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Does immunisation pay?

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ABSTRACT

Immunisation is a potentially profitable technique to improve ovine fecundity. It increases the proportion of multiple bearing ewes and lambs born as multiples. This calls for adequate feeding if production is to be sustained. The technique is therefore likely to have higher net returns in areas with ample summer feed. As the response to the treatment is variable, the probability of not breaking even with the cost of the drug can be as high as 30%. Where feed is adequate additional net returns of $1 to $2 per ewe can be expected if the response is a 25% increase in lambs born per ewe joined.

INTRODUCTION

The introduction of new technology such as immunisation for enhancing ovine fecundity calls for both technical and economic appraisal. Given that it has been established that immunisation is technically feasible, interest focuses on its profitability. Economic analysis can cover several facets including the pay-off to investment in further research, the pricing and marketing strategies of commercial firms, and the extra returns that farmers might expect. This paper presents a summary of an economic study of the returns and financial risks that farmers in different regions might face.

METHOD

In order to fully exploit the potential of immunisation, it is evident that changes in management strategies are needed. It is improbable that the full economic benefit can be realised by simply immunising and continuing with existing policies. However it is clear that in the management of a pasture based animal grazing systen many decisions are involved. These include type of stock; stocking rate; timing of key operations; extent of differential feeding to different classes of stock in different seasons; monitoring of animal performance; allocation of feed supplies throughout the year; timing, weights, grades and numbers of sale stock; and strategies used to provide flexibility when the season or price differs from that expected.

Inherent in many of the decisions are important interactions between both animals and feed supplies through time. The only feasible manner in which to evaluate the financial implications of introducing immunisation is through a simulation model (Arcus, 1963).

The model used in this study is based on 3 key elements: the pattern of pasture production from lambing to mating, the live-weight gain functions of different classes of animals and the interaction of feed supplies and animal performance with management decisions. The model allows for up to 50 paddocks and grazing, weaning and drafting policies can be varied according to pasture growth patterns, thus providing considerable management flexibility. Different birth weights, growth rates and mortality rates are included for single and multiple born lambs.

The introduction of immunisation changes the level and composition of the lamb drop, and in every case management strategies were sought to achieve the highest possible net returns through controlling the allocation of feed to single and multiple bearing ewes, and the timing of lamb sales. The financial implications were based on estimates of additional net farm income simulated for representative farms in 3 regions.

RESULTS

Flock Productivity

An example of the implications of immunisation for flock productivity is shown in Table 14. From an initial level of lambs born (LB) per ewe joined (EJ) of 120%, immunisation is assumed to increase this to 145%, based on the experimental evidence to date. Using the birth rank compositions reported by Davis *et al.* (1983) and mortality rates by birth rank reported by Smith (1983a), the average increase of 25% in LB/EJ results in a net increase of 18% in lambs weaned per ewe joined. The overall rate of lamb mortality is only marginally higher with the use of immunisation. However as the proportion of lambs born as multiples almost doubles from 33% to 62% then total lamb losses to weaning rise, so that of the 500 extra lambs born only 365 extra lambs are weaned, implying a marginal lamb mortality rate of 27%. A reduction of 5% in lamb mortality (marginal rate = 22%) would increase the number of extra lambs weaned from 365 to 390. Clearly, any steps to reduce lamb mortality are likely to raise the profitability of immunisation.

The marked increase in multiple bearing ewes highlights the importance of identifying them in order that they may be preferentially fed. Figure 2 summarises the change in the number and composition of the lambs born. At higher levels of lambing performance the proportion born as singles under immunisation drops dramatically.

TABLE 14 Response to immunisation.

	Control	Immunised
Ewes joined (EJ)	2000	2000
Lambs born	2400	2900
Lambs born/EJ (%)	120	145
Lambs born as multiples (%)	33	62
Ewes with multiples (%)	20	45
Overall lamb mortality (%)	15.3	17.3
Marginal lamb mortality (%)	-	27.0
Lambs weaned (LW)	2032	2397
LW/EJ (%)	102	120

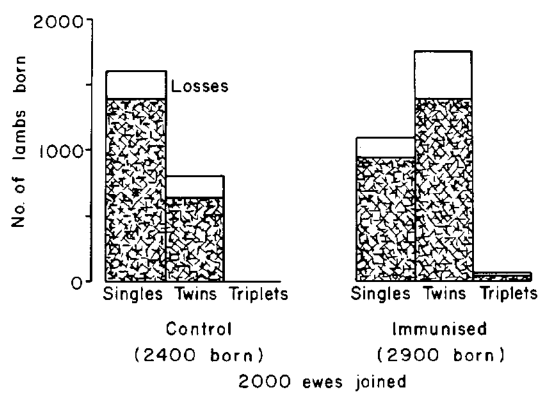

FIG. 2 Impact of immunisation by birth rank.

Financial Returns

Representative farms in 3 regions were analysed (Table 15). The regions were chosen to reflect 3 contrasting patterns of summer herbage growth rates (Radcliffe 1974 and 1975; J.A. Baars, pers. comm.). It was assumed that immunisation would raise the LB/EJ by 25%. The financial returns were estimated by calculating the number, weight and grade of extra lambs sold, allowing for a loss of ewe wool production, and including extra animal health costs. The cost of immunisation was taken as $2.07 per ewe per year, based on a cost of $1.50 per dose, an interest rate of 10% and a 4-year breeding life.

The financial returns were strongly influenced by region. Under dry summer conditions the net farm income rose by only 4% (no allowance was made for extra labour or management). However, net farm income would rise by as much as 12 to 13% in the other areas if a farmer immunised his entire flock and obtained a 25% increase in LB/EJ. This corresponds to an increase in net farm income of over $30/ha in Southland, or nearly 7 cents per EJ per each 1% increase in lambs born.

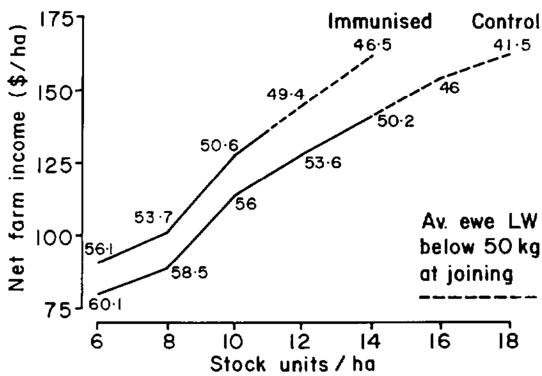

FIG. 3 Net farm income ($/ha) with and without immunisation: King Country. Numbers refer to live weights at joining for ewes with an average prelambing weight of 50 kg. The hatched segments correspond to joining weights below 50 kg.

The returns per hectare with and without immunisation are shown for the King Country case in Figure 3. It has been stressed that immunisation increases the proportion of multiple bearing ewes. For this reason extra feed must be allocated to them if they are to maintain their live weights. It was assumed that the average pre lambing weight was 50 kg. The results in Figure 3 show the average live weight of ewes at joining. Clearly at high stocking rates the ewes are not able to return to the 50 kg target, and at low stocking rates they gain weight. If a farmer wished to maintain this 50 kg target he could carry up to 14 SU/ha. However if immunisation is introduced at that stocking rate, it is no longer possible to maintain ewe live weights. In a typical year, ewes would reach joining at 45.5 kg. While it appears that net farm income per hectare has been increased by immunisation, the gain is shortlived, if in fact ewe body weights have been reduced. Regardless of whether ewes are immunised

TABLE 15 Net returns to immunisation in three regions.

Region	Dry Summer (Hawkes Bay)	Moist Summer (King Country)	Wet Summer (Southland)
Herbage growth Jan-Mar (kg DM/ha/d)	11	38	63
Stock units/ha	10	12	18
Ewes joined (EJ)	2000	2640	3240
Additional NFI[a] ($)	1366	3714	5516
Percentage increase in NFI	4%	13%	12%
Additional NFI[a]			
- per ha ($)	6.83	16.88	30.64
- per EJ ($)	0.68	1.41	1.70
- per EJ/1%[b] (cents)	2.7	5.6	6.8

[a]NFI = Net Farm Income, defined as gross receipts less all cash expenditure (including insurance, rates, interest and depreciation).
[b]The increase in net farm income per EJ per percent increase in LB/EJ.

in the following year, their lambing performance would reflect their lower joining weight; immunisation has in effect shifted some of next year's lambs back to the current year. At stocking rates above 11 SU/ha, net farm income could not be increased in a sustained manner using immunisation. A 4.5 kg drop in ewe joining weights would reduce next year's lambing by 8 to 10%, and such losses would soon outweigh the current returns from immunisation. Although this is an extreme example, in that few farmers will immunise their entire flock, it does emphasise the need for adequate nutrition of treated ewes if the profitability of immunisation is to be sustained.

Variability

The results in Table 14 and 15 refer to an expected response of 25%. Based on all the trials using androstenedione to mid 1984, the average response in LB/EJ has been 25.5% with a standard deviation of 12.6%. Decisions concerning the use of the technique and any analysis of its financial implications must reflect this variability. A normal distribution with mean 25.5 and standard deviation 12.6 (upper part of Figure 4) was used to analyse the financial consequences. In the lower part of Figure 4 are 2 rays, whose slopes are given by the returns from immunisation expressed in cents per ewe joined per percent increase in LB/EJ. These exclude the cost of the treatment. For example in Southland, one can expect returns of 15 cents per EJ for every 1% increase in LB/EJ. A response of 25.5% in LB/EJ would mean increases of (25.5 x 15)/100 or $3.83 per ewe (shown on the vertical axis). On average, the expected returns in all regions are greater than the costs of $2.07 per ewe per year. Figure 4 can be used to estimate the chances of not covering the costs.

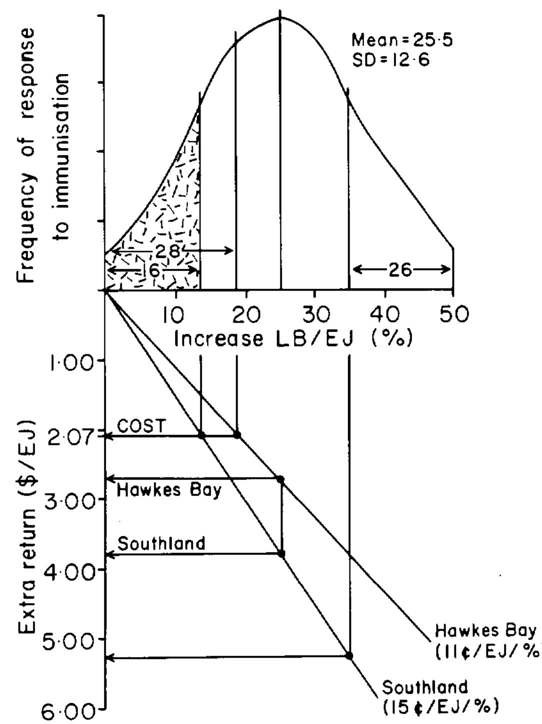

FIG. 4 The response to immunisation and the probability of not breaking even.

This is done in 2 steps.

(1) What response rate would be needed to cover the costs of immunisation?

(2) What is the probability of not achieving that level of response?

The first is addressed in the lower part of Figure 4. In Hawkes Bay if the cost is $2.07, one would need to obtain a response of (2.07/0.11) = 18.9% to break even. From the upper part of Figure 4 it is apparent that there is a 28% probability that this response would not be achieved. In Southland one would need a response of (2.07/15) = 14% and there is a 16% chance of not breaking even. On the other hand of course, there is a 26% chance of a response between 35% and 50% increase in LB/EJ. This would give extra returns of $5.25 to $7.50 per ewe for an investment of $2.07.

There are 2 major sources of variability in the economic returns to immunisation. One is the level of response in LB/EJ; the other is the survival rate of lambs to sale. These sources were combined in an analysis of the economic returns in a flock with a current level of LW/EJ of 100%, and assuming the annual average cost of immunisation is $2.07 per ewe. The results are presented in terms of lines of equal net return in Figure 5, using 3 different net prices for lambs ($16, $20 and $24) inclusive of return of wool if shorn. Two sets of iso-return lines are shown; one for a zero net return (i.e. the break-even return) and another for a net return of $2 per ewe. If the response to the drug is only a 10% increase in LB/EJ, then in order to break even lambs would need to fetch $24 each after all charges. If lamb mortality from birth to weaning is 15%, then a $2 net return per ewe can be obtained with a response to the drug of 22%, when lambs sell for $20. Given that the probability of getting at least a 22%, response is about 0.6, then the chances of a net return of $2 per ewe are reasonable provided lamb mortality is not significantly greater than 15% for the whole flock.

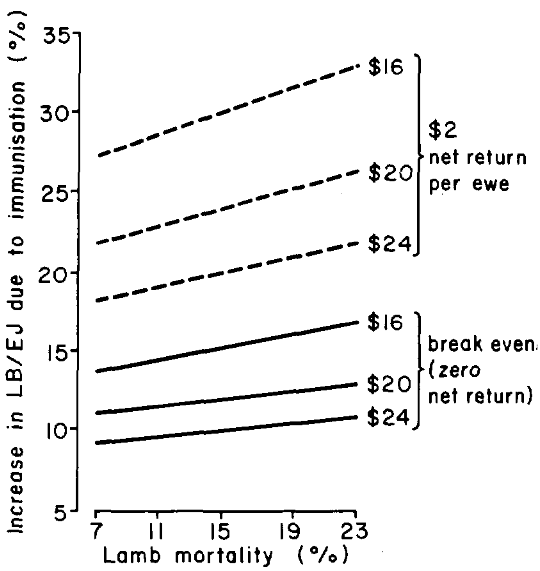

FIG. 5 Combinations of response to immunisation and lambs mortality which give equal net returns (---$2 per ewe; —$0, break even), for 3 net prices of lambs ($16, $20, $24).

CONCLUSIONS

The use of immunisation to increase ovine fecundity is a potentially profitable technique. However, the proportion of multiple bearing ewes and lambs born as multiples rises dramatically even among ewes whose current productivity is around the national average weaning rate of 100%. This calls for adequate feed supplies to grow the lighter multiple lambs, and to restore the body weights of multiple bearing ewes. Predictably the net returns are found to be highest in areas with ample summer feed supplies. In such areas, total net farm income could rise by 12% if the response to immunisation is at the average predicted level of a 25% increase in LB/EJ. This response is however variable, and the probability of not breaking even can be as high as 30% even in an average season. However in the more favoured areas, this probability falls to less than 20%.

ACKNOWLEDGEMENTS

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