Productive and reproductive indicators of livestock in the Guayzimi parish, Nangaritza canton, Zamora Chinchipe province, Ecuador

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Abstract

The evaluation of the cattle production system allows the diagnosis and suggestions of alternatives to improve production conditions. This study aimed to evaluate productivity and reproductive indicators and their relationship with the production systems in the parish of Guayzimi, canton of Nangaritza, in the province of Zamora-Chinchipe, Ecuador. A survey was conducted among bovine farmers in the study area, including questions related to social, productive, and reproductive aspects. A sample of 35 producers was analyzed using multivariate principal component analysis, descriptive statistics, correspondence analysis, and multiple correlation matrices Spearman's criterion. The results identified three main components: “Technical-Productive”, “Reproductive Efficiency”, and “Marketing,” which accounted for 35.1 %, 28.7 %, and 13.3 % of the total variance, respectively. Together, these components explained 77.7 % of the variance. The main issues identified were related to herd structure, showing a surplus of cows and bulls at 17.4 % and 78.6 %, respectively, and a deficit of heifers, calves, and young bulls at 21.3 %, 3.3 %, and 39.4 %, respectively. Additionally, a notable stagnation of females in the pre-reproductive stage suggesting they are not a significant variable in the production process. This study shows that achieving productive efficiency requires consideration of the relationship between 'herd organization + production organization + marketing” and the fact that stagnation in the flow of replacement female cattle is due to deficiencies in production strategies. Future studies could build on this

research to strengthen the foundation of bovine production in the Guaizimi, Nangaritza, Zamora-Chinchipe.

Keywords: Bovine; Diagnosis; Ecuatorian Amazon region; Livestock; Farm.

Study contribution

Through the evaluation of productive and reproductive indicators in the municipality of Guayzimi, Zamora-Chinchipe province, this study makes a significant contribution to bovine production in Ecuador. Based on surveys of bovine farmers, key components influencing the efficiency of production systems were identified. This study highlights not only structural problems affecting bovine productivity, but also the importance of herd organization, production management and marketing strategies as key elements in improving efficiency. In addition, artificial insemination is proposed as an essential strategy to face the volatility of the beef market. These conclusions are essential for the development of policies that promote the sustainability and competitiveness of the bovine sector, thus contributing to food security and the social well-being of rural communities involved in this activity.

Introduction

Bovine farming is one of the most widely distributed activities worldwide and occupies large areas of land. It represents a key economic and social sector, that covers various processes, including by-product production.[1] Therefore, it is crucial for farmers to have information about the status of their production systems and to monitor the behavior, well-being, and production of their animals so that they can make decisions that help improve

aspects or situations that are affecting their bovine herds to make them sustainable.[2] In Latin America and Ecuador, bovine farming is one of the most significant activities in the agricultural sector due to its economic contribution.[3] However, many producers still rely on traditional methods, using bovine as a means of subsistence and food security.

Additionally, the limited adoption of technical practices, such as maintaining productive, reproductive, and economic records, remains a major challenge in effective farm management. Furthermore, the lack of knowledge in interpreting these records further hinders the growth and development of the sector.[4] In the province of Zamora-Chinchipe, located in the Ecuadorian Amazon region (EAR), cattle represent the most profitable bovine species, with a total population of 59 076 head. The predominant breeds are mixed (49.7 %) and Creole (29.08 %), while specialized breeds such as Holstein (14.08 %), Brown Swiss (3.75 %), Brahman (1.98 %), and Jersey (0.49 %) are less common. Beef cattle account for 28 % of the herd, dual-purpose breeds for 62 %, and dairy cattle for only 10 %. Within the dairy sector, 1 125.39 milking cows are recorded, with an average milk production of 4.05 kg per cow.[5]

While dairy farming provides economic benefits to those involved, its contribution to other industries remains limited due to low technical development and the lack of value-added products.[6] The EAR is a conflict zone where various ecosystem exploitation models intersect, alongside the growing need for national and international civic responsibility in conserving ecosystems. As a result, the provinces within the EAR (Morona Santiago, Napo, Orellana, Pastaza, Sucumbíos, and Zamora-Chinchipe) exhibit the lowest levels of bovine production and productivity. This is due to producers using bovine farming methods that involve minimal technology application, lack of record-

keeping, reliance on artificial insemination for reproductive strategies, poor organization within production chains, limited agro-industrial development, inadequate inter-institutional collaboration, and the absence of public service networks.[7]

These factors hinder progress in improving the productive and reproductive indicators of cattle.[8] The development of studies that assess both the productive and reproductive indicators of cattle, as well as the social component, as inseparable parts of the bovine production system, will provide a means to measure efficiency in improving animal performance and productivity. By considering the cultural context of bovine farming in the region where the study is conducted, this approach will help identify strategies that enhance profits within bovine herds. In this regard, background information on this type of exercise in the Amazon region is provided by Benítez-Jiménez et al. (2018) in their characterization of a production system; however, for the canton Nangaritza area, it would be the first of its kind, contributing to the understanding of the reality of bovine farming in this region.

In consideration of the above-mentioned points, the objective of this study was to evaluate the status of bovine farming in Guayzimi parish, canton of Nangaritza, Zamora-Chinchipe province, employing productive, reproductive and social indicators.

Materials and methods

Ethical statement

No studies involving experimental animals or human subjects have been developed in this review. The origin and characteristics of the research that was developed do not justify the ethical statement

Study area

The study was carried out in the urban parish of Guayzimi, Nangaritza canton, located in the southeast of the province of Zamora-Chinchipe, at the geographic coordinates 4°02′49″S and 78°40′55″W, at an altitude of 2 000 m above sea level. This parish is the cantonal capital of the Nangaritza canton and has an area of 2 096 km². It has a warm-humid subtropical climate, with temperatures ranging between 18 and 20°C in the high parts and 24°C in the low parts, with rainfall between 2 000 and 3 000 mm per year.

Procedure

The territory of the parish was divided into four quadrants, and farms representative of the study area were randomly selected. To minimize subjectivity in the data collected, indicators with a relatively high level of reliability, as determined by Cronbach's alpha criteria, were evaluated.[9]

Methodological approach, design and sampling

A combined survey system was employed, with both quantitative and qualitative elements that could be verified on-site. This approach aimed to achieve favorable results and establish an initial information base for certain productive and reproductive indicators that were previously unknown in the dairy and meat cattle breeds raised in Guayzimi parish.

The research was designed based on the search for reference indicators for dairy and beef cattle breeds established in the study region; for this purpose, an observational and descriptive system was established.

The population consisted of bovine producers from Guayzimi parish registered with Agrocalidad (Phytosanitary and Animal Health Regulation and Control Agency), to a total of 110 bovine farmers in 2021. Sample size was calculated a confidence level of 95 %, a margin of error of 6 %, P = 0.05, and q = 0.95 using formula proposed by[10]. However, of the available universe (110 bovine farmers), the calculated sample size was ineffective for data collection as producers lacked production and reproduction records. Therefore, the entire population was visited, and it was found that 68.6 % did not have such records. This restricted sampling to the remaining 31.4 % of the population, representing 35 producers.

Methods and techniques

Survey: The survey was conducted directly with ranchers between November and December 2022. Door-to-door visits were made to administer the survey, which covered social, productive, reproductive, and technological indicators. The questions were directed to the head of each family. The survey consisted of open and closed questions covering social, productive, and reproductive aspects so that the producer could express themselves clearly without conditioning the answers.

Records evaluation: The records of each bovine production were used to complete and verify the information provided by each of the farmers, and they were used as a decisive tool in the evaluation of the productive and reproductive indicators used.

Statistical processing and analysis

The collected data was organized into a data matrix using Microsoft Excel® software, where information from production records and on-site surveys was consolidated. Descriptive statistics were generated using Statgraphics Centurion v16 software, and the assumptions of normality and homoscedasticity were tested using the Kolmogorov-Smirnov and Bartlett tests, respectively. To identify the factors determining productive efficiency on the surveyed farms, the multivariate technique of principal component analysis (PCA) was applied to extract the factors, using Varimax rotation with Kaiser normalization to minimize the factors defining the model.[11]

Compliance with data likelihood assumptions was verified using the Kaiser-Meyer-Olkin test. Additionally, correspondence analysis (CA) was used to explore the relationships between categorical variables.[12] Correlation analyses were conducted between productive and reproductive variables and categorical variables using Spearman's rank correlation coefficient.

Results

Productive growth, development, and reproductive indicators of farms within the Nangaritza canton, Zamora-Chinchipe province are presented in **Table 1**. The values among the productive indicators exhibit significant variability, while the growth and development indicators show less variation.The Ecuadorian Amazon has very particular characteristics in terms of bovine farming systems, with a wide range of land holdings (areas from 5 to 250 ha and more). It is also characterized by being an extensive system, where in most cases reproductive indicators are not monitored.[1] These aspects can contribute to high variability within the herd structure.

Table 1. Characteristics of bovine farms in Nangaritza, Zamora-Chinchipe

Indicators	Media	± SE	Min	Max	Shapiro-Wilk	
	Productive				*W*	*P*
Animals number	26.57 ±19.2	3.24	9	85	0.75	≤ 0.001
Bulls	2.34 ±2.8	0.48	0	10	0.76	≤ 0.001
Males born	3.06 ±2.66	0.44	0	10	0.85	≤ 0.001
Female born	3.35 ±4.72	0.81	0	26	0.81	≤ 0.001
Milk production (L/day)	27.11 ±23.8	7.42	0	170	0.66	≤ 0.001
Birth wight (kg)	33.1 ±9.97	1.69	0	45	0.68	≤ 0.001
Age at weaning (months)	6.54 ±2.31	1.69	0	12	0.79	≤ 0.001
Weraning weight (kg)	84.1 ±30.5	5.16	0	170	0.83	≤ 0.001
Age at slaughter (years)	3.89 ±2.5	0.42	1	10	0.77	≤ 0.001
Market weight (kg)	247.19 ±53	9.4	136	397	0.95	0.215
	Growth and development					
Number of calves	3.23 ±3.44	0.58	0	17	0.79	≤ 0.001
Number of heifers	3.63 ±4.07	0.68	0	35	0.78	≤ 0.001
Toretes	4.37 ±6.4	1.08	0	10	0.63	≤ 0.001
	Reproductive					
Numbers of vacones	3.89 ±4.3	0.72	0	20	0.8	≤ 0.001
Number of cows	9.29 ±8.19	1.38	0	35	0.82	≤ 0.001
Number of animals born in the last year	6.37 ±6.91	1.17	0	37	0.70	≤ 0.001
Number of services per animal (straws)	1.20 ±0.67	0.11	0	3	0.62	≤ 0.001

Age at first service (months)	20.23 ±6.0	1.02	0	30	0.75	≤ 0.001
Age at first birth (months)	28.71 ±7.9	1.34	0	39	0.66	≤ 0.001
Number calving per animal	5.57 ±2.16	0.36	0	10	0.89	≤ 0.004
Calving interval (month)	13.17 ±3.4	0.58	0	16	0.52	≤ 0.001
	Tenure					
Hectares	46.7 ±51.8	8.88	3	311	0.54	≤ 0.001

Reproductive indicators show an acceptable birth rate and efficient reproductive performance. However, there are signs of deteriorated replacement processes within the female group, along with prolonged reproductive age, which threatens the herd's productivity from a reproductive standpoint. The relationships between the variables under study were analyzed using PCA, resulting in three components related to 18 variables, which together explained 77.7 % of the total variance (**Table 2**). The first component primarily grouped variables related to herd management and one productive variable, leading to its labeling as "Technical-Productive." It is most strongly associated with "animals born in the last year" and "males," with a weight > 90 %. The weight of the other variables in this component was < 70 %, and this component accounted for 35.1 % of the total explained variance.

Table 2. Weight factors by components in the characterization of bovine livestock production the Guayzimi parish

Component	Variables	Weight factor	% Variance	Cumulative variance explained (%)
Technical-productive	Animals number	0.76	35.1	35.1
	Number of calves	0.89		
	Number of heifers	0.77		
	Number of cows	0.85		
	Animals born in the last year	0.93		
	Males	0.91		
	Females	0.77		
	Milk production per day (L/day)	0.85		
Reproductive efficiency	Birth weight (kg)	0.87	28.7	63.8
	Weaning age (months)	0.86		
	Age of first service (months)	0.91		
	Weaning weight (kg)	0.83		
	Age at first calving (months)	0.92		
	Number of deliveries/animal	0.50		
	Interval between births (months)	0.94		
Marketing	Number of toretes	0.84	13.3	77.7
	Number of bulls	0.76		
	Market weight (kg)	0.67		

Table 2. Extention

Component number	Eigenvalor	Percentage of variance explained	Cumulative percentage
1	7.87998	41.474	41.474
2	4.0813	21.481	62.954
3	2.78654	14.666	77.620
4	1.05556	5.556	83.176
5	0.832762	4.383	87.559
6	0.529877	2.789	90.347
7	0.459076	2.416	92.764
8	0.299793	1.578	94.342
9	0.244167	1.285	95.627
10	0.205525	1.082	96.708
11	0.176905	0.931	97.639
12	0.139649	0.735	98.374
13	0.135455	0.713	99.087
14	0.0835705	0.440	99.527
15	0.0443339	0.233	99.761
16	0.0320415	0.169	99.929
17	0.0114945	0.060	99.990
18	0.0019158	0.010	100
19	0.000048	0	100

The second component associated reproductive variables, labeled “Reproductive efficiency,” and was linked to the variables “Age of first service (months), Age at first delivery (months), and Intervals between births (months),” which presented weights higher than 90 %. Together with the rest of the components, they contributed 28.7 % to explain 63.8 % of the accumulated variance. The third component linked the number of young bulls and bulls to market activity/volume, leading to its designation as “Marketing.” This component explained 13.3 % of the variance (**Table 2**). The remaining variables in the study exhibited high homogeneity of variance, contributing little to differentiating the factors that describe the productive and reproductive indicators.

Based on the vector length, the variables animals born in the last year, animals number, number of calves, number of heifers and milk production per day (L/day) exhibited the highest variability. In contrast, the proximity between points suggests stronger similarity among birth weight (BW), age at weaning (AAW), age at first service (AFs), age at first calving (AFC), age at first born (AFB) and number of births per animal (NBA) [**Figure 1]**. Likewise, these variables were the most closely related according to the cosine angle opening criterion. Follow the same guidelines for figures. Figure captions must be placed below the figure and shall include the figure number, a concise and descriptive title, and may include a legend.

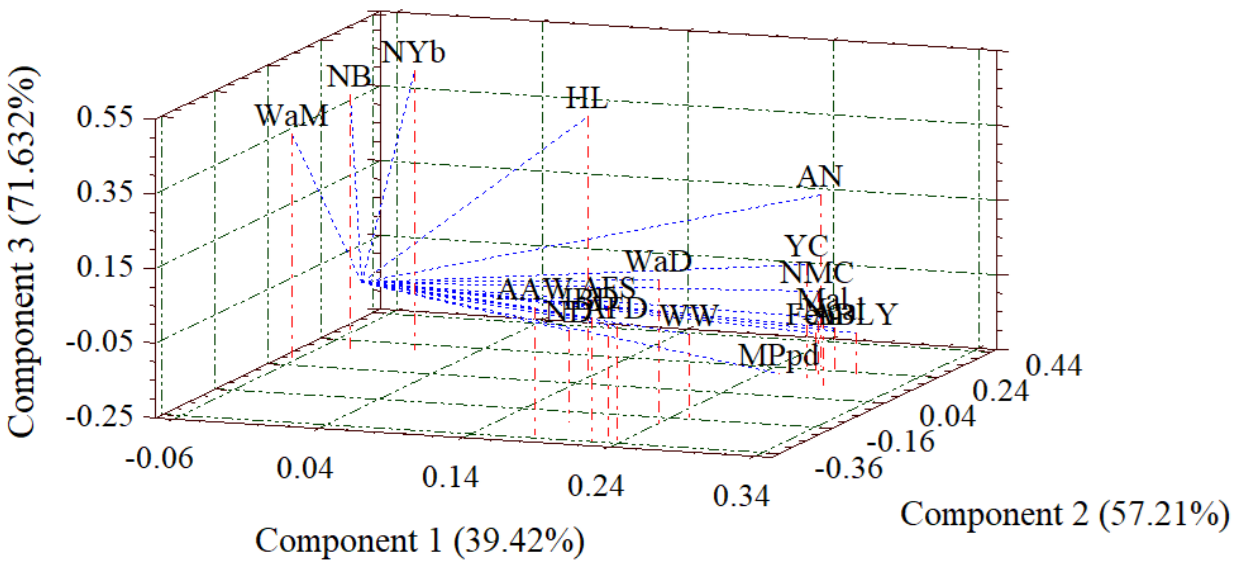

Figure 1. Component weight chart. AAW: age at weaning, AFs: age at first service, Fem: female, ND: Number of delivery, NMC: Number of male calves, Ncal: Number of calves, NB: Number of bulls, NYb: Number of young bulls, MPpd: Milk production per day, ABLY: Animals born last year, AFC: Age at first calving, HL: Hectares of land, IBD: Interval between deliveries, Mal: Males, YC: Joung cow, Nh: Number of heifers, AN: Animals number, WW: Weaning weight, WaM: Weight at the market, WaD: Weight at delivery.

Among the component values, all variables exhibited high variability except for weight at the market, suggesting uniformity in the weight of slaughtered animals and stability in purchase prices. Based on the cosine angle amplitude, the amount of land owned by producers, along with the animals number, determines the type of bovine farming they practice (extensive, semi-intensive, or intensive) (**Figure 2**).

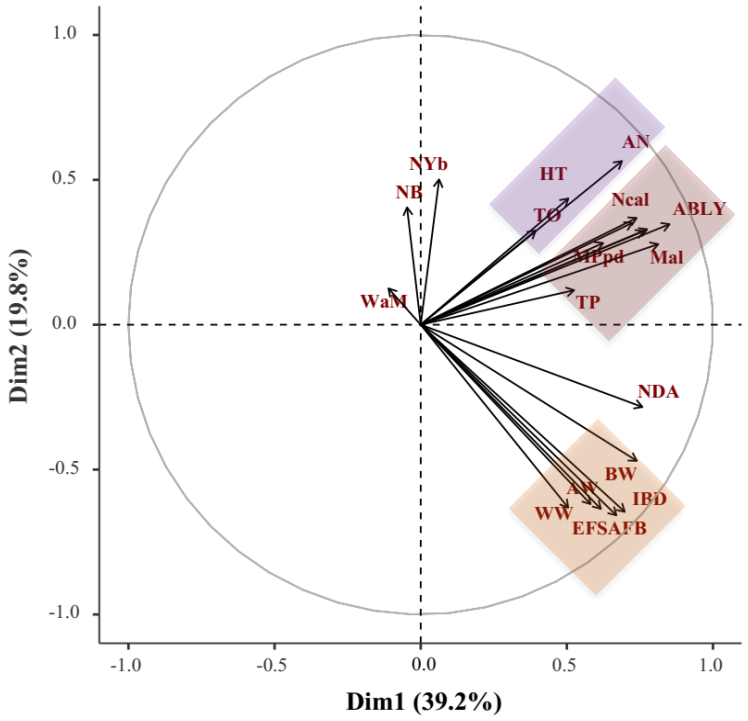

Figure 2. Component values for productive, reproductive and herd control variables. WW: Weaning weight, IBD: Interval between deliveries, BW: Birth weight, TP: Type of production, TO: Type of operation, AAW: Age at weaning, AFs: Age at first service, AFC: Age at first calving, NDA: Number of delivery per animal, MPpd: Milk production per day, Mal: Males, ABLY: Animals born last year, Ncal: Number of calves, HL: Hectares of land, WaM: Weight at the market, NB: Number of bulls, NYb: Number of young bulls, AN: Animals number.

The cosine angle opening suggested that the type of production (beef, milk, or mixed) is determined by herd movement indicators (number of males and calves), productive factors (daily milk production), and reproductive factors (animals born last year). This aligns with the fundamental structure of multipurpose bovine farms. Similarly, reproductive variables, such as birth weight, calving-birth interval, age at first calving, age at first

service, and weaning weight, affect the age at weaning (AAW). The principal component analysis for productive, reproductive, and demographic variables, through the cosine angle opening, suggested a relationship between the number of births per animal (NBA) and birth weight (BW), both of which exhibited similar variability based on the vector length (**Figure 3**).

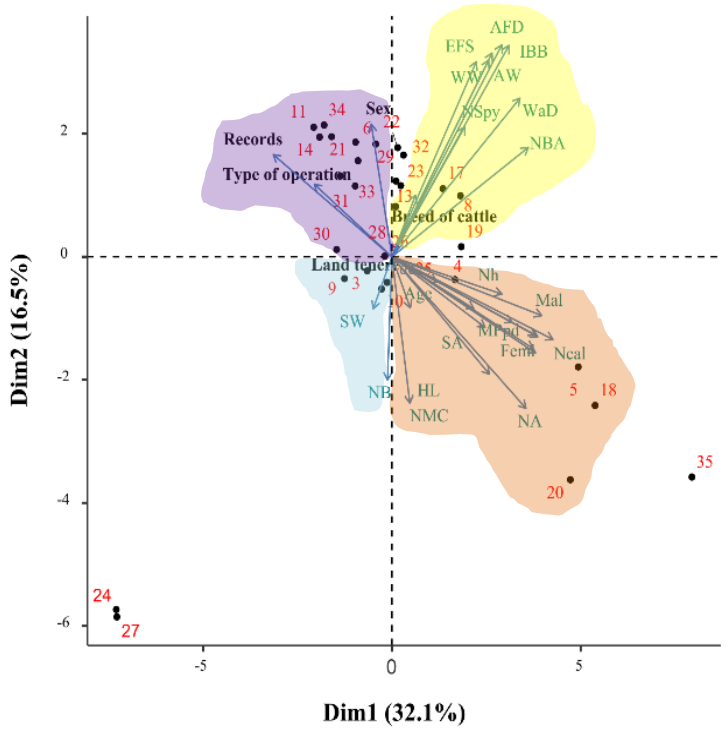

Figure 3. Principal component analysis for productive, reproductive, and demographic variables. NSpy: Number service per years, MPpd: Milk production per day, AFC: Age at first calving, AFs: Age at first service, Mal: Males, Feml: Females, Nh: Number of heifers, WW: Weaning weight, WaD: Weight at delivery, AAW: Age at weaning, NBA: Number of births per animal, AN: Animals number.

The reproductive variables of age at first service, weaning weight, age at weaning, interval between births, number of services per years are closely related, and NSpy exhibits the

least variability. It was identified that the type of land ownership (own, leased, upon division and inheritance), and others such as race (Charolais, Holstein Friesian, Brown Swiss, Gyr, Girolando, Jersey, Ayrshire, Normand, Red Viking) and age of the owner, as the most determining factors according to their proximity to the point of origin, which were closely related to the amplitude of the cosine of the angle with hectares of land and variables that describe the movement of the herd, Nh, males, females, number of calves, number of bulls, animals number, age at slaughter, MPpd, and SW (**Figure 3)**.

A correlation matrix between productive and categorical variables revealed no significant relationships, except for the BC was found to have a weak but positive and significant correlation with the type of operation (extensive, semi-intensive, and intensive) ($r = 0.47$, $P \leq 0.01$) and with the production type (meat, milk, mixed) ($r = 0.37$, $P \leq 0.05$) [**Figure 4**].

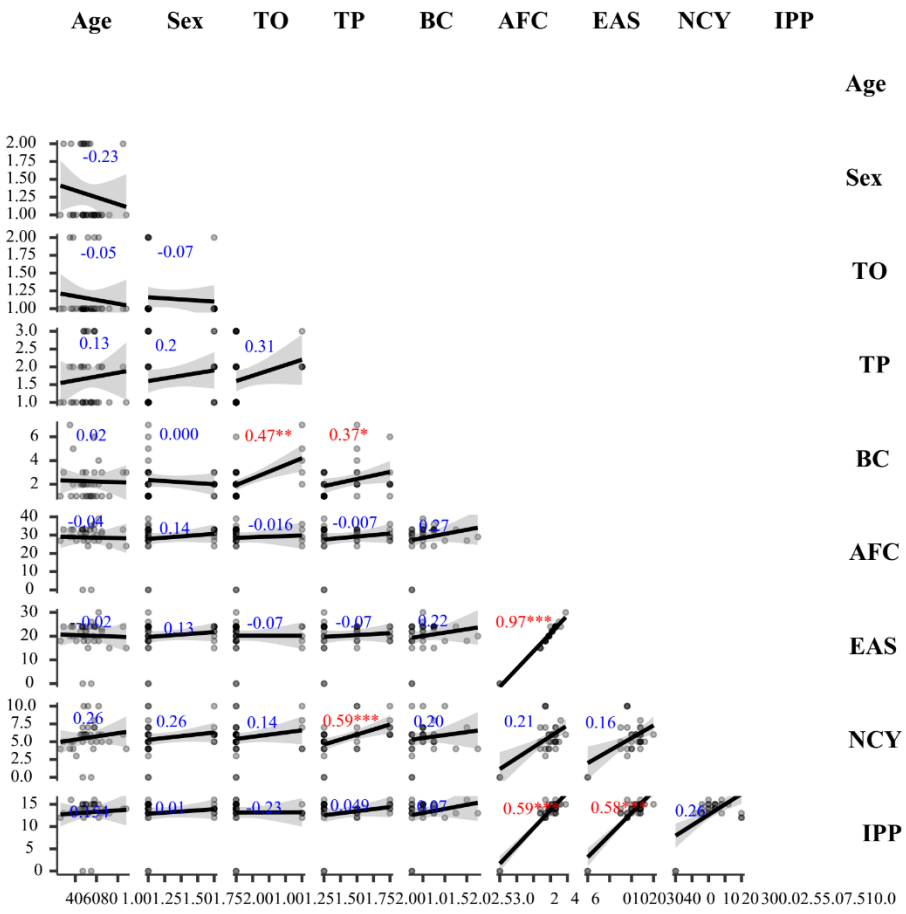

Figure 4. Correlation between productive variables and demographic variables (sex and age) of producers. TO: Type operation, TP: Type production, BC: Breed of cattle, AFC: Age at first calving, AFs: Age at first service, NCY: Number of calvings per year, IBD: Interval between deliverys.

However, AFs exhibited a strong and significant correlation with AFC (r = 0.97; P ≤ 0.001). In contrast, the TP had a significant (P ≤ 0.001) but weak correlation (r = 0.59) with the NCY. Similarly, the interval between deliverys significantly (P ≤ 0.001) but weakly correlated with both AFs (r = 0.58) and AFC. Among the reproductive variables, birth weight showed a weak positive correlation with the AN (r = 0.44) and WW (r = 0.52) at EAR, suggesting that it may be an influential indicator of bovine health and development.

Similarly, MPpd exhibited a low but positive correlation with AN and WW (r = 0.44, P ≤ 0.01). Additionally, animal weight and NA were correlated (r = 0.39, P ≤ 0.05). Moreover, the sex of the producers appeared to weakly but significantly (P ≤ 0.05) influence the NA they could manage (**Figure 5**).

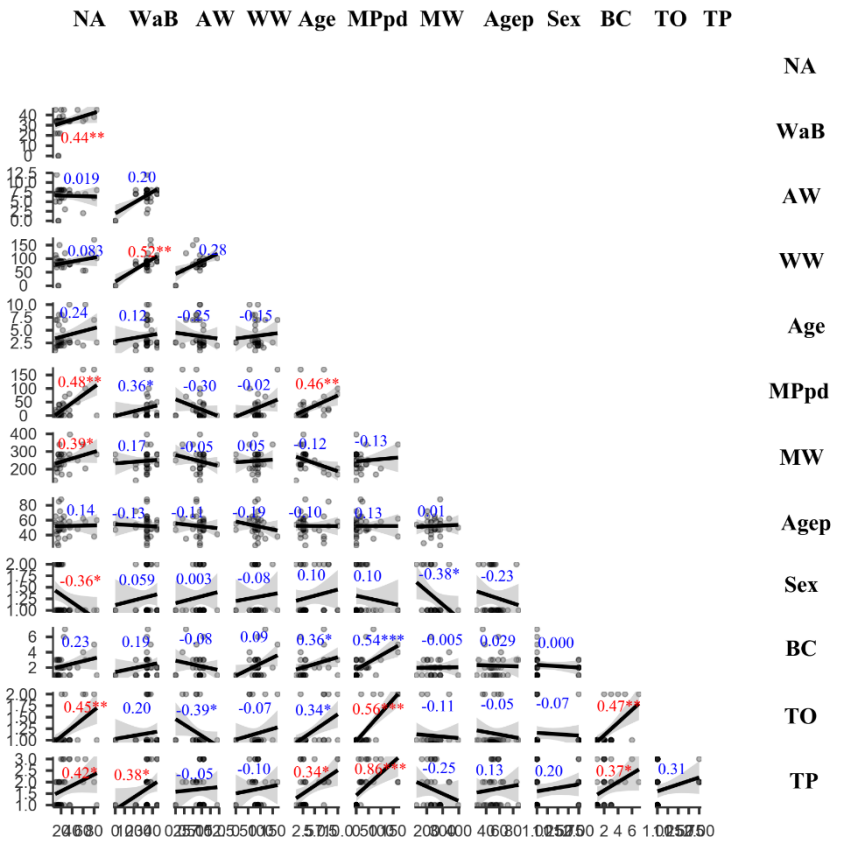

Figure 5. Correlation between reproductive variables and demographic variables (sex and age) of producers. AN: Animals number, WaB: Weight at birth, AAW: Age at weaning, WW: Weaning weight, Age: Slaughter age, MPpd: Milk production per day, MW: Market weight, Agep: Age producers, BC: Breed of cattle, TO: Type organization, TP: Type production.

The exploitation technology is associated with the AN, WaB, WW, and the sex of the producers, showing a weak but positive correlation (r ≥ 0.40, P ≤ 0.05). In contrast, the

age at slaughter exhibited a strong and highly significant correlation with the TP (r = 0.86, P ≤ 0.001). A correspondence analysis between demographic categories, herd control, and production systems revealed that the age category had no association with the other variables under study. However, the type of farm was strongly related to cattle breeds and the producer's sex. Additionally, land ownership and herd control records showed no connection to the productive purposes of interest within the areas considered in this study (**Figure 6**).

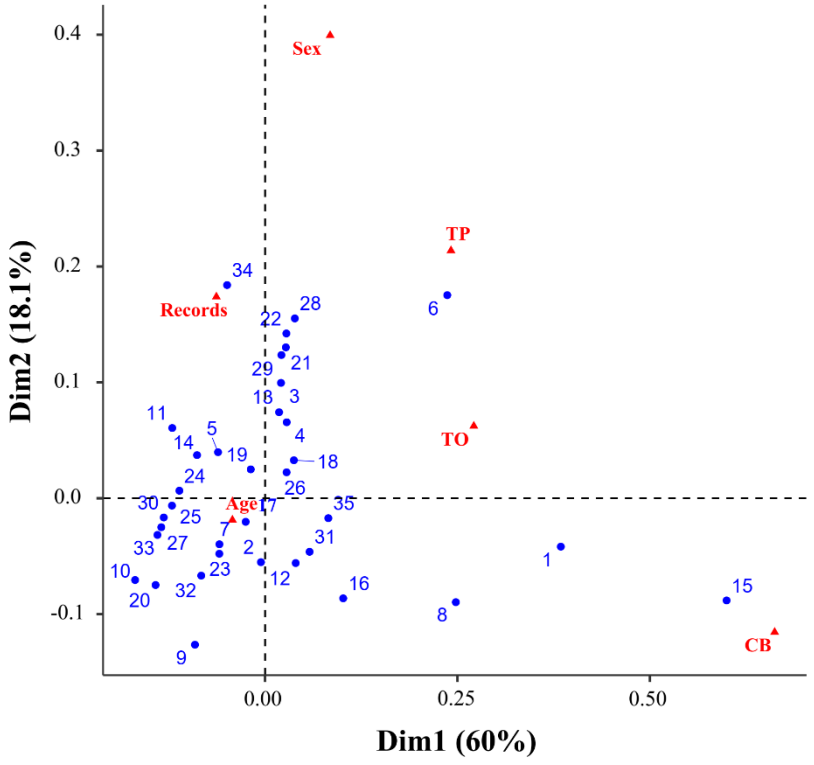

Figure 6. Correspondence analysis between demographic categories, herd control and production systems. Type of production, TO: Type of operation, CB: Breed of cattle.

Discussion

The Nangaritza canton, located within the EAR, is considered a conflict area, along with the other provinces of the EAR. In this tropical foothill region of Ecuador,[13] proposed an optimal herd composition to minimize genetic resource loss caused by improper management. Their suggested structure includes 29.8 cows, 17.58 calves, 25.4 heifers, 16.5 young bulls, and 5.6 bulls within the total herd.

Based on the recommended herd structure, the present study found an excess of cows and bulls by 17.4 % and 78.6 %, respectively, along with a deficit of heifers (21.3 %), calves (3.3 %), and young bulls (39.4 %). Despite acceptable birth rates among females in the pre-reproductive stage, stagnation is anticipated due to the low seasonal productivity of pasture.[14] This is exacerbating the problems currently facing the bovine production cycle in the region under study. Stagnation in any category disrupts the production cycle, but when it comes to disruptions in the production cycles of females, the scope has reproductive implications, a determining factor for any bovine farmer, as it forms the basis of the zootechnical flow pyramid.

A similar situation was identified by in Pastaza, Ecuador,[13] where stagnation among pre-reproductive females was attributed to insufficient weight for early reproductive integration. This deficiency in the reproductive process significantly deviated from the optimal parameters for herds with high reproductive efficiency.[15] Also reported a similar situation in Peru, attributing it, along with other factors, to the quality of the cattle (90 % criollo or crossbred).[16] This aspect is particularly relevant, as in the Zamora-Chinchipe province, the predominant cattle breeds are mestizo (49.7 %) and criollo (29.1 %).[5] This

preference is justified by the cattle's resistance to diseases and their ability to adapt to the climatic and management conditions of the Amazon.[17]

In terms of meat production, the number of developing males (bulls) could be recovered. However, the current number of bulls exceeds the recommended amount, making it reproductively inefficient, particularly since the reproductive system includes artificial insemination techniques. Nonetheless, this approach could serve as a strategy to produce high-quality calves for the milk or meat market, generating economic benefits.[16]

The results suggest a lack of sufficient knowledge in herd management, coupled with production systems unsuitable for the environmental conditions and productive culture. The primary issue identified is the application of production technology that is not well-suited to the ecosystem, a common challenge across the EAR provinces.[13, 18]

The above may explain the omission of heifers as a weight variable (**Table 2**), as they often serve as a link for herd replacement in reproduction in many regions.[13] In Zamora-Chinchipe province, the weight score assignment in the PCA is negligible (< 20), resulting its exclusion by Kaiser-Meyer-Olkin measure, as it was deemed irrelevant in contributing to the total variance explanation. Other studies have addressed the relationships observed for the variables grouped by each component, as follows,[19] conducted the study of 38 dual-purpose farms in the Cauto Valley, Cuba, and proposed the relationship "Productive efficiency = Organization of production + Management of cows after calving" to assess productive efficiency in such ecosystems.

Similarly, and used the same approach in the diagnosis of 16 farms in Jobabo municipality, Cuba, obtained the relationship "Productive efficiency = Organization of production + Organization of the reproductive process".[15] Additionally, and in other

studied that considered 27 cattle farms in the lower basin of the Cauto River, Cuba,[19] suggested the relationship "Reproductive efficiency = organization of production + organization of reproduction + carrying capacity of the system."

In this study, the relationship "Productive efficiency = production organization + reproductive organization + marketing" was found, indicating that productive efficiency is a complex, multifactorial process that varies across ecosystems. According to,[20] this can be seen as a dynamic, sustainable phenomenon. It is also important to consider the cultural factors in bovine production, as they influence the management strategies needed to achieve productive efficiency.[21]

In the context of Nagaritzia, Ecuador, age at first service, age at first calving, and interval between calvings are the key factors in reproductive efficiency, with values of 0.91, 0.92, and 0.94, respectively, in the "Reproductive efficiency" component. A similar study by[15] in Cauto Valley, Cuba, found a strong link between calf management and lactation, supporting the idea that reproductive practices differ by region and ecosystem.

However, in the present study, criteria such as available area, productivity and reproduction were closely related (**Figure 3**).[19] recommended quartering to make better use of the available area and increase pasture and herd productivity while ensuring herd health. They also observed a linear relationship between the number of paddocks and the reproductive index. In contrast, this study found correlations between bovine farm type, cattle breed, and milk and meat production (**Figure 4**), which are primarily linked to cattle feeding strategies, a topic widely discussed in scientific literature.[22–24]

Under different production conditions, these variables are linked to food availability, land area, and grazing group organization.[8] In this study, the focus on producing young

bulls with desirable traits for the meat market could be seen as a strategy to address market instability, particularly fluctuations in meat prices.[16, 25] Regarding the relationship between demographic variables (sex and age) and reproductive variables (**Figure 6**), several studies have emphasized its importance.[26–28] However, in this study, no clear relationship was observed, possibly due to the complex nature of families involved in agricultural production. Additionally, the correlation between SW and TP (meat, mixed, milk) has been explored. It is noted that in extensive systems, meat and milk yields tend to decrease due to the characteristics of the production system itself. Other studies have compared these systems, highlighting both the benefits and drawbacks for bovine production.[29, 30]

Conclusions

This study shows that the most important aspects to consider for achieving productive efficiency are the relationship between "herd organization + production organization + marketing." A stagnation in the flow of female cattle replacements was detected as a deficiency among production strategies, an aspect that is compensated for by the sale of male cattle. In addition, an imbalance between the different categories was noted, which together creates an environment that hinders the optimization of the production process. Subsequent studies will consider this contribution for the development of new results that will strengthen the baseline for bovine farming in the Guaizimi Nangaritza region, Zamora-Chinchipe, and establish viable tools and incentives for producers to control production and reproduction indicators.

Data availability

All relevant data are within the manuscript and its supporting information files.

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Conflicts of interest

“The authors have no conflict of interest to declare in regard to this publication”.

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