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Management of summer feed deficits on three high-performing dairy farms in the Manawatu

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Abstract

New Zealand dairy farmers rely on pasture grazed *in situ* to feed their herds. Summer is the most difficult period to manage because pasture production is usually highly variable and, in most years, less than herd requirements. Dairy farmers can use a range of options (e.g., summer forage crops, silage) to minimise the impact of both variable and inadequate summer feed supply. Much has been written about recommended procedures for planning and monitoring pasture-based systems, but there is little documentation on the processes actually used by New Zealand dairy farmers. To this end the summer management processes of three high-performing Manawatu seasonal supply dairy farmers were studied over 4 years. The farmers used management systems based on their experience. A range of simple techniques was used to identify potential feed deficits. The farmers then used a set of decision rules to select the best option or combination of options to overcome feed deficits. The study highlighted the potential benefits that could accrue from integrating farmer knowledge with scientific knowledge.

Keywords: dairy farmers, decision-making, farmer knowledge, monitoring, summer management

Introduction

New Zealand seasonal supply dairy farmers rely almost solely on pasture grazed *in situ* to feed their dairy cows. This low cost feed is, unfortunately, variable in terms of both quantity and quality. Variability of feed supply appears to be particularly difficult to manage over the summer months. For example, Campbell & Bryant (1978) found that at Ruakura No. 2 Dairy the coefficient of variation of per cow production was 5 times higher from 1 February to drying-off than from calving until 31 January.

Dairy farmers use a number of strategies to minimise the impact of a variable feed supply over summer, such as reducing cow condition, summer forage crops, pasture and/or maize silage and in some districts irrigation. If feed deficits are serious, part or all the herd may be dried off early. Although numerous publications have been written on the best methods of managing feed supply on New Zealand dairy farms (see for example du Faur 1981; Hill 1982; White 1982; Ridler & Hurley 1984; Bryant & Macdonald 1987; Brookes *et al.* 1992), there is little formal documentation on how New Zealand seasonal supply dairy farmers actually manage their pasture-based systems.

Farmer knowledge is now receiving recognition in farming systems research (Attonaty & Soler 1991; Brazendale et *al.* 1994; *Cerfet al.* 1994; Simpson 1994). An understanding of farmers' decision-making processes assists in developing research outputs that are more likely to be adopted by the farming community. This paper presents a report on a study of the decision-making processes used by three high performing Manawatu dairy farmers over the summer. The processes used by the farmers are described and then compared with those advocated in other publications.

Method

Ten high-performing Manawatu dairy farmers were identified in late 1991 by an experienced Dairy Board consulting officer. Each farmer was consistently a high performer within their district; had at least 10 years farming experience; had a thorough understanding of dairy farm management; and was able to meet the considerable time commitments of the study. Three farmers from districts with dissimilar soil types and climate were then selected from this list. Characteristics of their farms are shown in Table 1.

The three farmers were visited and interviewed[1] every 2-3 weeks from early January 1992 until they dried-off their herds. Farm walks were used to gather additional data. Semi-structured interviews were used, the interviews were taped, transcribed and then analysed using a form of discourse analysis (Todd *et al. 1993).* Results *were* verified with the farmers after each interview. Follow-up interviews were held at monthly intervals with the three farmers from early January until

[1] A series of pilot interviews were conducted independently with a fourth high performing dairy farmer to develop the research protocol.

drying-off the herd during 1993, 1994 and 1995. In total, the researchers spent some 60-70 hours on each farm with the farmers and their families, Interview findings were compared and contrasted both across years and between farmers to develop a generalised model of the farmers' management process.

Results and discussion

The decision-making processes used by the three farmers were similar, despite their quite different farming circumstances. All three aspired to the same goals over the summer period, namely "to ensure that as many cows as possible were in a lactating state at the start of the autumn rains [normally mid-March], and that both pastures and stock remained in reasonable condition". To achieve their goals the farmers used a process that consisted of first, identifying when a potential feed deficit existed and second, selecting and then implementing sequentially (from a range of management options) the best option or combination of options to overcome the deficit. Bryant & Macdonald (1987) also advocated the sequential use of options to delay the drying-off decision. However, they did not discuss the role of monitoring in determining when particular options should be implemented.

Table 1 Characteristics of the Manawatu seasonal supply dairy farmers, their farms, and associated dairy company data.

Parameter	Farmer 1	Farmer 2	Farmer 3	Company Average
Farmer age	50	31	34	
Years experience[a]	33	12	13	
Ownership	Owner-operator	Share-milker	Share-milker	
Farmer education	School Certificate	Dip.Agr.	Trade Certificate	
Farm location	Himitangi	Kairanga	Sanson	
Major soil type	Himitangi complex (sand)	Kairanga silt loam	Ohakea silt loam	
Milking area (ha)[b]	156.0	96.8	54.6	73.1
Cows peak milked[b]	272	322	154	173
Stocking rate (cows/ha)[b]	1.7	3.4	2.8	2.4
Average milk production[b]				
kg MS/ha[b]	553	979	862	680
kg MS/cow[b]	320	293	307	283

[a] Number of years dairy farming.
[b] Average data for 1989/90-1994/95.

Monitoring and its role in problem identification

Informal monitoring systems were used by the farmers during the summer to identify potential feed deficits. Formal pasture monitoring techniques (Ridler & Hurley 1984) were not used by the farmers because they found it difficult to reliably calibrate pasture height to kilograms of dry matter per hectare owing to high levels of dead matter (and dry matter) in the sward. A combination of information sources was used to confirm that the farm had a potential feed deficit.

The farmers maintained their herds on relatively fixed rounds of 24-30 days over the summer. At any one shift they were able, therefore, to observe the shortest and longest paddocks on the farm. Their visual assessment of feed on the paddock was used to estimate the current feed supply and feeding levels. Feed supply was verified with a farm walk every 3-7 days when the farmers visually appraised pasture levels in each paddock. Although pasture residuals were used when making grazing decisions, the farmers did not appear to think about pasture in terms of kilograms of dry matter. Rather, they appeared to pattern-match the state of a paddock against a mental picture based on experience to identify when the level of pasture cover in a paddock had declined below their critical level.

Post-grazing residuals were the primary means by which potential feed deficits were identified. The farm was said to be moving into a feed deficit when the cows were first seen to graze into a zone of the sward that was high in dead matter and stalky material – the farmers referred to this as "making the cows work". Post-grazing residuals were also used to visualise how pasture cover might appear on a paddock at the next grazing; given current and expected growing conditions. From this information they then predicted whether the herd would be fully fed in 3-4 weeks time and, therefore, an early warning of impending feed shortages.

Two of the three farmers used milk yield data to identify when to take action, contrary to the advice of Bryant and Macdonald (1987) who suggested to ignore milk yield data during the summer. In a normal season they used the decision rule that "if milkfat production approaches 0.6 kg MF/cow/day or declines at a rate of 0.01 kg MF/cow/day over a five-day period, the farm is then moving into a feed deficit". Their experience had shown that at production levels below 0.6 kg MF/cow/day both cow condition and pasture cover begin to decline below acceptable levels. This information constituted the decision rule to trigger the feeding of

supplements in order to maintain milk production at 0.6 kg MF/cow/day. In a very dry season the trigger level was reduced to 0.5 kg MF/cow/day. Daily milk production data were also used to validate their visual (and mentally calculated) estimates of cow intakes.

Cow condition was not a major concern to the farmers in a normal year until March. However, herd condition was monitored routinely by observing younger and thinner cows when shifting the herd. Any fall in the condition of the herd showed in these animals within a week of the herd being placed under nutritional stress. The yield, quality and stage of maturity of their summer crops; the level of other supplements on hand; and summer rainfall were also monitored by the farmers. Likely pasture and crop growth was predicted from soil moisture status, recent rainfall, and expected weather patterns. The farmers think in terms ofsignificant rainfall events – at least 25 mm (cumulative) since this was required to produce an effective increase in pasture growth.

Table 2 The sequence of management options used during a dry summer by three high performing Manawatu dairy farmers compared with that recommended by Bryant & Macdonald (1 987).

Option	High-Performing Farmers	Bryant & Macdonald (1987)
1.	Continue on a fixed round	Continue on a fixed round
2.	Sell known culls	Sell known culls
3.	Dry off or put on once-a-day milking, heifers (and thin cows) below 3.5 condition score units	Completely graze out the farm
4.	Feed crop	Dry-off low producing cows
5.	Sell empty cows	Once-a-day milking
6.	Feed out silage surplus to winter requirements	Dry-off thin cows
7.	Once-a-day milking	Feed out silage surplus to winter requirements upon the arrival of the autumn rains
8.	Dry-off part of the herd	Dry-off the entire herd
9.	Dry-off the entire herd	

Management options

Once a potential feed deficit had been identified the farmers selected what they regarded to be the best option or combination of options (from a suite of management options) to reduce its impact and delay drying-off as long as possible. In general there was a sequence in which these options are used, the least cost (and/or) most flexible options being used first (Table 2). Drying-off the herd, the most costly and least flexible option, was delayed as long as possible. The sequence of options for managing dry summer conditions was similar to that described by Bryant & Macdonald (1987) except for the use of a summer forage crop (an option not considered by Bryant & Macdonald). This option limits the extent to which the farm is grazed out over the summer.

The farmers, in agreement with Bryant & Macdonald (1987), saw no advantage in changing rotation length until the advent of rain. Instead, the sale of known culls was rated as the next option in the general sequence because this allowed feed demand to be reduced. Maintaining good herd records so that potential culls are known was an important aspect of this policy. However, in contrast with Bryant & Macdonald (1987), the farmers did not sell the majority of their empty cows until they had been pregnancy tested in early March.

The farmers delayed grazing out the farm through the use of a summer forage crop. However, in an extremely dry year the farmers were observed to use the strategy of grazing out the farm to delay grazing the summer forage crop until it reached an optimum yield. Bryant & Macdonald (1 987) recommend that farmers completely graze out the farm before drying-off low producing cows.

The farmers found that the heifers tended to lose condition first when placed under nutritional stress. The decision rule used over summer was; "if a heifer fell below condition score 3.5, then it should be put on once-a-day milking. If the heifer continued to lose condition, then it should be dried off'. This decision rule allowed the farmers to ensure the heifers went into the winter in good condition after their first lactation. The decision rule was also applied to mixed age cows and in an extreme year one farmer was observed to dry-off up to 25% of the herd during the latter part of the summer. Bryant and Macdonald (1987) recommended drying-off low producing cows first and did not differentiate between heifers and mixed age cows. The farmers noted that production from a heifer tended to be poor once their condition score fell below 3.5 condition score units.

The farmers aimed to have sufficient silage on hand (surplus to winter requirements) to allow them to feed their herd at one third of their total ration for 2-3 weeks after significant autumn rain. Supplementary feeding at this time allows higher post-grazing residuals which increases the pasture's response to rain, and compensates for the low quality of dry summer pasture with a high dead matter content. Bryant & Macdonald (1 987) also recommended that silage (surplus to winter requirements) be used in this manner. The timing of silage feeding in relation to once-a-day milking and drying-off part of the herd differed between the farmers and that recommended by Ruakura.

Effect of farm state on the sequence in which options are used

The sequence in which management options were used by the farmers varied between farms and seasons. Four general types of summer conditions were observed from the 12 replicates (3 farmers x 4 years). Owing to the differences in soil type and climate on each farm, the three Manawatu farmers could experience quite different conditions in any one year. Although the options available to each farmer in any one year tended to be the same, irrespective of the prevailing conditions, the quantity of each resource such as cow condition or summer crop that the farmer has on hand and the type of season experienced, varied dramatically from year to year. A set of decision rules helped the farmers determine the best option, or combination of options to use for a given set of farm conditions (refer to Figure 1).

Figure 1 Examples of the decision rules used by dairy fanners for a given set of farm conditions during summer.

Rule 1

IF milkfat production falls towards 0.6 kg MF/cow/day
AND there is silage surplus to autumn and winter requirements
AND the crop is still actively growing
AND the crop is still of good quality

THEN feed silage to maintain production at 0.6 kg MF/cow/day

Rule 2

IF milkfat production falls towards 0.6 kg MF/cow/day
AND there is not silage surplus to autumn and winter requirements
AND the herd is in good condition (>4.5)
AND cull cows are identified
AND the crop is still actively growing
AND the crop is still of good quality

THEN sell the cull cows and continue on a fixed round until the crop is ready to graze

Rule 3

IF milkfat production is below 0.5 kg MF/cow/day
AND there is silage surplus to winter requirements
AND the herd is in poor condition (<4.0)
AND cull cows are identified
AND the crop is still actively growing
AND the crop is still of good quality

THEN sell the known culls and feed sufficient silage to maintain production at 0.5 kg MF/cow/day.

The farmers stated that in a typical Manawatu summer they expected a 4- to 6-week dry spell followed by autumn rain in mid-March. In a typical season the farmers graze their herds on a fixed round until milk production and pasture residuals decline to the level at which they invoke action. The farmers then feed sufficient crop to maintain milk production at 0.6 kg MF/cow/day (the crop enables the farmers to milk their herds through until the expected rain). Silage, surplus to winter requirements, is then fed to the herd for 2-3 weeks to maintain cow intakes, increase pasture residuals, and allow the round to be extended. Throughout this period heifers and thin cows will be put on once-a-day milking or dried-off if their condition falls below 3.5 condition score units. Cull cows will be sold after pregnancy testing in early March.

The sequence of options used in a typical season was modified in response to the type of season and the state of the farm. For example, in a dry year where a farmer had a plentiful supply of silage, the silage was used before the crop to ensure the crop was grazed at the optimum time. In contrast, another farmer that did not have silage surplus to his autumn and winter requirements but whose cows were in good condition, used cow condition and the sale of known culls to delay the grazing of his crop. In 1995, an extremely dry year, one farmer used a combination of silage he normally used in the autumn, the sale of known culls and once-a-day milking to delay the grazing of his crop. These decisions can be modelled using decision trees (such as Figure 1). Decision rules were found to be surprisingly consistent across farmers despite the large variation in soil type and climatic conditions on each farm.

Conclusion

The results and their apparent agreement with published management recommendations, indicate that it may be possible to develop generic knowledge-based systems to assist dairy farmers manage their herds through the summer-autumn period. The next phase of the research is to investigate the decision making process of a cross-section of farmers.

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REFERENCES

Attonaty, J.; Soler, L. 199 1. Renewing strategic decision-making aids. *European Review of Agricultural Economics* ***18:*** 423–442.

Brazendale, R.; McRae, A.F.; Reid, J.I. 1993. Circumstances of two groups of farmers in contrasting climatic areas of New Zealand-Implications for extension? *Proceedings of the Australia-Pacific Extension Conference, Gold Coast, Australia, 1993.*

Conference and Workshop Series QC93012, pp. 612-615.

Brookes, I.M.; Parker, W. J.; Gray, D.I. 1992. The role of computer software in the feeding of farm livestock. *Proceedings of the New Zealand Society of Animal Production 52:* 11 1-l 14.

Bryant, A.M.; Macdonald, K.A. 1987. Management of the dairy herd during a dry summer. *Proceedings of the Ruakura Farmers' Conference 39: 53-56.*

Campbell, A.G.; Bryant, A.M. 1978. Pasture constraints on dairy production. *Proceedings of the Agronomy Society of New Zealand 8: 115-I* 17.

Cerf, M.; Papy, F.; Aubry, C.; Meynard, J.M. 1994. Agronomic theory and decision tools, pp. 343-355. *In* Systems Studies in Agriculture and Rural Development, J. Brossier and L. De Bonneval, (Eds.); INRA Editions, Versailles Cedex, France.

Du Faur, R. 1981. Dairy Herd Husbandry. Dairy Exporter Books, Ray Richards Publisher, Wellington, New Zealand.

Hill, L.J. 1982. Winter feed planning, pp. 180–182. *In* Dairy Production From Pasture, K.L. Macmillan and V.K. Taufa (Eds.); New Zealand and Australian Societies of Animal Production, Clark and Matheson, Hamilton, New Zealand.

Parker, W.J.; Gray, D.I.; Lockhart, J.C.; Todd, E.A.G. 1993. Drying-off management and the use of management aids on seasonal supply dairy farms. *Proceedings of the New Zealand Society of Animal Production 53:* 127-132.

Ridler, B.J.; Hurley, E.M. 1984. The management policy for Massey University's large herd. *Proceedings of the Ruakura Farmers' Conference 36:* 15– 19.

Simpson, B.M. 1994. Systematic integration of knowledge systems: An under-utilised potential for agricultural development in marginal areas, pp. 599-*602. International Symposium on Systems-Oriented Research in Agriculture and Rural Development,* Montpellier, France 2 1-25 November, 1994.

Todd, E.G.; Gray, D.J.; Kemp, E.A.; Lockhart, J.C.; Parker, W.J. 1993. Using KADS methodology: Expert systems in farm management, pp. 262-265. *The First New Zealand International Two-Stream Conference on Artificial Neural Networks and Expert Systems.* IEEE Computer Society Press, Los Alamos, California, USA.

White, D.H. 1982. Feed budgeting by systems simulation, pp. 178-l 79. *In* Dairy Production From Pasture, K.L. Macmillan and V.K. Taufa (Eds); New Zealand and Australian Societies of Animal Production, Clark and Matheson, Hamilton, New Zealand.

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