Ciência Rural, Santa Maria, v.48:07, e20170702, 2018
http://dx.doi.org/10.1590/0103-8478cr20170702
ISSNe 1678-4596
ANIMAL PRODUCTION

Economic-financial feasibility of pantaneiro lamb finishing systems

Leize Tatiane da Silva[1] José Francisco dos Reis Neto[1*] Guilherme Cunha Malafaia[1,2] José Alexandre Agiova da Costa[2]

[1]Programa de Mestrado em Produção e Gestão Agroindustrial, Universidade Anhanguera Uniderp, Rua Alexandre Herculano, 1400, 79037-280, Campo Grande, MS, Brasil. E-mail: jose.rneto@anhanguera.com.*Corresponding author.
[2]EMBRAPA Gado de Corte, Campo Grande, MS, Brasil.

ABSTRACT: *Technical and economic-financial performance of pantaneiro lamb finishing in feedlot (F) and semi-feedlot (SF) was evaluated. When analyzing the profitability, economic efficiency and the price sensitivity, was profit in all the scenarios evaluated. The gross margin (GM) was 69% and 52%, net margin (NM) was 65% and 48% and profitability index (PI) was 39% and 29%, as well as total productivity of factors (TPF) was R$1.53 and R$1.36, respectively, in the systems F and SF. Investment analysis showed that the activity is economically viable, remunerating all production factors and capital invested. Internal return tax was, respectively, 27% and 16% for the in feedlot and semi-feedlot systems.*
Key words: *production simulation; performance; sheep production; pantaneiro lamb, production systems.*

Viabilidade econômico-financeira de sistemas de terminação de cordeiros pantaneiros

RESUMO: *O desempenho técnico e econômico-financeiro de sistemas de terminação de cordeiros pantaneiros em confinamento (C) e semiconfinamento (SC) foi avaliado. Ao se analisar a rentabilidade, a eficiência econômica e a sensibilidade dos preços, foi apurado lucro em todos os cenários avaliados. A margem bruta (MB) foi de 69% e 52%, a margem liquida (ML) foi de 65% e 48% e o índice de lucratividade (IL) foi de 39% e 29%, bem como a produtividade total dos fatores (PTF) foi de R$ 1,53 e R$ 1,36, respectivamente, nos sistemas C e SC. A análise de investimento mostrou que a atividade é economicamente viável, remunerando todos os fatores de produção e o capital investido. A taxa interna de retorno foi, respectivamente, de 27% e 16% para a terminação em confinamento e semiconfinamento.*
Palavras-chave: *custos de produção; desempenho; ovinocultura; ovinos pantaneiros, sistemas de produção.*

INTRODUCTION

The Midwest region has approximately 6% (1,1 million of heads), of the national flock of ovines (18,4 million of heads) (SOUZA et al., 2017). Among the states that comprise it, the state of Mato Grosso do Sul has great potential for meat production, due to its geographical location being close to the city's largest consumer which is São Paulo, the favorable climatic conditions and the possibility of production on a large scale. According to COSTA & GONZALEZ (2012) the sheep farmer must seek the increase of zoothecnical indices, through the improvement of feeding, reproductive and sanitary management, in conditions that suit each system of production, by means of technological alternatives and management of greater technical and economic viability.

Pantanal breed of sheep is in the process of registration, making important studies of economic and financial viability that may influence its use by sheep farmers. ORRICO (2015) studying the use of diets enriched with crude glycerin (7.5%) instead of maize for Pantanal lambs, obtained an economic advantage with the substitution level, maintaining feedlot performance and carcass characteristics. ESPINOSA VILLAFUERTE (2016) studied finishing systems of Pantanal lambs. The highest cost of production was lamb acquisition (between 65 and 70%), followed by feed cost (between 18 and 20%). The highest profitability in the ILP system (semi-confinement: supplementation at 2% of the live weight in pasture of piatã grass + pigeon intercropped with maize for silage) with 30% to equal profitability in other systems with 27%, the best result for the ILP system was due to lower costs of food, sanitation and opportunity cost. BATISTA et al. (2018), studying quantitative carcass characteristics and economic viability of Pantanal

Received 10.02.17 Approved 05.27.18 Returned by the author 06.13.18
CR- 2017-0702.R1

lambs finished in different production systems, obtained purchase costs of lambs ranging from 61 to 75% and feeding costs ranging from 14.5% to 26.8% total variable production costs. The ILP system (semi-confinement: supplementation at 2% of live weight in sorghum and piatã grass) was the most viable, as a result of the income received from the sale of grains.

However, the sheep chain is still little studied in the country. Focused on the production of meat and wool, it is concentrated in the Brazilian Northeast and South; although, the latter region has lost its representativeness. Economic feasibility study enerate information that subsidize the creation of new races, in the case of the Pantanal races, is of fundamental importance to guide the decision-making process of rural producers. The present study aimed to evaluate economic and financial performance of systems of lambs' termination in feedlot (F) and semi-feedlot (SF), in order to offer the sheep farmer alternatives of production economically viable.

MATERIALS AND METHODS

Experiments were performed in the Model Farm of Beef Cattle of Embrapa, at the Midwest Embrapa Center of Goats and Sheep, in Terenos/MS, geographic coordinates 20º55'34"S and 54º81'24"W, altitude of 532m. were considered for the financial and economic analyzes and zootechnical performance of years 2011 and 2012, in the following finishing systems:

-Feedlot (F) -50 Pantaneiro lambs finished with sorghum silage based diet, provided *ad libitum* and energetic-protein concentrate, based on corn and soybeans meal (15% CP and 70% TDN), limited to a daily supply of 2% of body weight;

-Semi-Feedlot (SF) -50 Pantaneiro lambs finished on piatã-grass pasture (*Brachiaria brizantha* cv Piatã), deferred grazing for six months to lamb use in the alternated pasture system, supplemented at 2% of body weight, with the same concentration of feedlot system.

Pantaneiro origin lambs were weaned at 75 days and slaughtered in 2011 at 63 experimental days when they reached the average weight of 26.7kg and in 2012, at 70 days of experiment, with 26.22kg. At the system F a 200m² shelter with concrete floor, with space of 2m² per animal, and in the system SF a 1.2ha of pasture formed with piatã-grass was used.

Calculation sheets were assembled with the data of zootechnical performance resulting from the experiments and the prices adjusted for the date of March 2018 (US$1.00 = R$3.30). Property inventories (machinery, equipment and facilities) were prepared according to the methodology described by VIANA & SILVEIRA (2008). For the economic and financial analysis, spreadsheets in the program excel were elaborated. The calculation of cost of production followed the methodology of CAMPOS (2003), separating the effective operational cost (EOC), the total operational cost (TOC) and the total cost (TC). Therefore, it will be deemed as EOC the direct expenditures of the activity that, in its majority, vary directly with the increase or decrease in production, such as food, sanity, workforce, among others. The COT was composed by EOC added of depreciations with machines, equipment and facilities. The CT was obtained by adding value of the remuneration of capital invested and the opportunity cost of land in COT.

Lambs for finishing systems were evaluated in R$5.50 average live weight and the selling prices for the calculation of revenue were established based on those practiced in the region of Campo Grande of R$7,30 per kilo/live weight (CEPEA, 2018).

To calculate the opportunity cost, which is the minimum that the farmer loses out on earning in another activity to invest in sheep farming, a minimum rate of attractiveness of 6% per year was determined (real interest rate of savings accounts).

The method used in the depreciation calculation of the fixed capital was fixed quotas (or linear), with a residual value of 10%, in what is considered the new value minus the residual value and divided by the life span (HIRSFHFELD, 2000). It was considered the value of R$ 9.583 in the acquisition of the hectare of land. Out of the rate 7.95% a year (real rate of interest on savings accounts) 3% of real appreciation of the land have been discounted (CANZIANI & GUIMARÃES, 2009).

The indicators of profitability calculated were the rate of return (TR), gross margin (GM), net margin (NM), profitability index (PI) and Profit (P) or net income (NI), according to methodology used by CAMPOS (2003).

For the indicators of economic efficiency, the following were analyzed: The total productivity of the factors (TPF), rate of return (TR), point of equilibrium (PN) and family income, according to MARTINS et. al (2012).

For sensitivity analysis, which considers limits the price of the live weight lamb can vary without compromising economic feasibility of production systems, prices at three unfavorable levels were considered {-10%, -20%, -30%} and at three favorable levels too {+10%, +20%, +30%}.

At the production simulation, aiming to increase the productive capacity with the existing infrastructure, the capacity of termination was increased. It was considered the area of 0.5m² per lamb (CAVALCANTE et al., 2005) to the feedlot (F) and the pasture area for 6h in semi-feedlot (SF).

Four cycles of production in the System F were adopted, finishing of 500 lambs in each, totaling 2,000 lambs/ year. In the SF, system, three cycles were considered, two cycles of 500 lambs in each during the rainy season, and a cycle of 250 lambs during the dry period, totaling 1,250 lambs/year. Labor costs, for simulation purposes, were prorated by the number of hours worked annually, being proportional to the production costs, by the productivity in live weight obtained in each termination cycle, being considered that a worker has conditions of also produce lots of 250 or 500 lambs.

Cash flow was performed for ten years. The cash inflows were composed of rate of return (selling of live weight lambs) and residual value of investment. The cash outflows considered the initial investment (facilities, machinery and equipment, land) and working capital (GUIDUCCI et.al., 2012). From the year 1 to 9, the nominal balance was obtained by subtracting EOC (expenditure) from RT (receipt). Nominal balance was corrected year to year by the interest rate of 6%. In the 10th year of the project, it was added the sales revenue of live weight lambs and the residual value of the investment, and EOC was subtracted from this value.

From the cash flow, three indicators of economic viability were considered: net present value (NPV), internal rate of return (IRR) and the capital return period (*Payback)*, where:

a) NPV= a value at the moment considered initial (sum of the balances of cash flow), being discounted MRA (minimum rate of attractiveness) of 6%, adopted by the research. The investment is only feasible if NPV is higher than zero.

$$NPV = -II + \sum_{i}^{n} = 1 \frac{a_i}{(1 + MRA)^i}$$

where: II= initial investment in the period 0; a_i = income flow in the period i; MRA= minimum rate of attractiveness; i= period, where i=1, 2..., i.

b) IRR= annual rate (%) of return on invested capital. Investment is feasible if IRR is higher than MRA.

c)Period of capital return (*Payback*) = period (years) so that the farmer recovers the capital invested (Investment/Annual income).

RESULTS AND DISCUSSION

The zootechnical performance was similar between the systems. (Table 1). The weight gain in feedlot was 10.84kg and in semi-feedlot 10.46kg. Slaughter weight was, respectively, 26.60kg and 26.33kg, for F and SF. Carcass yield was 45%, the same between the finishing systems. The lambs were slaughtered aged 143 days at the average.

Table 1 - Productive results obtained in the Experimental Finishing Systems with 50 lambs.

Termination system	Feedlot	Semi-feedlot
Average initial live weight (kg)	15.76	15.87
Average live weight at slaughter (kg)	26.60	26.33
Daily average weight (g)	163.17	157.43
Number of finishing days	67	67
Carcass yield (%)	45	45
Carcass hot weight (kg)	11.97	11.85
Lambs mortality (%)	0	2
Slaughtered animals (heads)	50	49
Carcass total (kg)	598	574
Live weight total (kg)	1,330	1,276

Legend: *Mortality by photosensitization. (SOURCE: Experimental data).

The data generated from the research (Table 1) allowed to define the information for the simulation of economic feasibility of the activity. The number of animals slaughtered in feedlot is 60% higher than in pasture. In this scenario, the total cost to terminate 2,000 lambs in F was R$ 265,819 and to terminate 1,250 lambs in SF was R$ 169,827. A total cost over 57% for the feedlot.

Detailing of the production costs of finishing systems of lambs is reported in table 2. Of all the aggregate factors, the item that burdened the production system the most was the cost of lamb acquisition, which happened with ESPINOSA VILLAFUERTE (2016) e BATISTA et al. (2018), that represented 65.2% in F and 64.2% in SF. The second item that burdened F the most was feeding with 13.7%, and with 10.2% in SF. The third was the work force in SF with 10.5%, due to the lower number of finished lambs. Lambs' finishing analysis in F and the pasture performed by BARROS et al. (2009) indicated, respectively, the feeding, with 33.4% and 10.7%, and the workforce, with 33.4% and 10.7% as items that most influenced the effective operational cost. Depreciation and sanity presented values very close, other costs (fuel, energy, telephone) maintenance and conservation have the highest percentages in F than in SF.

Analyzing the indicators of profitability of the lambs' finishing system, the revenue obtained was higher in system F, value of R$388,307.04, higher

Table 2 - Comparative of annual costs of lamb finishing system, with 2% of feeding supplementation.

		----------Feedlot----------			----------Semi-Feedlot----------		
	Vu	Qt	Vt	P	Qt	Vt	P
1. Lamb acquisition cost			173,316	65.2		109,109	64.2
2. Feeding			36,296	13.7		17,289	10.2
Concentrate Fodder (kg)	0.79	29,180	23,052	8.7	21,885	17,289	10.2
Silage (kg)	0.13	101,880	13,244	5.0			
3. Sanity			10,050	3.8		6,405	3.8
Vermifuges (un)	1.99	2,000	3,980	1.5	1,250	2,488	1.5
Dewormer (tube)	8.25	120	990	0.4	90	743	0.4
Procedure Gloves (pair)	0.73	2,000	1,460	0.5	1,250	913	0.5
Other medications (un)	1.81	2,000	3,620	1.4	1,250	2,263	1.3
4. Work force			17,889	6.7		17,889	10.5
Workforce hired + taxes/month (day)	49.01	365	17,889	6.7	365	17,889	10.5
5. Other costs			6,698	2.5		2,059	1.2
Fuels and Lubricants (l)	3.95	584	2,307	0.9			
Electrical energy (kWh)	0.31	4,736	1,468	0.6	591	183	0.1
Telephone (day)	0.67	365	245	0.1	365	245	0.1
Office material (un)	26.50	9	239	0.1	4	106	0.1
Ear tags (un)	1.22	2,000	2,440	0.9	1,250	1,525	0.9
6-Maintenance and conservation			1,376	0.5		4,711	2.4
Roughage (Silage) (un)	458.65	3	1,376	0.5			
Pastures formation (un)						4,091	2.4
Pastures maintenance (un)						621	0.4
B-TOTAL OPERATIONAL COST - TOC			249,791	94.0		161,997	95.4
Depreciation			5,365	2.0		4,535	2.7
Facilities			4,070	1.5		2,937	1.7
Machines and Equipment			1,296	0.5		893	0.5
Pastures						704	0.4
C- TOTAL COST (TC)			265,819			169,827	
Opportunity cost (6% a.a.)			16,028	6.0		7,830	4.6
Facilities			4,262	1.6		2,448	1.4
Machine and Equipment			4,818	1.8		447	0.3
Land			1,513	0.6		1,513	0.9
Working Capital			5,435	2.0		3,421	2.0
Total cost per head of lamb			132.91			135.86	
Total cost per lamb (kg of live weight)			5.00			5.16	
Total cost per lamb (kg of carcass)			11.10			11.47	
EOC by lamb (kg of live weight)			4.59			4.83	
TOC by lamb (kg of live weight)			4.70			4.97	

Legend: un – units; Qt – quantity; Vu – unit value, in R$; Vt – total value, in R$; P – Relative Participation, in %;
Note: US$1.00 = R$3.30 in March 2018.

than in SF, with revenue of R$ 237,836.95. Gross margin (GM) is positive in both systems. This showed that the rate of return (TR) is higher than the effective operational cost (EOC). In the short run, the farmer will be able to remain in the activity, since that it is verified positive GM, sufficient to remunerate the fixed costs. In percentages,

GM was 59% in F and 51% in SF. The net margin (NM) was positive in both systems. This means that the producer may remain in the activity in the long run, TR is higher than TOC, in percentages, NM was 55% and 47%.

The profitability index (PI), therefore, was positive in both systems, which showed the relationship between the NM and the TR in percentage available in the activity, after the payment of TOC. The lowest profitability was 30% in SF, in both systems the producer may remain in the activity in the long run. The highest profit was obtained in F, R$ 2.30 per kg/live weight, and in pasture was R$ 2,14 per kg/live weight. The profit per kg/live weight in F is 7% higher compared to the pasture. The profit per live weight lamb (head) in F was R$ 61.24 and in SF R$ 56.38, the fall of the total cost per head in F is 9% compared to SF.

The equilibrium point, indicated the quantity of product necessary to cover all production costs, allowing the stability in the production systems analyzed which is 1,369 and 884 heads, respectively for F and SF. Below the level of production of 36,414 and 22,778kg, the net income generated would be negative, which would make the production systems economically unfeasible. The total productivity of factors (TPF) was R$ 1.46 and R$ 1.40, to F and SF, which indicated that the production systems are profitable and efficient, since that the greater a TPF, the better the profitability of investment (Table 3).

Return rate (TR) was also higher in the systems analyzed of 0.46% in F and 0.40% in SF. This means that, for each R$ 1.00 spent in F, it was generated R$ 0.46 of net income, which in SF, it was generated R$ 0.40. Also, family income is higher in 83% in F compared to SF. For each working month, the farmer monthly income in F was de R$ 11,543 and in SF was R$ 6,320.

The sensitivity analysis practiced in the research enabled to identify the limits of the price of lamb live weight that cause changes in indicators of economic efficiency of production systems. It was considered the range of -30% up to +30% of its original values that is R$ 7.30, at intervals of variation, upwards or downwards, to 10%. The net income (NI) was positive in all the scenario evaluated not only in F but also in SF as indicated in table 3.

When it comes to investment return, an internal rate of return (IRR) of 33% was obtained for F and one of 30% for SF. The IRR indicated the economical-financial feasibility of the systems, higher than MRA of 6% a year, the minimum desired for the negotiation. The IRR reached, a value greater than zero, indicated the economic-financial feasibility of the system, i.e., in addition to achieving the minimum expected (MRA on the value of 6%), a result in surplus money was obtained in feedlot equivalent to R$ 921,238.17 and in the pasture R$ 406,051.67. This indicated that the system allows the farmer to recover the capital invested within 10 years. The period of return on investment measured in relation to the business time, showed that the total return of initial investment, for the system recommended by the study, will occur in 4 years, in F and 5 years in SF.

CONCLUSION

The analysis of economic and financial indicators of production systems showed positive values, demonstrating the financial viability of the termination systems in F and SF (supplementation on pasture). The two production systems showed profitability and economic efficiency in production conditions.

The costs of production of both production systems are burdened mainly by the cost of acquisition of the lambs. The own creation of lambs and the use of specialized race in meat production may decrease the production costs.

The investment analysis shows that the activity is economically viable, paying all the factors of production and the invested capital, the internal rate of return above the minimum rate of business attractiveness.

The factor which must be highlighted when it comes the results observation is the profitability increase in scale production. The higher the lambs' production, the more diluted is the production cost, which positively impacts on the profit and the family's monthly income. Thus, when increases in production are simulated, considered the existing infrastructure, lambs' termination of in feedlot had higher economic returns than the system in pasture.

It was verified that the time of return on investment occurred in the four years for F and the five years for SF for both the finishing systems, using the maximum production capacity of each system, in annual finishing cycles.

Finally, the research presents some limitations, that is, the characteristic of the experiment that precludes a large-scale analysis of Pantanal lamb finishing systems; however, it offers technical data that allow to carry out the simulation. It is known that the simulation method may present distortions that do not fully capture the real conditions of a tax system, while providing subsidies for a plantain at the level of a commercial productive unit.

Table 3 - Analysis of Economical Sensitivity of the Lamb Finishing Systems.

	----------Less favorable (%) ---------			Neutral (%)	----------More favorable (%) ----------		
Sensitivity	-30	-20	-10	0	10	20	30
Price of kg live weight (R$)	5.11	5.84	6.57	7.30	8.03	8.76	9.49
Feedlot							
Net Profit (R$)	5,996	44,827	83,657	122,488	161,319	200,149	238,980
Equilibrium point (Heads)	1,956	1,711	1,521	1,369	1,245	1,141	1,053
Equilibrium point (kg)	52,476	45,067	40,460	36,414	33,103	30,044	28,256
Total productivity of the factors (TPF)	1.31	1.17	1.02	1.46	1.61	1.75	1.90
Rate of return (TR) (%)	0.02	0.17	0.31	0.46	0.61	0.75	0.90
Family income (R$)	22,024	60,854	99,685	138,516	177,347	216,177	255,008
Monthly family income (R$)	1,835	5,071	8,307	11,543	14,779	18,015	21,251
Semi-feedlot							
Net Profit (R$)	-3,341	20,443	44,227	68,010	91,794	115,578	139,361
Equilibrium point (Heads)	1,238	1,083	963	866	788	722	666
Equilibrium point (kg)	31,703	28,369	25,320	22,788	20,716	18,912	17,071
Total productivity of the factors (TPF)	0.98	1.12	1.26	1.40	1.54	1.68	1.82
Rate of return (TR) (%)	-0.02	0.12	0.26	0.40	0.54	0.68	0.82
Family income (R$)	4,489	28,273	52,056	75,840	99,624	123,408	147,191
Monthly family income (R$)	374	2,356	4,338	6,320	8,302	10,284	12,266

Note: US$1.00 = R$3,30 in March 2018.

BIOETHICS AND BIOSSECURITY COMMITTEE

We authors of the article entitled “Economic-financial feasibility of lamb finishing systems” declared, for all due purposes, the project that gave rise to the present data of the same has not been submitted for evaluation to the Ethics Committee of the Universidade Anhanguera (Uniderp), but we are aware of the content of the Brazilian resolutions of the National Council for Control of Animal Experimentation CONCEA if it involves animals. Thus, the authors assume full responsibility for the presented data and are available for possible questions, should they be required by the competent authorities.

ACKNOWLEDGEMENTS

The authors would like to thank the Univerdiade Anhanguera (Uniderp) for financial support, and to the EMBRAPA Gado de Corte, Campo Grande, MS, Brasil, for assignment of researchers and facilities.

DECLARATION OF CONFLICT OF INTEREST

The authors declare no conflict of interest. The founding sponsors had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish results.

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