WHEN MORE IS MORE – A PRÈCIS!

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Introduction

Fertiliser applications historically have being relatively 'uniform' in rate and type such that soil fertility could be expected to be uniform across the farm. In reality, this is seldom the situation for many reasons including soil type, topography, animal behaviour, paddock history, fertiliser spreading patterns. With current costs of fertiliser relative to farm returns, pasture performance in relation to soil fertility should be maximised as the most economic use of fertiliser dollars. This can be achieved by quantifying the variability of soil fertility across the whole farm, by soil testing all or many more paddocks than usual, so that differential rates of fertiliser/lime can be applied. This will allow either increased productivity in low fertility areas where appropriate and financial savings where less or no fertiliser may be required. In the 2009/2010 dairy season, all the paddocks on Niaruo dairy farm, Eltham, Taranaki were sampled and fertiliser was applied differentially. This paper reports on the pasture production and soil fertility changes between the 2008/2009 and 2009/2010 dairy seasons when the change from uniform application of fertiliser to differential application was instituted.

Method

The aim of this study was to accurately place required nutrients at the paddock scale to achieve a soil nutrient status that, in individual paddocks, did not limit pasture production while at the same time did not exceed requirements.

The study was undertaken on Niaruo dairy farm, a 96.4ha South Taranaki dairy farm, which is split into an 85ha milking platform (flat to rolling) and an 11.4ha heifer area (rolling to steep). When this study was started the farm was producing 90,000kgMS, however this has been increased to 103,000MS in the 2009/10 season, with a production target of 110,000kgMS for the 2010/11 season. The five year production target for the milking platform is 135,000kgMS.

The majority of the farm can be spread by a ground spread vehicle, although 22ha of steeper contour is required to be put on by helicopter. Previous to the undertaking of this study the farm adopted a blanket fertiliser application approach with every paddock getting the same fertiliser type and rate irrespective of its current soil nutrient status. The farm currently uses between 120 and 150 kg N/ha/year.

The project began in the spring of the 2009/10 season by undertaking soil sampling on every paddock. A sampling route was devised from a GPS farm map and loaded into a handheld GPS to allow for continuity in sampling from year to year. Ten soil cores (2.5cm x 7.5cm) were taken per paddock, bagged, and sent to the ARL lab for analysis.

Soil tests results

Given that there is spatial, temporal and laboratory errors associated with reported soil test values in the range of 2-5% for pH; 15-20% for Olsen P; 20-30% for quick test K (QTK) and 20-40% sulphate-S (Edmeades et al. 1985) the results for Niaruo dairy farm were sorted into six 'blocks' based on soil fertility ranges and fertiliser nutrients recommended accordingly (Table 1). The aim was to exploit this variability by applying less than maintenance, maintenance or capital rates of fertiliser nutrients (or lime) where these strategies would provide production and/or financial savings to the farm operation.

Table 1: Fertiliser categories for individual paddock application based on soil test values in 2009/10.

Olsen P	QT K	Fert Mix	Fert Values	Fert Type
<40	>10	Full maintenanceP, No K	50 P,0 K	550kg/ha Super P
<50	>10	Half maintenanceP, No K	25 P, 0 K	275kg/ha Super P
<40	<10	Full maintenance P, Full maintenance K	50 P, 50 K	550kg/ha Super P + 100kg/ha KCl
<50	<10	Half maintenance P, Full maintenance K	25 P, 50 K	275kg/ha Super P + 100kg/ha KCl
>50	<10	No P, Full maintenance K	0 P, 50 K	100kg/ha KCl
N/A	N/A	Heifer maintenance P, Heifer maintenance K	30 P, 35 K	330kg/ha Super P + 50kg/ha KCl
N/A	N/A	No Application	0 P, 0 K	

Individual fertiliser mixes were applied to individual paddocks using a Sanford's twin disc spreader with appropriate GNSS to aid in guidance and nutrient placement. Forty-two paddocks required no P, while 25 paddocks required no K. Three paddocks required P at half maintenance while 3 required full maintenance P and 22 required full maintenance K (Fig. 1).

The area that was required to be applied by helicopter (22ha) was applied as a blanket application under the "Heifer maintenance" category (Table 1).

Pasture production

Individual paddock pasture growth rate data was collected every week using an XP1 Rapid Pasture Meter to compare annual paddock growth rates with current soil nutrient status.

Results and Discussion

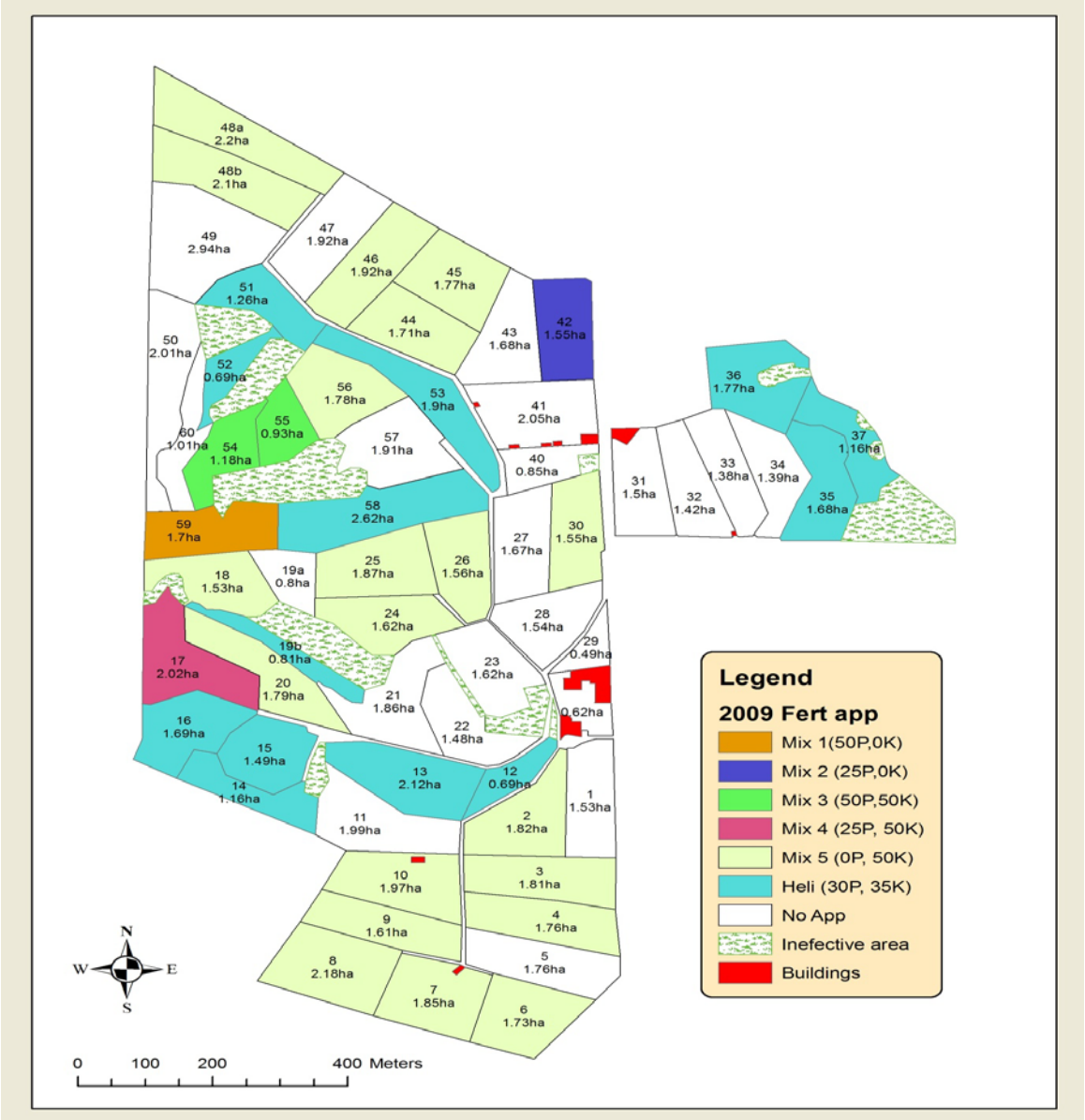
Soils and Fertiliser programme

The median and range for soil pH, Olsen P, QTK and sulphate-S for the farm sampled in the 2009/2010 and 2010/2011 seasons are shown in Table 2.

Table 2: Soil test results for 2009/10 and 2010/11

Soil test	**pH**	**Olsen P**	**QTK**	**Sulphate-S**
2009/10 Average	6.1	65	10	11
Range	5.9-6.5	32-106	5-18	6-17
2010/11 Average	6.3	70	11	15
Range	6.0-6.5	30-115	5-20	5-40

Figure 1: Fertiliser application map for 2009/2010



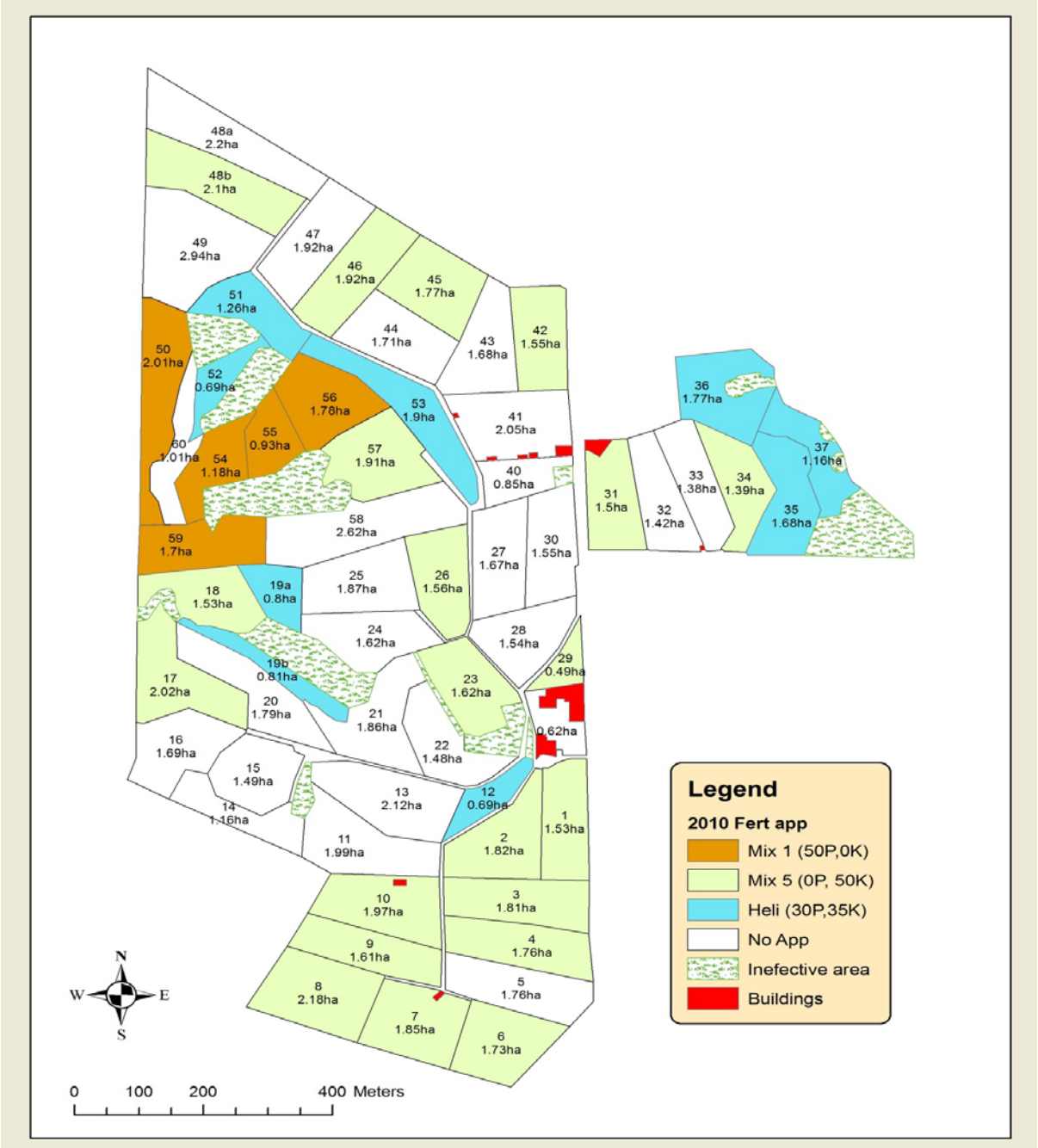
In the 2010/2011 year there has been little change in the overall average and range of fertility status of the paddocks on this farm (Table 2), despite the fact that for a large proportion of the farm receiving either no P or K fertiliser in the last 12 months. In fact, given the current paddock by paddock soil fertility, the fertiliser application plan for this year has been simplified to only 3 fertiliser mixes (Table 3).

Table 3: Fertiliser categories for individual paddock application based on soil test values in 2010/11.

Olsen P	QT K	Fert Mix	Fert Values	Fert Type
<40	>10	Full maintenance P, No K	50 P,0 K	550kg/ha Super P
>50	<10	No P, Full maintenance K	0 P, 50 K	100kg/ha KCl
N/A	N/A	Heifer maintenance P, Heifer maintenance K	30 P, 35 K	330kg/ha Super P + 50kg/ha KCl
>50	>10	No Application	0 P, 0 K	

This year, 44 paddocks on the milking platform required no P fertiliser and 3 required full maintenance P, while 22 paddocks required full maintenance K (Figure 2).

Figure 2: Fertiliser application plan for 2010/2011



Fertiliser Costs

The fertiliser programme prior to the 2008/09 year cost approximately $30000 annually and the change in fertiliser expenditure over the last three dairying years is has been marked, especially as a result of the beginning of the whole farm testing programme instituted in 2009/2010 year (Table 4). Given that milk production on the farm was 90,000 kg MS in 2008/09 and 103,000 kg MS in 2009/10 and targeted for 110000 kg MS in this dairy season, the nutrient use efficiency on this farm had increased 4 fold in the last three seasons (Table 4).

Table 4: Effect of whole farm testing and differential fertiliser application on farm fertiliser costs.

Year	Fertiliser cost	Nutrient Use Efficiency ($/kg MS)
2008/09	$22058*	0.25
2009/10	$10583	0.10
2010/11	~$6500**	~0.6

*Three quarters of what was recommended. Final quarter not applied due to low payout.

**Approximate cost – invoice not yet received.

Pasture Production

Total annual pasture production for the 2008/09 year (before differential fertiliser application) was lower than the total in 2009/2010 (Table 5) which is a reflection of climatic differences between years. Nevertheless, the whole farm pasture production data shows that there was no loss of pasture production caused by applying less fertiliser nutrients (Table 5).

Table 5: Pasture production or the 2008/09 and 2009/10 dairy seasons

	2008/09	2009/10
	Pasture growth (tDM/ha)	**Pasture growth (tDM/ha)**
Mix 1	15.03	14.74
Mix 2	11.43	12.27
Mix 3	12.71	12.40
Mix 4	13.05	13.54
Mix 5	12.52	13.54
Helicopter	12.30	12.65
No Application	12.00	13.63
Overall Average	**12.54**	**13.33**

Concluding Remarks

One of the benefits of bringing all paddocks on a farm up to the same pH and P status, and ensuring that sufficient annual K and S is applied as required is that any constraint to pasture production from major nutrient deficiencies is overcome. In terms of pastoral farming, pasture grown on farm is the cheapest forage available for livestock production. In the case of Niaruo Farm, the process of testing all paddocks and altering the amounts and types of nutrients accordingly has lead to fertiliser expenditure which is approximately only 20% of the cost of the blanket “one rate fits all” approach used prior to 2008/09. This was achieved without compromising pasture production and hence milk production on the farm.

On a cautionary note , evening out the variability in soil fertility across flat to rolling intensive farms may still not mean that all paddocks will produce to the same absolute level because there may be other limitations to pasture growth such as soil physical constraints e.g. differences in drainage, water holding capacity and differences in micro-climates and/or pasture composition.

References

Edmeades, D.C; Cornforth, I.S.; Wheeler, D.M. 1985. Getting maximum benefit from soil testing. New Zealand Fertiliser Journal: 16-17.