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A modelling study of the productivity and profitability of unmated and mated ewes on North Island hill country

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ABSTRACT

Feed intake and wool production data on unmated, single- and twin-bearing/rearing ewes from a year-long field trial were incorporated into feed budget models of a hill country farm. Increasing the basal liveweight of an unmated ewe from an average of 45 to 55 kg increased greasy wool production from 4.15 to 5.10 kg/ewe. Relative to the annual feed requirements (614 kg DM/y) of a typical breeding ewe (1 sheep stock unit (ssu)) on the case farm the annual feed requirements of unmated 45, 50 and 55 kg ewes were estimated to be 0.58, 0.66 and 0.72 ssu. At 1991 costs and prices the gross margins (GM) were $15.50/ssu for breeding ewes (100% lambs weaned) and, depending on liveweight, from $7.12 to $8.11/ssu for the all-wool options. The breeding ewe policy remained more profitable even if low lamb prices or a poor lambing percentage were achieved.

Keywords Feed budget model, wool production, unmated ewes, hill country, profitability.

INTRODUCTION

High wool prices compared to returns from lambs during the period 1985-1990 created a demand for information on the profitability of all-wool systems and generated a need for improved data on feed intake and wool production of unmated ewes relative to that of pregnant/lacating ewes. The evaluation of all-wool policies can be undertaken using farm feed budget models which quantify the temporal relationship between feed supply (pasture production) and animal feed demand, in conjunction with a financial analysis such as gross margins (GM). This approach is less expensive than carrying out farmlet studies, but depends on the availability of data which quantify relationships between inputs and outputs in the farm system. The present study compared unmated and breeding ewe policies (for crossbred ewes) by generating experimental data not previously available in the literature (Parker *et al.* 1991) and, as described in this paper, incorporating these findings into a model for a lower North Island hill country farm.

METHODS

Feed budget models

A simulation model (all-wool) was developed to investigate the effect of liveweight (LW) on the feed requirements and wool production of unmated ewes. This model was a modification of the McCall (1984) sheep farm model which had been adapted to a spreadsheet (VP Planner Plus) format by Gray (1987) to study hill country breeding ewe policies. Model outputs (monthly and per annum) included pasture cover, ewe LW and liveweight change (LWC), and ewe fleeceweight and wool growth rate (on a greasy and clean basis). Clean wool yield, which could be varied each month, was set at 70%. Feed requirements for unmated ewes (Table 1) were developed with the all-wool model from the associated field study (Parker *et al.* 1991) and the data of Rattray (1986) for fleecefree LWs of 45, 50 and 55 kg on July 1. For each LW the opening (July 1 19XX) and the closing (June 30 19(XX+1)) pasture covers were set at 1,500 kg DM/ha, and within-year upper and lower pasture cover bounds were set at 2,700 and 700 kg DM/ha, respectively. Ewes were shorn twice-yearly in October and March. Replacements were purchased in October (as wet dry ewes from breeding flocks) and in February (as cast for age ewes) to maintain a fixed monthly number of ewes. Ewe intakes were altered to match pasture supply with feed demand within the specified pasture cover bounds, but were constrained to be a maximum of 3.5% of LW at the beginning of each month and to achieve no net change in LW by the end of the year. The feed intake data was transferred to a spreadsheet (Multiplan) "farm" model of feed supply (kg DM/ha) and feed requirements (kg DM/hd/d; Table 1) to study the effect of alternative all-wool policies on a case study property. Flock replacement feed requirements were derived by Gray (1987) for a 20 kg ewe lamb at weaning reaching 55 kg by two tooth mating.

Case study farm

Massey University's hill country sheep farm, Tuapaka, was used as a case study property. The farm comprises 341 effective hectares of easy to steep hill land and is typical of lower North Island summer moist hill country. Net herbage accumulation averages 7,184 kg DM/ha/y (Table 1). The annual rainfall average is 1132 mm. Pasture and animal performance data have been recorded since 1981.

A feed budget of the sheep and cattle policy at Tuapaka, simplified to monthly data inputs, was prepared using the farm model. Winter stock numbers included 2,350 ewes, 605 ewe hoggets, 42 other sheep, and 145 yearling and 40 rising two-year Friesian bulls. This represented 3,588 su (10.5 su/eff. ha), and a 22% cattle to sheep ratio. Ewes lambed from early-September and weaned 100% lambs in late December. Except for 650 ewe replacements all lambs were sold as stores (woolly) at weaning. The bulls, purchased as weaners in November, were sold at 18 months (two thirds) and 30 months of age. Other details of sheep

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TABLE 1 Monthly feed requirements (kg DM/hd/d) of unmated and single- and twin-bearing/rearing ewes and flock replacements, and net herbage accumulation rates (NHA; kg DM/ha/d) for the Tuapaka hill country farm.

	Ewe classes[a]					Flock replacements[b]		
	Unmated			Single	Twin	Lamb	Hogget	NHA
	45kg	50kg	55kg	(55 kg)				
Jul	0.7	0.8	0.8	1.0	1.1		1.0	10
Aug	0.9	0.9	0.9	1.1	1.2		1.3	13
Sep	1.0	1.4	1.6	2.5	2.6		1.6	17
Oct	1.2	1.8	2.0	2.8	3.0		2.0	28
Nov	1.4	1.4	1.9	2.7	2.9		2.1	43
Dec	1.1	1.1	1.5	2.3	2.4		2.4	31
Jan	1.0	1.0	1.2	1.5	1.5	1.0	1.8	20
Feb	1.0	1.0	1.0	1.2	1.2	1.1	1.7	16
Mar	1.0	1.0	1.0	1.5	1.5	1.3		22
Apr	0.9	0.9	0.9	1.2	1.2	1.4		16
May	0.8	0.8	0.9	1.0	1.0	1.5		12
Jun	0.8	0.8	0.8	1.0	1.0	1.0		8
Annual	359	408	441	603	630			7184

[a] Derived from Parker *et al.* (1991); Rattray (1986) and Gray (1987).
[b] Derived by Gray (1987) for a 20 kg lamb reaching 55 kg at two tooth mating.

TABLE 2 Performance and financial values used to calculate gross margins for breeding and all-wool sheep policies.

	Breeding	All-wool
Lambs weaned/ewe mated (%)	100	-
Death rate (% wintered)		
:ewe	4	3
:other	3	-
Annual replacement rate (%)	25	20
Fleece weight (kg) :ewe	4.8	4.1-5.1
:hogget	3.0	-
:lamb	1.1	-
:ram	5.0	-
Wool return (c/kg greasy net)		
:ewe/ram	250	255
:hogget	265	-
:lamb	260	-
Sheep sales (purchases) ($/hd)		
:ewe	13	12(15)[a]
:lamb	15	-
:ram	(220)	-
Shearing ($/sheep)	1.50	1.50
Animal health ($/ssu)	1.30	0.80
Interest on capital (%)	12.50	12.50

[a] Prices are for a 55 kg ewe. Values for 50 and 45 kg ewe purchases and sales were $2 and $4 less, respectively.

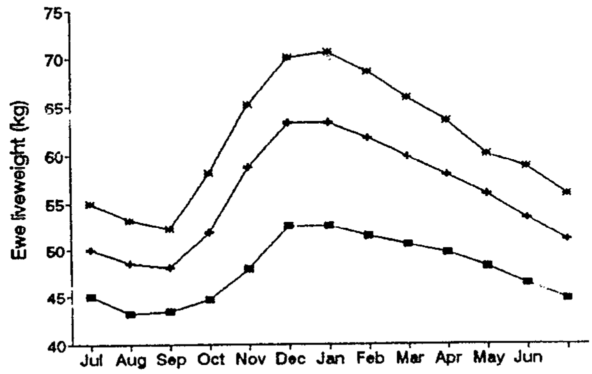
performance and financial returns used to estimate the gross margin per sheep su (GM/ssu) are summarised in Table 2.

An all-wool policy for each ewe LW was developed iteratively by substituting unmated ewes, at the intakes shown in Table 1, for breeding ewes and their replacements until the annual feed demand matched that of the breeding ewe policy (i.e. beginning and end-of-year average pasture covers were 1,500 kg DM/ha). To reduce the number of stock policy permutations, the same cattle policy and fixed monthly sheep numbers (rather than a range of buying and selling policies) were assumed for each sheep option. Performance parameters used to derive the all-wool GM are presented in Table 2. Wool production of the unmated ewes was estimated using the all-wool model and the feed requirements listed in Table 1.

RESULTS AND DISCUSSION

The fleece-free LW profiles for the unmated ewe policies are presented in Fig. 1. Ewe LW increased rapidly from September to December in a pattern similar to that recorded in the field trial (Parker *et al.* 1991) and decreased through the late summer-winter period as feed intakes were reduced to a maintenance (or lower) level to transfer pasture forward to the late winter. The end-of-year fleece-free LW was within 0.5 kg of the basal LW for each LW option. Wool production (greasy) was predicted to be 5.10, 4.73 and 4.15 kg for the 45, 50 and 55 kg LW ewes, respectively. Thus, for these LW profiles, increased wool production by heavier ewes could be compensated for by running lighter ewes with lower wool production at a higher stocking rate. The difference in annual wool production of unmated and mated 55kg ewes of 6% compares with a 6 and 12% difference in wool weights between dry and single- and twin-rearing ewes of similar LW recorded by Sumner and McCall (1989). The need to reduce LW over the winter months, to prevent excessive accumulation of body condition, restricted the opportunity to maximise wool growth during the period when unmated ewes have their greatest advantage over pregnant ewes (Sumner and Squire 1989, Sumner and McCall 1989, Parker *et al.* 1991). In addition the greater average age of the unmated flock (due to the purchase of wet dry and cast-for-age ewes as replacements) limits the wool production advantage of unmated ewes (Sumner and Squire 1989) and the flexibility to revert to a breeding policy. The production targets for the bull beef policy, which generated more than twice the returns of either of the sheep systems, restricted the 1 July level of pasture cover to around 1,500 kg DM/ha. Annual feed consumption, rounded to monthly intervals, was 441, 408 and 359 kg DM/ewe for the 45, 50 and 55 kg ewes, respectively (i.e. 0.72, 0.66 and 0.58 of the annual feed requirement estimate of 614 kg DM for a typical ewe in the Tuapaka flock weaning 100% lambs). These estimates are similar to those of Coop (1965) of 594 kg DM/y for a 54 kg ewe weaning a single lamb at 14 weeks of age and 417 kg DM/y for a wether (a proxy for an unmated ewe) of a similar liveweight (i.e. 0.70 ssu). Sumner and Squire (1989) estimated lower annual requirements of 520 kg DM/y for a 55 kg breeding ewe rearing a single lamb to weaning at 12

FIGURE 1 Fleece-free liveweight profiles for 45 kg (■—■), 50 kg (+—+) and 55 kg (*—*) unmated ewes in an all-wool production system.

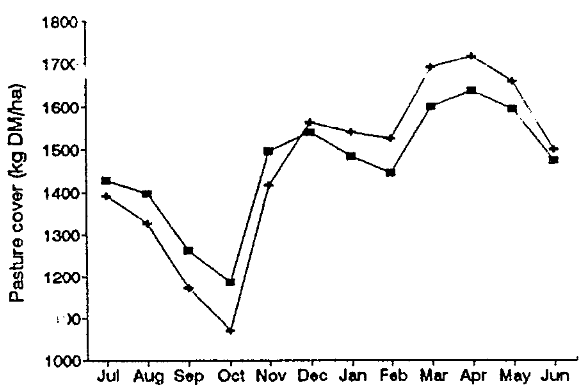


at 12 weeks, and 345 kg DM/y (i.e. 0.66 ssu) for an unmated ewe of the same weight.

The simulated monthly pasture cover for the Tuapaka breeding ewe and bull system and the 50 kg ewe all-wool policy are shown in Fig. 2. Unmated ewes were increased to a fixed monthly number of 3,950, 4,270 or 4,850 depending on the ewe size selected (55, 50 or 45 kg), or 1.68 to 2.06 the number of breeding ewes (2,350).

Within-year changes in monthly pasture cover for each all-wool policy were similar to those predicted for the breeding ewe system. The total feed consumption by the all-wool ewe policies

FIGURE 2 Predicted changes in farm pasture cover for a breeding ewe (■—■) and an all-wool policy with 50 kg ewes (+— +). Both sheep policies are run in conjunction with a 2-year bull beef policy.



(ewe numbers x kg DM/ewe/y=1.74 x 106 kg DM) was equivalent to an annual average feed intake by the 2350 breeding ewes plus their replacements of c. 740 kg/DM/y.

The GM for the breeding ewe policy was $15.50/ssu, while those for the all-wool policies were: $8.11/ssu (55 kg; $5.84/ewe); $7.95/ssu (50 kg; $5.25/ewe) and $7.12/ssu (45 kg; $4.13/ewe). Capital requirements for sheep wintered, which reflected ewe LW (Table 2), were $52,523 for the breeding ewe policy and $59,250 (55 kg), $55,510 (50 kg) or $53,350 (45 kg) for the all-wool policies. The minimum opportunity cost of an all-wool policy at Tuapaka in 1991 was $7.39/ssu or $20,499 for the 2,774 breeding ewe and ewe hogget su on the farm. Lamb returns could fall to $2.70/hd (at 100% lambs weaned) or lambs weaned to 39% (at $15/lamb) before the returns from the 55 kg ewe all-wool policy were equivalent to those from the breeding flock. These returns indicate that a higher stocking rate all-wool system with lower pasture cover levels (i.e. without bull beef) and greater within-year variation in LW would not improve overall farm returns. Some small savings for casual labour may be realised with the all-wool options (e.g. no docking), but no change in the cost of permanent staff would be achieved on the case farm.

The ratio between unmated ewes and a breeding ewe plus her replacement is dependent on ewe LW (which is a function of stocking rate), the flock replacement rate and the management system adopted (e.g. an earlier lambing date with the same December 1 weaning date, or the retention of lambs for finishing would both increase annual feed demand of the breeding policy relative to that of unmated ewes). It is therefore difficult to provide a common set of conversion factors for farmers considering a change to an all-wool system, and a farm feed budget should be prepared to assess the change in ewe numbers for each situation. The feed intake data presented here can be used for this purpose, and local costs and price data can then be used to derive comparative GMs. All-wool farming of Romney ewes on the case farm would be less profitable, and more exposed to price risk because of a larger dependence on wool prices, than breeding ewes and might be considered only if sheep breeds with significant wool premiums (e.g. Drysdale and Merino) were farmed (Sumner and Squire 1989) or if permanent labour requirements were able to be reduced.

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