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Financial efficiency in the confinement system for beef cattle

[*Eficiência financeira no sistema de confinamento de bovinos de corte*]

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ABSTRACT

The beef cattle breeding system in Brazil has been growing more and more in the history of animal production, leading the country to fit into the world scenario as the main exporter of beef. Seeking to increase this efficiency, the objective of this paper is to evaluate factors that affect the confinement of beef cattle, influencing the Profitability and Return of the system, to define values that maximize them. To do so, a database was used. It consisted of the observation of 1961 animals, collected in the commercial confinement of Fazenda Bragança, in the city of Lucas do Rio Verde – MT. Data were analyzed using multiple linear regression models, in which the financial gain, Profitability and Return variables were explained by the variables: race, entry weight and days in confinement, selected by the stepwise method. Based on the results, there is greater financial efficiency for animals that enter the feedlot with greater weight and that remain for 163 days. It is concluded that the entry weight and days in confinement significantly influence the financial efficiency, allowing the adjusted equations to help producers in making decisions regarding the formation of lots and, mainly, in the purchase of animals.

Keywords: profitability, return, entry weight, days in confinement

RESUMO

O sistema de criação de gado de corte no Brasil vem crescendo cada vez mais no histórico de produção animal, enquadrando-se no cenário mundial como o principal exportador de carne bovina. A fim de aumentar essa eficiência, tem-se como objetivo avaliar fatores que afetam o confinamento de bovinos de corte e influenciam na lucratividade e rentabilidade do sistema, de modo a definir máximos valores. Para isso, utilizou-se um banco de dados, composto pela observação de 1961 animais, os quais haviam sido coletados no confinamento comercial da Fazenda Bragança, na cidade de Lucas do Rio Verde – MT. Esses dados foram analisados por meio de modelos de regressão linear múltipla, em que as variáveis de eficência financeira, lucratividade e rentabilidade foram explicadas pelas variáveis raça, peso de entrada e dias em confinamento, selecionadas pelo método stepwise. Com base nos resultados, tem-se maior eficiência financeira para animais que entram no confinamento com maior peso e que lá permanecem por 163 dias. Conclui-se que o peso de entrada e os dias em confinamento influenciam na eficiência financeira de forma significativa, permitindo que as equações ajustadas auxiliem os produtores na tomada de decisão para a formação de lotes e, principalmente, na compra de animais.

Palavras-chave: lucratividade, rentabilidade, peso inicial, dias em confinamento

INTRODUCTION

Brazil has about 162.5 million hectares used as pasture (Empregos…, 2020), which is the least expensive method for beef cattle production, but presents low efficiency in its majority with little use of supplements for animal growth, thus becoming an activity of no financial surplus. With such record, confinements have been spreading with high productive efficiency, but at increased production costs.

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The main concern of any agricultural company is the financial evaluation and determination of profits and losses. In search for bigger profit, it is necessary to know the animals which will go in the system (weight, age, and breed), given that these factors will directly impact consumption and weight gain, becoming essential for the financial return of the system.

Although the utilization of confinements is considered of elevated technological cost, it has spread through production units all over Brazil (Lopes, 2013), which prompts studies on the economic viability of the system, therefore aiding the decision-making process for an effective implementation.

The goal of this study is to evaluate how the characteristics of confined beef cattle influence on Profitability and Return of the system, and to set values which allow their maximization.

MATERIAL AND METHODS

Data were collected in the commercial confinement of Fazenda Bragança, in the city of Lucas do Rio Verde – MT, Brazil, between the months of January and March 2017. The research involved 1837 animals of the Nelore breed and 124 crossbred ones, which weighed an average of 252.95kg (Nelore) and 256.46kg (crossbred) and remained in confinement from 95 to 240 days.

The nutritional plan of the animals consisted of 21 days on an adaptation diet, with 14.5% Crude Protein (CP) and 74.95% Total Digestible Nutrients (TDN). The Voluminous/Concentrate ratio in this diet was 44.9: 55.1%. After the adaptive 21 days, the animals had their diet changed to a fattening one, aiming at greater muscular deposition at the ratio of 14% CP and 78.79% TDN. The Voluminous/Concentrate ratio in this diet was 71.6:28.4%. In the last 80 to 150 days in confinement, the animals were fed with 13.5% CP and 83.8% TDN in the finishing diet, which seeks a better carcass finishing and subcutaneous and intramuscular fat deposition. The Voluminous/Concentrate ratio in this diet was 13.7:86.3% (Table 1).

Table 1. Percentage of nutrients contained in the diets of the animals for each stage of confinement

Nutrients	Adaptation	Fattening	Finishing
DM %	47.3	54.1	65.3
CP, % DM	14.5	14.0	13.5
EE, % DM	3.2	3.5	3.9
Ash, % DM	5.1	4.7	4.4
NDF, % DM	28.2	23.0	16.9
ADF, % DM	15.9	12.3	8.0
NFC, % DM*	50.7	56.7	63.7
NDT, % DM**	74.9	78.8	83.3
Forage, % DM	68.9	48.3	27.3
NDF Forage, % DM	25.5	15.7	10.5

Glossary: DM = Dry Matter, CP = Crude Protein, EE = Ether Extract, NDF = Neutral Detergent Fiber, ADF = Acid Detergent Fiber, NFC = Non-Fibrous Carbohydrates, TDN = Total Digestible Nutrients.
*NFC = 100 – (%CP + %EE + %Ash + %NDFcp) (Weiss, 1999)
**TDN = CP dig + NDFcp dig + NFC cp dig + (2.25 EEdig) (Sniffen *et al*., 1992).

For the use of the trough management method as criterion for the increase or decrease of diet offer, there were daily visual analysis followed by scores on leftover or insufficient feed, as well as control over the quality and characteristic of the foods, diet balancing, processing and mixture of the diet ingredients and the way they were offered to the livestock (Owens, 2011).

At the end of confinement, the animals were led to the handling corral for weighing and weight gain assessment, using ADG = ((Final Weight – Initial Weight) /Days in Confinement)).

The days in confinement were calculated considering the date the farm animals started the adaptation diet and the date they went out of it. The Dry Matter Intake (DMI) was calculated according to the average consumption of the lot. The daily cost was calculated according to the cost of the daily diet, DMI and the Operational Cost. The cost of the diet was calculated through the average of the costs of adaptation, fattening and finishing diets. The Operational Cost was considered 36.4% of the feeding costs (Coan, 2015).

The database consisted of the observation of 1961 animals, being 1837 Nelore and 124 crossbreds. At first, the data were divided into two groups, according to the entry weight in the confinement, up to 300kg and over 300kg, so that the average of those groups concerning the days in confinement and financial patterns were compared using Student's t-test, with a significance level of 0.05.

The data were analyzed through multiple linear regression, in which breed (Nelore or crossbred), entry weight in confinement, and days in confinement were the independent variables (explanatory), selected through the stepwise method, and Profitability and Return, featured in percentage, were the response variables, obtained by:

$$\boldsymbol{Profitability} = \left(\frac{Net\ Profit}{Gross\ Revenue}\right) * 100\%$$

$$\boldsymbol{Return} = \left(\frac{Net\ Profit}{Total\ Cost}\right) \times 100\%$$

in which Total Cost is composed by the purchase cost of the unfinished cattle, feeding cost, costs related to fixed expenses like herd health, among others.

A greater utilization capacity was identified in those financial variables, once, as they are percentage measures, they are not impacted by obsolescence in their values, and, therefore, they can be easily interpreted in multiple financial situations in the industry.

From that, the selected model was:

$$Y_i = \beta_0 + \beta_1 \times breed + \beta_2 \times days + \beta_3 \times weight + \beta_4 \times days^2 + \beta_5 \times weight^2 + \varepsilon_i$$

in which:
Y_i represents the variables of financial efficiency: Profitability and Return.
Breed is a binary variable, defined by 0 and 1, in which 0 designates the Nelore animal and 1 the crossbred animal.
Days refers to the number of days the animal was confined for
Weight, expressed in kilograms (kg), refers to the weight of the animal as it entered confinement,
$\beta_0, \beta_1, \ldots, \beta_5$ are the parameters of the model, estimated through the least square method, and, lastly
ε_i is the random error, for which $\varepsilon_i \sim N(0, \sigma^2)$.

After the adjustment of the multiple regression, this study proceeded to the building of the response surface plot for the variables Profitability and Return as function of the explanatory variables Entry weight and Days in confinement, followed by the two-dimensional contour plot for these explanatory variables. The plots were built considering the Nelore breed (0).

After adjusting the models, the optimal values were obtained, which represent the values of days and weight that result in maximum Profitability and Return. If $\beta_4, \beta_5 \neq 0$, these local optimal values are obtained through the following matrix:

$$\begin{bmatrix} x_{0(days)} \\ x_{0(weight)} \end{bmatrix} = -0{,}5 \times \begin{bmatrix} \beta_4 & 0 \\ 0 & \beta_5 \end{bmatrix}^{-1} \times \begin{bmatrix} \beta_2 \\ \beta_3 \end{bmatrix}$$

Otherwise, the optimal point is found by differentiating the function regarding each variable and setting the result equal to zero.

If the values found were not contained within the interval of confinement days (95 to 358 days) and entry weight (144 to 430kg), their extreme values were considered, which returned the maximum values for the variables analyzed.

All analyses were performed through the R software (R Core…, 2020).

RESULTS AND DISCUSSION

Comparison between the main evaluated parameters was performed, according to genetic group and entry weight (Table 2).

It is possible to observe that the animals which go into confinement lighter remain, on average, for more days and generate less Return ($p<0.05$). Besides, it may be noted that 75% of the animals yielded profit, also showing an associative tendency between the variables Entry weight and Days in confinement, once the heavier animals, which stay for less days in confinement, tend to generate more profit.

Table 3 presents the results of the hypothesis tests for the parameters included in the multiple linear regression model to explain the financial variables assessed.

Table 2. Grouping of animals and comparison of average Days in confinement, Profitability and Return according to entry weight in confinement (up to 300kg and over 300kg), for each genetic group

Crossbred	≤ 300kg	> 300kg
Number of Animals	91	33
Entry weight (Kg)	231.5±34.9	325.3±74.2
Days in confinement	198.8±36.2a	120.9±60.6b
Profitability (%)	6.0±8.4b	21.8±5.3a
Return (%)	7.8±10.2b	28.4±18.5a
Nelore	≤ 300kg	> 300kg
Number of Animals	1367	470
Entry weight (Kg)	227.5±33.6	326.9±20.5
Days in confinement	207.6±36.9a	121.9±19.8b
Profitability (%)	3.9±9.5b	18.0±5.3a
Return (%)	5.0±10.1b	22.4±8.1a

[a-b] Averages followed by distinct letters, on the same line, differ significantly through the t-test ($p<0.05$).

Table 3. Selection, estimate and significance of the parameters included in the multiple linear regression model for the variables Profitability and Return

	Profitability		Return	
Parameter	Estimate	P-Value	Estimate	P-Value
Intercept	-59.01	<0.001	-49.60202	< 0.001
Breed	1.81	0.003	2.511459	0.0003
Days	0.27	< 0.001	0.209793	< 0.001
Weight (Kg)	0.23	< 0.001	0.173631	< 0.001
I (days ²)	-0.0008	< 0.001	-0.000644	< 0.001
I (weight Kg²)	-0.0002	< 0.001	--	--

It is possible to notice that all values differ significantly from 0, at a 0.05 level of probability. The equation obtained by the adjustment of the multiple regression model for Profitability, with an adjusted coefficient of determination of 62%, is given by:

$$Profitability = -59.011829 + 1.808877 \times breed + 0.268458 \times days + \\ + 0.232839 \times weight - 0.000822 \times days^2 - 0.000177 \times weight^2$$

When assessing Return, the equation obtained for it through the adjustment of the multiple regression model, with an adjusted coefficient of determination of 64%, is given by:

$$Return = -49.602016 + 2.511459 \times breed + 0.209793 \times days + \\ + 0.173631 \times weight - 0.000644 \times days^2$$

Through the Profitability equation, it is possible to observe that the genetic group of crossbred animals generates a Profitability that is 1.8% higher than the Nelore. As for Return, the crossbred group yields a Return that is 2.5% higher than the Nelore.

From the adjusted equation, the response surface plot is obtained (Figure 1a) with the prediction for Profitability, according to the variation of the entry weight and days in confinement, whose projection in the two-dimensional plane results in the contour plot (Figure 1b).

The estimated Maximum Profitability point is 163.22 days and 657.36kg according to the model. However, as the optimal value for weight extrapolates the evaluated interval, the maximum weight within the evaluated interval (430kg) is considered the one which gives back the most Profitability, keeping the confinement period at 163 days.

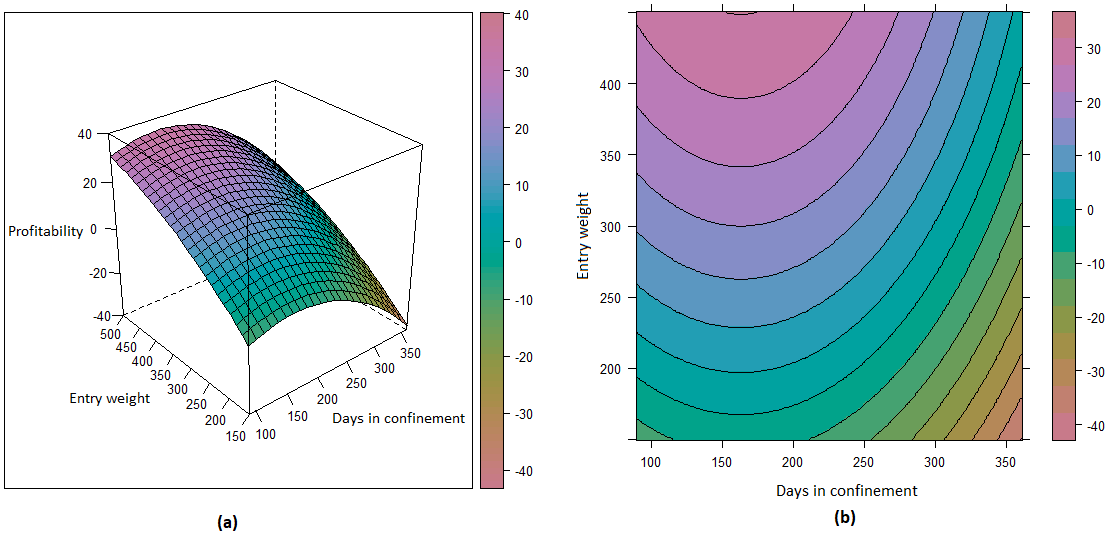

Figure 1. Estimate of Profitability (%) of Nelore beef cattle, as a function of entry weight (kg) in confinement and days in confinement.

Regarding Return, the response surface (Image 2a) and contour (Image 2b) plots, generated from the adjusted model, present the estimates expected for Return, according to the variation of entry weight and days in confinement, through which it is possible to visualize the curves with the value levels from which the animal features positive Return.

The maximum Return is obtained within 163 days of confinement. In contrast, for the entry weight, the greatest Return is obtained with the highest weight, which is 430kg in the evaluated interval.

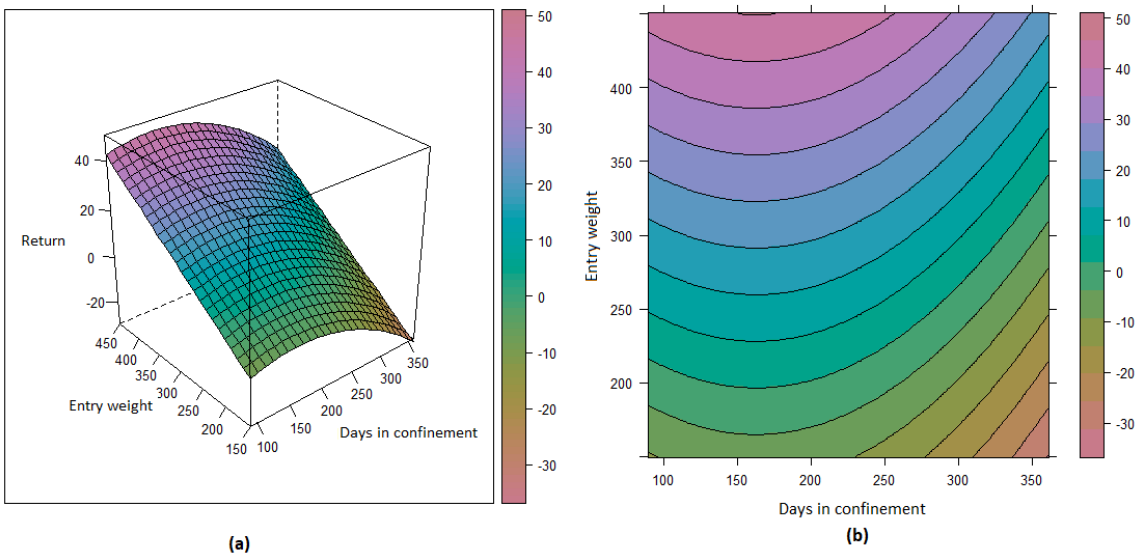

Figure 2. Estimate of Return (%) of Nelore beef cattle, as a function of entry weight (kg) in confinement and days in confinement.

CONCLUSION

In conclusion, it is possible to estimate the financial efficiency, per animal, of beef cattle in confinement based on the breed of the animal (Nelore or Crossbred), its weight when entering confinement and the number of days that it will remain confined. Maximum Profitability and Return were obtained by keeping the animals in confinement for 163 days. Regarding entry weight, the higher it is, the greater the financial efficiency in the interval of values analyzed.

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