Plan conservatively when setting forward contracts for beef production from pasture

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Abstract

Forward supply contracts reduce flexibility to deal with the inherent variability in pastoral farming. This paper addresses: 1) the percentage of a mob (70, 80 or 90%) to select for a supply contract and 2) methods to decide on the number of animals to supply (stocking rate), given uncertain pasture growth. Riverside Farm pasture growth data were used to simulate a 100 ha finishing block. A meat company winter contract was used with steers contracted on 1 April for supply in mid July and mid August. Analyses were performed using the Stockpol model. Analyses showed grain supplements to ensure 90% of the mob achieved contract weights would increase profit by about $9000 at all stocking rates (1 S-2.5 steers/ha) compared with accepting only 70% of animals achieving contract weight. Stockpol-predicted profits for 4 stocking rates (1.8, 2.0, 2.2 and 2.5 steers/ha) given 1000 possible outlooks for pasture growth showed the optimum stocking rate derived using average pasture growth overestimated the optimum under uncertain pasture growth by about 10%. The more conservative stocking rates carried less financial risk in years of below-average pasture growth.

Keywords: contract, model, pasture growth, risk, steer, supplementation, variability

Introduction

The evaluation of risk requires an answer to two questions. First, what are the possible outcomes of a decision? This is commonly answered by a sensitivity analysis. Second, how often can each outcome be expected? The answer to both questions can be completely answered by exhibiting a probability frequency distribution of outcomes for the decision in question. In this paper we present the method to answer these questions within the context of contracts for farmers to supply animals for slaughter.

Contract supply of stock removes flexibility to deal with variable pasture growth. Farmers commonly cope with variable pasture growth by either selling stock lighter than planned or by varying the time of slaughter. With contract production these actions can carry high penalty costs. The alternatives of supplementary feeding or penalising performance of other stock classes can be equally costly.

In setting forward contracts farmers need to consider the effects of variability in pasture growth to ensure they have a high probability of meeting the contract. Planning the number of animals to commit to a forward contract should involve a feed budget. Variables include the amount of feed on hand at the start, expected pasture growth until contract delivery and the weight distribution of the available stock. The objective of this paper is to show the importance of also considering variability in pasture growth as part of this planning process.

Methods

We present our method through a case study. Our model farm has the following characteristics.

A Wairarapa farmer is contracting supply of prime steers in July and August. The contract is to be signed at the start of April. The Richmond prime steer and heifer supply contract for winter 1993 is used as a format. Features are:

1. The number of steers to be supplied in each 1 l-day period from 5 July to 27 August need to be specified
2. Cattle supplied above 270.5 kg carcass weight attract a grazing bonus of 1.5 c/kg carcass weight per week from the date the contract is signed until slaughter.
3. The grazing bonus is on top of the existing beef schedule at the time of slaughter.
4. Assumptions about schedule prices at slaughter are stated in Table 1.
5. It is assumed that half of the steers will be supplied in mid July and half in mid August. For simplicity it is assumed that all steers carried will be contracted and correct numbers will be supplied on the agreed date. The penalty for not meeting the contract weight will thus be reflected in the schedule price paid.
6. The steers are to be carried on a fixed area of land (100 ha).
7. For simplicity, it is assumed that the average liveweight of steers on hand on 1 April is 510 kg irrespective of the number to be carried.
8. Variation in start liveweight is approximated by assuming a standard deviation of 20 kg in start

liveweight. In practice a farmer could manipulate both the mean and variation in initial liveweight by selling steers down to the number required. This introduces a degree of complexity not considered in this paper.

9. Average pasture cover on the steer block is assumed to be 1900 kg DM/ha on 1 April.
10. Hay is available at a cost of $5 per bale. It is assumed hay can be fed up to the rate of one bale (18 kg DM) per 12.5 steers per day from 1 May until mid August. This level represents a maximum hay intake of 23% of the diet for a steer growing 0.2 kg/day.

Table 1 Assumed prices for each carcass weight range.

Carcass weight (kg)	Base schedule (c/kg carcass)	Contract bonus (c/kg carcass) 1 9 Jul	16 Aug
220.5-245	243	0	0
245.5-270	256	0	0
270.5-295	267.5	22.5	26.5
295.5-320	279.5	22.5	28.5
320.5-345	269.5	22.5	26.5

Analysis

Feed profile analyses (e.g., Milligan et *al.* 1987) were conducted for the case study farm using the Stockpol model (Marshall et *al.* 1991). Average pasture growth rates for the Riverside farm in the Wairarapa were used (Table 2). These were derived from the rates of pasture growth (cage trim technique - Radcliffe 1974) which were required by Stockpol to mimic pasture cover on Riverside in the years 1987/88 to 1990/91 (Blanchard 1993).

In the initial analysis no account was taken of pasture growth variability in determining the optimum number of steers to contract. Average pasture growth rates were used. The analysis focused on the best target liveweight gains for the steers over winter. Liveweight gains required to get 70%, 80% or 90% of the steers to achieve the qualifying carcass weight (270.5 kg, 525 kg liveweight) were compared at a number of stocking rates (1.5-2.5 steers/ha).

Table 2 Average and standard deviation of pasture growth rates (kg DM/day).

Month	Average	Standard deviation
April	13	3.5
May	6.4	6.3
June	7.1	2.4
July	13.4	2.1
August	17.6	2.5

Optimal stocking rate under variability

The second analysis took the best target liveweight gain strategy from analysis one (i.e., that which ensured 90% of steers met contract) and compared conclusions about the optimum number of steers to carry given uncertain pasture growth expectations. The objective of this analysis was to calculate the probability frequency distribution of profit given variation in pasture growth. Stockpol was modified to incorporate a bootstrapping algorithm' (Hinkley 1988). This derived different monthly combinations of pasture growth for 1000 feed profiles for each option. A standard deviation in pasture growth rate in each month was calculated to construct a normal distribution of pasture growth rates from which to randomly sample. Standard deviations were calculated from Blanchard (1993) (Table 2). Where negative rate of pasture growth values were selected by the bootstrap these were assumed to be zero.

In both analyses target liveweight gains were always met by supplementing wirh barley grain. The Stockpol model indicated when to feed barley to ensure targets could be met. The various liveweight gain and stocking rate strategies were evaluated on net profit by considering both the value added to the steers over the contract and the cost of feed supplementation. Barley was assumed to cost $300/t. Steers were valued at $665/head ($1.30/kg liveweight) on 1 April.

Results

Target performance

Target liveweight gains needed to increase to expand the proportion of the mob that qualified for the grazing bonus (Table 3). The resultant increase in average per head performance is also shown in Table 3.

Table 3 Average per head steer performance when achieve 70, 80 or 90% of the mob above 270.5 kg carcass weight (525 kg liveweight).

Criterion	Target level 70%	80%	80%
Liveweight gain (kg/hd/day)	0.19	0.26	0.38
Average carcass weight (kg)	260.5	265	262.5
Return ($/hd)	799	830	881
Increase in value ($/hd)	134	165	216

[1] The bootstrap algorithm generates a large number of samples for each of the inputs which are random variables. The profit calculated from each sample drawing is also a random variable. Repeating this procedure over a large number of samples forma a frequency distribution for the profit variable. The frequency distribution generated converges to the true probability distribution of the variable in question (Hinkley 1988).

Net profit over the period of the contract improved as the proportion of cattle attracting the grazing bonus increased. This stood out over all stocking rates (Table 4). The cost of the additional barley (Table 5) to ensure greater liveweight gains was more than compensated for by the grazing bonus heavier carcasses attracted.

When 90% of steers achieved specifications then a stocking rate of around 220 steers/100 ha (2.2/ha) gave the greatest return based on average pasture growth expectations (Table 4). However, predicted profit levels were similar between 200 and 250 steers/100 ha.

Table 4 Net profit ($,OOO) for each target performance, assuming average pasture growth rates.

	Steer numbers on 100 ha				
Target level	250	220	200	180	150
70%	20.7	20	19.8	18.9	19.9
80%	24.8	24.1	24.1	22.1	19.8
90%	29.2	29.8	29	27.9	25.9

Table 5 Tonnes of barley required to achieve target performance, assuming average pasture growth rates.

	Steer numbers on 100 ha				
Target level	250	220	200	180	150
70%	7.6	0	0	0	0
80%	19.5	9.1	1.6	0	0
90%	40.5	28.3	19.4	11.3	1.1

Effects of uncertainty in pasture growth

The frequency distribution generated under variable pasture growth for the 90% attainment strategy is illustrated in Figure 1 for a stocking rate of 2.2 steers/ha. This gives information about the number of times an expected outcome will occur. For example, the probability (chance) of receiving less profit than $24 750 is 1 in 5, or 20%. It is the sum of the frequencies of profit less than $24 750. A decision about the best number of stock to run can be made based on the acceptable degree of risk. A method to assess the stability of an option is to compare the level of profit at a preset probability of at least receiving that profit. The level of risk accepted by the farmer is determined by the chance of success which is acceptable.

Table 6 shows a comparison of the range in profit from 4 stocking levels. The lower stocked options are characterised by a lower range between minimum and maximum profit. On average, expected profit under uncertain pasture growth remains highest at the 2.2/ha stocking level, albeit by a small margin. However, if we are concerned about minimising risk, the minimum profit we can expect at least 90% of the time is higher at stocking levels of 1.8 and 2 steers/ha (Table 6) than at 2.2 or 2.5 steers/ha.

Figure 1 The probability frequency distribution of net profit for a stocking rate of 2.2 steers/ha.

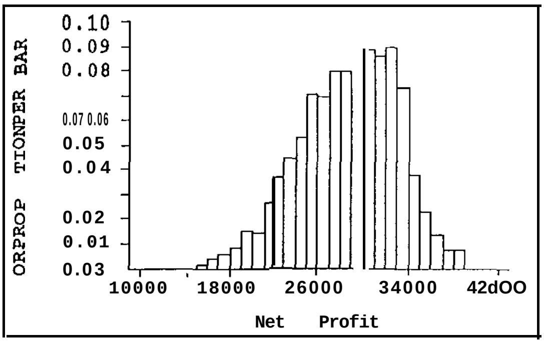

Table 6 Net profits ($,OOO) achieved with a range of probabilities as a result of variable pasture growth rates (Assumes supplements fed to ensure 9% of the mob meets the target carcass weight).

Probability of achieving a profit	Steer numbers on 100 ha			
greater than recorded in the table	250	220	200	180
100% (minimum)	14.9	15.8	17.4	16.5
90%	22.3	22.7	23.2	23
80%	24.4	24.7	25.2	24.7
Average	28.6	28.6	20.3	27.3
1% (maximum)	43.7	30.2	34.9	31.3

Discussion

The supply of stock in a specific weight range at a specific time confronts the farmer with issues of how to manage the inherent variability in animal liveweights, animal growth and pasture growth. The results of this study depend on the assumptions used about the initial weight and standard deviation in weight of steers. However, the results do allow us to establish some general principles in setting forward contracts for stock supply.

The first principle is that, where a bonus payment creates a large difference in price per kg of carcass, the most profitable strategy is to ensure that most cattle in the mob achieve the threshold weight. Any additional cost of supplementary grain can be more than compensated for by increased returns from the product. A low cost mentality which allows a significant proportion of the mob to fail a contract can greatly reduce profits, even in a poor year.

Target liveweight gains to achieve, say, 90% of animals above a threshold weight can be calculated within Stockpol, which allows for the increase in variance in mob liveweight through time (e.g., Webby *et* al. 1993). Because the variance of mob liveweight increases with time, simply taking the weight of an animal ranked 90% down the mob and calculating the liveweight gain required by it to achieve the contract will result in fewer than expected animals achieving the contract. In this study the latter approach suggested a target liveweight gain of 0.3 kg/day and resulted in only 82% of animals achieving the target weight. The liveweight gain required for 90% of animals to make the weight was 0.38 kg/day.

A conservative approach, which would allow more cattle to be carried, is to ensure that a high proportion of steers already qualify for a contract at the time of signing without requiring weight gain. Still another approach is to split a mob, giving those animals below a threshold weight preferential feeding. The latter is likely to result in greater profit levels for additional supplement used.

The case study showed a number of points pertinent to analyses conducted using average pasture growth expectations. The first point is that planning using average pasture growth give can give biased estimates of average profit levels. In Figure 1 the mean of the profits under uncertainty is less than the estimate of profit using average pasture growth rates. In this case mean profit was overestimated by $1200, or 4%, by using average pasture growth figures. The bias occurred because the additional cost of feeding supplements in poor years outweighed savings in good years. In this case the level of bias was not great. However, there are situations where it could lead to a major mistake. In this study barley was used to buffer variability in pasture growth, and it buffered profit levels between years. An analysis where barley was not used would have resulted in a greater overestimate of average profit using average pasture growth rates.

Where a given level of profit is sought with a high probability, conservative stocking rates are favoured. As the variability in pasture growth rate increases, reductions in stocking rates are increasingly favoured relative to those calculated under average pasture growth conditions. This is most notable where stability of profit is an important objective (Pleasants *et al.* 1994). The adage of allowing at least a 10% safety margin in stock numbers appears to be appropriate when working with average pasture growth rates.

Few people consider the effects of variability directly in the analysis of animal production options. For example, the Stockpol model (Marshall *et al.* 1991) currently operates with only one set of specified pasture growth rates at a time. Single factor sensitivity analyses are the main means of assessing effects of variability. Issues associated with variability in animal production will increase in importance as New Zealand breaks out of commodity trading in agricultural products. Specifications on supply will become increasingly common. There will be a need for farmers, consultants and scientists to become familiar with concepts such as probabilities of achieving certain outcomes for both feed and financial planning. This will extend to a need for tools such as Stockpol to be developed to provide output in this form.

Conclusions

A major conclusion from the study is that farmers should aim to ensure at least 90% of animals within a mob achieve contract specifications in order to maximise profit from forward contracts during winter. This involves using supplementary feed to ensure targets are met. Carrying animals through winter with little chance of achieving weight specifications is an expensive use of feed, even in poor years.

The second conclusion is that farmers need to plan conservatively on numbers of animals to carry through winter for contract supply if planning is done using average pasture growth rate information. The adage of at a least a 10% safety margin in stock numbers below the suggested optimum appears appropriate. The degree of conservatism will need to increase with increasing variability of pasture growth.

Finally, variability of profit can be an important decision-making criterion owing to the need to consider risk. There is a need for decision makers to evaluate options based on probabilities and there is a need for the tools to give them this information.

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