

## New Zealand Society of Animal Production online archive

This paper is from the New Zealand Society for Animal Production online archive. NZSAP holds a regular annual conference in June or July each year for the presentation of technical and applied topics in animal production. NZSAP plays an important role as a forum fostering research in all areas of animal production including production systems, nutrition, meat science, animal welfare, wool science, animal breeding and genetics.

An invitation is extended to all those involved in the field of animal production to apply for membership of the New Zealand Society of Animal Production at our website [www.nzsap.org.nz](http://www.nzsap.org.nz)

[View All Proceedings](#)

[Next Conference](#)

[Join NZSAP](#)

The New Zealand Society of Animal Production in publishing the conference proceedings is engaged in disseminating information, not rendering professional advice or services. The views expressed herein do not necessarily represent the views of the New Zealand Society of Animal Production and the New Zealand Society of Animal Production expressly disclaims any form of liability with respect to anything done or omitted to be done in reliance upon the contents of these proceedings.

This work is licensed under a [Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License](http://creativecommons.org/licenses/by-nc-nd/4.0/).



You are free to:

**Share**— copy and redistribute the material in any medium or format

Under the following terms:

**Attribution** — You must give [appropriate credit](#), provide a link to the license, and [indicate if changes were made](#). You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use.

**NonCommercial** — You may not use the material for [commercial purposes](#).

**NoDerivatives** — If you [remix, transform, or build upon](#) the material, you may not distribute the modified material.

<http://creativecommons.org.nz/licences/licences-explained/>

# MODELLING THE CONTRIBUTION OF FORAGE CROPS TO PRODUCTION, PROFITABILITY AND STABILITY OF NORTH ISLAND DAIRY SYSTEMS

C. P. MILLER

*Massey University, Palmerston North*

## SUMMARY

A range of forage sources and a range of cow feeding options were defined and assembled as a linear programming model to synthesize and evaluate alternative North Island dairy systems and to develop research priorities. Forage crops significantly increased production and average and minimum income in Northland systems but had a much smaller effect on a Ruakura system. Average profitability was increased only slightly by conservation. The most rewarding research area would be to increase pasture yield.

## INTRODUCTION

The last five years have seen a considerable research effort into developing higher producing beef and dairy systems incorporating forage crops (*e.g.*, Campbell *et al.*, 1978; Stephen and McDonald, 1978; Taylor *et al.*, 1979), usually after a theoretical evaluation of physical and economic performance (*e.g.*, Bell, 1976; Stephen and McDonald, 1977). These assessments have usually studied only a few among the many possible combinations of forage sources and methods of utilization.

This paper reports some results of a study where, in conjunction with the field development and testing of dairy feeding systems in Northland (Taylor *et al.*, 1979), a linear programming model was used to try to identify those factors which are important in system performance and areas which might reward further research. Aspects considered here are (a) the levels of cropping and of conservation, and (b) the yields of pasture and crop.

## MODEL

The model year is composed of 26 fortnights, in each of which are specified a set of feed sources and a set of feed requirements. Feed sources, which may be pasture or crop (grazed or conserved) or concentrates, are specified by timing, yield, metabolizable energy (ME) content, crude protein (CP) content and cost. Cow requirements for each lactation pattern are specified by timing, ME requirement, minimum CP requirement, maximum dry

matter (DM) intake, and milkfat (MF) production. Lactation lengths of 183, 211, 239, or 267 days combined with three planes of nutrition gave 12 basic lactation patterns with MF production varying from 117 to 161 kg/cow. In seasons better than average, ME production could increase to a maximum of 180 kg/cow. Calving time was also a variable. Gross margin was usually the objective function to be maximized. Most systems were simulated through nine arbitrary seasons, and the results reported are means except where otherwise indicated.

## RESULTS AND DISCUSSION

### LEVEL OF CROPPING

Cropping resulted in increases in production and in economic performance. In Northland (Table 1) the largest relative effect was on minimum income and internal rate of return to farm capital. Minimum net income, for example, more than doubled between the best all-grass system and the best cropping system.

TABLE 1: EFFECTS OF LEVELS OF CROPPING AND CONSERVATION ON AVERAGE SYSTEM PERFORMANCE

	<i>Percent of Farm Cropped</i>					
	0	20			40	
	5 <sup>1</sup>	12 <sup>1</sup>	11 <sup>1</sup>	33 <sup>1</sup>	11 <sup>1</sup>	16 <sup>1</sup>
Dry matter (t/ha)	9.5	9.5	12.6	14.4	14.0	14.7
Stocking rate (cows/ha)	2.4	2.2	2.7	3.2	2.9	3.1
Milkfat (kg/cow)	139	155	157	161	162	159
Net income <sup>2</sup> (\$/ha)	170	199	253	273	278	292
Minimum net income (\$/ha)	26	57	75	150	140	147
Rate of return (%)	1.3	2.2	3.8	4.4	4.6	5.0

<sup>1</sup> Percent of feed grown that is conserved.

<sup>2</sup> Average net income of Northland dairy farms, 1976-7, estimated at \$90.00/ha (N.Z.D.B., 1979).

In Ruakura conditions, an optimal level of cropping was only 10%, and the effects of cropping on the performance parameters of Table 1 generally small. Dry matter yield and milk production both increased by more than 10%, but gross margin by only 2.5% and minimum net income by 24%.

In both environments, increasing the cropping level beyond the optimum point resulted in higher milkfat production and only slight reductions in profitability.

## LEVEL OF CONSERVATION

At any level of cropping, increasing conservation level resulted in higher production and profitability (see Table 1). In all-grass systems the whole effect resulted from better feeding of (fewer) cows, while in cropping systems greater conservation enabled higher forage yields and higher stocking rates. The effect of conservation was at all times smaller than the effect of cropping. At any cropping level, the model predicted it would be more profitable to grow more crop than to conserve more of the existing forage.

## CROP AND PASTURE YIELD

The benefits resulting from higher forage yields are fully realized only if system organization and management are re-optimized appropriately. An optimizing model does this efficiently and dispassionately, and the results that follow are therefore from comparisons between systems, each with its individual management.

Higher pasture yields resulting from three different sources produced similar increases in milkfat production, but even when the cost of extra forage was deducted, economic responses differed quite widely (Table 2), depending on the timing of the additional forage. The change of species in Table 2 refers to the use of a summer-growing grass while change of site refers to exchanging Ruakura pasture yields for those of Northland.

TABLE 2: SYSTEM RESPONSES TO HIGHER PASTURE YIELD ASSUMING NO EXTRA COST

	<i>Reason for Higher Yield</i>		<i>Site</i>
	<i>Nitrogen</i>	<i>Species</i>	
Pasture DM (kg/ha)	3 000	5 000	5 890
DM/MF (kg/kg)	30.0	29.1	27.8
Gross margin (c/kg DM)	3.7	5.2	5.9

Production responses to increasing maize yield were much the same (29.1 kg DM/kg MF) as for pasture, emphasizing that metabolizable energy content is a reasonable basis for comparing the nutritive value of forages, provided that the forage is fitted into an appropriate system.

Estimates of the gross margin response to increased yield of other forages, comparable with the estimates of Table 2, are

(cents/kg) 4.5 for greenfeed maize, 5.7 for Sudax, 6.5 for red clover, 3.0 for subterranean clover, 6.0 for pasture silage, 5.6 for maize silage, and 4.3 for oat silage. Estimates for greenfeed cereals were 4.7 to 5.4c in the July-September period but less than 3.0c at later times. If these estimates were to be weighted by the potential area of each, all except that for pasture would be significantly reduced.

Three main conclusions can be drawn from the foregoing. First, existing forage crops have a profitable role to play in appropriate Northland dairying systems. Secondly, increased conservation appears to have a limited role in increasing farm profitability, though industry profitability could benefit from a more even product flow (Kerr and Hurnard, 1979). Thirdly, research and development on grazing forages, preferably perennial, pasture-type forages, would bring the highest rewards in the short term.

#### REFERENCES

- Bell, B. A., 1976. *Res. Paper 6/76*. Economics Division, Ministry of Agriculture and Fisheries, Wellington.
- Campbell, A. G.; Clayton, D. G.; McDonald, K. A., 1978. *Proc. Ruakura Fmrs' Conf.*: FPP166.
- Kerr, J. P.; Hurnard, S. M., 1979. *Dairyfmg A.*: 111.
- N.Z.D.B., 1979. *An Economic Survey of Factory Supply Dairy Farms in New Zealand*. N.Z. Dairy Board, Wellington.
- Stephen, R. C.; McDonald, R. C., 1977. *Proc. Agron. Soc. N.Z.*, 7: 5.
- , 1978. *Proc. N.Z. Soc. Anim. Prod.*, 38: 147.
- Taylor, A. O.; Hunt, B. J.; Hart, N. D.; Guest, J.; Walker, A. B.; Harris, H., 1979. *Tech. Rep. No. 7*. Plant Physiology Division, Department of Scientific and Industrial Research, Palmerston North.