

Factors Affecting Weight Gain in Nelore Calves from Birth to Weaning in the Bolivian Tropic

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Abstract

Retrospective data corresponding to the period between 2002 and 2018 were used, belonging to the Cooperativa Agropecuaria Integral San Juan de Yapacan í Santa Cruz, Bolivia. Data corresponding to 663 male and female calves born to primiparous and multiparous cows were used. The calves had 13 individual weight controls. The calves had 13 individual weight controls. Variables used: Date of birth, Calf live weight at birth in kg, Calf live weight at weaning in kg, Average daily gain in kg, Live weight of cow in kg, Number of calving of cows.

The mean values and standard deviations of the weights at birth were 35.1 ± 4.6 kg for males and 32.3 ± 4.7 kg for females, at 240 days (weaning) the weight of the males was 229 ± 35.8 kg and for females 206 ± 31.5 kg. The mean values and standard deviations of the weight increases were 0.807 ± 0.14 kg for males and 1.0 ± 0.13 kg for females. The selected model with the regressor variables: Year, Sex of the calf, Number of calving and Live Weight at Birth, all significant ($p \leq 0.001$). No interaction was significant to be considered in the model ($p \geq 0.05$). The live weight at birth, the sex, the years and the number of deliveries of the mothers showed in this work and for the animals analyzed to be the factors affecting the increase in live weight in the rearing stage (from birth to weaning) in Nelore calves in the Bolivian tropics.

Keywords: Nelore calves, birth weight, weaning weight, calving number, grazing system

1. Introduction

An objective to be met by any livestock system is that it generates efficient productive results that allow maximizing economic returns (Damasceno Carvalho et al., 2015).

The production of beef cattle has calves as one of the main stages in the production chain. Although this does not always generate the highest income as if it does the fattening stage, it is still the main link for the maintenance of the meat production chain (Christofari et al., 2008; Gomes et al., 2013). An economic indicator in the beef cattle industry is birth weight, this being the first variable to be measured in a calf (Utsunomiya et al., 2013). The growth phase until weaning in beef cattle is considered very important.

The stage from birth to weaning in beef cattle is considered of utmost importance. During this phase there are several factors that must be taken into account, among them: maternal aptitude, genetics, sex, month and year of birth, the age of the cow and the age of the calf. (Paro de Paz et al., 1999).

Mart ínez et al. (1998) showed that the elements that most affect the weight of the calf at weaning were: the date of delivery, year of birth, sex of the calf and age of the cow. Being significant the interaction of date of delivery x year of birth. Analyzing and understanding the behavior of the weights of calves born according to the different times of the year is necessary to improve economic performance (Reisenauer et al., 2001).

The Beef Cattle Selection Index is a tool used based on calf weights at a very young age. The average daily

weight gain is a factor that indicates the growth potential of an animal and gives the possibility of using it as a selection indicator, helping to deepen an increased earliness of growth and greater weight at slaughter. Although, the search for greater weight in young calves may lead to a higher live weight at mature age, with the consequence that this entails (higher maintenance costs) due to this directional selection. (Silva et al., 2001; Boligon et al., 2009).

For this reason, the objective of this work was to evaluate the factors that affect live weight gain from birth to weaning in Nelore calves in grazing systems in the Bolivian tropics.

2. Materials and Methods

Retrospective data corresponding to the period between the years 2002 and 2018, belonging to the Cooperativa Agropecuaria Integral San Juan de Yapacan í(CAISY) located in the Japanese Community San Juan (16 ° 59 ' 0 " of the south latitude, 63 ° 58 ' 0 " west longitude) Santa Cruz, Bolivia. They are located at an altitude of 286 m.a.s.l., the tropical climate, with abundant rains for much of the year and only three dry months without rain. The average temperature is 24.3 °C annually, rainfall is between 986 mm and 1805 mm on average for both cooperatives.

2.1 Animals

The data corresponding to 663 male and female calves born to primiparous and multiparous cows between 2002 and 2018 were analyzed. In the months of May and July of each year, the primiparous cows calve (they enter earlier in order to have a better recovery before entering in service for the second time), and the multiparous cows calve between the months of July and September. In the months of October and November all the cows that go into heat are inseminated, December and January the bulls enter. Calves are weaned at 240 days. The cows are checked gynecologically at weaning, as well as their health. All calves from birth to 240 days individual live weights were obtained every 30 days.

2.2 Feeding and Handling

The herd fed on an intensive grazing basis (high load in reduced space). The pastures were composed of *Brachiaria decumbens*, *Brachiaria humidicola*, *Brachiaria dictyoneura*, *Cynodon dactylon* and *Panicum maximum cv mombaza*.

2.3 Body Weight Record

13 individual live weight controls were performed on all calves, at the same time (8:00 am) with confinement in pens the night before. A brand manual scale (POCKET BALANCE; Made in Germany) was used for the first day of birth. From two months of age, mothers and babies were weighed with a brand electronic scale (ICONIX New Zealand Ltd.).

2.4 Variables Used

Date of birth (DB)

Calf live weight at birth (CWB) in kg

Live weight of the calf at weaning (CWW) in kg

Average daily gain in kg (CWW - CWB) / 240 days

Live weight of cow (LW) in kg

Number of calving (NC)

2.5 Statistical Analysis

A Multiple Linear Regression Model was applied. To select the best predictors, the Stepwise method is used based on the bidirectional approach, which in each step tests which variables are excluded or included in the model. The quality of the model was evaluated using the Akaike criterion. The model selected by the previous method was the one that contained as regressors the variables: Year, Sex of the calf, Number of calving and Live Weight at Birth. No interaction was significant to be considered in the model. The statistical analyzes were carried out with the R 4.0.0.

3. Results and Discussion

The mean values and standard deviations of the weights at birth were 35.1 ± 4.6 kg for males and 32.3 ± 4.7 kg for females, at 240 days (weaning) the weight of the males was 229 ± 35.8 kg and for females 206 ± 31.5 kg.

The mean values and standard deviations of the weight increases were 0.807 ± 0.14 kg for males and 1.0 ± 0.13

kg for females.

Table 1. Model

Variables Regresoras	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Year	1	30903	31.5271	3.042e-08	***
Sex	1	79647	79647	81.2567	< 2.2e-16***
NC	1	12417	12417	12.6681	0.0004021***
BW	1	4937	4937	5.0363	0.0251948*
Residuals	585	573411	980		

ns (not significant); * ($p \leq 0.05$); ** ($p \leq 0.001$); *** ($p \leq 0.0001$)

NC: Number of calving; BW: Birth weight

Table 1 shows the results of the selected model with the regressor variables: Year, Sex of the calf, Number of calving and Live Weight at Birth, all significant. No interaction was significant to be considered in the model.

Table 2. Coeficients Estimated

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	-2064.6284	533.4270	-3.870	0.000121 ***
Year	1.1161	0.2657	4.200	3.08e-05 ***
Sex	21.1976	2.6995	7.852	1.96e-14 ***
NC	2.9235	0.8484	3.446	0.000610 ***
BW	0.6175	0.2752	2.244	0.025195 *

ns (not significant); * ($p \leq 0.05$); ** ($p \leq 0.001$); *** ($p \leq 0.0001$)

NC: Number of calving; BW: Birth weight

Table 2 shows the results of the estimated values of the variables identified in the model. Residual standard error: 31.31 on 585 degrees of freedom Multiple R-squared: 0.1824, Adjusted R-squared: 0.1768 F-statistic: 32.62 on 4 and 585 DF, p-value: <2.2e-16

In Nelore cows, calving ease is associated with low birth weights of 30 kg on average. The live weight of the calf at birth is indicative of the ability to express its genetic potential, although it must be monitored to prevent dystocia (Menezes et al., 2013; Araújo et al., 2014).

In this work, the birth weights were 35.1 ± 4.6 kg for males and 32.3 ± 4.7 kg for females (Figure 3). Being similar to those reported by Ikeda *et al.* (2020) and Dias *et al.* (2015), not coinciding with what was presented by Molina Kamei *et al.* (2017) where the average birth weight was 37.6 kg. Although, in Figure 3 it is observed that live weight at weaning has a direct relationship with live weight at birth and that it is highly variable within sex, being deeper in males.

Direct additive genetic effects and maternal effects influence calf growth characteristics (Albuquerque and Meyer, 2001).

In tropical breeds, maternal effects are often missed during genetic evaluation due to limited data (Wasike et al., 2009). In this work the live weights at 240 days (weaning) of the males was 229 ± 35.8 kg and for the females 206 ± 31.5 kg, higher than those recorded by Lopes et al. (2013), where the mean weight at the 240 days was 183.8 kg, but similar to those reported by Dias et al. (2015) with live weights at weaning of 232.2 ± 19.2 .

The live weight at weaning is related to the mean live weight gain, which were 0.807 ± 0.14 kg for males and 1.0 ± 0.13 kg for females. This difference could have been in part due to the management, quality and quantity of pastures received by the calves analyzed in this work (Figure 1, Table 2, Table 3 and Table 4).

Table 3. Estimated equations for male calves according to the model used

Male	
Intercept	-2043.4308
Year	1.1161
Number of calving	2.9235
Birth weight	0.6175

Table 3 shows that the final live weight at average weaning in calves increases 1.11 kg for each year that passes.

Table 4. Estimated equations for female calves according to the model used

Female	
Intercept	-2064.6284
Age at calving	1.1161
Live weight	2.9235
Average weaning weight	0.6175

Table 4 shows that the final live weight at average weaning in calves increases 1.11 kg for each increase in the mother’s age

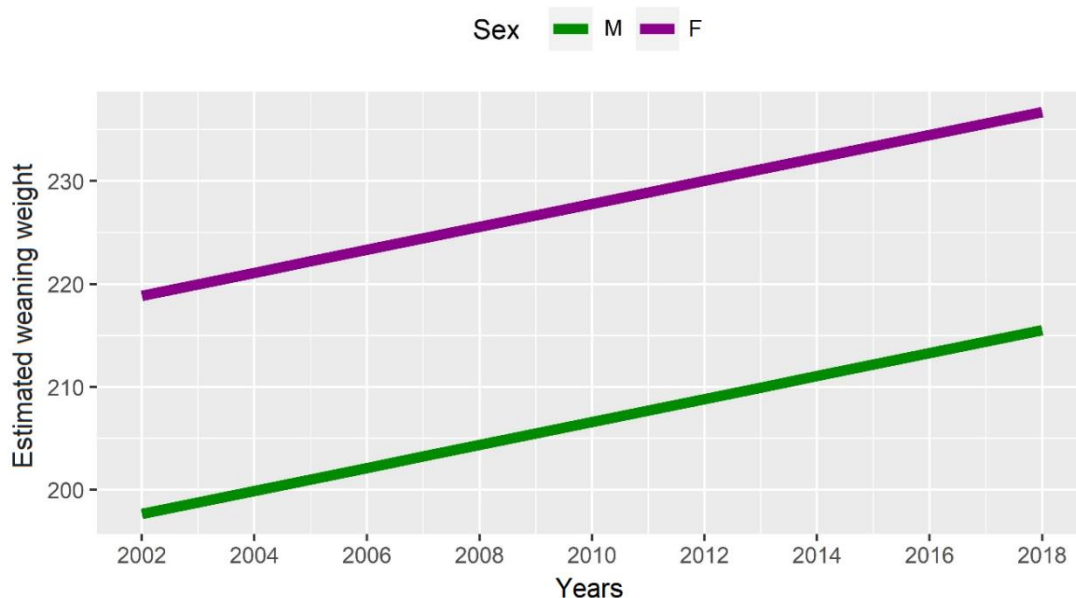


Figure 1. Estimated weaning weight according to years for each sex

Figure 1 shows how the weaning weight in both calves and calves had a sustained increase in kg at weaning through the years analyzed, both in a linear trend.

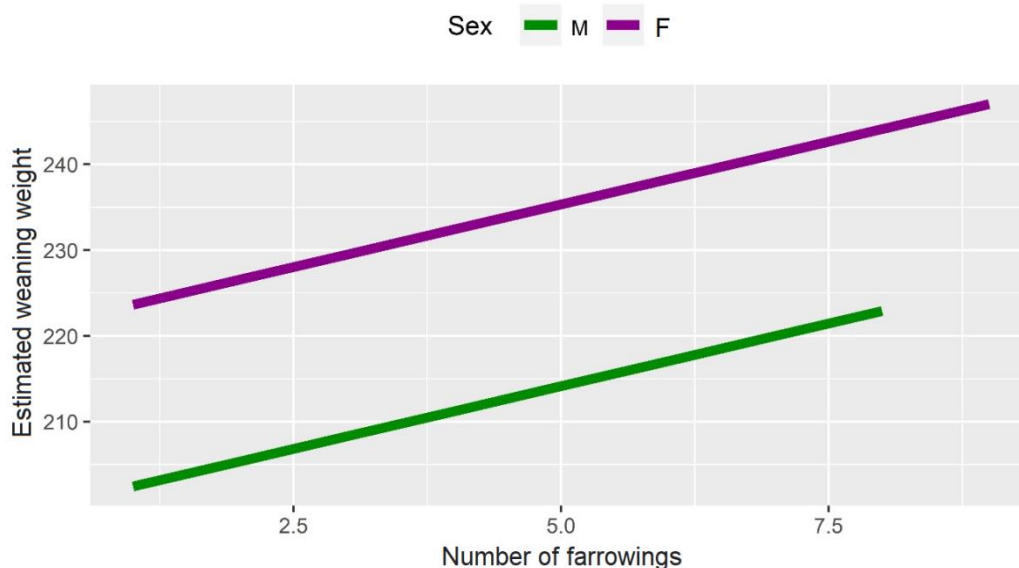


Figure 2: Estimated weaning weight according to Number of farrowings for each sex

Figure 2 shows how the estimated weaning weight in both calves and calves had a sustained increase in kg at weaning according to the number of calving of the cows, both in a linear trend. The effect of the age of the cow on the weight is a consequence mainly of the maternal capacity, more specifically of the milk production capacity in the cow during its useful life (Figure 2).

In general, the weight of weaned calves increases with the age of the cow, until it reaches physiological maturity, a time when the cows show greater performance in the characteristics of maternal capacity. After maturity, the tendency is for calves to lose weight (Paro de Paz et al., 1999).

The results of this study do not coincide, where the cows showed that the greater the number of calving they had a greater weight at weaning, and coinciding with the results shown by Ikeda et al. (2018) where the adult cows had a higher calf weight at birth without showing significant differences with the group of young cows (GA: 34.1 ± 0.8 ; CG: 32.3 ± 0.5 kg).

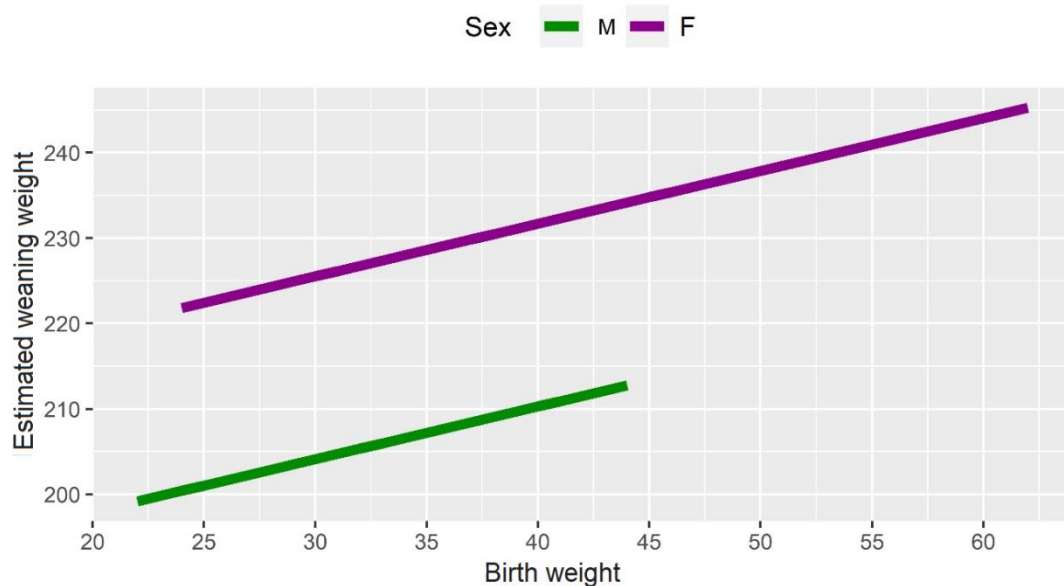


Figure 3. Estimated weaning weight according to birth weight for each sex

Figure 3 shows how the estimated weaning weight in both calves and calves had a sustained increase in kg at weaning according to birth weight, both in a linear trend. Cabrera *et al.* (2001) conclude in their work that the magnitude of the maternal effect and the effect of the environment on the cow were of magnitude in all the live weights analyzed at weaning, thus suggesting their inclusion in the different models.

4. Conclusions

The live weight at birth, the sex, the years and the number of deliveries of the mothers showed in this work and for the animals analyzed to be the factors affecting the increase in live weight in the rearing stage (from birth to weaning) in Nelore calves in the Bolivian tropics.

Conflict of Interest

The authors declare that they have no competing interests.

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