Feasibility of grazing sheep production systems using long-term economic indicators and the methodology of the soil expectation value

Viabilidade de sistemas de produção de ovinos a pasto utilizando indicadores econômicos de longo prazo e a metodologia do valor esperado da terra

Thayla Sara Soares STIVARI[1]; Rafael Felice Fan CHEN[2]; Augusto Hauber GAMEIRO[1]; Alda Lúcia Gomes MONTEIRO[3]; Camila RAINERI[1]; Juliana Batista Andrade SILVA[4]

[1] Universidade de São Paulo, Faculdade de Medicina Veterinária e Zootecnia, Nutrição e Produção Animal, Pirassununga – SP, Brasil
[2] Universidade Federal do Paraná, Setor de Ciências Veterinárias, Curitiba – PR, Brasil
[3] Universidade Federal do Paraná, Faculdade de Zootecnia, Curitiba – PR, Brasil
[4] Médica Veterinária Autônoma, São Paulo – SP, Brasil

Abstract

Due to the high value of land in Brazil, it is necessary to conduct studies about the economic feasibility of the choice of production strategy. The soil expectation value determines the maximum purchase price of the bare land, considering the horizon of infinite time. Therefore, this methodology was used to assess the financial-economic feasibility of sheep production systems in pasture with either creep feeding or creep grazing termination of unweaned lambs. Six scenarios were proposed to evaluate the economic feasibility, according to the finishing strategy, the dry matter (DM) offer per kg of body weight (BW) per day (12% or 8%) and the corresponding percentage of white clover supplementary pasture area (30% to 50% - relative to the main pasture area). The soil expectation value was positive in all of the evaluated systems Creep grazing finishing system with 8% DM offer per kg BW and with 30% of reduction on the white glover area resulted in the largest financial return (R$ 289,043.71) and the highest internal return rate (1.74%). The most economically attractive scenario, however, was the creep feeding finishing system with 8% DM offer per kg of BW, which allowed expenses with the land as high as R$ 22,950.68 per hectare. Adjustments in the main pasture offer, which do not compromise animal performance, can enable economic improvement on the feasibility of grazing sheep production systems. The soil expectation value can be used as an economic indicator in the choice of location or expansion of grazing sheep farms.

Keywords: Animal production. Creep feeding. Creep grazing. Land cost. Production strategy.

Resumo

Devido ao valor elevado da terra no Brasil, é necessária a realização de estudos de viabilidade econômica durante a escolha da estratégia de produção. O valor esperado da terra determina o preço máximo de compra da terra nua, considerando o horizonte de tempo infinito. Portanto, essa metodologia foi utilizada para avaliar a viabilidade econômico-financeira de sistemas de produção de ovinos em pastagem com terminação em *creep feeding* ou *creep grazing* de cordeiros não desmamados. Seis cenários foram propostos para avaliar a viabilidade econômica de acordo com a estratégia de terminação, a oferta de matéria seca (MS) por kg de peso vivo (PV) por dia (12% ou 8%) e a área de pastagem suplementar correspondente de trevo branco (30% a 50% – em relação à área de pastagem principal). O valor esperado da terra foi positivo em todos os sistemas avaliados. O sistema com terminação em creep grazing com 8% de oferta de MS/PV e com redução da área suplementar para 30% apresentou o maior retorno financeiro (R$ 289.043,71) e a maior taxa interna de retorno (1,74%). No entanto, o cenário economicamente mais atraente foi o sistema de *creep feeding* com 8% de oferta de MS/PV, permitindo despesas de até R$ 22.950,68 por hectare. Ajustes na oferta da pastagem principal, que não comprometam o desempenho do animal, podem permitir melhores resultados econômicos de sistemas de produção de ovinos em pastagem. O valor esperado da terra pode ser usado como um indicador econômico na escolha da localização ou ampliação de sistemas de produção de ovinos em pastejo.

Palavras-chave: *Creep feeding. Creep grazing*. Custo da terra. Estratégia de produção. Produção animal.

Correspondence to:
Thayla Sara Soares Stivari
Avenida Duque de Caxias Norte, 225 – Centro
CEP 13635-900, Pirassununga, SP, Brasil
e-mail: thayla.stivari@gmail.com

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Introduction

Allied to the vast area of pastures, new strategies for grazing sheep production have been tested and improved every year in order to achieve higher productivity and profitability. Among these strategies, what stands out is the management at finishing stage using dietary supplements exclusively for the lambs. The exclusive and differentiated feeding of offspring can improve body weight gain and reduce days to slaughter, taking advantage of better feed efficiency and resulting in higher quality meat (QUADROS, 2005).

In this context, two main systems have been used: those using concentrate feed (creep feeding) and those using forage with high nutritive quality (creep grazing). Supplying concentrate feed based on grains has been a successful practice, once it is composed of ingredients with high contents of proteins and / or carbohydrates. However, expenditures with concentrate may increase production costs and reduce profitability. On the other hand, studies of creep grazing strategy in Brazil are scarce (HENTZ et al., 2012; PIAZETTA et al., 2009; RIBEIRO et al., 2013; SILVA et al., 2012; STIVARI et al., 2011) and their economic feasibility have not been widely studied (STIVARI et al., 2013). Silva (2010) reported no difference regarding the average daily gain when comparing both supplementation systems. However, due to the need of extra land space for creep grazing and the high land cost in Brazil, economic feasibility studies concerning this technique may help producers determine implementation likelihood of this technique at their farm.

A method used in the forestry industry to analyze the feasibility of the project is the soil expectation value (SEV), or land expectation value, or the "Faustmann Model", which was developed to determine the maximum purchase price of the bare land, considering the horizon of infinite time (GAFFNEY, 1960). This method consists of the determination of the updated value of net perpetual income, land cost excluded. It is based on the net present value (NPV) of a bare land area to be used for production given an infinite series of rotations/cycles or, in other words, the maximum land purchase price so that the activity is feasible (BUONGIORNO; GILLESS, 1987; SANTOS; PAIVA, 2002; SILVA; FONTES, 2005).

The objective of this study was to analyze the feasibility of grazing sheep production systems under two dietary strategies of supplementation (creep feeding and creep grazing) for finishing lambs by using the SEV method.

Material and Methods

This research was developed using data obtained from an experiment carried out between September and December of 2007 at Canguiri Experimental Farm, Federal University of Paraná State (UFPR), which used the Suffolk sheep flock from the Laboratory of Research and Production of Sheep and Goat (LAPOC) in Pinhais, Paraná, Brazil (latitude 25°25' South, longitude 49°8' W and elevation 915 m above sea level). The climate is Cfb, Köppen classification, which corresponds to the humid subtropical climate (mesothermal). The systems studied featured the use of annual ryegrass (*Lolium multiflorum* Lam) oversown with Tifton-85 (*Cynodon* sp.) as the main pasture, and the use of two lamb supplementation strategies: (1) *ad libitum* creep grazing of white clover (*Trifolium repens*) and (2) creep feeding with concentrate feed at 2% of body weight (BW) per day.

Ribeiro (2010) evaluated the performance and carcass characteristics of lambs. From this study, we used data of initial body weight (IBW) and final body weight (FBW), average daily gain (ADG), slaughter age, carcass yield and average carcass weight. We also used pasture production data from Silva (2010) that obtained them in the same experiment (Table 1). From these technical coefficients the economic and financial analysis of such systems was developed, extrapolating them to a representative commercial farm. Long- and short-term approaches were included. Long-term (LT) analysis consisted of projecting a monthly cash

flow to a ten-year horizon, to a total of 120 months, from which the economic indicators, NPV and internal rate of return were calculated.

In order to outline the commercial farm, a fixed number of 300 ewes was adopted, the excess ewes being considered as animals for sale. The average production coefficients adopted were obtained from LAPOC records of 2007: 88% of fertility rate; 140% of birth rate; 1.6 of prolificacy; 4% of mortality among adult animals; 9% of neonatal mortality; 13% of annual disposal of ewes and disposal of one ram and one ruffian per year.

These coefficients were applied in both systems. Furthermore, it was considered that there was no lamb mortality during finishing period. This premise was based on the results of Ribeiro (2010) and Silva (2010).

The animals were maintained in pasture during the whole year, with an offer of 12% of BW per day as natural matter of forage. During the reproductive period, *flushing* strategy was used, 15 days before mating, with 300 g of concentrate (16% of crude protein – CP – and 74% of total digestible nutrients – TDN – in dry matter – DM) per animal per day. During the 15 days before and after parturition, pregnant females were offered the same concentrate feed (800 g daily per animal), added with forage (2,4 kg of corn silage per animal per day). In system 1 (*creep grazing*), the white clover supplement showed 24.1% of CP and 75.4% of TDN in the DM. In system 2 (*creep feeding*), the concentrate feeding was composed of: soybean meal (40%), corn bran (40%), wheat bran (15%), mineral supplement (2%), limestone (2.5%) and common salt (0.5%); adding up to 24.7% CP and 89.2% TDN in DM. Previous studies showed that there were no statistical differences ($p < 0.05$) between both finishing systems for daily weight gain.

All prices used for calculations were the averages during the year of 2011, obtained from the SEAB-PR database (PARANÁ, 2011) of prices paid to the

Table 1 - Annual ryegrass (*Lolium multiflorum* Lam), over sown with Tifton-85 (*Cynodon* sp.), and herd production data, between September and December 2007 (at Canguiri Experimental Farm), of finishing lamb systems and area required to support 300 ewes, their lambs, breeding ram and ruffians, considering a supply of 12% DM per kg of BW – Pinhais – 2007

	Finishing systems	
Herd production data	***Creep grazing***	***Creep feeding***
Initial lamb body weight (kg)	17.33 ± 3.07	16.96 ± 3.86
Final lamb body weight (kg)	33.17 ± 1.31	33.04 ± 0.29
Average lamb daily gain (g)	274[a]	307[a]
Lamb slaughter age (days)	94[a]	90[a]
Carcass yield (%)	48.67[a] ± 3.43	47.78[a] ± 1.98
Average warm carcass weight (kg)	16.16[a] ± 1.52	15.71[a] ± 0.65
Pasture production data (*)		
Stocking rate (kg BW/ha)	2,255.5	2,276.3
Accumulation rate (kg de DM/ha)	83.9	89.2
Forage mass (kg de MS/ha)	3,922.6	3,863.4
Main pasture area (ha)1	17.2	17.1
Area for Rams (ha)	0.6	0.6
Area for white clover pasture (ha)2	9.0	-
Total area (ha) (**)	26.8	17.7

(*) Pasture evaluation was carried out every 21 days (SILVA, 2010)

(**) Total area = pasture areas, legal reserve, permanent reserve and area occupied with land improvement.

[1] Annual ryegrass (*Lolium multiflorum* Lam) over sown with Tifton-85 (*Cynodon* sp.)

[2] Creep grazing of white clover (*Trifolium repens*) *ad libitum*

Means followed by distinct lowercase letters at the lines showed significant difference by Tukey's test at 5% probability

Source: (RIBEIRO, 2010; adapted from SILVA, 2010)

farmer. Occasional missing price data was obtained through local survey of the suppliers in Curitiba region. All the prices were deflated to August, 2011, by the National Index of Prices Paid to the Consumer (INPC) (INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA, 2011). Acquisition cost of corn silage ready for consumption was R$ 0.43/kg. Expenses with pasture establishment and management were calculated according to the model proposed by AgraFNP (ANUALPEC, 2010). In order to calculate fixed cost, a farm inventory was made of the necessary land, equipment and facilities for the systems and prices of each new item and its useful life. The area required to maintain the flock and forage offer was stipulated, based on the pasture production data of 2007 for each system (Table 1). The formula used to calculate the area (HERINGER; CARVALHO, 2002), was:

$$\text{AREA} = \frac{[(\text{DM accumulation rate x No. days}) + \text{forage mass}]}{\text{No. days intended offer}} \text{ x } 100 \quad (1)$$

The creep grazing group maintained the proportion used by Silva (2010) of 2:1 (main pasture/ creep grazing), adding up to 9 hectares of pasture, divided into attached paddocks and the ewe's main paddocks. Twenty percent of the total area was considered legal reserve, 5% of the total area as permanent reserve and 0.03 hectares occupied with land improvement.

In order to compute expenses with maintenance and repairs, we considered 2% of each farm asset's cost per year, except for the fences, to which was attributed a 15% annual rate, and machinery and equipment, with a rate of 10% of each asset's purchase price per year. Depreciation was obtained through the Linear Method (HOFFMANN et al., 1981), in which it is equal to the cost of the asset reduced by the salvage or residual value, divided by the estimated useful life. The salvage value was 10% of the asset's cost to machinery and 20% to land improvement, except for the fences, for which the salvage value was considered zero. The useful lifespan was 30 years for the sheepfold and storehouse, 15 years for fences, water fountains, feeders, salt troughs, refrigerator and feed mixer, and five years for the mower and scales. These estimations were obtained from historic experience in LAPOC.

Medication costs were estimated based on LAPOC consumption. Vaccinations and their reinforcements were also accounted for, and expenses with antiparasiticides were estimated based on what was used in the experiment itself. The contributions of the costs of health management were not a concern at this study, due to its low contribution to the total cost (7.91% and 8.31% for creep grazing and creep feeding, respectively) and its slight difference among them (3%).

Monthly cost of technical assistance was 60% of the Paraná state minimum wage (R$ 708.14). The workforce consisted of one employee paid the regional minimum wage plus employment charges equivalent to 45.59% of the full amount (COMPANHIA NACIONAL DE ABASTECIMENTO, 2010). The tax deductions considered over the total income were: INSS (Social Security) at a 2.3% rate over income and 1% over fees. ITR (land value tax) was not computed due to the fact that the farm's area is less than 30 hectares, being thus exempted from the charge (BRASIL, 2005). General expenses corresponded to 1% of the variable cost, except for technical assistance, taxes and fees. (SISTEMA FAEP, 2005).

For estimating invested capital we considered the total amount invested in land, improvements, machinery, equipment and livestock from the inventory. The market interest rate of 0.5% per month (reference value historically used by Savings Account) was used to establish the opportunity cost of the immobilized capital. The opportunity cost of the working capital was the nominal rate of interest used by the Caixa Econômica Federal bank in loan funds (1.89% per month) over the direct production expenses. The selling prices were those verified in the region in August, 2010, as follows: R$ 5.46 per kilogram of live finished lamb; R$ 3.80 per kilogram

of disposed animals (sheep and ruffians); R$ 400.00 per one-year-old male; R$ 300.00 per seven-month-old female and R$ 1,388.00 per adult ram.

Once all the production cost items were calculated, they were organized by the method proposed by Companhia Nacional de Abastecimento (2010) in: variable cost (VC), fixed cost (FC), operating cost (OC), total production cost (TC). VC was considered as the sum of all direct production expenses; FC as the depreciation and permanent labor; OC = VC + FC and; TC = OC + opportunity cost of the immobilized capital. Also: the gross margin (GM) was the total income (TI) minus VC; the net margin (NM) = TI – OC and; the economic result (ER) = TI – TC. Return on assets (RA) was calculated dividing the economic result (ER) by the total investment minus working capital (BARATA, 2003).

Cash flow was stipulated for a 10-year period (120 months). In month 120, the income was added with the residual value of all the liquid assets. The financial feasibility of the systems was assessed through profitability indicators calculated on free cash flow (FCF): soil expected value (SEV) and internal rate of return (IRR). The calculation method for IRR was based in Noronha (1987), as follows:

$$IRR = \sum L_{t\,n}{}_{t=0} /(1 + \rho^*)^t = 0 \quad (2)$$

Where:

t = month (0,1,2,3,…,n)

L = net cash flow according to the corresponding month

ρ* = internal rate of return, which makes the sum of the monthly balances of the cash flow, brought to the present value, equal to zero.

The SEV was obtained through the formula:

$$SEV = \frac{R(1 + i)^t}{(1 + i)^t - 1} \quad (3)$$

SEV = soil expected value

R = updated perpetual net income

i = discount rate

t = time length of cycle/rotation

The simulation of scenarios was carried out as proposed by Gitman (1997) and makes it possible to verify how the best production systems are affected by variation of one or more variables in the result of the investment analysis. In this context, six scenarios were proposed, according to the finishing strategy, the dry matter offer per kg of BW per day from12% to 8% and the corresponding percentage of white clover supplementary pasture area (relative to the main pasture area) from 30% to 50%. For better understanding, the scenarios were organized as such: 1) creep feeding finishing system and 12% dry matter offer per kg of BW per day; 2) creep grazing finishing system, 12% dry matter offer per kg of BW per day and supplementary pasture area with 50% of the dimension of the main pasture; 3) creep grazing finishing system; 12% dry matter offer per kg of BW per day and supplementary pasture area with 30% of the dimension of the main pasture; 4) creep feeding finishing system and 8% dry matter offer per kg of BW per day; 5) creep grazing finishing system, 8% dry matter offer per kg of BW per day and supplementary pasture area with 50% of the dimension of the main pasture; 6) creep grazing finishing system; 8% dry matter offer per kg of BW per day and supplementary pasture area with 30% of the dimension of the main pasture. All economic-financial results ascertained were compared through descriptive analysis.

Results and Discussion

When analyzing VC, the expenditures related to the items that vary according to the produced amount (number of lambs), we observed that the cost of feeding, when compared to pasture management cost, encumbered the creep feeding system by R$ 6,298.75 more than the creep grazing system (Table 2). This result is similar to that described by Emmick (1991) that concluded that, from the livestock feeding perspective, pasture is the cheapest of all types of feed to produce and use. Nevertheless, production cost analysis should not take only variable costs into

account. It is also necessary to add the costs that do not vary according to the produced amount, represented by the fixed costs. Among them, the cost with depreciation of land improvement (fences, troughs etc.), machinery and others stands out. Depreciation cost can be a strategy that helps farmers to retrieve the capital asset, replacing it when it becomes economically obsolete and / or presents problems for using them. Total operating cost of the creep feeding system was R$ 1,720.00 (or R$ 5.73 per ewe), cheaper than the total operating cost of the creep grazing system. This was because it had approximately nine hectares less than in the creep grazing system, thus resulting in lower expenses for fences, for example.

When analyzing the TC, *creep grazing* system had the highest production cost, mainly due to the opportunity cost (R$ 42,777.52). However, this sum of the opportunity cost must not be understood as an actual outlay; it is rather an implicit income, in which all the factors of production (land, labor and capital) are being remunerated. When all these components are included, even with zero profit, there are no reasons for the farmer to abandon the activity, since he is being paid for the use of his own factors of production.

When evaluating the short-term financial and economic results (i. e. one production cycle) of the proposed scenarios, it was possible to verify that the economic result (TI – TC) and the return on assets were superior for scenario 4 (creep feeding finishing system and 8% dry matter offer per kg of BW per day) (Table 3).

Regarding the white clover area, the reduction from 50% to 30% brought little impact on the net margin per hectare, regardless of the dry matter offer. Nevertheless, when comparing the alterations in dry matter offer, there was a significant increase on this indicator when the offer was reduced from 12% to 8%,

Table 2 – Annual costs and incomes (R$/year) of sheep production in annual ryegrass (*Lolium multiflorum* Lam), over sown with Tifton-85 (*Cynodon* sp.), at Canguiri Experimental Farm, using creep feeding or white clover (*Trifolium repens*) *ad libitum* creep grazing finishing systems in modules with 300 ewes – Pinhais – 2007

Expenses (R$)	Finishing systems	
	Creep grazing	Creep feeding
a) Concentrate feed (flock)	12,218.53	19,535.20
b) Animal health (flock)	9,959.28	9,624.61
c) Ram purchase	1,500.00	1,500.00
d) Pasture maintenance (flock)	14,879.99	13,862.07
e) Technical assistance (flock)	5,098.61	5,098.61
f) Machinery, equipment and land improvement maintenance	15,791.59	10,329.71
g) Electrical power	600.00	700.00
h) Interest on working capital	1,072.66	1,087.82
i) General expenses	560.22	566.39
j) Variable cost – VC (a+b+...+j)	61,680.87	62,304.41
k) Depreciation of machinery, equipment and land improvements	8,519.08	6,166.34
l) Permanent workforce	12,841.80	12,841.80
m) Fixed cost – FC (l+m)	21,360.87	19,008.13
n) Total Operating cost – OC (k+n)	83,041.74	81,312.54
o) Opportunity cost of immobilized capital	42,777.52	34,450.45
p) Total production cost – TC (o+p)	125,819.26	115,762.98
(*) Incomes (R$)		
Sale of animals for reproduction	53,988.00	53,988.00
Sale of disposed animals	10,488.00	10,488.00
Sale of live finished lamb	75,341.01	75,045.73
Total revenue (R$/ year)	139,817.01	139,521.73

(*) Number of animals sold: 416 live finished lambs; 74 young animals for reproduction (41 males and 33 females) and adult animals (38 sheep, one ruffian and one ram)

Table 3 – Short-term financial and economic results of six different sheep production scenarios using annual ryegrass (*Lolium multiflorum* Lam), over sown with Tifton-85 (*Cynodon* sp.), at Canguiri Experimental Farm, using creep feeding or white clover (*Trifolium repens*) creep grazing finishing systems, in modules of 300 ewes – Pinhais – 2007

Economic indicator	Finishing systems					
	12% DM offer per kg of BW per day			8% DM offer per kg of BW per day		
	Creep feeding[1]	Creep grazing 50%[2]	Creep grazing 30%[3]	Creep feeding[4]	Creep grazing 50%[5]	Creep grazing 30%[6]
Gross margin (R$)	77,217.33	78,136.14	80,344.71	84,654.38	87,781.77	89,254.15
Net margin (R$)	58,209.20	56,775.27	59,797.98	66,829.78	68,418.56	70,433.71
Net margin per hectare (R$/ha)	3,288.65	2,118.48	2,512.52	5,663.54	3,822.27	4,429.79
Economic result (R$)	23,758.75	13,997.75	19,808.13	37,482.78	33,532.16	37,405.75
Return on assets (%)	4.28	2.03	3.07	7.92	5.96	7.02

[1] Scenario 1: creep feeding finishing system, 12% DM offer per kg of BW per day; [2] Scenario 2: creep grazing finishing system, 12% DM offer per kg of BW per day, supplementary pasture area with 50% of the dimension of the main pasture; [3] Scenario 3: creep grazing finishing system, 12% DM offer per kg of BW per day, supplementary pasture area with 30% of the dimension of the main pasture; [4] Scenario 4: creep feeding finishing system, 8% DM offer per kg of BW per day; [5] Scenario 5: creep grazing finishing system, 8% DM offer per kg of BW per day, supplementary pasture area with 50% of the dimension of the main pasture; [6] Scenario 6: creep grazing finishing system, 8% DM offer per kg of BW per day, supplementary pasture area with 30% of the dimension of the main pasture

in all the scenarios above. This refers back to the idea of adequate and strategic pasture management (CAYLEY et al., 1999, SCOTT; CACHO, 2000; TRAPNELL et al., 2006), which allows animal performance to be at a desirable level and stocking and forage offer rates to be adequate and financially attractive.

In the long-term analysis (Table 4), SEV was positive in all the systems, marking the feasibility of these projects. In other words, at a 0.5% discount rate, the sum of incomes in a 10-year period was superior to the investment in the activity. Creep grazing lamb termination with an 8% DM offer per kg BW, with reduction to 30% of the main pasture (scenario 6) obtained the largest financial return among the scenarios proposed and the highest IRR (1.74%). IRR must be equal to or above market interest rate (the reference in this project being the Savings Account); this positive rate indicates that the capital invested in the activity was recovered and the balance available each year yielded interest equal to the IRR (GUIMARÃES; CAZIANI, 2004).

Table 4 – Economic result of six scenarios of sheep production systems in modules of 300 ewes: 12 or 8% DM offer of annual ryegrass(*Lolium multiflorum* Lam), over sown with Tifton-85 (*Cynodon* sp.), at Canguiri Experimental Farm, using creep feeding or white clover (Trifolium repens) creep grazing lamb termination – 30 or 50% of the main pasture area – Pinhais – 2012

Economic indicator	Finishing systems					
	12% DM offer per kg of BW per day			8% DM offer per kg of BW per day		
	Creep feeding[1]	Creep grazing 50%[2]	Creep grazing 30%[3]	Creep feeding[4]	Creep grazing 50%[5]	Creep grazing 30%[6]
Internal rate of return - IRR (%)	1.37	1.18	1.31	1.72	1.64	1.74
Soil expected value - SEV (R$)	197,106.59	167,295.41	196,117.52	270,818.04	269,828.97	289,043.71
Soil expected value per hectare - SEV/ha (R$ / ha)	11,135.97	6,242.37	8,240.23	22,950.68	15,074.24	18,178.85
Total pasture area (ha)	17.70	26.80	23.80	11.80	17.90	15.90

[1] Scenario 1: creep feeding finishing system, 12% DM offer per kg of BW per day; [2] Scenario 2: creep grazing finishing system, 12% DM offer per kg of BW per day, supplementary pasture area with 50% of the dimension of the main pasture; [3] Scenario 3: creep grazing finishing system, 12% DM offer per kg of BW per day, supplementary pasture area with 30% of the dimension of the main pasture; [4] Scenario 4: creep feeding finishing system, 8% DM offer per kg of BW per day; [5] Scenario 5: creep grazing finishing system, 8% DM offer per kg of BW per day, supplementary pasture area with 50% of the dimension of the main pasture; [6] Scenario 6: creep grazing finishing system, 8% DM offer per kg of BW per day, supplementary pasture area with 30% of the dimension of the main pasture

The SEV/ha values refer to the maximum price that can be paid for the land. That said, the creep feeding finishing system with 8% DM offer per kg of BW was the most economically attractive scenario, for it allows expenses as far as R$ 22,950.68 per hectare. The average prices of the hectare in arable areas in the estate of Paraná are displayed in table 5.

Given the values above, the creep grazing systems with 12% DM offer (scenarios 2 and 3) would not be economically feasible in pastures of good nutritional quality (high support). The remaining scenarios would be economically feasible in the presented regions; however, in pastures of low support (inferior nutritional quality), the average daily gain may be compromised, resulting in the necessity of supplementation with concentrated feed or another forage, increasing the variable cost of the system.

Conclusions

Sheep production systems using creep feeding achieved better economic indexes, once the forage offer is adjusted, when compared with those using creep grazing. Adjustments in the main pasture offer that do not compromise animal performances also enable economic improvement. Soil expectation value can be used as an economic indicator in the choice of farm location or expansion. All systems were demonstrated feasible when the soil expectation value was taken into consideration.

Table 5 – Average prices of the hectare in arable areas in the estate of Paraná (R$/ha) – Pinhais – 2012

	Pasture			
Region	**High support (R$/ha)**	**Low support (R$/ha)**	**Sloping lands (R$/ha)**	**Sand stones oil (R$/ha)**
Campo Mourão	8,000.00	5,933.00		
Cascável	9,500.00	6,500.00		
Curitiba		3,400.00		
Guarapuava	9,000.00	4,500.00		
Londrina			4,567.00	8,7503.00
Paranavaí	10,533.00	9,000.00		
Ponta Grossa	8,333.00	4,233.00		
Telêmaco Borba	8,000.00	5,900.00		
Umuarama	9,500.00	7,267.00		

Source: adapted from Agrianual (2012)

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