A simulation of the economic and financial efficiency of activities associated with beef cattle pasture

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Abstract

This work aims to compare economic and financial efficiency of renovation and maintaining pastures in different systems to produce beef cattle. Was simulated three different production systems (Brazilian Cerrado), characterized as extensive, semi-intensive, and intensive, and considering the following annual renovation and maintenance rates, respectively: 0% and 25% for intensive; 7% and 33% for the semi-intensive system; and 10% and 40% for the intensive system. The extensive system yielded the lowest gross profit, of US$ 37,359, followed by the semi-intensive system with US$ 78,464, and the intensive system with US$ 150,880. The net present value (NPV) was higher in the intensive system US$ 1,277,593 and smaller in extensive system US$ 347,803 as well as the internal rate of return (IRR) and other financial analysis, pointing out the existing increment between systems. The economic efficiency determined through the sensitivity analysis showed that extensive systems require a revenue growth of up to 5.48% annually, whereas intensive requires a rate of 1.85%. The costs to renovation and maintaining pastures generated high monetary values, though due to the profitability for in each system. This indicates that the systems can pay for such activities while also generating a profit. However, the financial risk is presented to the most extensive producers, a fact that may explain the difficulties to improve the production rates of the Brazilian beef cattle.

Keywords: Support systems. Profitability. Sensitivity analysis.

1. Introduction

Beef cattle production plays an important role in the Brazilian economy because it is the second largest producer of beef cattle in the world, producing 9.7 million tons of meat (USDA, 2015) with an effective herd of around 211 million cattle spread over 170 million hectares of pasture, a mean occupancy rate of 1.23 cattle per hectare (Cerri et al., 2016).

Cattle raised in pastures occupy at least a fourth of the total use of soil worldwide. Currently, there is a need to use less environmentally harmful production systems by decreasing pollutant gases emissions or preventing the deforestation of native forests. Therefore, farms must consciously manage their resources to prevent such things as poor land use leading to soil degradation (Doole and Kingwell, 2015). An advantage of intensification of beef cattle production systems would be to reduce the emission of pollutant gases by up to 57% per kilogram of meat produced (Mazzeto et al., 2015). In addition to those environmental problems, there are also an economic nature problem as Nesper et al. (2015), pointing out that in the country about 8 million hectares are degraded each year, and the cost to recover these areas can reach up to US$ 200 per hectare.

Thus, Brazil is undergoing a change in which it is leaving behind agricultural expansion and extensive land use and adopting systems that increase productivity in the cultivated area. The tendency is an increased use of fertilizers and correctives in farms associated with more modern and efficient animal management practices (Lobato et al., 2014).

Another situation that requires greater knowledge by producers concerns the constant fluctuation in the amounts paid for live cattle, according CEPEA ESALQ (2018) when the amount paid to 15 kg of meat goes from R $ 155.80 in March 2016 to R $ 150.08 in September (2016), continuing to fall to R $ 136.80 in April (2017) ending in July (2017) with the lowest price of R $ 124.5, from this point, the price of the amount paid begins pa to recover but not exceeding R $ 145.00 in February (2018). This fluctuation serves as an indication to the producer to realize how crop and off-season movements are not as clear as in other crops.

These changes are important because traditional extensive systems will not be able to meet demand in the near future. Nevertheless, taking this step requires high level management by technical staff and farmers and using simulations may enable a more profitable method to manage changes in herds and resources (Ash et al., 2015).

Simulations allow for faster and less expensive responses compared to the physical results obtained in real situations (Machado et al., 2010), but there is a need to develop less complex models, it means, a program more friendly and simple interface, which would make its use more efficient for the user. Therefore, Martin et al. (2011) argue that for success in using a simulator, it should be simple and practical, able to handle practical issues from day to day, without neglecting agronomic and zootechnical knowledge.

Once the producer or manager of the property is aware of the production data, together with the costs and investments necessary to carry out the routine procedures, it becomes resilient to market oscillations. Besides the advantages mentioned above, the confidence gained from the practice of these activities can stimulate the producer to invest capital in activities considered to be more intensive, keeping in mind the popular maxim "to make money, you must spend money," begins to occur change in the Brazilian cattle rancher's cultural profile.

Therefore, this study compares the economic and financial efficiency of renovation and maintenance activities associated with pastures in different beef cattle production systems, evidencing mainly the evolution of costs and revenues as the property is intensified.

2. Materials And Methods

2.1. Bioeconomic model

This study is based completely on simulation data, using part Brumatti et al. (2011) bio economy model, which can interpret and interact with zootechnical indexes and the structure of herd with cost and revenue centers.

The simulation uses the interaction of three major calculation centers: the herd simulator, the production indexes, and the cost and revenue control centers (Figure 1). The interaction of these centers can provide economic values in terms of investments, revenues, costs, expenses, and profitability, which are instrumental in obtaining financial results, such as net present value (NPV), internal rate of return (IRR), benefit/cost ratio (BCR), profitability index (PI), and Payback Period.

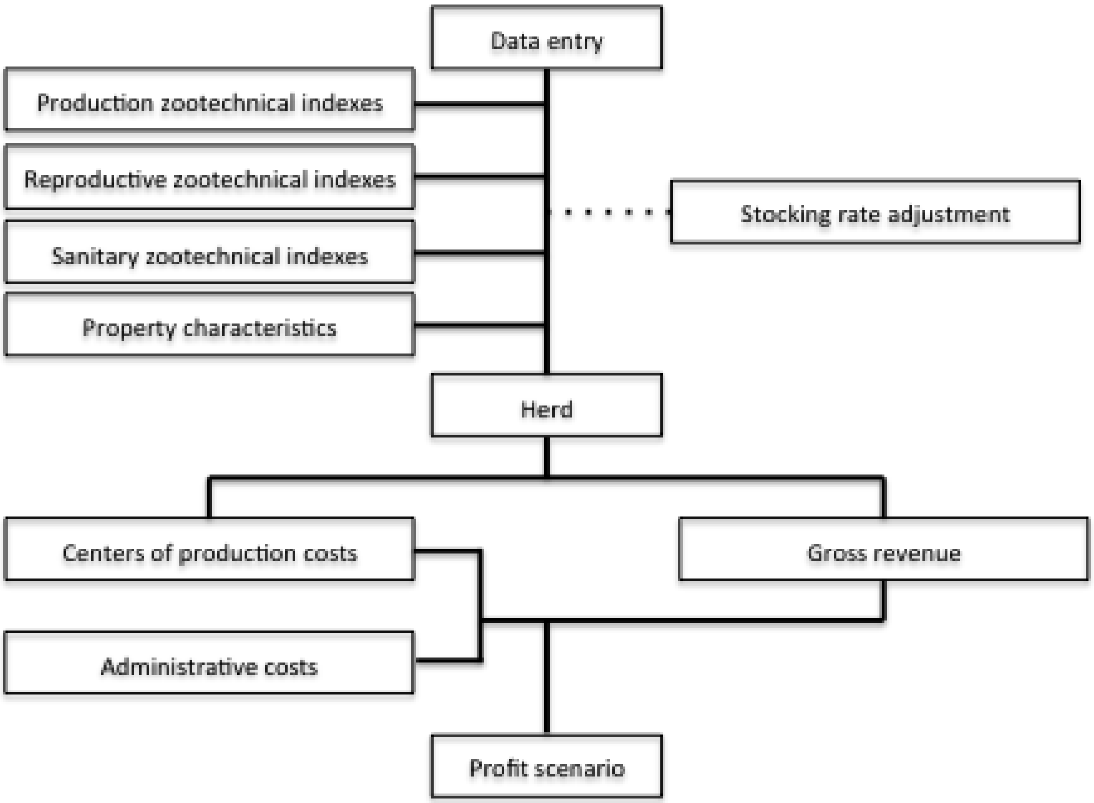

Figure 1. Bioeconomic model flowchart.

Through information about reproductive, sanitary and zootechnical rates informed by the user, the model can estimate the number of animals in the herd and also, their respective weights in kilograms.

Those numbers influence the real stocking rate, confronting and adjusting to the desired stocking rate, these calculus are necessary to determinate the total quantity and average weights for each category at the initial herd until the same reach the stability, which occurs at the sixth year of implantation of the system.

For all animal category worked in this study, was applied their respective zootechnical indexes, like mortality rates and weight gains, reported by the user in the respective control centers. For breeding categories, was applied the fertility rate as described in each scenario. Thus, the quantities obtained for each category is conditioned to their respective zootechnical indexes. Once the stable herd has been obtained, it supplies the quantities of animals needed to simulate a fully active property.

This work used the US dollar as the currency for analysis, fixed at R$ 3.44 based on exchange rates for the period between May and October 2015 according to the Central Bank of Brazil. For the financial analysis, we considered as the investment value the costs to implement activities associated with pastures.

2.2. Bioeconomic equations

The economic calculations were obtained using the following equations:

$$FP = PB + PHeiS + PC + PCB \quad (1)$$

where: FP= farm profit, PB= profit per steers, PHeiS= profit per sold heifer, PC= profit per cow, PCB= profit per slaughter bulls.

$$PB = N * (\left(NPC * \left(CW * CY * \frac{R\$}{kg}\right)\right) - ((NPC * CS) + Erat)) \quad (2)$$

where: N= number of cows in reproduction, NPC= number of products per cow, CW= carcass weight (kg), CY= carcass yields (%), R$/kg= price per kilo of steers (R$), CS= cost per steers (R$), Erat= total administrative expenses* percentage of herd category.

$$CS = ((NPC * DCS) + (NPC * ICS) \quad (2.1)$$

where: DCS= direct cost steers category, ICS= indirect cost of remaining categories on the category steers.

$$PHeiS = N * (\left(NPC * \left(LW * \frac{R\$}{kg}\right)\right) - ((NPC * CH) + Erat)) \quad (3)$$

where: N= number of cows in reproduction, NPC= number of products per cow, LW= live weight (kg), R$/kg= price per kilo (R$), CH= cost of sold heifer (R$), Erat= total administrative expenses* percentage of herd category.

$$CH = (NPC * DCSHei) + (NPC * ICSHei) \quad (3.1)$$

where: DCSHei= direct cost category sold heifer, ICSHei= indirect cost of remaining categories over category sold heifer.

$$PC = N * (\left(CCull * \left(CW * CY * \frac{R\$}{kg}\right)\right) - (CCcull + Erat)) \quad (4)$$

where: N= number of cows in reproduction, CCull= percentage of culled cows, CW= carcass weight (kg), CY= carcass yield (%), R$/kg= price per kilo of live cow (R$), CCcull= cost of each culled live cow (R$), Erat= total expenses* percentage of herd category.

$$CCcull = (NCcull * DCCull) + (NCcull * ICCcull) \quad (4.1)$$

where: NCcull= number of culled cows, DCCcull= direct cost of category culled cow, ICCcull= indirect cost of remaining categories over culled cows.

$$PCB = N * \left(\left(BCull * \left(CW * CY * \frac{R\$}{kg}\right)\right) - (CB + Erat)\right) \quad (5)$$

where: N= number of cows in reproduction, BCull= percentage of culled bulls, CW= carcass weight (kg), CY= carcass yield (%), R$/kg= cost per kilo of live bull (R$), CB= cost of each bull (R$), Erat= total expenses* percentage of herd category.

$$CB = (NBcull * DCBCull) + (NBcull * ICBDull) \quad (5.1)$$

where: NBcull = number of culled bulls, DCBCull= direct cost category culled bull, ICBDull= indirect cost of remaining categories over culled bulls.

2.3. Characteristics of simulated systems

The study simulated three systems of beef cattle production the “Cerrado” biome: extensive, semi-intensive, and intensive, with a total farm size of 1,500 hectares, from which 20% are set aside as an environmental reserve, leaving 1,200 hectares of farmed area.

The data used to feed the simulators were obtained from adaptations of average zootechnical values found in the region of the state of Mato Grosso do Sul (MS) presented by Corrêa et al. (2006), considering a history of analyzes presented in the articles by Gaspar *et al.* (2017) and Pini et al. (2014) (Fig. 2 and 3).

The simulations illustrate properties located in the center-west region of Brazil, whose predominant biome is the cerrado, very similar to the world-known savannah biome. The similarities are given due to the predominantly warm climate with well defined periods of drought and rainfall.

The collected data matrix, Corrêa et al. (2006) was generated through a round table, made up of producers from the region, together with researchers from EMBRAPA Beef Cattle, as well as technicians from various agencies such as the State Agency for Animal Health and Plant Protection (IAGRO) and Brazil Bank.

The data worked by Pini et al. (2014), were obtained through contrast between the literature and information collected through interviews with rural farmers of MS. The data used and in Gaspar et al. (2017) were collected through literature review, even though they have gone through a thorough investigation to make the data more reliable, that is, to bring them in the most realistic way possible since there are some small modifications over the years due to technological innovations.

In this way, Figure 2 and 3 show the nature of the data used in the literature consulted and that aided in the modeling performed in the present study, considering that it was chosen to add a scenario of intensive technological application, resulting in Table 1 that presents the production indexes for each scenario.

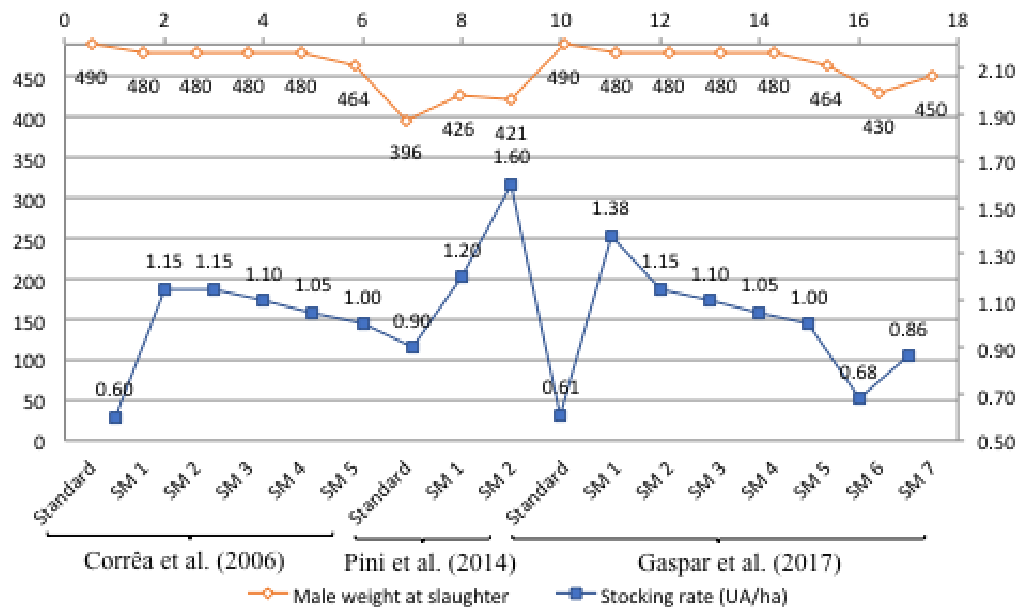

Figure 2. Data regarding the weight of cattle at slaughter and stocking rate of the scenarios obtained in the literature.

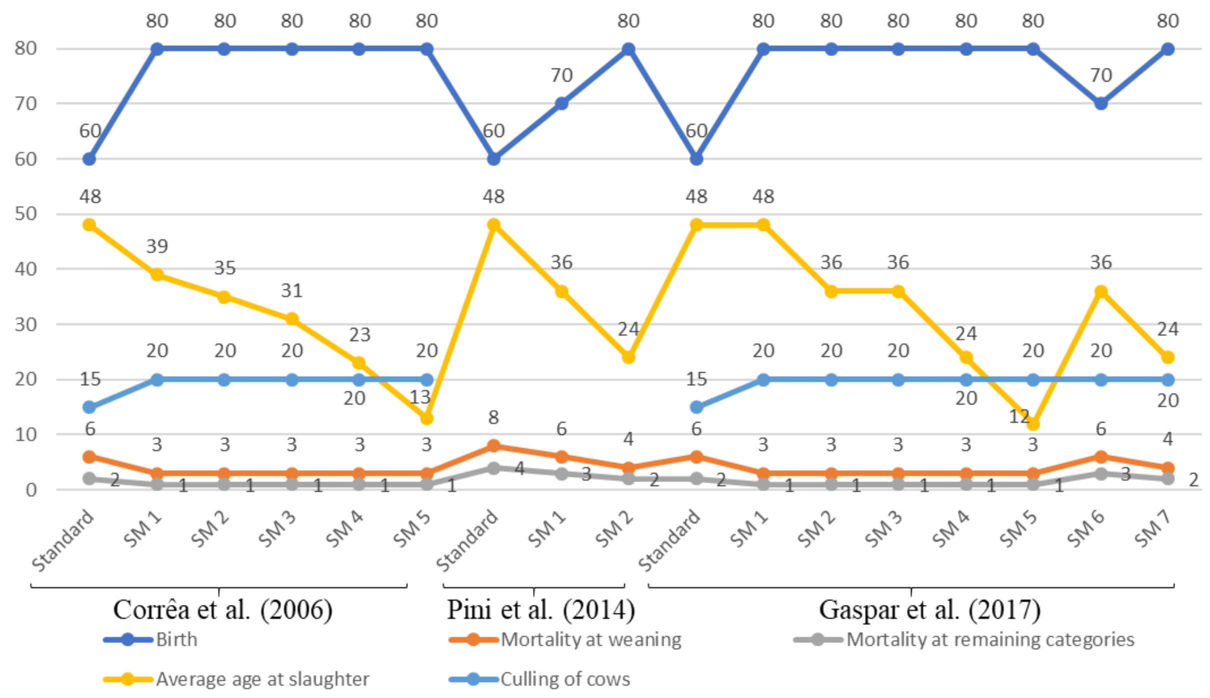

Figure 3. Data referring to the other zootechnical indexes, collected in the literature, used to perform the simulations.

Table 1: Average zootechnical indexes for the production systems under evaluation

Variables	Systems		
	Extensive system	Semi-intensive	Intensive
Birth	70%	80%	91%
Mortality at weaning	6%	3%	2%
Mortality at remaining categories	2%	1%	0.5%
Male weight at weaning	159 kg	196 kg	237 kg
Average age at slaughter	60 months	36 months	24 months
Male weight at slaughter	471 kg	476 kg	513 kg
Culling of cows	20%	20%	15%
Stocking rate (UA/ha)	0.8	1.2	1.6
Annual pasture renovation rate	0%	7%	10%
Annual rate of pasture maintenance	25%	33%	40%

Source: Modified from Corrêa et al. (2006).

In addition to the production indexes, Table 2 presents the inputs used in each evaluated production system, with the exception of extensive system, which uses none type of fertilizer or input to provide an accurate representation of the producer's traditional methods as observed in reality. Activities in the semi-intensive and intensive systems included items such as harrowing, fertilizing, liming, plowing, and sowing during renovation; and liming, fertilizing, hoeing, and controlling invasive species and pests for maintenance. For the extensive system, the simulation contains only one manual hoeing.

Table 2: Inputs and amounts applied in each simulated system

Input	Semi-intensive		Intensive	
	Renovation (kg/ha)	Maintenance (kg/ha)	Renovation (kg/ha)	Maintenance (kg/ha)
Seeds	20		20	
Limestone	1,374	690	1,374	690
Single superphosphate	444	222	444	222
Herbicide (L)		1		1
Ant insecticide				1
Potassium chloride	100	60	100	60
FTE	40		40	
Agricultural urea	111	111	111	222

Applications prescribed for a typical soil of the Cerrado biome, characterized by a high concentration of aluminum and low saturation of bases in the soil.

The nutritional management of the herd varied according to the system under evaluation: the extensive system included only mineral salts supplementation for the whole herd, and the semi-intensive system also included mineral protein supplementation for rearing categories, with an estimated consumption of 450 g/UA/day during a 120-day period. The intensive system used the Creep Feeding method for the initial categories, in addition to protein supplementation for young bulls, bulls, and heifers during a 120-day period, finishing with a confinement phase of 90 days at a daily cost per animal of 1.57 dollars in order to slaughter bulls at 24 months.

2.4 Sensitivity analysis

This study uses two different sensitivity analyses to measure the impact of renovation and maintenance activities on farm’s operating cash flow, gradually establishing different renovation rates that fluctuate around 1% of the renovation area (Figure 4). The first included fixing the farm’s gross margin, whereas the second fixed the activity based on gross profit. For this and the financial analyses of each system, the simulation used an average revenue growth rate (RGR) for each scenario according to the 1% fluctuation.

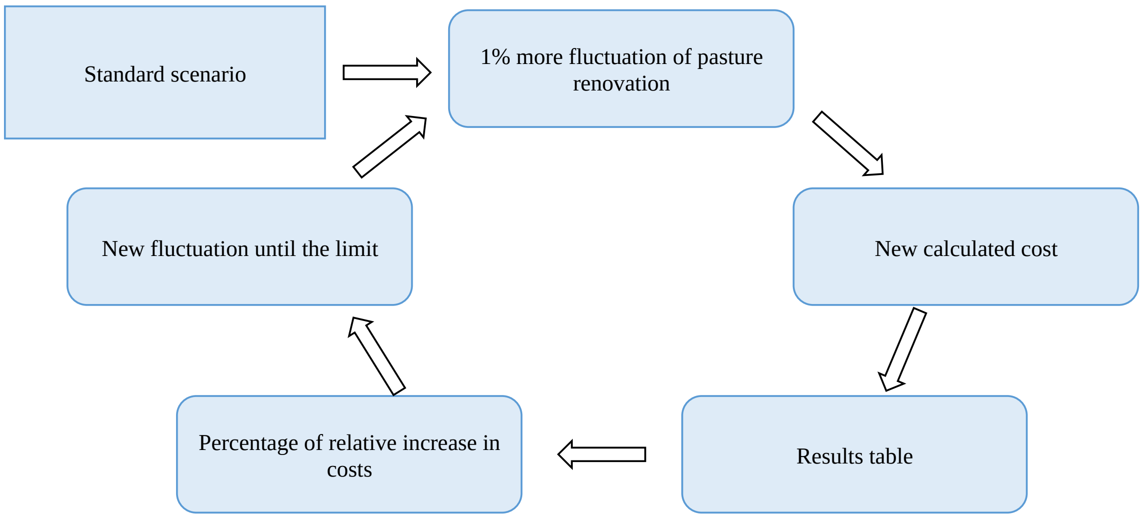

Figure 4. Flow of the economic sensitivity analysis.

An additional extensive system exclusively for the financial and sensitivity analyses, called extensive system [2] was created. However, this analysis contains the same activities established in the intensive scenario in order to assess the system in terms of economic behavior.

2.5 Financial analysis equations

Financial results were obtained using the following mathematical equations proposed by Gitman (2001) and Assaf Neto (2006):

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} - \text{Investment} \quad (6)$$

If NPV ≥ 0, the investment is accepted.

$$IRR = \sum_{t=0}^{n} \frac{CF_t}{(1+i)^n} = 0 \quad (7)$$

If IRR ≥ the Cost of Capital, the investment is accepted.

$$PI = \frac{\sum \text{Present value of cash flows}}{\text{Initial investment}} \quad (8)$$

If PI ≥ 1, the investment is accepted.

$$BCR = \frac{\sum \text{Discounted value of incremental benefits}}{\sum \text{Discounted value of incremental cost}} \quad (9)$$

If BCR ≥ 1, the investment is accepted.

$$\text{Payback} = \frac{\text{Initial investment}}{\text{Average annual cash inflows}} \quad (10)$$

3. Results and Discussion

3.1. Economic analysis

The physical results for the herd structure from the simulated systems indicated that when the farm adopts semi-intensive and intensive systems, there is an increase in the number of animals. This evolution may be partly justified by the quantity of arrays in each simulated scenario: 401 arrays in the extensive system, 686 for semi-intensive, and 875 for intensive (Table 3). Corrêa et al. (2006) used simulations to assess improved beef cattle production systems and observed that farm intensification increased the total quantity of arrays and herd, mainly due to the use of correctives and fertilizers in conjunction with better organized production systems, and thus increasing the pasture's support capacity and improved zootechnical indexes.

The improved production indexes affected the quantity of reared animals and the time spent to reach the slaughter weight. In the semi-intensive and intensive systems, the number of animals in the rearing phase was higher than that in the extensive system.

Table 3: Physical herd results

Quantities	Extensive system		Semi-intensive system		Intensive system	
	Rearing	Sale	Rearing	Sale	Rearing	Sale
Cows	401		686		875	
Bulls	16		23		29	
Calves	264		532		777	
Rearing and finishing						
Heifers 12-24m	129	-	264	-	387	-
Heifers 24-36m	127	-	141	120	134	250
Heifers >36m	85	39	-	-	-	-
Males 12-24 m	129	-	258	-	326	61
Males 24-36m	127	-	220	35	62	262
Males 36-48m	122	3	40	178	9	52
Males 48-60m	102	17	4	35	1	8
Males >60 m	-	106	-	5	-	-

Note: "m" denotes months.

The systems evaluated yielded a positive gross margin, indicating that regardless of the type of production system farmer's use, the activity should be viable in the short term since the revenues exceed the total costs (Table 4).

The intensive system yielded the greatest revenue based on the number of animals sold, which was around 771, followed by the semi-intensive system with approximately 521 animals sold, and finally the extensive system with 245 animals sold.

The systems maintained this rank in terms of the total inputs, where intensive systems were the most expensive, costing $ 269,201 against $ 133,908 and $ 25,294 for the semi-intensive and intensive systems, respectively. Åby et al. (2012) observed that when using the bio economic model to assess the intensive and extensive systems to raise cattle, the intensive system showed higher cash inflows than the extensive system; similarly, the costs were higher, indicating the importance of the relationship between cash in and cash out.

In terms of effective costs, we noted that the costs of forage and nutritional inputs were the highest for the remaining inputs, which is considered normal since fluctuating market prices affect these inputs more significantly. Similarly, Pacheco et al. (2014) assessed the economic characteristics of confining Red Angus calves and observed that the component concentrates, supplements, and forage were not only higher than for buying animals, but depending on the scenario may in fact become the highest production costs.

The costs of feeding in this study were higher than those found by Lopes and Magalhães (2005), who performed a profitability analysis of the finishing phase in beef cattle reared under confined conditions, where feeding was responsible for 22.3% of the effective operational costs, a very low percentage compared to the 38.4% of feeding contribution found in the current study.

This difference may be due to the fact that Lopes and Magalhães (2005) computed only the costs related to confinement, whereas this study accounts for the costs of all activities involved in a complete cycle.

Table 4: Economic results of the simulated production systems

Items	Extensive system		Semi-intensive system		Intensive system	
	U$	%	U$	%	U$	%
Revenue						
Steers	84,697	55.3	180,358	54	315,939	57
Live cow	46,576	30.4	81,436	24.4	79,557	14.3

Heifer	20,074	13.1	68,613	20.5	154,384	27.8
Bulls	1,928	1.3	3,673	1.1	4,685	0.8
Gross revenue	153,275		334,080		554,565	
Costs						
Inputs						
Forage	2,039	1.3	83,531	25	120,879	21.8
Nutrition	10,868	7.1	29,008	8.7	121,286	21.9
Reproduction	8,196	5.3	14,749	4.4	18,675	3.4
Sanitary	4,191	2.7	6,620	2.0	8,361	1.5
Total of inputs	25,294	16.5	133,908	40.1	269,201	48.5
Labor management	23,831	15.5	30,884	9.2	35,673	6.4
Maintenance*	10,688	7.0	10,688	3.2	10,892	2.0
Effective operational cost	59,813	39.0	175,481	52.5	315,766	56.9
Depreciation	21,441	14	21,441	6.4	23,272	4.2
Total operational cost	81,254	53	196,921	58.9	339,038	61.1
Remuneration	17,442	11.4	17,442	11.4	17,442	3.1
Administrative expenses	5,233	3.4	5,233	1.6	5,233	0.9
Taxes	11,987	7.8	36,020	10.8	41,973	7.6
Total costs	115,915	75.6	255,616	76.5	403,685	72.8
Gross profit	37,359		78,464		150,880	
Gross margin		24.4		23.5		27.2

*Maintenance of machinery, equipment, and fuel.

Table 4 shows that the gross profit obtained in the extensive system was lower, at US$ 37,359, followed by the semi-intensive system at US$ 78,464, and the intensive system at US$ 150,880, demonstrating that more technical systems generate higher profitability compared to those using low-level technology. In contrast, Barbosa et al. (2010) assessed productivity and economic efficiency for complete cycle systems through simulation that included only fluctuating birth rates, and observed that as birth rates increased, the economic efficiency of the system decreased, caused by a decrease in live weight sold because there was a higher retention of pregnant cows in the herd.

The semi-intensive system showed a smaller gross margin, which is acceptable, since when the total costs of the activity increase compared to revenue growth, the margin tends to narrow. Therefore, project should not be validated solely on gross margins.

As system intensification increases, production costs tend to increase, making them hypothetically more risky since they require strategies to acquire and optimize input use, and professionalization of the labor force to manage the herd adequately, among other elements. According to Nasca et al. (2014), the limiting factors in new technology adoption Argentinian farms are the lack of perception of future risks and uncertainties, which encourages farmers to continue working under extractive systems.

Table 5 depicts costs and unit profits for different systems for pasture-related activities.

Table 5: Economic results for the costs and unit profits of pasture-related activities

Costs	Extensive system	Semi-intensive system	Intensive system
Pasture/animal/day	0.01	0.12	0.14
Pasture/hectares	5.11	73.02	104.14
Pasture/animal unit	6.40	60.85	67.04
Profit			
Pasture/animal/day	0.08	0.11	0.17
Pasture/hectare	31.13	65.39	125.73
Pasture/animal unit	39.01	54.65	80.97

Values presented in US dollar.

The per-hectare cost of pasture was higher in the semi-intensive and intensive systems compared to the extensive system. Nevertheless, it is important to note that the extensive system had almost no activity performed in the pasture aside from manual hoeing, whereas the other systems included different procedures such as use of herbicides, ant insecticide, harrowing, fertilizing, and liming, among others. These high costs nearly match the costs outlined in the Iowa State technical bulletin (ISU EXTENSION, 2008) of $ 220.90 per acre for activities performed in low fertility soils.

Another interesting observation is that the extensive system yielded a lower profit per hectare compared to the other pasture systems, demonstrating that despite its low cost of $ 5.11, its profit is also proportionally low, being $ 31.13. Therefore, despite the seemingly high costs to farmers of other systems, they pay back their implementation in addition to providing much greater profits compared to the extensive system.

This may be due to the fact that phosphorus, which is a limiting nutrient for to produce and establish forage plants, is incorporated in the soil along with nitrogen, enabling the soil to develop and maintain plants (Euclides et al., 2010). This helps plants withstand defoliation and enable more animals to use the pasture, increasing the system’s efficiency.

3.2. Financial analysis

Table 6 shows the results obtained in the financial risk assessment. All scenarios have acceptable values, however the results in the extensive scenarios show values, which indicate a high financial risk to the producer. BCR from those extensive scenarios was very close to

1.0, indicating a high financial risk for the evaluated Project, this means that for each U $ 1.0 invested in the activity the extensive scenario should obtain U $ 1.22, this risk is even more worrying in the case of the extensive scenario [2] because it represents a gain of U $ 1.04 for each U $ 1.0 invested, results very different from those obtained by the more intensive scenarios.

All systems presented a PI greater than one, meaning that any of the systems are profitable, though a higher value in this evaluation indicated higher profitability (Table 6). Compared to the PIs, the results indicate that the intensive system was the most profitable compared to the other systems, a finding in line with Santana et al. (2013) assessment of the economic performance of intensive systems for a complete cycle. The study concluded that the greatest profitability is obtained in systems that can sell a higher volume of live weight per hectare.

These results differ from those obtained by Damasceno et al. (2012) when analyzing the profitability of beef cattle production in the grazing system in the extensive model, obtaining a negative profitability (5.25%) since the revenue was not enough to cover the total operational cost Interestingly, in the study cited, there were more intensive techniques such as artificial insemination and the use of protein supplements for several categories, and yet, the results were satisfactory, until the moment that some other values such as depreciation are inferred. The authors believe that adopting some more intensive techniques will lead to small improvements that can reverse the current situation.

Additionally, in the extensive system, which includes pasture-related activities, maintaining the same production indexes characteristic of an extensive system were lower than that in traditional systems due to an increase in production costs.

Table 6: Financial results for the simulated systems

	Extensive system	Extensive system [2]	Semi-intensive system	Intensive system
Investment	158,928.07	187,118.74	134,725.49	112,271.24
PI	1.22	1.04	3.03	7.00
BCR	1.05	1.01	1.19	1.30
NPV	$ 35,575.0	$ 7,384.81	$ 273,788.0	$ 673,266.0
IRR	14%	9%	56%	134%
Payback deducted	6 years	7 years	2 years	1 year

Opportunity cost of 8.00% for all systems.

The IRR is an outstanding analytical tool to select projects because it makes the results easy to understand and analyze. As the systems grow in intensification, the higher the values compared to less technological systems. For example, the activity in the semi-intensive system has a discount rate of 56%, thus, the interest rate required to match the NPV of the project at zero would be 56%. The IRRs obtained for all systems were higher than the minimum attractiveness rate of the investment established at 8.0%. Similarly, Barbieri et al. (2016) found IRR (10.91% a.a.) higher than the minimum rate of attractiveness stipulated by at least 82% when analyzing the economic feasibility of confinement of beef cattle.

Similarly, Santana et al. (2013) validated all scenarios because they found higher IRRs related to their discount rate of 6.75% applied to a one-year simulation, however, the IRR of the intensive system was lower than that found in this study, 16.2% versus 134%. This difference may be due to the number of animals reared and their management, for example, the absence of Creep Feeding.

Deducted payback provides a simpler interpretation because it involves only determining the minimum time required to reclaim the invested amount. Activities related to cattle production usually have high payback periods, however, for the semi-intensive and intensive systems, the values were considerably low, even more when compared to the results obtained by Ávila et al. (2015), evaluating investment projects for full-cycle production of super-young beef cattle by means of simulations of data practiced in the region of the state of Rio Grande do Sul, and the results indicated, for both confinement and pasture termination systems, considerably higher payback values of 73 and 20 years respectively. However the payback rate was not the only bad result, the IRR and NPV of the projects were also substantially detrimental to the use of these projects. The justification for this would be a high cost structure to support the large volume of animals in different phases, in addition to the underutilization of the support capacity in some periods of the year.

As expected, the NPV results were greater than one dollar for all system, and thus all are acceptable. This means that, for example, the intensive system requiring an investment of $ 112,271.24 returned an NPV of $ 673,266.00 when cash inflows and costs are deducted and using a discount rate of 8.0%, demonstrating that it is a viable project. Similarly, Euclides et al. (1998) assessed the performance of calves in *Brachiaria decumbens* pastures and subject to different diets and observed that the treatment that used no supplements aside from one mineral mixture returned the lowest NPV, and more supplementation increased the NPV values.

3.3. Sensitivity analysis

The results of the sensitivity analysis for the various simulated systems showed that in situation (a), the gross margin will remain constant only with a proportionally greater increase in the revenue from the activity compared to its costs, which is different from the scenario observed in situation (b), which does not need such a significant rise in revenues compared to costs to maintain a constant profit.

The logic behind these fluctuations is in fact to demonstrate the minimum interval required to implement the technique; that is, in the case of maintaining a constant gross margin, the farmer will need a higher economic efficiency compared to the fluctuation to maintain a constant gross profit.

In Table 7, the results indicate that the extensive system in situation (a) with a CMR of 5.48% would require at least an excess of 267.20 kilos of meat produced for each 1% of the renovation area, whereas for situation (b) with a CMR of 4.15%, the production requirement is smaller, at 202.08 kilos.

Table 7: Sensitivity analysis results for the extensive system focusing on fixed gross margin (a) and fixed gross profit (b)

Sensitivity	A				B			
	Revenue	Cost	Profit	Margin	Revenue	Cost	Profit	Margin
0%	153,275	115,916	37,359	24%	153,275	115,916	37,359	24%
1%	161,681	122,273	39,408	24%	159,632	122,273	37,359	23%
2%	170,087	128,630	41,456	24%	165,989	128,630	37,359	23%
3%	178,493	134,987	43,505	24%	172,346	134,987	37,359	22%
4%	186,899	141,344	45,554	24%	178,703	141,344	37,359	21%
5%	195,305	147,702	47,603	24%	185,060	147,702	37,359	20%
6%	203,710	154,059	49,652	24%	191,417	154,059	37,359	20%
7%	212,116	160,416	51,701	24%	197,775	160,416	37,359	19%
8%	220,522	166,773	53,750	24%	204,132	166,773	37,359	18%
9%	228,928	173,130	55,798	24%	210,489	173,130	37,359	18%
10%	237,334	179,487	57,847	24%	216,846	179,487	37,359	17%
11%	245,740	185,844	59,896	24%	223,203	185,844	37,359	17%
12%	254,146	192,201	61,945	24%	229,560	192,201	37,359	16%
13%	262,552	198,558	63,994	24%	235,917	198,558	37,359	16%
14%	270,958	204,916	66,043	24%	242,274	204,916	37,359	15%
15%	279,364	211,273	68,092	24%	248,631	211,273	37,359	15%
16%	287,770	217,630	70,140	24%	254,989	217,630	37,359	15%
17%	296,176	223,987	72,189	24%	261,346	223,987	37,359	14%
18%	304,582	230,344	74,238	24%	267,703	230,344	37,359	14%
19%	312,988	236,701	76,287	24%	274,060	236,701	37,359	14%

20%	321,394	243,058	78,336	24%	280,417	243,058	37,359	13%
21%	329,800	249,415	80,385	24%	286,774	249,415	37,359	13%
22%	338,206	255,773	82,433	24%	293,131	255,773	37,359	13%
23%	346,612	262,130	84,482	24%	299,488	262,130	37,359	12%
24%	355,018	268,487	86,531	24%	305,846	268,487	37,359	12%
25%	363,424	274,844	88,580	24%	312,203	274,844	37,359	12%

Values given in US dollar.

For the semi-intensive system (Table 8), in situation (a) with an average growth in revenue of 2.93% for each 12 hectares renovation, an increment of at least 306.26 kilos of meat should occur, which is different from situation (b) with a CMR of 2.24%, which has a smaller increased production requirement of 234.33 kilos.

Table 8: Sensitivity analysis results for the semi-intensive system focusing on fixed gross margin (a) and fixed gross profit (b)

Sensitivity	A				B			
	Revenue	Cost	Profit	Margin	Revenue	Cost	Profit	Margin
7%	334,080	255,616	78,464	23%	334,080	255,616	78,464	23%
8%	343,863	263,101	80,762	23%	341,565	263,101	78,464	23%
9%	353,645	270,586	83,059	23%	349,050	270,586	78,464	22%
10%	363,427	278,070	85,357	23%	356,535	278,070	78,464	22%
11%	373,210	285,555	87,654	23%	364,019	285,555	78,464	22%
12%	382,992	293,040	89,952	23%	371,504	293,040	78,464	21%
13%	392,774	300,525	92,250	23%	378,989	300,525	78,464	21%
14%	402,556	308,009	94,547	23%	386,474	308,009	78,464	20%
15%	412,339	315,494	96,845	23%	393,958	315,494	78,464	20%
16%	422,121	322,979	99,142	23%	401,443	322,979	78,464	20%
17%	431,903	330,464	101,440	23%	408,928	330,464	78,464	19%
18%	441,685	337,948	103,737	23%	416,413	337,948	78,464	19%
19%	451,468	345,433	106,035	23%	423,897	345,433	78,464	19%
20%	461,250	352,918	108,332	23%	431,382	352,918	78,464	18%
21%	471,032	360,403	110,630	23%	438,867	360,403	78,464	18%
22%	480,815	367,887	112,927	23%	446,352	367,887	78,464	18%
23%	490,597	375,372	115,225	23%	453,836	375,372	78,464	17%
24%	500,379	382,857	117,522	23%	461,321	382,857	78,464	17%
25%	510,161	390,342	119,820	23%	468,806	390,342	78,464	17%

Values given in US dollar.

On the other hand, the intensive system (Table 9) with a CMR of 1.85% in situation (a) the gain from the renovation should be equal to or greater than at least 298.30 kilos of meat, which is higher than the 217.14 kilos required for situation (b) with a CMR of 1.35%.

Table 9: Sensitivity analysis results for the intensive system focusing on fixed gross

margin (a) and fixed gross profit (b)

Sensitivity	A				B			
	Revenue	Cost	Profit	Margin	Revenue	Cost	Profit	Margin
10%	554,566	403,686	150,880	27%	554,566	403,686	150,880	22%
11%	564,848	411,170	153,678	27%	562,050	411,170	150,880	22%
12%	575,130	418,655	156,475	27%	569,535	418,655	150,880	21%
13%	585,412	426,140	159,273	27%	577,020	426,140	150,880	21%
14%	595,694	433,625	162,070	27%	584,505	433,625	150,880	20%
15%	605,977	441,109	164867	27%	591,989	441,109	150,880	20%
16%	616,259	448,594	167,665	27%	599,474	448,594	150,880	20%
17%	626,541	456,079	170,462	27%	606,959	456,079	150,880	19%
18%	636,823	463,564	173,260	27%	614,444	463,564	150,880	19%
19%	647,106	471,048	176,057	27%	621,928	471,048	150,880	19%
20%	657,388	478,533	178,855	27%	629,413	478,533	150,880	18%
21%	667,670	486,018	181,652	27%	636,898	486,018	150,880	18%
22%	677,952	493,503	184,450	27%	644,383	493,503	150,880	18%
23%	688,234	500,987	187,247	27%	651,867	500,987	150,880	17%
24%	698,517	508,472	190,045	27%	659,352	508,472	150,880	17%
25%	708,799	515,957	192,842	27%	666,837	515,957	150.880	17%

Values given in US dollar.

Therefore, it is evident that despite the fact that intensification requires the production of greater amount of meat for each additional percentage of renovation pasture, these are less sensitive to the need to increase revenue. This means that these systems are better prepared for an eventual increase in pasture renovation rates compared to the extensive and extensive [2] systems (Figure 5), which depend on a greater increase in revenue to cover forage costs.

This greater financial need by farmers with less capacity to production, may explain the great difficulty in this sector to applying the production techniques already developed in pasture management. This economic limitations coupled with high financial risk, as shown in this article, contributes to the high levels of degradation of pastures remain in Brazil, resulting in a low performance indexes (Bustamente et al., 2012; Strassburg et al., 2014). Therefore, it’s crucial for the good performance of production as new technologies are developed with a focus not only on the great technical performance, but especially in the great economic performance, coupled with more effective public policies for releasing rural credit applied to renovation of pastures which will result on improving the productive performance of farms.

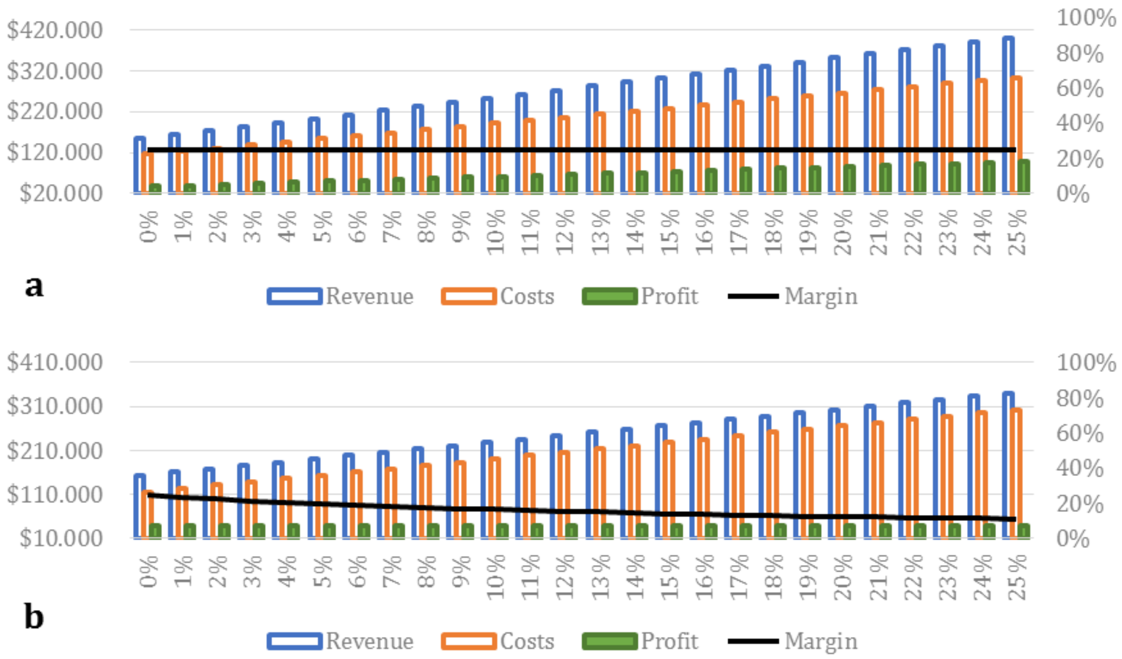

Figure 5. Sensitivity analysis results for extensive system [2] focusing on fixed gross margin (a) and fixed gross profit (b).

When comparing the results for the extensive system to extensive system [2], it is clear that the costs of activities associated with the pasture did not greatly affect the system's economics because in situations (a) and (b) of extensive system [2] (Figure 5), the CMR was 6.46% and 4.88%, respectively, which are close to the values obtained for the extensive system. Note, however, that these simulations we did not consider the possible production gains in the herd for each additional percentage of renovation area, which would affect the farm's zootechnical indexes positively, and consequently increase the revenue even more.

This need applies to the set of actions that the Brazilian government has implemented in an attempt to reduce the impact of agricultural activities on ecosystems. A good example of this is the creation of the ABC (Low-Carbon Agriculture) Plan, which aims to recover 15 million hectares of degraded pastures until 2020, among other actions and programs, committed to reduce greenhouse gas emissions (Garcia and Vieira Filho, 2014).

4. Conclusion

The work can deliver the scientific community and the producers and technicians in the area, consistent results in detail and discussed about all the economic issue that primarily encompassing the management of pastures, crucial point for the production of beef in Brazil.

These results are even more relevant when said that 90% of the national beef production is obtained through systems that use pasture as the predominant form of feed for animals, in this way, this work becomes a valuable tool for comparison of techniques, since zootechnical, economic and financial details are discussed.

In this context, the study evaluated three beef cattle production systems, finding that each were attractive under the production conditions and indexes used in the simulation. The profitability of the systems in descending order is intensive, semi-intensive, and extensive.

The economic and financial results obtained in this paper show that the intensive and semi-intensive scenarios presented more attractive values, reaching 3 and 2 times more profit when compared to the extensive scenario. Therefore, the financial risk is presented to the most extensive producers, a fact that may explain the difficulties to improve the production rates of the Brazilian beef cattle.

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