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Economical analysis of year round lamb production

P.C.H. MOREL, P.R. KENYON[1] AND S.T.MORRIS[1]

Institute of Food, Nutrition and Human Health, Massey University,
Private Bag 11-222, Palmerston North, New Zealand.

ABSTRACT

The traditional lamb production system in New Zealand is driven largely by the seasonal pattern of pasture growth and ewes lambing once a year. An alternative is the implementation of year-round lamb production systems such as the STAR system, where ewes lamb five times over a three-year period, thus providing a continuous supply of lambs. A modeling exercise was undertaken to assess the economic viability of the STAR system. The model simulates pasture growth and flock energy requirement on a daily basis over a three year period for both the traditional system and the STAR system and calculates gross margins. The model was run for a 100ha block using average Manawatu pasture growth rates. The two systems were set to consume 11000 kg DM/ha of pasture per year. The model indicates that, at the same lambing percentage (160%) the STAR system earned an extra 26% of income compared with the traditional system. Even at a lower lambing percentage (148 versus 160) the system can match a seasonal lamb production system. With a 10 % premium for out of season lambs the STAR system generates an extra 56% in profit.

Keywords: Year round lambing; production system; profitability.

INTRODUCTION

The traditional lamb production system in New Zealand is driven largely by the seasonal pattern of pasture growth. Ewes are mated in the autumn so that they lamb at the beginning of the spring pasture flush, to produce lambs for slaughter through the summer and autumn period. Such a system is associated with a poor utilisation of the meat-processing capacities and a lack of continuity in the supply of chilled lambs for overseas markets (Taylor, 1982). An alternative is the implementation of year-round lamb production systems such as the STAR system, in which individual ewes lamb five times over a three year period (McCutcheon *et al*, 1995). In the STAR system a set of lambs are born every 73 days, resulting in a continuous year round supply of lamb. Briefly, in the year round system ewes are initially divided into 3 flocks with a flock mated on 11 January, 25 March and 5 June. The 11 January mated ewes will lamb from 5 – 25 June and will be mated again on 21 August while the 25 March mated ewes will lamb from 21 August to 10 September and be mated for a second time on 1 November. Ewes mated on 5 June will lamb from 1 November to 20 November and will be mated again on 11 January. Sheep breeds with a long natural mating cycle, high fecundity and high milk production will be best suited for the STAR system. Currently, in New Zealand, Dorset, Polled Dorset, East-Friesian and their crosses will meet these criteria.

Presently an experiment is being conducted at Massey University to evaluate the STAR system under New Zealand‘s pastoral conditions. A modeling exercise was undertaken to assess the economic viability of the STAR system. In this paper a detailed description of the model and results of the economical analysis are presented.

METHOD

The model simulates pasture growth and flock energy requirement on a daily basis over a three-year period starting in September for both the traditional system (once a year lambing) and the STAR system and calculates gross margins on a 100 ha block.

Pasture

The daily pasture dry matter (DM) growth rates are based on the Manawatu 10 year monthly averages (Figure 1). The metabolisable energy (ME) content of the pasture was set at a constant 11 MJME/kg DM. The pasture cover (kg DM/ha) at the start (1 September) was set to 1200kg DM/ha. Pasture cover was calculated as the pasture cover at the end of the previous day plus the pasture dry matter growth on the day less the pasture dry matter used by the flock on the day. The pasture dry matter used by the flock on the day was calculated as the kg DM needed to cover the ME requirements of the flock multiplied by a utilization factor. The utilization factor represents the fact that not all pasture growth can be utilized by the animal (Korte *et al*., 1987). This factor was set to 0.85.

[1]Institute of Veterinary, Animal and Biomedical Sciences, Massey University, Palmerston North, New Zealand

Reproductive performance

The following parameters are use in the model to simulate the reproductive performance of the flock. The first one is the conception rate per mating cycle. The ewes are mated over a two-cycle period. The mating period is 34 days in the traditional system. In the STAR system, ovulation is induced by hormonal treatment so that the mating period is 22 days, 5 days for the induced ovulation plus 17 day for the following natural cycle. It is assumed that all ewes which conceive actually lamb. The lambing percentage (% Lamb) is defined as the number of lambs born per ewe lambing expressed as a percent. There is no pre-weaning mortality.

Ewe metabolisable energy requirement

If not specified otherwise, the formula used to calculated the energy requirements are derived from the data presented by Geenty & Rattray (1987).

The maintenance energy requirement (ME_m) is equal to (0.335 x Liveweight$^{0.75}$) / 0.64.

The ewe liveweight was set at 60 kg.

During the flushing period (20 day before mating in the traditional system) the ME requirement is equal to 1.5 x ME_m. There is no flushing period in the STAR system.

The ME requirement for fetal ($ME_{fet)}$ growth is:

= (1 + (%Lamb -100)/100)) x (0.0759 x e$^{0.2044 \text{ x Pregnancy Week}}$)

The ME requirement for milk production (ME_{milk}) is calculated as follows:

Kg milk for a single lamb =

1.2 + 0.42 x week – 0.071 x week^2 + 0.002 x week^3

Multiple factor (adjusting kg milk for multiple birth) =

1 / ((% Lamb x 0.0054) + 0.464)

Milk yield (kg) =

(multiple factor x kg milk for a single lamb x % lamb) / 100

ME_{milk} = Milk yield x 4.7 / 0.7

During lactation ME_m is increased by 30 %.

Lamb metabolisable energy requirement

The maintenance energy requirement (ME_m) is equal to (0.39 x Liveweight$^{0.75}$) / 0.75.

The lambs birth weight (BW) at birth is calculated as follows:

= basal BW + (((ewe liveweight – 50) / 10) x 0.350) + ((% Lamb -100) x -0.65).

This formula is derived from data presented by Tissier & Theriez (1978).

The basal BW was set at 4 kg.

The energy requirement for growth was set at 5.17 MJME per kg body weight gain.

All lambs are weaned together 100 days after the birth of the first lambs in the traditional system and 73 days after the birth of the first lamb in the STAR system.

Before weaning, lamb pasture intake is calculated as the difference between the lambs energy requirement to growth at the set daily weight gain, and the energy available from milk. If the energy provided by the milk is greater than the lambs requirement for growth, the ewe pasture intake is reduced to match the energy requirement of the lambs.

Financial parameters

Pasture was valued at 8 cents/kg DM and the additional fixed cost per ewe for year round lambing was $12/year compared with $5/ewe for the traditional system. Lamb sales were valued at $2 kg/liveweight at weaning and culled ewes valued at $40 per ewe. Replacement ewes are selected from within the flock, and the replacement rate (which is equal to the culling rate) was set at 20 %.

Simulation

Four scenarios were simulated, over a three-year period starting on the first of September, to investigate the effect of stocking rate alone (A), lambing percentage (B), lamb price (C) and lamb growth rate (D) on the difference in profitability between the traditional system and the STAR system. For each scenario the stocking rate was adjusted so that the DM usage over the three-years was the same for both systems. The model input parameters which differ between the traditional and STAR systems for the different scenarios are given in Table 1. All the others input parameters were set at the levels mentioned in the above model description.

TABLE 1: Model input parameters for a three-year simulation of different scenarios in the traditional (T) and STAR (S) systems.

Scenario	A[1]		B		C		D	
System	T	S	T	S	T	S	T	S
Stocking rate	17.50	17.10	17.50	17.35	17.50	17.10	17.50	17.00
Lambing percentage	160	160	160	148	160	160	160	160
Growth rate (kg/d)	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.22
$ kg LW	2.0	2.0	2.0	2.0	2.0	2.2	2.0	2.0
Fixed Cost per ewe/year ($)	5	12	5	12	5	12	5	12

[1] A: Effect of stocking rate; B: lambing percentage; C: price per kg lamb; D: growth rate

RESULTS AND DISCUSSION

Scenario A. Due to the higher annual feed demand in the STAR system (as individual ewes average 1.67 pregnancies and lactations per year) the same stocking rate as the traditional system cannot be maintained on a given farm, unless supplements are bought in, which is often uneconomical in New Zealand (Rattray, 2001). Therefore it is important to determine what the adjusted stocking rate should be and whether the STAR system would still be economical at this level. The simulation indicates that the STAR system earned an extra 26% in income compared with the traditional system, and this occurred at a lower stocking rate (17.1 v 17.5 ewes/ha). (Tables 1 and 2). The daily pasture dry matter growth rates, dry matter requirements and pasture dry matter cover for scenario A are represented in Figures 1 and 2 for the STAR system and the traditional system, respectively. In the STAR system there is a quasi constant daily dry matter requirements all year round (25-35 kg DM/ha) resulting in a high pasture cover over the summer months. Managing this excess pasture cover may be one of the problems of the STAR system.

Scenario B. Although it is not known, it is possible that under outdoor pastoral condition, the lambing % will be decreased in the STAR system compared with the traditional system, as it is known that both ovulation rates and lamb loss rates are affected by season (Morris, 1997). The simulation indicates that similar returns are obtained in each system when the lambing % in the STAR system is 148% vs 160% for the traditional (Tables 1 and 2).

FIGURE 1: Daily pasture dry matter growth rate , daily dry matter requirement and daily pasture dry matter cover over one year for the STAR system.

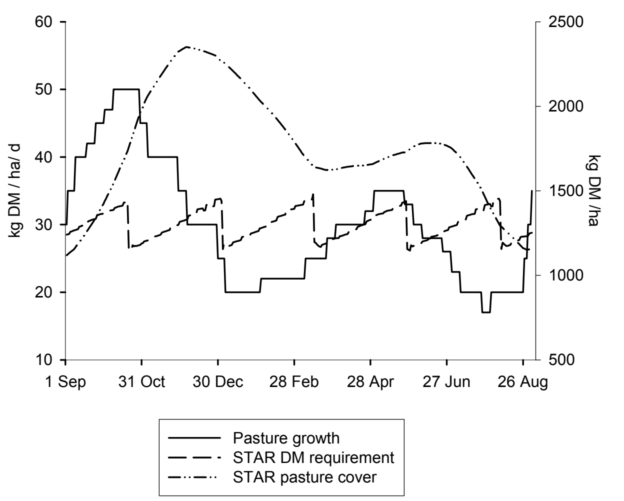
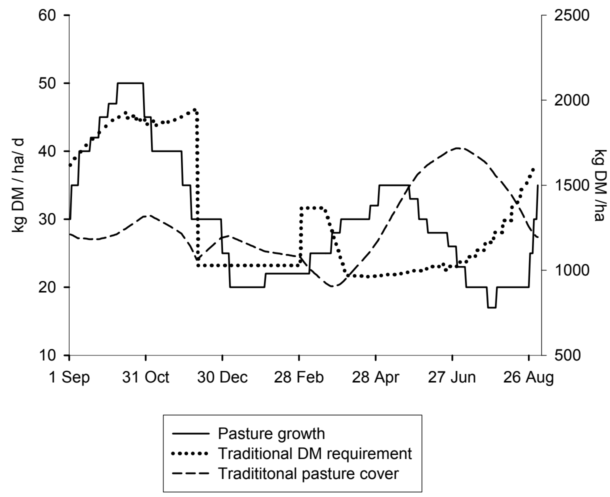


FIGURE 2: Daily pasture dry matter growth rate , daily dry matter requirement
and daily pasture dry matter cover over one year for the traditional system.



Scenario C. Premiums for out of season lamb are often offered for lambs produced outside the traditional spring lambing period. In this scenario we have studied the effect of having an extra 10% in lamb value (from \$2 to \$2.20/kg) for the STAR system. This generated an extra 65% of revenue above the traditional system (Tables 1 and 2).

Scenario D. The STAR system potentially produces a large number of lambs which are weaned early, at a relatively light weight and are sold store. A small increase in individual weaning weight would have a multiplicative effect on the returns. This scenario investigated the effect of 10% increase in average lamb growth in the year round system as these lambs are weaned at 70 days at a time when ewe milk and lamb growth is at its maximum (the 10% increase amounted to an extra 20g/day). This generated an extra 56% in income over the traditional system.

In conclusion, a year round lamb production system that sells lambs at weaning (73 days after birth of the first lamb) to a lamb finisher is a highly profitable option for those farmers who are able to plan their feed supplies (to coincide with 5 different lambing groups in one year). The present model is only a simplistic model based on a set of assumptions, as more data becomes available from the experiment currently conducted at Massey University the model will be refined.

TABLE 2: Number of animals, dry matter usage and financial performances for a three-year simulation of different scenarios in the traditional (T) and STAR (S) systems.

Scenario[1]	**A**		**B**		**C**		**D**	
System	**T**	**S**	**T**	**S**	**T**	**S**	**T**	**S**
no. Ewes	1750	1710	1750	1735	1750	1710	1750	1700
No. Ewes culled	1050	1026	1050	1041	1050	1026	1050	1020
no. Lambs	7014	12107	7014	11284	7014	12107	7014	12036
Lamb LW (kg)	25.4	17.4	25.4	17.4	25.4	17.4	25.4	18.7
Cover End (kg DM/ha)	1193	1191	1193	1213	1193	1191	1193	1145
DM usage (T)	3303	3292	3303	3284	3303	3292	3303	3301
Income ($)								
Lamb sale	356779	420510	356779	391946	356779	462560	356779	450227
Ewe sale	42000	41040	42000	41640	42000	41040	42000	40800
Expenses ($)								
DM cost	264239	263383	264239	262720	264239	263383	264239	264102
Fixed cost Ewe	26250	61560	26250	62460	26250	61560	26250	61200
Balance ($)	108290	136606	108290	108406	108290	178657	108290	165725
S / T (%)		126		100		165		153

[1] A: Effect of stocking rate; B: lambing percentage; C: price per kg lamb; D: growth rate

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