Modelling feed profiles and production options

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Abstract. *A new research tool to identify forage combinations to satisfy livestock production requirements has been developed. The whole-farm model uses linear programming to maximise income received from a wide range of alternative crop, fodder and livestock activities for mixed farms over a single year. The model enables crop and fodder solutions to be individually tailored to the resources available for individual farms, and also for different rainfall scenarios. It enables the assessment of new animal production systems.*

Introduction

The key to efficient livestock production from grazing enterprises is to optimise the conversion of pasture into meat and fibre production. Substantial productivity gains are possible by more accurately predicting and matching pasture supply with the livestock feed requirements. Livestock production systems are highly sensitive to changing pasture conditions with small variations in feed supply and quality, within and between seasons, significantly affecting the amount and quality of wool and meat produced.

Methods

A whole-farm linear programming model (Grain & Graze Whole Farm Model) was developed to use simple modelling to identify better strategies, including research and development, and policy options, to improve the income of farmers and overcome grassland degradation. The model requires input data to define farm structure, crop and forage production and energy demands of livestock.

Farm structure

Australian Bureau of Statistics data were used to provide information on farm size, crop combinations and livestock enterprises for selected areas.

Crops and forages

The SGS Pasture Model (www.imj.com.au/sgs) was used to predict growth rates for a range of forages using climate data obtained through Silo-Datadrill (Jeffrey *et al.* 2001). Metabolizable energy (ME) of forages and other sources of feed was obtained from a number of sources including the SGS Pasture Model, Victorian Department of Primary Industries (www.feedtest.com.au/feedtest_averages.htm), New South Wales Department of Primary Industries (NSW DPI) (www.agric.nsw.gov.au/tools/fes), and commercial interests. Over 180 possible crop and pasture rotations were incorporated. Average yields for a range of crops in rotations were obtained from NSW DPI District Agronomists, accounting for the effect on yield of crop position in the rotation. Derived harvest indices for each crop compared to an annual grass pasture enabled the determination of crop yields for a range of rainfall scenarios. Farm budgets and costs were taken from NSW DPI (www.agric.nsw.gov.au/reader/budget) and individual researchers.

Livestock

Livestock systems (11 sheep, 13 cattle, two goat) were based on NSW DPI data (www.agric.nsw.gov.au/reader/budget) and producer input. A modified ME calculator developed from a herd structure model, was used to calculate (on a monthly basis) the nutritional requirements (ie. ME) per production unit. Options were added to the model to change breeding times, weaning percentages and target markets, and to incorporate the choice of breeding or trading enterprises.

Results and discussion

The model has been used to evaluate the economic consequences of some potentially important changes to mixed farming systems across the Central-West and Lachlan Catchment Management Authority (CMA).

An example of the application of the model is the effect of changing the livestock enterprise on the same forage and cropping mix. For an average farm in the central zone of the Lachlan CMA at Parkes (farm size of 1070 ha, of which over 500 ha is cropped), the results of changing the livestock enterprise from a standard 21 micron self-replacing Merino flock with the same cropping and forage mix are presented in Table 1.

The data show that changing the livestock enterprise greatly affects whole-farm gross margin even when livestock numbers are held constant (Merino x terminal ram option 2). Further, other enterprises which are equally or more profitable (meat or angora goats, Merino x terminal ram option 3) allow a substantial

Table 1. Alternative enterprise details for a typical farm in the high rainfall zone at Parkes, NSW

Livestock enterprise	Whole-farm gross margin ($/ha)	Livestock number	% change in stock numbers
21 micron Merino ewes x Merino rams	187.13	1588	0
Meat goat	204.06	1221	-23
Angora goat	188.62	1225	-23
21 micron Merino ewes x terminal rams[A]	283.44	1841	16
21 micron Merino ewes x terminal rams[B]	261.21	1588	0
21 micron Merino ewes x terminal rams[C]	187.26	755	-52

[A]optimal solution
[B]constrained to constant livestock numbers relative to standard
[C]constrained to constant gross margin/ha

decrease in livestock numbers and should thus improve sustainability. The most profitable solution, Merino x terminal ram option 1, requires an increase in stock numbers and may lead to less than acceptable natural resource management outcomes such as decreased ground-cover with the potential for increased erosion. Nevertheless, potential clearly exists for a change in livestock enterprise to achieve both economic and ecological benefits.

Conclusions

The results from the model indicate that selection of an appropriate livestock enterprise can be expected to increase sustainability of mixed farming systems as stocking rate can be reduced without economic penalty. The associated reduction in grazing pressure should facilitate improved management of pastures with benefits in terms of increased perenniality and greater stability of production under a more variable climate. Biodiversity benefits can also be expected. The model is proving to be an important research tool in evaluating new strategies to improve the income of farmers and overcome grassland degradation.

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References

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