SIMULATION AS AN AID TO PREDICTING PASTURE RESOWING PROFITABILITY

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Summary

The profitability of resowing a pasture with lucerne was examined by a simulation model. The importance of considering the whole system and particularly the economic factors were highlighted since an approximate 40% increase in value of animal product was required to make resowing profitable. Stocking rate, gross margin per dry sheep equivalent for both resown and rundown systems, opportunity cost, stochastic sequence and pasture life significantly affected both before and after tax profitability. Such simulation studies enabling examination of the whole system appear useful decision aids to the livestock producer. Other pasture resowing systems are suggested for further simulation experimentation.

I. INTRODUCTION

Pasture resowing in higher rainfall non-cropping areas has often been recommended but seldom with a sound economic basis (e.g. Hagerstrom 1964); however the livestock producer wants to know if pasture resowing is likely to be profitable. Research work has concentrated on biological responses e.g. perennial pasture species response under cutting and grazing, while the incorporation of economic factors into the system has been largely neglected. Simulation has enabled "experimentation" with complete systems including economic components (Anderson and Dent 1972).

This paper examines the usefulness of a simulation model for evaluating a pasture resowing problem viz. the resowing of lucerne (Medicago sativa) into sandy soils originally carrying "weedy" pastures in the South-East of South Australia.

II. MATERIALS AND METHODS

The data for the model (Smith 1973, Smith 1974) was based on a model property typical of some properties in the South-East of South Australia. The use of cumulative distribution functions (CDF) allowed representation of those stochastic components likely to be the endpoints of uncertainty in the biological and financial components of the system (see Figure 1).

The model compared the profitability of two systems (each 1000 ha) over a 20 year period. One system remained rundown pasture throughout the period, while the other was resown to lucerne at the rate of 100 ha annum⁻¹ until the entire area was successfully resown. Four alternative methods of lucerne resowing were examined with varying costs.
establishment successes and grazing losses (Smith 1973, Smith 1974). The chief measures used to summarize the comparisons were differences in net present value (NPV) of the systems both before and after tax. Other summary measures included the maximum level to which gross margins (both before and after tax) from the resown system fell behind those from the rundown system, and the years in which those peaks occurred.

Experimentation with the model aimed at estimating a response surface by fitting a second order polynomial function for pasture resowing for the particular example used. Stocking rate, gross margin per dry sheep equivalent (GM dse\(^{-1}\)) for resown pastures, GM dse\(^{-1}\) for rundown pastures and interest rate or opportunity cost were the factors examined by a central composite design (Candler and Cartwright 1969; Smith 1973).

Other coefficients estimated were for pasture life (initially assumed to be 20 years) and for various stochastic sequences - the latter as dummy variables. These were estimated from supplementary points within the central composite design.

III. RESULTS

Stocking rate, GM dse\(^{-1}\) for resown pastures, GM dse\(^{-1}\) for rundown pastures, interest rate or opportunity cost and most of the interaction terms had highly significant effects on the summary measures. The estimated response functions were used to predict results for various assumptions about pasture resowing. Iso-performance graphs provided a useful visual method of presentation of the results (Figure 2). Different stochastic sequences showed that while the expected "best bet" level of profitability and method of resowing was indicated by experimentation, extreme stochastic sequences could change the overall profitability of pasture resowing, and markedly alter the rankings for the most desirable methods of resowing.

The overall results of the lucerne resowing example suggest that an approximate increase of 40 percent in livestock product value is required to make pasture resowing profitable under the most likely product prices. Such increases may result by increasing stocking rate, increasing GM dse\(^{-1}\) from the resown system relative to the rundown situation, higher product prices, or some combination of these. Thus in Figure 2(a) with assumptions of rundown and resown stocking rates of 5.0 and 6.0 dse ha\(^{-1}\) respectively and an opportunity cost of 0.12, profitability ($0 isoperformance line) is not reached with a rundown GM dse\(^{-1}\) of $5 until the resown GM dse\(^{-1}\) is 1.2 that of the rundown. However with higher prices e.g. GM dse\(^{-1}\) of $10 for the rundown, then profitability is reached with the resown GM dse\(^{-1}\) being equal to that of the rundown.

Cash flows and peak debts were shown to be of importance. Peak debt usually occurred 5-7 years after the resowing programme had commenced, although with certain stochastic sequences this period could reduce to 3 or 4 years or be extended up to 10 years. The effect of taxation was to even out the extent of losses or gains to the individual.
Fig. 1. Cumulative distribution functions (CDF) for gross margin per dry sheep equivalent for resown and rundown systems.
Resown mean = $7.20  Rundown mean = $6.00

Fig. 2. Examples of isoperformance lines of expected net present value (NPV) ($ x 10^{-2}$) from budgetary response functions (assuming stocking rates of 5.0 dse ha$^{-1}$ for rundown and 6.0 dse ha$^{-1}$ for resown).
(a) Before tax for varying resown and rundown GM dse$^{-1}$ (opportunity cost = 0.12).
(b) After tax for varying resown and rundown GM dse$^{-1}$ (opportunity cost = 0.12).
(c) After tax for varying rundown GM dse$^{-1}$ and opportunity cost (resown GM dse$^{-1}$ = 1.2 rundown GM dse$^{-1}$).
IV. DISCUSSION

The results emphasize that more than just a 5 or 10% biological response is required before pasture resowing with lucerne is likely to be profitable. Additionally several years will generally elapse before the producer will be as well off as if he had done nothing. If the producer has to borrow money or if there are alternative profitable "on farm" investments then the risky and long term nature of pasture resowing will appear unattractive. The range of opportunity costs used in this study (4-9%) is considered conservative in view of the current inflation, high interest rates and low terminal values. Investment in pasture resowing is likely to be more attractive to investors with a high marginal tax rate, since they are more likely to have used up their higher profitability farm investment alternatives. It must be stressed however that investment in pasture resowing is long term, and hence current decisions should be based on medium - long term expectations, rather than short term expectations.

Simulation studies such as this may be criticized in that they suffer from a shortage of reliable data - both biological and especially economic. However the farmer with or without his advisers is obliged to make current decisions with the best available information. To this end we believe our model serves a very useful purpose in synthesizing available data for the pasture resowing system. Additionally such a model should aid public decision makers and highlight areas in which researchers should concentrate their activity. Several other pasture resowing problems in South Australia may be better investigated by experimenting with the whole system e.g. by means of a simulation study. These include replacement of annual grasses and herbs by perennial grasses, replacement of subterranean clover (Trifolium subterraneum) cv Yarloop by a low oestrogen subterranean clover and the replacement of paspalum (Paspalum dilatatum) by winter active perennial grasses on flood irrigated swamps. Such experimentation would be more relevant to the animal producers decision problem but would probably mean curtailing of traditional pasture species evaluation sequences.

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VI. REFERENCES