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Consideration of alternative lamb drafting strategies

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ABSTRACT

A model that simulates lamb growth and feed consumption and makes economic assessments on export carcass grading returns is described. It simulates a flock of lambs of specified weight and sex and then, using relationships between live weight, carcass weight and GR, derives grading profiles for various drafting strategies.

The option of drafting on the basis of live weight has been compared with options based on GR estimates of high, average and poor accuracy.

These drafting policies were evaluated on the basis of several alternative fixed endpoints including total feed consumption, carcass weight and carcass value. Generally results obtained when drafting on GR were better than those based on live weight alone when GR was measured with high accuracy and when carcass weights were high.

This model could be useful in making a wide range of evaluations and comparisons other than those reported.

Keywords Lamb drafting; simulation model; fatness; carcass grading; GR measurement; live weight.

INTRODUCTION

The returns paid to farmers for lamb carcasses slaughtered for export are primarily determined by the weight and the carcass tissue depth over the last rib (GR measurement) at a position 11 cm off the midline.

Assessments of alternative criteria that can be used when selecting lambs for slaughter may be made in a number of ways. The simplest approach is to assume relationships between carcass weight and tissue depth GR and then use the export lamb carcass schedule of prices to calculate changes in return/head with increases in carcass weight. A development of this method considers a population rather than a single carcass, so that calculations can be made of the proportion of carcasses that can fall into the fatter grades before the average price/carcass falls. Bray (1984) showed for a specific group of ewe lambs that the highest price/carcass resulted when approximately 25% graded T or F. This approach may be generalised by using computers to create simulated flocks of lambs that are specified with regard to key relationships and which may be "grown" and selected for slaughter in various ways. (Shadbolt, 1984; Kirton and Shadbolt, 1985).

The present paper further develops the assessment by estimating the feed requirements that will accompany the various alternatives. In addition, key parameters and relationships are treated not as constants but as normally distributed random variables with specified standard deviations in the case of parameters and residual standard deviations in the case of relationships. Relationships of importance include those relating live weight to carcass weight, carcass weight to GR, and estimated to actual GR.

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THE SIMULATION MODEL

A model was developed to identify optimal lamb drafting strategies for a prime-lamb producing flock of 2700 F1 Border Leicester X Romney ewes mated to Suffolk rams, grazed on Massey University's Keeble Farm. The model was programmed in Basic for an IBM PC micro-computer and incorporates the following 5 steps. The figures shown below were used in the simulation described but can be modified from run to run.

1. Live weights of lambs prior to the first draft were generated from a normal distribution. In this simulation the starting point was taken to be 1 December, with an average live weight of 25 kg and a standard deviation of 3 kg. A sex effect was included by adding 1.5 kg to the starting weight of rams and subtracting 1.5 kg from the starting weight of ewe lambs.

2. Individual carcass weights (CCW) were generated for each lamb using the following regression equations for each sex:

$$\text{Ram CCW} = -2.04 + 0.473\ \text{LWT}$$
$$\text{Wether CCW} = -1.92 + 0.473\ \text{LWT}$$
$$\text{Ewe CCW} = -1.80 + 0.473\ \text{LWT}$$

A residual standard deviation of 0.67 kg was included so that animals of the same live weight would have varying carcass weights. The average dressing out percentage for 30 kg live weight lambs were 40.5, 40.9 and 41.3 for rams, wethers and ewes, respectively (Kirton *et al.*, 1984).

3. Individual GR tissue depths were derived according to the sex and carcass weight of the lamb:

$$\text{Ram GR} = -10.8 + 1.2\ \text{CCW}$$
$$\text{Wether GR} = -13.0 + 1.5\ \text{CCW}$$
$$\text{Ewe GR} = -15.2 + 1.8\ \text{CCW}$$

A residual standard deviation 2.6mm produced variation in GR for lambs of the same carcass weight.

The average tissue depths of a 14 kg ram, wether and ewe were 6, 8 and 10 mm, respectively.
These relationships were based on data from 561 ewe and 496 ram records of GR measurement and carcass weight collected at export freezing works from 8 single-sex groups of lambs from Massey University's Keeble farm. Intermediate values were chosen to represent wethers.

4. The decision to slaughter or retain individual lambs was made on the basis of live weight and/or GR criteria. The effect of accuracy of prediction of fatness in the live animal was investigated by including a random normal error in predicting GR on the live animal. If the predicted GR exceeded the drafting criterion GR, the animal was killed. The wool pull and pelt value were assumed to be $5.00 and the killing costs $10.00.
5. Animals not fulfilling the drafting criteria were grown on to the next slaughter date. The time until the next drafting and the growth rate over that period could be varied. For this paper the growth rate assumed was 200 g/d with a standard deviation of 20 g/d. Thus growth rates of individual lambs were not identical. At the end of a phase of growth, carcass weights were recalculated as in 2 above. GR tissue depths were recalculated as GR at last draft plus the change in carcass weight since last draft multiplied by the slope of the regression equation in 3 above. This ensured that lambs which were initially fatter (or leaner) than average maintained this deviation at later weights.
Individual feed requirements were calculated during each growth phase using a mathematical function (Townsley, 1986) to integrate the point data presented as feed requirement tables by Ulyatt *et al.* (1980).

Steps 4 and 5 were repeated until all lambs had been killed or until the final slaughter on 20 April. Information from individual drafts as well as entire season summaries were provided in the form of grading profiles of slaughtered animals, levels of feed consumption and histograms of carcass weight and GR frequency distributions.

Analyses used the 1985-86 opening grading schedule to investigate the effect of sex, drafting interval and drafting criteria. The drafting criteria were live weight and/or GR assessment on the live animal with a 1, 3 or 5 mm residual standard deviation. The same criteria were used for all drafts within one season, with the live weight criterion ranging from 32 to 46 kg live weight and the GR criterion from 6 to 13 mm.

RESULTS

Model output from each draft included the number of animals reaching the slaughter criteria and the number of animals from that draft falling into each of the export grades. Average live weight, carcass weight, GR and schedule price for each grade could also be obtained. A sample of the information is shown in Figure 1 for ram lambs drafted every 14 d with a weight cutoff of 38 kg.

Various lamb drafting options were compared on the basis of several characteristics derived from the whole season summary. These included average carcass weight, average price/carcass, total feed consumed by 2000 lambs, the proportion of carcasses grading T or F, and the proportion of lambs drafted by 12 January. In some cases the marginal revenue was calculated for one system relative to another by dividing the change in total revenue by the change in the total dry matter consumed (Table 1).

The results of drafting on live weight (Table 1) demonstrated that the average price/head increased up to about 17 kg for rams, but then declined as the proportion of T and F grade lambs increased above about 15 percent. The comparable weight for ewes was about 14 kg. The ewe results in Table 1 also show how the decline in price/carcass with increasing carcass weight ceases when almost all the carcasses grade T or F.

The data in Table 1 can be used to answer a number of questions about the relative merits of the alternative slaughter criteria with several possibilities being illustrated in Table 2.

Drafting on the basis of GR had a clear advantage over the use of live weight alone provided the accuracy of prediction was high (1 mm SD), but there was little advantage with a SD of 3 mm and the results were poorer if the SD was 5 mm (Table 1, Table 2). The data of Table 1 also suggest that the ability to detect differences in GR between lambs with high precision (low SD) will be a disadvantage if at the same time the absolute values of predicted GR consistently under-estimate true GR.

Because of limitations associated with drafting on either GR or live weight alone, ways of combining the 2 measurements are often used. An analysis of 2 possibilities in this regard (Table 3) suggested that they do not provide higher returns than those obtained when GR was estimated with high accuracy, but that they did provide a form of insurance in case the accuracy of GR prediction was poorer than expected.

All results reported here are for a drafting interval of 14 d and an average growth rate of 200 g/d to give an average increase in live weight between drafts of 2.8 kg. The effects of increasing either drafting interval or growth rate while maintaining the same cutoff criterion would be to increase both the average carcass weight and the variation in carcass weight.

DISCUSSION

The results presented apply strictly only under the sets of conditions that are specified, but there are a number of general patterns that emerge which seem likely to apply over a range of conditions and animal types.

The scheme in which animals were chosen with the most accurate assessment of GR measurement

TABLE 1 Characteristics of drafting schemes based on a range of live-weight and GR criteria. In each case there were up to 11 drafts for the 2000 lambs at intervals of 14 d, with the first being on 1 December when the mean live weight was 26.5 kg for rams and 23.5 kg for ewes (SD = 3 kg). Data are for ram lambs unless otherwise specified.

Drafting criterion	Carcass weight (kg)	Price ($)	Feed (t)	(T + F)[1] (%)	Drafted by 12 Jan. (%)	Marginal revenue[2] (c/kg)
Live weight (kg)						
32	13.8	15.63	114.9	0.6	82	
34	14.7	16.77	151.2	2.5	62	6.3
36	15.6	17.59	190.6	6.0	37	4.2
38	16.6	18.19	231.7	12.8	16	2.9
40	17.5	18.12	272.1	25.0	6	
42	18.5	17.65	315.4	38.5	1	
44	19.4	17.07	360.3	51.3	0	
46	20.4	15.37	409.6	70.2	0	
GR (1mm)[3]						
6	14.9	17.09	154.2	0.1	59	
7	15.7	17.95	185.0	0.1	46	5.6
8	16.5	18.97	218.8	0.9	35	6.0
9	17.3	19.81	256.3	3.7	24	4.5
10	18.1	19.76	289.1	13.4	16	
11	18.8	18.27	327.7	35.3	10	
12	19.7	15.78	369.9	64.7	6	
13	20.4	13.49	402.3	88.3	3	
GR (3mm)[3]						
7	14.7	16.52	149.9	0.3	61	
9	16.2	18.04	214.6	5.7	40	4.7
11	17.7	18.05	279.9	22.5	23	
13	19.3	16.19	355.1	55.7	11	
GR (5mm)[3]						
7	13.9	15.35	119.5	0.8	72	
9	14.9	16.44	164.0	4.2	57	4.9
11	16.3	17.24	219.9	13.0	41	2.8
13	17.8	16.84	290.3	32.5	25	
Live weight (kg); Ewes						
28	12.1	11.69	91.8	2.4	89	
32	14.0	13.58	158.0	22.4	51	5.7
36	15.9	12.01	234.4	64.3	9	
40	17.7	9.65	318.1	92.7	1	
44	19.6	9.87	404.8	99.7	0	

[1] % of carcasses graded T or F.
[2] Marginal revenue is relative to the previous system in the Table, and is the extra return/extra kg of feed DM required. Only positive values are shown.
[3] The value in brackets is the standard deviation in predicting GR in the live lamb.

indicated that this option was more profitable than selection on live weight for all schemes except those slaughtering at very light weights when there were effectively no T or F grade carcasses using either criterion. However, in schemes drafting on GR with a standard error of prediction of 3 mm, the returns were much closer to those that would be achieved using live-weight criteria. The comparison of drafters' assessment of GR on live animals with GR obtained from the carcasses of the same animals in the meat works would indicate that an experienced drafter has a standard error of prediction close to 3 mm (MAF trials, unpublished). In practice, their accuracy may be improved by separating lines of different sexes and including only a small range of live weights in any one mob to be assessed. The provision of training clinics where the individual animals could be assessed and then slaughtered may be advantageous. Some individual drafters had prediction errors considerably in excess of 3 mm.

Determination of optimal policies for an individual situation requires consideration of more than just the average price returned/head. At the very minimum, the feed requirements for alternative policies should be determined and taken into account. For finer tuning, the profile of feed demand and cash flow resulting from lamb sales may also be important components. A comparison of various options utilising differing lamb growth rates should also be made as this can be manipulated in practice and could have important

TABLE 2 Characteristics of drafting schemes for ram lambs based on live weight or GR assessment at 3 levels of accuracy when they are compared at total feed consumptions (for 2000 lambs) of 200 or 250t, at a carcass price of $17.00, or at a carcass weight of 17.5 kg.

Drafting scheme	Carcass weight (kg)	Price ($)	Feed (t)	Cutoff[1]
Total feed = 200t				
Live weight	15.85	17.85	200	36.6 kg
GR (1 mm)	16.05	18.40	200	7.4 mm
GR (3 mm)	15.85	17.85	200	8.5 mm
GR (5 mm)	15.80	17.10	200	10.3 mm
Total feed = 250t				
Live weight	17.00	18.20	250	39.0 kg
GR (1 mm)	17.15	19.70	250	8.8 mm
GR (3 mm)	17.10	18.30	250	10.1 mm
GR (5 mm)	17.00	17.20	250	11.9 mm
Carcass value = $17				
Live weight	14.80	17	164	34.4 kg
GR (1 mm)	14.80	17	150	5.8 mm
GR (3 mm)	15.00	17	157	7.4 mm
GR (5 mm)	15.60	17	193	10.0 mm
Carcass weight = 17.5 kg				
Live weight	17.5	18.18	267	39.8 kg
GR (1 mm)	17.5	19.92	265	9.3 mm
GR (3 mm)	17.5	18.20	268	10.7 mm
GR (5 mm)	17.5	17.05	275	12.6 mm

[1] The cutoff value necessary to fulfil the requirements of the comparison being made.

TABLE 3 A comparison of drafting schemes based on either live weight (36 or 40 kg) or GR (10 mm) criteria alone, with 2 schemes in which the live weight and GR information are combined. These schemes involved either alternating drafts based on live weight and GR, or requiring that both live weight and GR criteria were met. General specifications were as for Table 1.

Criteria	Weight cutoff (kg)	GR SD[1] (mm)	Carcass weight (kg)	Price ($)	Feed (t)	(T + F)[3] (%)
Live weight alone	36	NA[2]	15.6	17.59	191	6
	40	NA	17.5	18.12	272	25
GR alone	NA	1	18.1	19.76	289	13
Both	36	1	18.3	19.47	299	20
	40	1	18.9	18.56	328	35
Alternate	36	1	16.0	18.16	207	6
	40	1	17.5	19.16	265	14
GR alone	NA	5	15.6	17.02	194	8
Both	36	5	17.5	18.29	269	21
	40	5	18.7	17.44	324	41
Alternate	36	5	15.5	17.37	185	6
	40	5	16.4	18.04	224	10

[1] The standard deviation in predicting GR in the live lamb.
[2] Not applicable.
[3] % of carcasses graded T or F.

implications.

The model could also be useful for farmers during the killing season to determine likely numbers of animals available for slaughter using different cutoffs and different drafting intervals. It will be used for this purpose to monitor the Keeble Farm flock at Massey University.

The effect of sex on a range of live-weight and GR criteria is not reported in detail as there is limited scope for manipulation of management with the exception of non-castration resulting in half the lamb flock performing as rams rather than wethers. Many prime-lamb producers are already leaving male lambs entire.

The effect of varying the interval between successive drafts was not large, with little difference between drafting less frequently and weekly drafting at a slightly lower cutoff criterion. Therefore, in an on-farm situation note can be taken of other factors affecting the frequency of drafting, such as availablility of killing space in the meatworks, labour requirements for mustering and selecting animals for slaughter, and the likelihood of drafting enough animals in one mob to justify a truck for carting to the works.

The determination of relative economic values is an important component in any breeding programme. The recent interest in breeding leaner sheep and the importation of animals suitable for use in such breeding schemes have resulted in a greater need for relative economic merits for traits such as body composition and lean growth rate. This model could assist in the derivation of such values.

The extent to which the export lamb carcass grading schedule encourages the production of certain grades of lamb could be examined by this model. For example, the required size of the financial incentive to give the production of large, lean lambs a competitive advantage could be determined.

CONCLUSIONS

The commonly accepted methods of comparing policies and making on-farm recommendations have often been based on information on only a part of the overall system. The results from a more complete knowledge of the system can provide a better overall assessment and may lead to a different decision.

It is apparent that there is no single best policy for drafting lambs which will always maximise profit or ability. The optimal policy is determined by the particular constraints applying to an individual system.

Most systems would appear to benefit from more accurate assessment of GR, so it would be advantage-

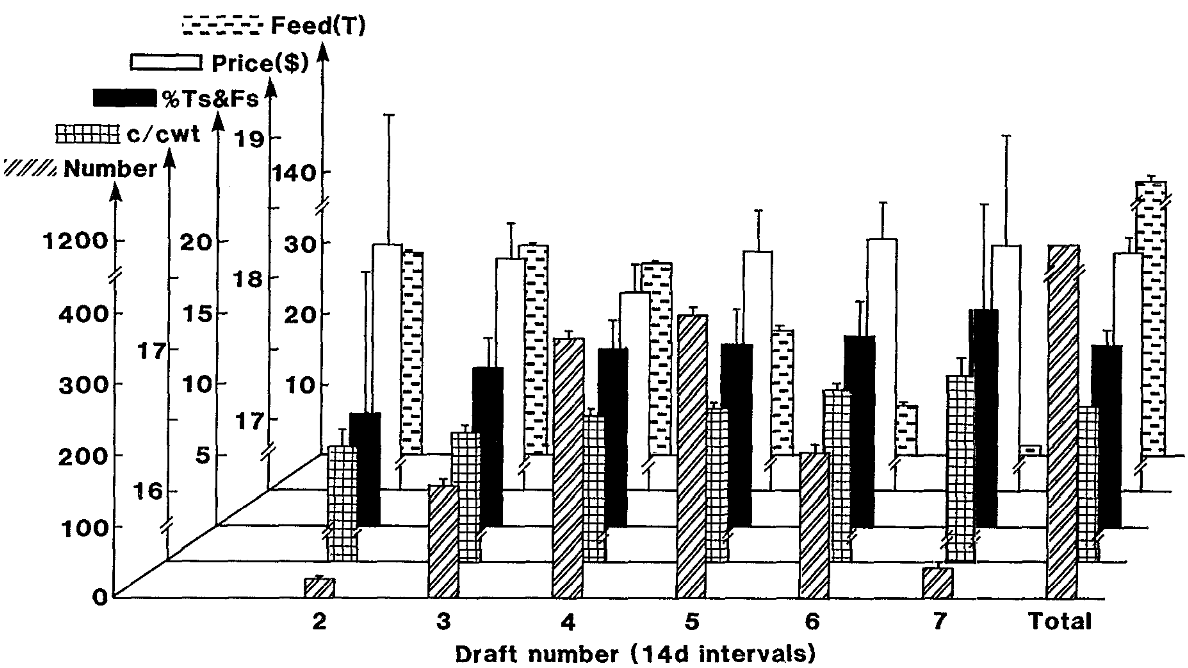

FIG. 1 Means with standard deviation bars for 10 simulation runs each involving 1200 ram lambs that were drafted at 2-week intervals with a live weight cutoff of 38 kg. Values are not given for the first draft on 1 December when the mean live weight was 26.5 kg (SD = 3 kg), because very low numbers were involved. For drafts 2 to 7 and for the overall season (Total), values are shown for number of lambs drafted, average carcass weight, the percentage of carcasses falling into the T and F grades, the average price/carcass, and the quantity of feed consumed since the previous draft.

ous to be able to determine the accuracy of individual drafters. Methods of improving their accuracy, such as by using single-sex mobs and small ranges of live weights need to be encouraged.

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