ECONOMICS OF LANDCORP'S WAIHORA ROMNEY BREEDING SCHEME

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INTRODUCTION

The Land Corporation Limited (Landcorp; formerly the Fields Directorate of the Department of Lands and Survey) farms more than one million breeding ewes (some 2% of the national ewe flock), in addition to beef cattle, deer and goats. Four open-nucleus breeding schemes produce virtually all of Landcorp's annual Romney ram requirement. The largest of these schemes is located in the central North Island with the nucleus on Waihora and Kakaho farms.

McArthur (1983) modelled the economic efficiency of the Waihora scheme. The net present value of the scheme from 1981 onwards was estimated to be $75 per ewe ($ 1981). Uncertainty analyses indicated that this value was sensitive to, among other things, the estimated genetic gains in number of lambs born, weaning weight and hogget live weight.

This study aimed to re-assess the theoretical predictions of individual trait genetic gains in the Waihora scheme, and to estimate new economic weights which optimize the net present value of the scheme as a whole.

METHODS

Genetic gains

Structural characteristics of the Waihora breeding scheme were derived from the mean annual movements and selection rates of animals for years of birth 1975 to 1984.

The breeding objective (H) of the scheme was (and remains) very similar to that of Sheeplan (Clarke and Rae, 1977). Indexed (I_N) selection criteria of nucleus flock replacements comprised of the deviation of the dam's lifetime number of lambs weaned (NLW), and the individual's adjusted weaning weight (WW), hogget live weight (HLW) and hogget fleece weight (HFW) deviations. At three dam weaning records (the mean at Waihora), the correlation between I_N and H is 0.337. All

sires were bred in the nucleus and no nucleus females were transferred to the base.

During the period under study the selection of base-born two-tooth replacements for the base was by subjective appraisal (i.e., $r_{IH} = 0$). However, base-born ewes that reared twins at their two-tooth lambing were selectively screened into the nucleus. The correlation of the index using this single individual expression of NLW with H is 0.297. In the absence of individual flock information the base was treated as a single unit.

The equations of James (1977), summarised by Mueller and James (1984), were used to predict steady state genetic gains in the Waihora breeding scheme.

Husbandry considerations

The predicted individual trait genetic gains in the system were adjusted for the effects of reduced survival and lower weaning weights of multiple-born lambs, as well as for the lower stocking rate necessary to manage heavier ewes producing more lambs and wool per unit land area. After t years of selection the adjusted gains above base year (t=0) values were expressed in terms of weights of lamb weaned (L'_t) and wool produced (W'_t) and the number of lambs weaned (N'_t) on a per ewe basis.

Economic analyses

Unit prices for weights of lamb weaned (P_L) and wool produced (P_W), together with the costs of managing extra lambs (C_N), managing ewes rearing additional lambs (C_E) (Fleming, 1988) and servicing the nucleus recording requirements (C_R) were incorporated into the economic evaluation. After t years of selection, the marginal annual cash flow (b_t) was calculated as:

$$b_t = P_L(L'_t) + P_W(W'_t) - C_N(N'_t) - C_E - C_R .$$

The net present value (PV) of the breeding scheme over a 50-year time horizon, which included 30 years of selected improvement in the scheme, was estimated as:

$$PV = \sum_{t=1}^{30} b_t (1-i)^t + \sum_{t=31}^{50} b_{30} (1-i)^t$$

where i = 0.05; the real rate of interest (e.g., Smith, 1978).

An improvement time span of 30 years was chosen as a period likely to induce changes in physical performance that would be within the expectations of the population concerned under the farming conditions experienced in practice.

The effect of varying each variable in the PV function was examined using "equi-probable" variations of one standard deviation. Where possible, standard deviations of the variables used in the PV function were estimated using a variety of sources (e.g., Tait, 1983; Lewer and Wickham, 1986 unpublished review; Nicoll, 1987 unpublished). The product of the standard deviation of each variable and a numerically

determined first derivative of the PV measured equi-probable sensitivity.

Estimation of the economic values (V_i) of the traits in the selection index which optimized the PV of the scheme as a whole was performed iteratively. Iterations commenced from the existing Sheeplan economic values and involved calculating the first derivative with respect to V_i for the PV function, summing the scaled derivative with V_i, and recalculating the PV.

RESULTS

The PV of the Waihora breeding scheme was estimated at $100.9 per ewe ($ 1988). Accounting for the 215 368 ewes in the scheme (8 236 Nucleus + 207 132 Base ewes), this per ewe return amounts to a PV of $21.7 m at a real interest rate of 5%.

The results of the sensitivity analyses are summarised in Table 1. The PV of the scheme was particularly sensitive to the price per kg of lamb weaned, the interest rate, and the heritability estimates for NLW and WW. Also sensitive were the heritability of HLW, the genetic correlations of NLW with WW and HFW, and the price of wool. PV was insensitive to the costs incorporated in the model.

Optimising the PV of the Waihora breeding scheme increased the value per ewe by $13 to $114.07. The economic values and predicted steady state genetic gains for the individual traits are presented in Table 2.

Table 1 Sensitivity of the present value (PV) of the Waihora Romney breeding scheme to a standard deviation change in selected individual model variables

Variable	Expected value	Standard deviation	Sensitivity $
$/kg lamb weaned	$1.00	$0.50	64.18
h^2NLW	0.10	0.10	53.47
Interest rate	0.05	0.01	38.76
h^2WW	0.20	0.10	35.13
h^2HLW	0.35	0.20	-13.65
r_g NLW/WW	0.12	0.10	12.62
r_gNLW/HFW	-0.05	0.15	11.83
$/kg wool	$5.00	$2.00	-10.41

Table 2 Comparison of estimates derived form using Sheeplan and Optimized-PV economic values in the Waihora Romney breeding scheme

	Trait			
	NLW (lambs)	WW (kg)	HLW (kg)	HFW (kg)
Economic values (cents):				
Sheeplan	554	24	0	92
Optimized-PV	533.1	64.2	-20.0	165.0
Genetic gains/year:				
Sheeplan	0.029	0.23	0.58	0.013
Optimized-PV	0.024	0.24	0.45	0.023

Comparisons were made between estimates obtained under current selection index practice using the Sheeplan economic values and those using the economic values that optimized the PV of the scheme.

Optimizing the PV of the Waihora breeding scheme resulted in increased economic weightings for WW and HFW, and decreased weightings for NLW and HLW. Predicted steady state genetic gains showed similar directional differences to the economic values.

DISCUSSION

The results of this study relate to theoretically-predicted steady state genetic gains in the Waihora breeding scheme, and not to actual improvements being achieved. Furthermore, these predictions assumed that seleciton decisions were confined to the nominated selection criterion, which may not have occurred in practice (Dodd and Delahunty, 1983), particularly in the selection of nucleus-bred sires by base flock managers.

Nevertheless, examination of the Waihora Romney open nucleus breeding scheme indicated a substantial amount of economic gain equivalent to a present value of $21.7 m over the 50-year time horizon. This supports the suggestion of King (1985) that breeding programmes represent sound investment opportunities when quite small improvements were disseminated to a large population.

Optimizing the present value of the breeding scheme to estimate the economic values of the traits in the selection index presented the opportunity to evaluate the current Sheeplan economic weightings. The negative emphasis on hogget live weight reflected the practical importance of restricting increases in ewe size under pastoral conditions. The benefits of extra ewe carcass weight were not estimated in this study and adjusting for larger animals by reducing stocking rates may have been a more costly option than others available. Clarke and Rae (1977) estimated that the extra costs of maintaining heavier ewes approximated the extra value of heavier carcasses; they set the Sheeplan economic value of hogget live weight

to zero. Morris et al. (1982) drew similar conclusions in their study, although the price of aged ewes has since declined substantially.

The optimized-PV economic value of hogget fleece weight was greater than that used in Sheeplan. An increased relative emphasis on fleece weight in Sheeplan has also been advocated in the past (e.g. Morris et al., 1982; Wickham and McPherson, 1985).

It is noted that it would not be necessary to alter economic values by optimizing the present value of the entire scheme as was done in this study. Direct alteration using partial budgeting to calculate the economic values would usually be expected to optimize the present value of the scheme, provided the prices used to calculate this present value were the same as those used in the partial budgeting.

The results have indicated that in using Sheeplan, Landcorp's Waihora Romney breeding scheme is profitable. However, in the light of current market prospects, coupled with the overall breeding objective of maximising profit from commercial production, greater economic emphasis should be given to fleece weight. Annual genetic gains in fertility (number of lambs weaned) and ewe live weights would be reduced if optimal economic values were used (Table 2). However, given a continuation of the current favourable relative price of wool, the present value of the entire system in the long term would be increased.

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