ISSN: 2054-7412

SERVICES FOR SCIENCE AND EDUCATION UNITED KINGDOM

EJAS European Journal of Applied Sciences

VOLUME 8, NO 4

# Age at First Calving and its Relationship with Efficiency Indicators in Nelore Cows in a Grazing System in the Bolivian Tropics

**[1]Atsuko Ikeda, [2]Yoichiro Hayashi, [3]Juan Antonio Pereira, [1,4]Pablo Roberto Marini**

*[1]Faculty of Veterinary Science, Universidad Nacional de Rosario, Argentina*

*[2]Cooperativa Agropecuaria Integral San Juan de Yapacani, Bolivia*

*[3]Faculty of Veterinary and Zootectist, Universidad Autonomo Gabriel Rene Moreno, Santa Cruz, Bolivia*

*[4]Career of the Scientific Researcher (CIC-UNR), Universidad Nacional de Rosario, Argentina*

atsukoikedakato@hotmail.com,

**ABSTRACT**

Age at first calving is a factor attend for female cattle efficiency. The objective of this study was to evaluate the age at first calving and its relationship with productive efficiency indicators in Nelore cows in a grazing system of the Bolivian tropics. For the research, retrospective data corresponding to the period between 2005 and 2019 were used. The data belong to the Cooperativa Agropecuaria Integral San Juan de Yapacaní, Santa Cruz - Bolivia. The data corresponding to 259 Nelore breed cows, primiparous and multiparous, with a total of 800 calvings were used. The age at first calving of the cows was 1098 ± 152 days for the total of the cows analyzed. That three groups of cows were found with significant differences ($p \leq 0.05$) among them according to age at first calving, where from that differentiation the cows that take longer to reach their first birth (1263 days) have an intermediate longevity (2203 days), the highest live weight, the lowest number of births and the shortest calving interval (440 days). The Accumulated Production showed that the cows of with significant differences ($p \leq 0.05$) among them according to age at first calving. In the same way the low age category showed the Calf Index. It is concluded that the age at first birth does not affect longevity, reproductive behavior and the number of births during their life. But when compared with efficiency indicators such as the Accumulated Production and Calf Index, the cows belonging to the low age category were the most efficient.

**Keywords:** Age at first calving, Grazing system, Nelore cows, Productive efficiency indicators

## 1 Introduction

The Nelore breed is the most important among bovine breeds destined for meat production in Bolivia. Proof of this is that 8% of the bovine population for meat corresponds to pure animals of this breed and 75% to Nelore crossbred animals. The pre-eminence of the breed is explained by its natural adaptability to the sub-tropical environment. The Nelore breed, whose origin dates back more than 3,000 years in the State of Madras (India), and which was introduced in Bolivia more than 70 years ago, is the bovine with the greatest potential for impact, expansion and development within of the cattle herd of Santa Cruz. According to the Federation of Cattlemen of Santa Cruz in 2012, it represented 42.2% of the total stock that amounted to 3,591,946 heads [17]. The incorporation of

**DOI:** 10.14738/aivp.84.8865
**Publication Date:** 23th August, 2020
**URL:** http://dx.doi.org/10.14738/aivp.84.8865

Nelore breed cattle into production systems is, therefore, an extraordinary advance for obtaining heavier animals with high daily profits at a lower cost, that is, more efficient. Boligon *et al*. concluded in a work that inclusion of age at first calving in the selection index should improve the reproductive and productive performance of females [2]. The disposal of young cows regarded to weights and/or weight gain may reduce at long-term the age at first calving of females. However, the selection considering only a greater weight gain until after yearling can cause increased female mature weight that depending on the production system, is not desirable.

Age at first calving is a bottleneck for female cattle efficiency according to Nogueira [15], and essentially all Nelore females currently calve for the first time at three to four years of age [14]. Several factors can influence this discrepancy, such as average age at slaughter, reproductive efficiency and feeding system [3]. According to Lôbo [9], in extreme dry areas in northeast of Brazil, first calving can occur as late as five years of age.

In addition to its potential in terms of animal growth, two other important characteristics that define the biological aptitude of a breed, such as the survival capacity and reproductive potential, cannot be omitted. Thus, the fertility and fecundity of the herds and the persistence of the breeding stock in the system are presented as characters no less important than the growth itself and as such should be taken into consideration [5]. These same authors evaluated the reproductive parameters of Nelore cows in the Parabano ranch (Cordillera Province, Santa Cruz Department) and concluded age at first calving was 1086 ± 268 days and average interval between calving of 476 ± 128 days. A work by Ikeda [7] showed in Nelore cows grouped according to age: Adult Group, cows that were ≥ five years old and Growth Group, cows that were less than five years of age, that adult cows had the lowest calving intervals (Adult Group: 379.9 ± 28, Growth Group: 505.6 ± 18 days), better body condition (Adults Group: 2.4 ± 0.06, Growth Group: 2.2 ± 0.02), the highest live weight (Adult Group: 461.3 ± 7, Growth Group: 418.3 ± 5 kg,) and greater weight of the calf (Adults Group: 34.1 ± 0.8, Growth Group: 32.3 ± 0.5 kg). It has been concluded that adult cows have a better productive and reproductive behavior, and as a consequence, spend lower costs during the productive cycle. Consequently, the objective of this study was to evaluate the age at first calving and its relationship with productive efficiency indicators in Nelore cows in a grazing system of the Bolivian tropics.

## 2 Materials and Methods

For the research work, retrospective data corresponding to the period between 2005 and 2019 were used, belonging to the San Juan de Yapacaní Integral Agricultural Cooperative (CAISY) located in the San Juan Japanese Community, Santa Cruz, Bolivia (16 ° 59 ' 0 "south latitude, 63 ° 58 '0" west longitude). The Japanese community is located at 286 meters above sea level and presents a tropical climate, with significant rainfall in most months of the year and a short dry season with little effect on the general climate.

The annual average temperature is 24.3 ° C in San Juan de Yapacaní with average rainfall of 1805 mm. The precipitations are minimum in the month of July, with average values of 50 mm. The rainiest month in January with an average rainfall of 330 mm. The highest average temperatures correspond to the month of January, with values of 26.5 ° C and the lowest to the month of July with records of 20.7 ° C

## 2.1 Animals

The data corresponding to 259 Nelore cows, primiparous and multiparous, with a total of 800 calvings were used. The primiparous cows have birth between the months of May and July of each year, while the rest do so between the months of July and September. Weaning calves occurs between seven and eight months in several times depending on the body condition and general condition. Gynecological control is performed routinely, at weaning calves, by a technical advisor, as well as health.

## 2.2 Food and Handling

The feeding of the herd was managed under intensive grazing conditions, on 82 hectares with cultivated pastures of *Brachiaria decumbens (*10 to 14 t / ha / year of DM), *Brachiaria humidicola* (8 to 12 t / ha / year of DM), *Brachiaria dictyoneura* (7 at 9 t / ha / year of DM), *Cynodon dactylon* (10 to 20 t / ha / year of DM) *and Panicum maximum cv mombaza* (20 to 28 t / ha / year of DM).

## 2.3 Reproductive

The first artificial insemination (AI) was done to the cows in October, then the second AI in early December. In the end of December natural conceptions were made. To the heifers the first AI were performed in August then the second AI in September, natural conceptions were made in September.

## 2.4 Body weight record

During the study period, at least three individual weight controls were carried out on all cows and their young. The weighing of the animals was always carried out at the same time (8:00 a.m.) with previous confinement the previous night. To this end, an electronic balance calibrated ICONIX FX1 Mark was used for cows and calves from the two months of age and until weaning, while, at birth, the calves were weighed with a POCKET hand scale.

## 2.5 Variables to analyze

Live weight of cow (WC) in kg: average weight of cow of its life

Weight of the calf at birth (WCB) in kg: average calf weight at birth of all calvings

Weight of calf at weaning (WCW) in kg: Average weight of calf at weaning of all calvings

Total weight of weaned calf (WWC) in kg: Σ of weights at weaning of each cow)

Age at first calving (AFC) in months: Age of first birth (date of birth - date of first calving)

Number of calving (NC): The number of births (Σ of births of each cow)

Longevity (L) in days: Discard date or death - date of birth

Calving interval (CI) in days: average days between calvings

Calf Index (CT) in kg: Total production of weaned calf / longevity

Accumulated Productivity (PAC) in kg [10]

$$PAC = \frac{P_d * n_p * C_a}{EVP_n - C_i}$$

PAC: Pd = average weight of weaned calves (kg); np = total number of calves produced by the cow (born calves); Ca = constant equal to 365 days that allows expressing fertility on an annual basis; EVPn = age of the cow at the last parturition (days); The characteristics were analyzed using Ci = constant equal to 550 days approximately 18 months, representing the age at the first conception.

# 3 Results

The age at first calving (average ± standard error) of the cows was 1098 ± 152 days for the total of the cows analyzed. Table 1 shows that three groups of cows were found with significant differences (p≤0.05) among them according to age at first calving, where from that differentiation the cows that take longer to reach their first birth (1263 days) had an intermediate longevity (2203 days), the highest live weight, the lowest number of births and the shortest calving interval (440 days). At the other extreme, younger cows at the time of first birth (964 days), had the longest longevity (2448 days), intermediate live weight, the highest number of births and an intermediate calving intervals (459 days).

**Table 1: Productive and reproductive variables by category**

| Category (Number of cows) | AFC (days) | L (days) | LW (kg) | NC | CI (days) |
|---|---|---|---|---|---|
| Low (86) | 964±12 $^{c}$ | 2448 ± 104$^{a}$ | 494 ± 6$^{ab}$ | 3 (1-11) | 459 ± 16$^{a}$ |
| Medium (86) | 1086 ± 12$^{b}$ | 2195 ± 104$^{a}$ | 477 ± 6$^{b}$ | 3 (1-9) | 481 ± 16$^{a}$ |
| High (87) | 1263 ± 12$^{a}$ | 2203 ± 103$^{a}$ | 499 ± 6$^{a}$ | 2 (1-9) | 440 ± 18$^{a}$ |

Note: Different letters in the column indicate significant differences (p≤0.05). NC was not statistically significant by the Wilcoxon test and the Kruskal-Wallis test.

All values correspond to the arithmetic mean ± standard error with the exception of the NC (number of calvings) median and ranges AFG: Age at first calving, L: Longevity, LW Live weight, NC: Number of calvings, CI: Calving interval

In Table 2, it was observed that the results of the Accumulated Production showed that the cows of with significant differences (p≤0.05) among them according to age at first calving.

The results showed that the group of cows of the low age category was the one with the highest Calf Index, producing since the birth of 0.257 kg of calf per day. For the two aggregate indicators used in this work, the cows of the low age category at first birth were the most efficient.

**Table 2: Variables of productive efficiency by category**

| Category (Number of cows) | PAC (kg) | CT (kg) |
|---|---|---|
| Low (86) | 126.8 ± 3.8$^{a}$ | 0.257 ± 0.1$^{a}$ |
| Medium (86) | 124.1 ± 3.8$^{ab}$ | 0.248 ± 0.1$^{ab}$ |
| High (87) | 108.3 ± 3.8$^{b}$ | 0.215 ± 0.1$^{b}$ |

Note: Different letters in the column indicate significant differences (p≤0.05)

PAC : Accumulated Productivity in kg of weaned calf per year

CT: Calf Index ,Total production of weaned calf / longevity

# 4 Discussion

The results of age at first calving (AFC) are below that reported by Duitama *et al*. [4] where it showed that the average in Brahman cows was 1226 days being similar to the values found in Nelore cattle [10], and of 1180 days reported by García *et al*. [6]. Although, coinciding with the results presented by Flores and Ortiz [5], where they evaluated Nelore bellies in the Parabano ranch (Cordillera Province, Santa Cruz Department) where the age at first birth was 1085 ± 268 days. The longevity showed in this work, that the group of lower age at first birth (964 days) in coincidence with the results of Segura-Correa *et al.* [22], where it was reported that the cows that had their first birth at two years of age,

they had a better rate of permanence after their third season of service than the cows that gave birth at three years of age. The same trend has been reported for the Brown Swiss breed as the discar rate increases linearly as the age at first birth increased [23], since the delay in age at first birth is related to a low fertility [18]. Age at first birth can influence the number of births of a cow during its useful life in the herd, because the higher sexual precocity of the cows leads to a longer productive life [16,18,23]. A disadvantage of cows that have calves younger ages, however, is that they are more likely to have dystocic births and produce lighter calves at first calving than females that calve for the first time at older ages. However, in the long term, females that calve for the first time at an early age tend to recover and surpass the accumulated performance of those that calve at older ages[16].

The growth of the animals is related to the capacity of gain of corporal mass, being affected by the feeding, climatic conditions, health and genetics. Knowledge of this process is very important for meat production systems, because it is possible to identify life stages of the animal that describe different growth rates [11, 13]. The weights found are higher than those cited by Rosa *et al.* [20], where the average adult weight was 447 kg, with a coefficient of variation of 11%, but below those found by Lopes *et a*l. [12] of 555 ± 71 kg in adult cows. Age at first calving is the most used female reproductive trait to evaluate the fertility in beef cattle. This trait can be measured early and it is easily obtained, being expressed in most of the females placed in breeding. Nevertheless, is not simple because the reproductive traits generally have low heritability according to Boligon *et al*. [2]. With respect to reproductive behavior, the AFC (mean ± standard error) of the cows was 458 ± 122 days for the total of the cows analyzed, these results being similar to the previous one of Ikeda and Marini [8] where they found that the cows the longest had the lowest intervals between calvings with an average interval between calvings of 476 ± 128 days and at 439 days reported by García *et al.* [6].

They are superior to the 96.74 kg ± 46.70 kg of PAC weight reported by Azevedo *et al.* [1] and lower than those of Rosa [19] , working with herd data from the Genetic Improvement Program of the Raza Nelore in Brazil, with an average of 144 kg for PAC and Schwengber [21], also working with the information generated in the flocks of the Genetic Improvement Program of the Nelore Breed in Brazil with an average of the PAC of 130 kg of calves. In the same way the low age category showed the Calf Index.

The last indicator of efficiency, the Calf Index, is an indicator that involves several stages of the life of the cow, not only production, longevity and reproduction but also the stage of rearing of the cows. Within the framework of an aggregate approach, the advantage of grazing systems is sought, the kg of calf weaned by a cow do not represent the most appropriate indicator to operationalize a complex variable such as productive efficiency and other aggregate indicators should be incorporated. In a measure of more integral production as the case of PAC and CT. Having indicators of this nature would help to avoid the overvaluation of one of the characters involved in the characterization of a good cow of meat and would allow to identify the biotypes more adapted to the different environments existing in each place of production.

## 5 Conclusion

It is concluded that the age at first birth does not affect longevity, reproductive behavior and the number of births during their life. But when compared with efficiency indicators such as the PAC and CT, the cows belonging to the low age category were the most efficient.

**ACKNOWLEDGEMENT**

To San Juan de Yapacaní Integral Agricultural Cooperativa (CAISY) located in the San Juan Japanese Community, Santa Cruz, Bolivia, for facilitating the use of databases.

**REFERENCES**

[1] Azevêdo, D.M.M.R., et al., *Produtividade Acumulada (PAC) das Matrizes em Rebanhos Nelore doNorte e Nordeste do Brasil*. 2005, Revista Brasileria de Zootecnia 34: p. 54-59.

[2] Boligon, A.A., L., at al., *Study of relations among age at first calving, average weight gains and weights from weaning to maturity in Nellore cattle.* 2010. R. Bras. Zootec., v.39, n.4: p.746-751. **DOI**:10.1590/S1516-35982010000400007

[3] Day, M.L., and G.P., Nogueira, *Management of age at puberty in beef heifers to optimize efficiency of beef production* 2013. Animal Frontiers Vol. 3, No. 4: p.6-11. **DOI** :10.2527/af.2013-0027

[4] Duitama, O.C., et al. *Productividad acumulada y su relación genética con características reproductivas en hembras Brahman.* 2013. Revista Medicina Veterinaria Zootecnista de Córdoba 18: p3658-3664. **DOI:**10.21897/rmvz.132

[5] Flores, V.H.D., and T.T.J. Ortiz, *Determinación de los parámetros reproductivos de losvientres Nelore en la estancia Parabano* (Provincia Cordillera Departamento Santa Cruz). 2010.Tesis de grado FMVZ – UAGRM Santa Cruz – Bolivia: p.57.

[6] García, G.A., et al., *Caracterización productiva y reproductiva de las explotaciones ganaderas del bajo cauca y el litoral atlántico antioqueños. II*. 2003. Comportamiento de cuatro grupos raciales Bos indicus en un sistema de bosque seco tropical (bs-T). Revista Colombiana de Ciencia Pecuaria 16: p.117-125.

[7] Ikeda, A., *Evaluación de la dinámica de la condición corporal en vacas Nelore y su efecto sobre índices productivos y reproductivos en un sistema de pastoreo intensivo de producción* (prov. Ichilo Santa Cruz, Bolivia). 2018. Tesis de Maestría. Universidad Autónoma Gabriel René Moreno, Facultad de Ciencias Veterinarias (Bolivia) : p.106.

[8] Ikeda A, and P.R. Marini,. *The behaviour of nelore cows of different ages as an indicator of efficiency in a pasturing system in the bolivian tropic*. 2018 WBC2018 Congress, Japón: WBC20 Congress.

[9] Lôbo, R.N.B., *Genetic parameters for reproductive traits of zebu cows in the semi-arid region of Brazil*. 1998. Livest. Prod. Sci. 55: p. 245–248. **DOI**.10.1016/S0301-6226(98)00142-0

[10] Lôbo, R.N.B., et al., *Average estimates of genetic Parameters for beef and dairy cattle in tropical regions.* 2000 Animal Breeding Abstract 68: p. 433-461.

[11] Lopes, F.B., et al., *Ajustes de curvas de crescimento em bovinos Nelore da região Norte do Brasil.* 2011, Revista Brasileira Saúde Produccion Animal 12: p. 607-617.

[12] Lopes, F.B., et al., *Análises de dados longitudinais em bovinos Nelore Mocho por meio de modelos não lineares*. 2016. Archivos de Zootecnia 65: p. 123-129.

[13] Malhado, C.H.M., et al., *Modelos não lineares utilizados para descrever o crescimento de bovinos da raça Nelore no estado da Bahia, 1. Efeito ambiental*. 2009. Revista Brasileira Saúde Produccion Animal 10: p. 821-829.

[14] Malhado, C.H.M., et al., *Age at first calving of Nellore cattle in the semiarid region of northeastern Brazil using linear, threshold, censored and penalti models*. 2013. Livest. Sci. 154: p. 28–33. DOI: 10.1016/j.livsci.2013.02.021

[15] Nogueira, G.P., *Puberty in South American Bos indicus (Zebu) cattle.* 2004. Anim. Reprod. Sci. 82: p. 361–372. **DOI**: 10.1016/j.anireprosci.2004.04.007

[16] Núñez-Domínguez, R., et al., *Lifetime production of beef heifers calving first at two vs. three years of age.* 1991. Journal of Animal Science 69: p. 3467-3479. **DOI**: 10.2527/1991.6993467x

[17] Peredo, J.C., et al., *Producción de ganado bovino en Bolivia*. 2012. Federación de Ganadería de Santa Cruz, Santa Cruz, Bolivia: p. 3-20.

[18] Rogers, P.L., et al., *Evaluating longevityof composite beef females using survival analysis techniques*. 2004. Journal of Animal Science 82: p. 860-866**. DOI**: 10.2527/2004.823860x

[19] Rosa, A.N.,. *Variabilidade fenotípica e genética do peso adulto e da Produtividade acumulada de matrizes em rebanhos de seleção da raça Nelore no Brasil.* 1999. Ribeirão Preto: Universidade de São Paulo. Tese (Doutorado em Ciências) - Universidade de São Paulo: p. 114.

[20] Rosa, A.N., et al., *Peso adulto de Matrizes em Rebanhos de Seleção da Raça Nelore no Brasil.* 2001. Revista Brasileria de Zootecnia 30: p. 1027-1036.

[21] Schwengber, E.B., et al., *Produtividade acumulada Como critério de seleção em fêmeas da raça Nelore*. 2001. Ciência Rural, 31: p. 483-486. **DOI:** 10.1590/S0103-84782001000300020.

[22] Segura-Correa, J.C., J.G. Magañ Monforte, F. Centurión-Castro, 2013. Efecto de grupo racial y edad al primer parto sobre el número de partos durante la vida útil de vacas cebú. Universidad Autónoma de Yucatán, Merida, Yucatán, México, 41-44. **DOI:**10.4067/S0301-732X2013000100007

[23] Vukasinovic, N., and J. Moll, L. Casanova, *Implementation of a routine genetic Evaluation for longevity based on survival analysis techniques in dairy cattle populations in Switzerland*. 2001 Journal of Dairy Science 84: p. 2073-2080. **DOI:** 10.3168/jds.S0022-0302(01)74652-8