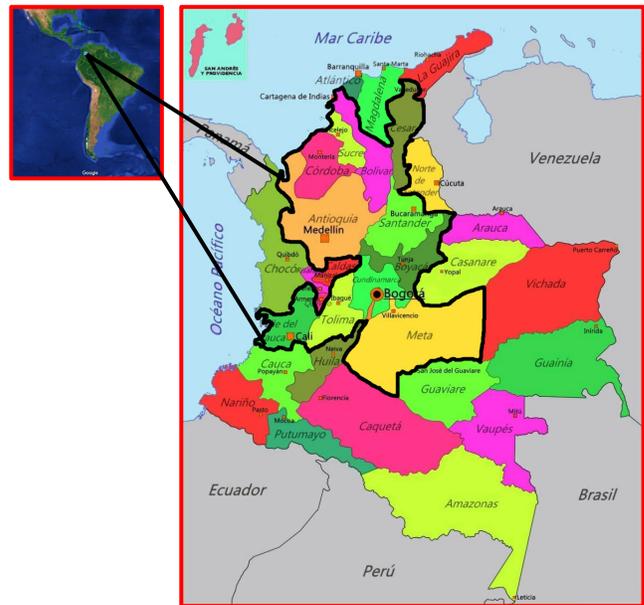
economy, possesses an inventory of 27,234,027 bovine heads distributed in 623,794 estates (7). Among the main producing departments highlight Antioquia (11.35%), Córdoba (7.84%), Casanare (7.84%) and Meta (7.51%).

In Latin American countries, like in Colombia, although some backgrounds exist (8), the technical characteristics, the economic importance and the perspectives of the livestock production systems based on creole breeds are not recently documented. Among the most spread creole bovine breeds in the Colombian tropic we find the Romosinuano (also known as Romo) and the Hartón del Valle. The first one is for meat purpose and receives its name due to their lack of horns and its place of origin is the Sinú River Valley in Cordoba Department. On the other hand, the Hartón del Valle breed is considered as a double purpose breed and is settled on the Cauca River Valley. These breeds can now be found at different regions of Colombia and are characterized by a medium to small size, with a coat of fur of light yellow to glowing red color, and it is possible to find dark-skinned animals, this is, with black heads and legs (9). Therefore, the objective of this work was to identify and characterize the main technical-economic attributes of the bovine production systems based on specimens of the creole breeds Romosinuano and Hartón del Valle, in zones with the agricultural climate conditions of the lowland Colombian tropic.

MATERIALS AND METHODS

Location and description of the study area.

The areas located in altitudes from 0 to 1000 meters over sea level (Lowland Tropic) were considered as production units, and are located in the Andean Region at the departments of Antioquia, Boyacá, Cundinamarca, Valle del Cauca and Santander; the Orinoquía in Meta; as well as the Caribbean Region in Bolivar, Cordoba, Cesar and Sucre (Figure 1). The selected regions included zones with dry hot climates and with a range of annual precipitation of 1,001 to 2,000 mm, as well as a humid hot climate with 2,001 to 3,000 mm and an annual average temperature of 24°C (10).



Source: Adapted from IGAC and Google Maps, 2019.

Figure 1. Country location and study area location.

Study universe. This study considered the producers linked to the Asociación Nacional de Criadores de Razas Criollas y Colombianas (ASOCRIOLLO) and the Asociación de Criadores de Razas Criollas y Colombianas de Los Llanos Orientales (ASOCRIOLLANOS). We requested the board of directors of each organization to provide us a list of the producers who raise Romosinuano and Hartón del Valle breeds. We later made a list of 49 producers located in the study area.

Obtaining information. The information of interest was obtained through a statistical sampling survey in the first term of 2019, considering the producers who managed bovine production systems in the study area. For such purpose, field visits were made to the production units and a semi-structured survey form was applied; the information received was verified through direct observation.

Interview. This procedure provided information about animal handling and the management of the concerned bovine production systems. The survey form included 134 questions, distributed in the following sections:

a) general data, b) animal inventory, c) feeding, d) reproduction, e) genetics, f) sanitation, g) meadow management, h) management routines, i) technical assistance, j) natural resources, k) marketing and l) complementary information. The survey form was preliminary validated in 10 units of bovine production.

Sampling. Due to the exploratory nature of this study, a sampling method of the random unrestricted type was chosen for estimating the proportions, and for such purpose a same *priori* selection probability (50%) of the production system according to its purpose of meat type or double purpose was considered. On the other hand, the consolidated list of producers was considered as the sampling frame, and any estate with a bovine inventory equal or larger than 30 heads was considered as an interest production unit. The following table shows the criteria used for determining the size of the final sample size.

Table 1. Statistical criteria for sample size.

Criterion description	Mathematical Formula
n: Sample size	
N: Total number of producers in the list = 49	$n = Npq / ((N-1) D + pq)$
p: Meat vocation productive purpose probability	
q: Double vocation productive purpose probability	
D: Sampling parameter	$D = B^2 / 4$
B: Estimation error (0.10) n=33.1	

Systematization and data analysis. Using an *Excel Microsoft Office 2019* spreadsheet, the information obtained in the field was recorded

and with such spreadsheet a database was made with the study interest variables. Once said information was validated, we used descriptive statistic procedures for estimating the productive performance parameters of the herds.

On the other hand, in the procedure for estimating the production costs and income, we considered the acquisition annualized prices for inputs, labor, asset depreciation, other expenses and sales. The profitability of the production system was determined subtracting the sales cost from the production total cost; the relation between these values provided a respective profitability index. With the purpose of making the understanding of the results ease, we present the monetary amounts of the estimated parameters in United States Dollars (USD), using the market representative exchange rate provided by the Colombian Central Bank and which corresponded to COP \$3,942 on the 14th day of May 2020. Likewise, and with the purpose of homogenizing the parameters, we present the annualized average amounts per belly and surface unit according to the production system identified in the study area.

Determination of the technological level. The criteria and parameters used for defining the technological level (TL) of the bovine production systems considered in this study were those proposed by the Colombian Federation of Cattle Breeders in 2012, and which are presented in the table below:

Table 2. Classification parameters per technological level of bovine production units in Colombia.

Classification Parameter	Technology Level		
	Low	Medium	High
1. Irrigation system available			
2. Improved pastures available.			
3. Food supplements supplied.			
4. Genetic improvement plans are in place.	Should present at least one parameter	Total amount of 2 to 4 parameters	Total amount of 5 to 7 parameters, numbers 4 & 7 are obligatory.
5. Pasture mechanization is performed.			
6. A programmed pasture grounds turnover is made.			
7. Technical, accounting & economic records are used.			

RESULTS

Estate description. The estates used for bovine production have an average surface of 318.2 hectares, and the range of this one was from 27 to 1,760. The surface distribution was 63.5% of pastures mostly of the *Brachiaria* and *Panicum* genders, 1.6% of silviculture grazing (*Gliricidia*, *Guazuma*, *Leucaena* and *Crescentia*), 14.6% of forestry reserve and the rest corresponded to construction, diverse agricultural plantations and water reservoirs. On the other hand, we determined that land tenure of the production unit lands was 87% private ownership and 13% in rent.

Socioeconomic characteristics of the producers. Evidence was found that the production units were 96% managed by men. Among the main socioeconomic characteristics of the producers highlight their average age, 58 years old, a superior level education (16 years), as well as 20 years of experience in cattle raising. In 52% of the cases, we determined that the producers practiced this activity as their main economic activity, because by possessing a higher level of education they can join the labor market in a formal manner and, in turn, 48% of them devote to cattle raising as a complementary activity addressed to savings and the generation of an additional income.

Productive purpose. The meat vocation livestock constituted production systems with the following objectives: a) Breeding; b) Full cycle; and c) Breeding and raising, as well as their combinations. In addition, in the area of study we identified production units devoted to a Double Purpose and Breeding system, (Table 3). The election of the productive purpose is related to the predominant product market in the geographical area where each livestock estate is located. However, the Harton del Valle breed is expanding along the Atlantic Coast and the East Plains in Colombia. Therefore, this breed producers, in addition to selling milk and calves, endeavor for satisfying the demand of breeding animals with a supposed genetic value for improving the herds.

Herd size and structure. The animal inventory of the production units varied from 19 to 971 heads, with an average of 349 and a standard deviation of 289 heads. The total inventory of the sample was 8,029 heads, with a herd structure formed by stallions (2%), cows (45%), raising and belly heifers (17%), developing males and

young stallions (10%), Heifers (14%) and Calves (12%). On the other hand, and in relation to the breed type, in 57% of production systems we observed animals of the Romosinuano breed and in 43% the Harton del Valle breed.

Table 3. Herd distribution according to productive purpose and breed.

Productive Purpose	FH	BTF(%)	
	(%)	RO	HV
Meat- Breeding	17	100	-
Meat- full cycle & Breeding	17	75	25
Meat- full cycle	13	100	-
Meat- breeding & raising	17	75	25
Double purpose-Breeding	22	100	-
Double purpose	14	100	-

FH= Herd Frequency; FTR(%)= Breed type frequency (%); RO= Romosinuano; HV= Hartón del Valle.

Description of the zootechnical management.

92% of the producers in the sample managed their herds under free grazing systems, while the rest managed their herds under a semi – stabling system. Regarding the feeding complement of their herds, the provision of balanced food to young (13%) and adult (9%) animals highlights; this practice was not reported for other animals. All producers provided *ad libitum* mineralized salt of the commercial kind to the whole herd. As for the management of animal reproduction, in 96% of the production systems, the observance of ruts was the standard, as well as in an equal proportion the female covering method was continuous mating. On the other hand, the implementation of genetic improvement programs through the introduction of creole bulls, acknowledged as pure and with a genealogic record issued by an association of breeders to the herds, predominated.

The sanitary management of the herd consisted in preventive control programs that included the application of vaccines for diseases under official control in Colombia (Foot and Mouth Disease, Paralytic Rage and Brucellosis); as well as vaccines for clostridium diseases. Likewise, 70% of the producers performed sprinkling activities using chemical products for controlling ectoparasites (flies and ticks), and the administration of oral and injectable medicines for fighting against affectations resulting from endoparasites. The producers in the sample

stated that in the previous year, the losses due to sanitary problems didn't exceed 3% of their animal inventories.

Finally, we highlight that the distribution of the production systems, according to the grazing

method, corresponded to 52% of the intensive rational type (Voisin rational grazing and ultra-high-density grazing), 44% of the turnover kind and the rest corresponds to forestry grazing. Other herd management practices are presented in Figure 2.

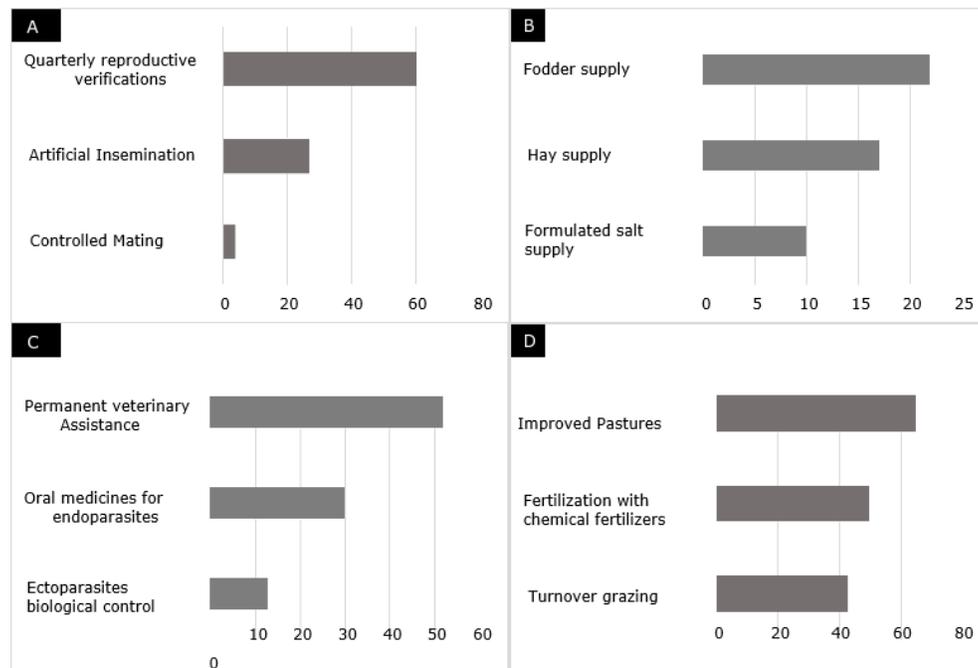


Figure 2. Frequency of animal and meadow management practice adoption in the sample. A. Productive management practices. B. Nutritional management practices. C. Sanitary management practices. D. Meadow management practices.

Productive parameters. The main animal performance parameters for the Romosinuano breed were weight at birth and at weaning, 28.04 ± 1.3 kg and 185.04 ± 45.48 kg respectively, as well as fertility of $80 \pm 16\%$ and an interval between births of 408 ± 43 days. To such respect, for the Harton del Valle breed, we observed 28.10 ± 0.32 kg and 199.5 ± 8.32 kg, and $82 \pm 9\%$ and 354 ± 13 days, respectively. Likewise, an index of racial purity of 0.96 and 0.68 was determined for reproductive males and bellies, respectively. On the other hand, for Double Purpose systems, a milk daily production of 4.81 ± 0.92 liters per cow and a lactation period of 258.75 ± 15.53 days.

Administrative characteristics. The producers in the sample stated they use an entrepreneurial vision, condition this that was linked to the size of the estate, herd inventory and education level. On the other hand, we found evidence of a permanent recording of productive data for all the herds. However, only in 52% of the cases, the recording of accounting and economic data

was reported through annotations in field and in specialized software. Likewise, we determined that workforce in production units corresponded to occasional workers under informal contract and payment per wage; these characteristics correspond to entrepreneurial type cattle raising in tropical areas of Colombia. Finally, we emphasize that technical assistance generally consisted in recommendations regarding the reproductive management of the herd, provided by qualified veterinarians.

Technological level. Based on the FEDEGAN criteria, evidence was found that 48% of the production units present a medium technological level and 52% has high level; likewise, no low technology units were found in the sample. It is important to mention that the observed technological level is directly related to the socioeconomic characteristics of the producer, as well as to his education level, years of experience in the activity and investment capacity. The main animal performance indicators, according to technological level and racial type, are shown in Table 4.

Table 4. Animal performance parameters, according to racial type and technological level.

Variable	Romosinuano		Hartón del Valle	
	MTL	HTL	MTL	HTL
Annual fertility rate (%)	77.0±16.0	82.6±17.1	82.0±13.0	81.20±5.2
Interval between births (days)	380.8±50.0	431.6±30.0	360.0	348.0±16.4
Birth rate (%)	90.0±10.5	86.5±9.0	82.0±4.5	83.50±8.9
Open days	102.5±40.5	151.7±13.3	72.0±16.4	90.60±19.5
Age 1.st heifer mating (months)	26.7±6.0	22.6±4.0	25.40±1.9	26.80±1.3
Weight 1. st heifer mating (kg)	355.0±70.0	310±19.1	312.0±10.9	314.0±19.5
Age 1.st birth (months)	35.7±6.0	31.6±4.0	34.40±1.9	35.80±1.3
Weight at birth (kg)	27.8±2.0	28.2±1.1	28.0	28.20±0.4
Weaning weight (kg)	170.0±24.0	197.9±57.0	200.0	199.0±12.4
Weaning age (days)	245.0±12.2	242.1±28.0	240.0	240.0

MTL: Medium Technological Level; HTL: High Technological Level.

Sale price. In the study area, the sale price of the main marketed products was 0.32, 1.06 and 954.05 USD for milk liter, kilogram of animal standing for supply (weaning and fattened calf) and breeding animal, respectively. The price of the first products is determined by the behavior of the regional and national markets, while in the case of the third product, its price is determined by the producer and, with less frequency, established by mutual agreement between the purchaser and the seller.

Economic performance indicators. The total production cost per livestock unit in the sample was constituted by 46% of the variable type costs and the remaining part was constituted by the amount of fixed costs. Within the first type costs, we can highlight the headings of workforce payments (21.3%) and the purchase of supplements for animal feeding (70.4%). On the other hand, we determined that the sale average income was 73,230 USD in 2019, which favored a profitability range of 3,235 to 37,198 USD. The cost structure and the economic performance indicators, according to the production unit purpose, is shown in the table below.

Table 5. Economic performance indicators of the bovine systems, according to productive purpose.

Indicator	Genetic meat		FC meat & genetics		CC meat		BR Meat		DP & genetics		DP	
	μ	σ	μ	σ	μ	σ	μ	σ	μ	σ	μ	σ
Grazing hectares	33.7	18.4	219.5	282.8	217.0	175.1	424.5	333.0	179.8	136.6	198.0	27.1
Number of bellies	30.0	16.0	110.0	92.0	250.0	96.0	422.0	135.0	142.0	115.0	251.0	103.0
Total income	22.421	4.448	48.362	36.224	71.328	27.406	106.352	56.037	45.350	25.420	185.477	5.493
Variable cost	7.736	2.193	9.808	3.494	17.228	3.271	19.146	4.891	9.730	4.740	126.516	22.672
Workforce	5.009	1.445	5.391	1.743	7.477	1.624	6.540	2.297	4.730	1.666	6.540	-
Feeding	1.560	1.414	2.309	1.306	6.794	1.296	9.473	4.120	2.965	2.260	117.558	22.580
Medicines	94.0	63.0	326.0	226.0	726.0	218.0	800.0	407.0	257.0	182.0	472.0	70.0
Reproductive Exam	75.0	55.0	292.0	305.0	328.0	193.0	843.0	537.0	433.0	349.0	763.0	313.0
Maintenance	793.0	317.0	1.015	293.0	1.268	-	1.110	317.0	888.0	347.0	1.226	73.0
Fuel	872.0	159.0	1.364	476.0	1.776	-	1.364	476.0	1.218	526.0	1.057	183.0
Utility services	127.0	-	127.0	-	127.0	-	127.0	-	127.0	-	127.0	-
Fixed costs	9.820	2.441	26.324	27.517	36.055	17.559	74.438	58.053	21.058	12.164	26.898	944.0
Other fixed payments	76.0	-	76.0	-	76.0	-	76.0	-	76.0	-	76.0	-
Depreciation	8.278	2.412	22.413	27.790	32.570	16.738	70.061	56.201	16.152	13.632	13.781	11.583
Taxes	673.0	133.0	1.451	1.087	2.140	822.0	3.191	1.681	1.361	763.0	5.564	165.0
Rent	-	-	1.370	2.740	-	-	-	-	2.581	5.772	6.251	10.826
Total cost	17.556	3.964	36.132	29.533	53.282	19.459	93.584	60.464	30.787	16.589	153.414	22.345
Profitability	4.865	1.905	12.230	7.525	18.046	9.252	12.768	7.050	14.563	9.208	32.063	20.655
Profitability index	29.0%	13.0%	37.0%	15.0%	33.0%	9.0%	21.0%	16.0%	45.0%	12.0%	23.0%	18.0%
Ha/year profitability	144.0	103.0	56.0	27.0	83.0	53.0	30.0	21.0	81.0	67.0	162.0	763.0
Belly/year profitability	164.0	121.0	111.0	82.0	72.0	96.0	30.0	52.0	102.0	80.0	128.0	201.0

FC=Full cycle; BR= Breed & Raise; DP= Double purpose.

All economic amounts are expressed in United States Dollars (USD). Exchange rate on the 14th day of May 202, published the Central Bank of Colombia.

DISCUSSION

Starting with the first disembarkation of the first cattle breeds in America during the Conquest, groups of local breeds were shaped known as "creole" breeds, which constituted all the Colombian livestock until the beginning of the 20th Century (11). However, in modern times, the introduction of foreign breeds and the indiscriminate crossings resulted in a drastic reduction of the creole bovine cores in the countries of Latin America (3). During the second half of the 20th Century, different Colombian authors published results about the productive performance of the herds constituted by animals of different creole breeds existing in the country (8). However, no official figures exist of the inventories and current characteristics of the systems made up by Colombian creole bovines. Therefore, in this discussion we considered local backgrounds of the last two decades, as well as recent results of similar works made in Mexico.

Around 2002, the specimens of creole breeds were only linked to production systems of extensive type, characterized by an exhaustion of natural resources, scarce capital investment and low technological level (12). On the contrary, this work was currently associated to creole bovines with production systems of the entrepreneurial type; the evidences obtained indicate that a direct relation exists between the size of the estate and the scope of the entrepreneurial vision. Regarding the estate size, in Mexico we observed an average surface of 110 hectares in livestock systems characterized by their entrepreneurial management. The estate size in the sample was larger than the one reported for other livestock farms, such as those in the Tolima Department (13) and in the East Plains of Colombia (24). On the other hand, in double purpose systems in Mexico, an inventory of 300 animals was reported, managed under a specialized technological level; and a similar condition was observed in this study sample.

The Colombian creole breed census published in 1999, reported a producer's average age of 48 years and a superior education level for 36.8% of them (8). The producer's age in the sample exceeded in ten years the census average and

the portion with superior education was higher. In Mexico, the age of the producers and their experience in cattle breeding were similar to that of the values obtained in the sample (15, 16, 17, 18). The advanced age of the producers is associated to a process of land inheritance in the rural mean. Likewise, in Mexico we observed that bovine production semi-technified and technified systems were managed by producers with a superior level of education. Currently, it is indicated that the Colombian creole bovines are part of agricultural ecosystems with a highlighted technological level, managed by producers with advanced age and superior education level.

As for animal performance, a weaning weight of 172 kg at 219 days from birth was determined in 2018 for Romosinuano specimens, this under the conditions of the Mexican tropic (19). The figures were similar in the sample, but they exceeded the estimates for this same breed in herds located in the Mexican States of Tabasco and Veracruz (20). Regarding the Harton del Valle breed, a weight range at birth of 31 to 35 kg and at weaning of 165 to 178 kg at 245 days (21) was reported in Colombia in 2001. For this last breed, a lower weight was reported at birth, but a higher one was reported at weaning. In general terms, it is considered that a weight at birth higher than 30 kg, as occurs in foreign breeds, is related to dystocia problems at birth time. Therefore, the birth of light newborn calves is a desirable characteristic of the Colombian creole bovines (22).

Regarding the reproductive performance, for the Harton del Valle breed we determined an interval range between births of 360 to 390 days (8); this parameter was like the one seen in the sample. On the other hand, and for herds in the lowland Colombian tropic, an interval between births of 422 ± 131 days (23) was reported for the Romosinuano breed, a value like that of the sample. In tropical areas of Mexico, it was recently observed that the age and weight parameters at first mating in Romosinuano heifers, decreased as the technological level of the production system progressed (24), a condition that was also observed in this study. It is also considered that improvement in feeding practices favors weight increase in first delivery as well as the postpartum recovery of creole females (25).

Milk production in Harton del Valle breed was estimated in 1,683 liters and 284 days, meaning 5.9 liters/cow/day, under the conditions of

the Colombian medium land tropic (8); these parameters were lower in the sample. However, in the East Plains and for this same breed, a milk production range of 4.0 to 7.0 liters/cow/day was reported (26, 27). The milk daily production is related to feeding quality and the comfort conditions of the animals. The Colombian lowland tropic presents a limited offer of forages and extreme heat indexes; therefore, a lower milk production was reported in the concerned herds. Among the interviewed producers we observed a preference for the intensive rational grazing methods, a characteristic that contrasted to the 20th Century's reports, which indicated a continuous grazing as the most common method. The rusticity of the creole livestock favors a lower supply of a balanced feeding by the producers, and the supply of mineralized salt was constant as a common practice among the producers for complementing the nutrients arising from the forages consumed by the livestock.

Regarding the economic performance of the herds, we observed higher expenses in feeding and workforce payments in the Double Purpose and Breed and Raise systems. In addition, it is important to note that the profitability indexes of the production systems exceeded the minimal acceptable value, defined as annual 12% (28). The highlighting economic results were attributed to the sale of breeding specimens.

In conclusion, the attributes identified in the bovine production systems based on the Romosinuano and Harton del Valle creole breeds were linked to the availability of natural resources, work capital, socioeconomic characteristics of the producers, as well as to their entrepreneurial management capacity. The surrounding current changes demand more efficient technological

responses from these livestock systems, a condition that implies an increase in the offer of meat and milk at low production costs. The results obtained positioned the intensive rational grazing methods and the exploitation of creole breeds, as suitable alternatives for improving the technical-economic performance of the herds in the Colombian tropical areas. Likewise, we highlight as an important finding, the medium-high technological level that was determined for the concerned production systems; being more profitable the one oriented to Double Purpose and Breeding. The evidences obtained suggest the importance of promoting sustainable livestock practices in grazing that include the good use of local resources. On the other hand, and in consonance with the results obtained from this study, we recommend to multiply the creole bovine cores and their crossing with other conventional breed specimens; this, with the purpose of providing adaptability gens to the calves for being able to reach better productivity and profitability indicators in the Colombian livestock sector.

Conflict of interest

The authors of this study state that no conflict of interest exists with the publication of this manuscript.

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