Chapter 16
Developing a Fertiliser Management Plan

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16 Developing a Fertiliser Management Plan

16.1 Introduction

The purpose of a fertiliser management plan is to guide soil and fertiliser management decisions across the farm throughout the coming season or year. Fertiliser management plans are used by dairy farmers and farm managers for the following purposes:

- Budgeting for fertiliser expenditure.
- Ordering fertilisers; types/blends, quantities, and delivery dates.
- Applying fertilisers; types/blends, the rates in each paddock/farm management zone (FMZ), and the frequency/timing of applications.
- Targeting use of dairy effluent as a fertiliser.
- Maintaining healthy and productive soils and implementing management recommendations specific to the farm.
- Managing risks to humans, animals and the environment.
- Monitoring, record keeping and reviewing management decisions.
- A communication tool for the management team, farm staff and contractors.

16.2 Components of a Fertiliser Management Plan

There are a number of important components in a Fertiliser Management Plan including the following:

Farm map

Soil characteristics and soil constraints

Soil fertility and trends

Soil health assessment

Crop and pasture condition

Utilising on-farm nutrients

Fertiliser program

Nutrient Budget

Managing risks

16.2.1 Farm Map

Soil and fertiliser management recommendations are specific to individual paddocks, or groups of paddocks known as Farm Management Zones (FMZs). A farm map is used to identify the FMZs, and to discuss soil and fertiliser management decisions with farm staff and contractors. FMZs can be shown by simply highlighting the area directly onto the farm map (See Figure 16.1), using a clear plastic overlay, or by creating a digital shape file using mapping software. Paddocks or FMZs are labelled on the farm map and referred to in the fertiliser program.

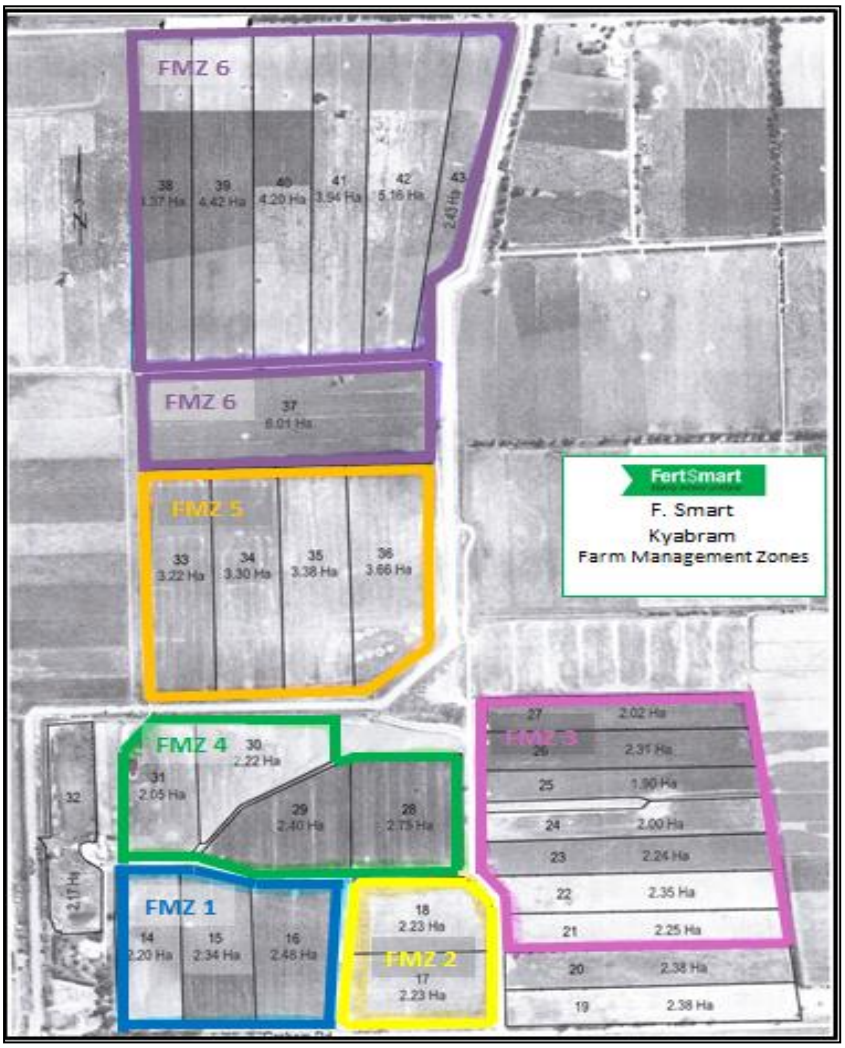

Figure 16.1 Farm map showing farm management zones.
Source: Fert$mart Planning Pilot

Aerial photographs and satellite imagery make ideal bases for additional information including; soil types, fence lines, paddocks and farm infrastructure. Farm maps can be used to calculate paddock areas, and hence the fertiliser quantities required across different parts of the farm. Soil nutrient levels can be represented spatially on farm maps using what is known as nutrient mapping (See Chapter 15.4.2). Nutrient maps provide a snapshot of nutrient levels across the farm and are growing in popularity with farmers and advisors as a nutrient management tool.

16.2.2 Soil Characteristics and Constraints

An important part of nutrient planning is to manage physical and chemical limitations of the soil, also known as soil constraints (See Chapter 7). Soil constraints are present due to the inherent soil characteristics, or as a result of soil and fertiliser management. Management strategies to address limiting soil factors or to improve soil condition should be considered and included in the fertiliser management plan. The following factors have the potential to limit production even when plant nutrients are adequate:

- pH
- Salinity
- Water logging

- Slaking and dispersion
- Soil surface condition
- Soil structure

For more information on soil characteristics and constraints, refer to Chapters 4 to 7.

16.2.3 Soil Fertility and Trends

Current soil fertility levels across the farm are essential to include in a fertiliser management plan. If soil testing records are available, it is also very useful to include soil fertility trends. The key information to include in the plan is as follows:

- Soil test results for each FMZ.
- A visual comparison of the soil fertility status (P, K, S, pH and OC) in each farm management zone, with the optimum level for the specific soils and production system (Figure 16.2). The soil fertility guidelines for the relevant dairy region are used to compare current fertility levels with the optimum levels (generally 95% to 98% of potential production for dairy pastures).

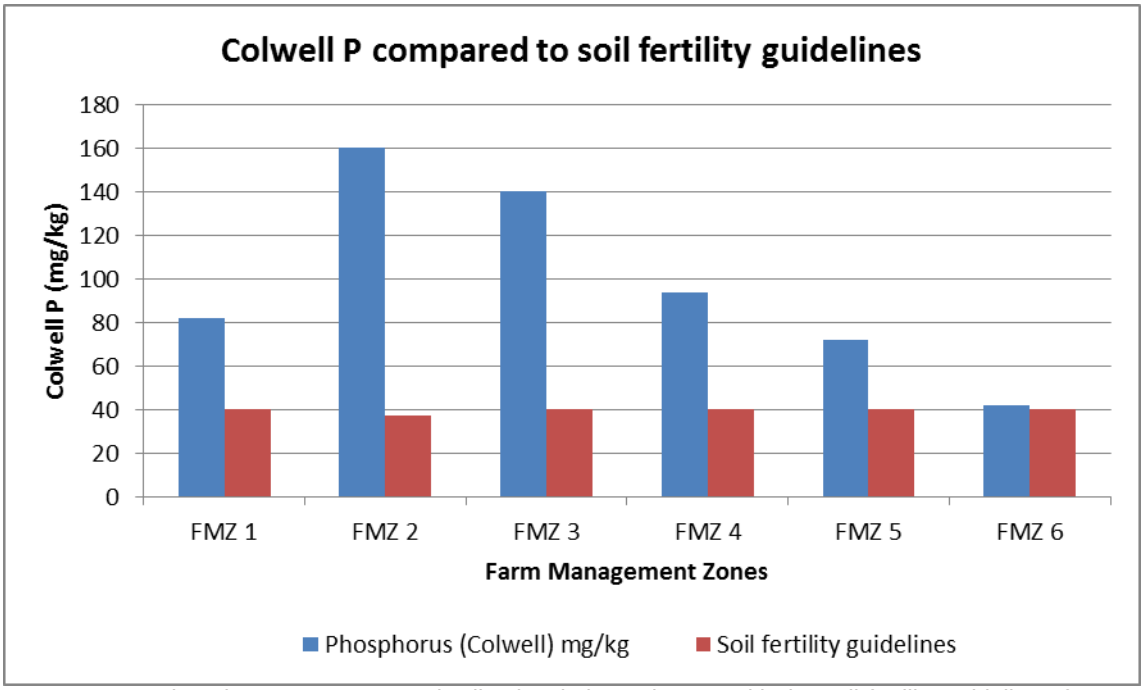

Figure 16.2 A comparison between current Colwell P levels in each FMZ with the soil fertility guidelines for specific soil types (Note: Optimum Colwell P values vary with soil type and PBI).

- Look for trends in the soil fertility status (P, K, S, pH and OC) over time for each FMZ and make comparisons with the optimum level for these soils and the farm production system (e.g. Figure 16.3). Soil fertility trends provide useful feedback on the effectiveness of previous fertiliser management decisions in maintaining soil fertility at the optimum levels and help to refine the fertiliser program. This feedback loop is like having on-farm research to find the optimum fertiliser program for the farm soils and production system.

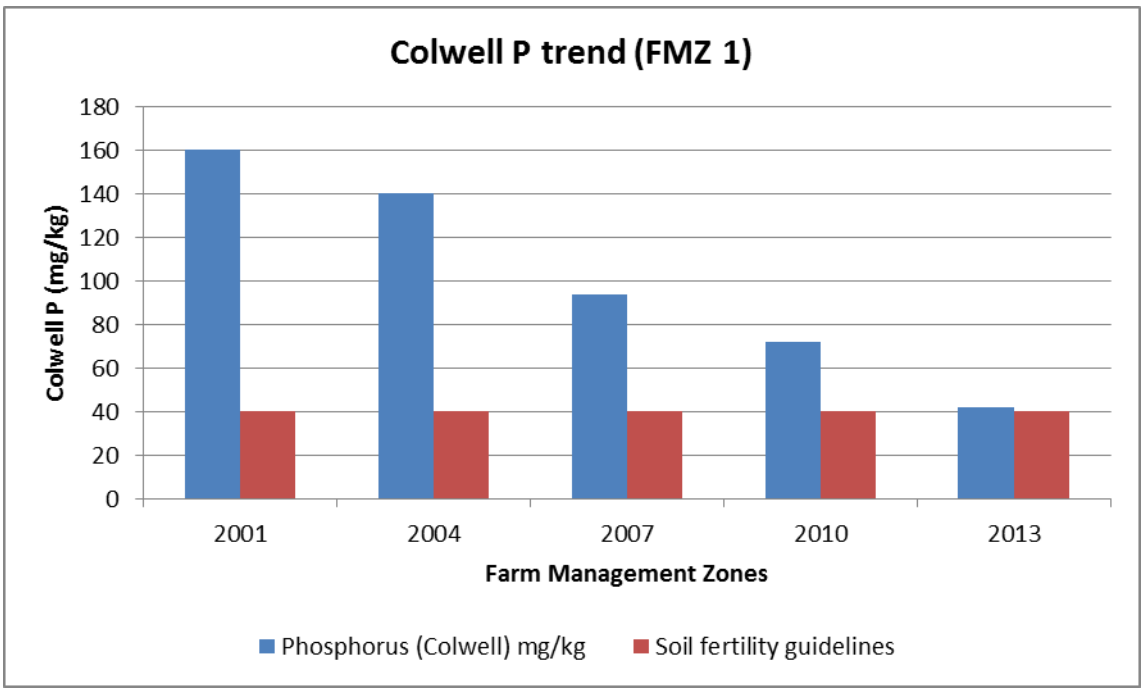

Figure 16.3 Example of Colwell P trends in FMZ 1 between years 2001 and 2013 compared to the soil fertility guidelines for this soil type.

16.2.4 Soil Health

Include a report on the soil health status and how to manage soil health in each FMZ. A soil health assessment is based on field observations and soil test results. Some basic indicators to include are as follows:

- Percentage ground cover or bare ground
- Depth of thatch layer/root mat layer.
- Organic carbon as shown on the soil tests (Walkley and Black test method)
- Fine root development and depth (top 30cm).
- Soil organisms (e.g. earthworms, beetles, fungi).
- Nodule development on legumes.

There are many more indicators that can be used to assess and monitor soil health. For more information refer to Chapter 5.

16.2.5 Crop and pasture condition

Production can be limited by crop and pasture condition (e.g. species, plant population, diseases, pests and weeds). Crops and pastures in good condition and suited for the purpose will use soil nutrients more efficiently than unhealthy and weedy stands. Provide management recommendations to maintain productive crops and pastures. See Chapter 1.1.8 for information on how to assess and manage crop and pasture condition.

16.2.6 Making the most of on-farm nutrients

Appraise the current use of organic fertilisers (including on-farm manure, effluent and compost) and consider cost effective management options to use effluent more strategically in the fertiliser program. To assist with management decisions it is worthwhile discussing the costs and benefits of infrastructure upgrades that result in more efficient use of effluent as a fertiliser. Effluent calculations

can be used to approximate the quantity of nutrients available as a fertiliser, and hence the estimated value of effluent. For more information on using dairy effluent as a fertiliser - See Chapter 13.3.

16.2.7 Fertiliser Program

The fertiliser program is the key guide for fertiliser management decisions in each FMZ throughout the year. The fertiliser program is developed by adhering to the following steps:

1. Identify and briefly state the production system for the farm, then pasture and crop yield targets and pasture consumption targets for each FMZ.
2. Consider the soil fertility and trends in soil fertility (see Section 16.2.3).
3. Use a nutrient budget to determine nutrient removal and accumulation (see Section 16.2.8).
4. Work out the fertiliser program for each farm management zone. At this stage you might start to identify the FMZs with similar requirements.

The fertiliser program follows the 4Rs principles (Right fertiliser source, Right rate, Right place, and Right time) and includes the following detail (see the example in Figure 16.4):

- Fertiliser types (product names and analysis)
- Application rates (kg/ha)
- Application areas (FMZs/ paddocks)
- Timing and frequency of applications (including split applications)
- How the products are applied (e.g. broadcast, banded)

The following links provide information to help in developing a fertiliser program:

Introducing fertilisers (Chapter 11)

Nitrogen fertilisers (Chapter 12)

Calculating rates and costs (Chapter 14)

Nutrient planning (Chapter 15)

Fertiliser Program 2012/2013

Fertiliser products top-dressed unless otherwise indicated using DairySAT BMP (best management practices). Products are based on past use. Discuss all aspects fully with your Fertcare C accredited advisor.

			Fertiliser kg/ha				2012 / 2013	
FMZ		Area	N	P	K	S		Fertiliser Program
1	No 14-16 (Perm't)	7.4	193	13	0	16	Spring Summer Autumn Autumn Winter	2 x 70 kg/ha Urea NPKS 46:0:0:0 Nil 1 x 150 kg/ha Single Super NPKS 0:9:0:11 2 x 70 kg/ha Urea NPKS 46:0:0:0 2 x 70 kg/ha Urea NPKS 46:0:0:0
2	No 17-18 (Perm't)	4.6	161	13	0	16	Spring Summer Autumn Autumn Autumn Winter	2 x 70 kg/ha Urea NPKS 46:0:0:0 Nil Gypsum required. Refer FMZ 2 notes 1 x 150 kg/ha Single Super NPKS 0:9:0:11 2 x 70 kg/ha Urea NPKS 46:0:0:0 1 x 70 kg/ha Urea NPKS 46:0:0:0
3	No 21-27 (Perm't)	16.0	161	0	0	0	Spring Summer Autumn Autumn Winter	2 x 70 kg/ha Urea NPKS 46:0:0:0 Nil Gypsum required. Refer FMZ 3 notes 2 x 70 kg/ha Urea NPKS 46:0:0:0 1 x 70 kg/ha Urea NPKS 46:0:0:0
4	No 28-31 (Perm't)	10.1	129	0	0	0	Spring Summer Autumn Winter	Irrigated with effluent pond liquid * Irrigated with effluent pond liquid * 2 x 70 kg/ha Urea NPKS 46:0:0:0 2 x 70 kg/ha Urea NPKS 46:0:0:0
5	No 33-36 (Perm't)	13.5	129	21	24	27	Spring Summer Autumn Autumn Autumn Winter	1 x 70 kg/ha Urea NPKS 46:0:0:0 Slurry likely to be applied Gypsum required. Refer FMZ 5 notes 1 x 300 kg/ha Super Potash 5:1 NPKS 0:7:8:9 2 x 70 kg/ha Urea NPKS 46:0:0:0 1 x 70 kg/ha Urea NPKS 46:0:0:0
6	No 37-43 (Annual)	32.0	97	35	40	45	Spring Summer Autumn Autumn Autumn Winter	1 x 70 kg/ha Urea NPKS 46:0:0:0 Nil Agricultural lime required. Refer FMZ 6 notes. 1 x 500 kg/ha Super Potash 5:1 NPKS 0:7:8:9 1 x 70 kg/ha Urea NPKS 46:0:0:0 1 x 70 kg/ha Urea NPKS 46:0:0:0

* Effluent pond liquid is applied to FMZ 4, but slurry will be pumped out onto FMZ 6 in summer 2013.

Figure 16.4 Example Fertiliser Program for a dairy farm (Source: Fert$mart Planning Pilot)

16.2.8 Nutrient Budget

It is worthwhile including a farm nutrient budget and discussing what this means to farm nutrients and fertiliser management. The farm nutrient budget is used to work out the total quantities of nutrients that need to be brought onto the farm to replace nutrients exported from the farm in saleable products. The nutrient budget alerts decision makers to situations of soil nutrient rundown or nutrient build-up which can be managed effectively through the fertiliser program (Refer to the farm nutrient budget example in Figure 16.5).

FARM GATE NUTRIENT BUDGET

Milking area is 83.0 ha and stocking rate is 3.3 cows /ha.
As background any pasture silage cut is fed back out on the milking area.
Calculations based on DPI Nutrient Planning guidelines being updated for Fertsmart website.
Stock movements have been relatively constant between years.

	2011/12		
Milk production (litres)	1644672	19815	litres per milking ha (6097 x 3.25)
Total Butterfat (kg)	72703		
Total Protein (kg	56398		
Total MS (kg)	129101	1555	MS kg per milking ha (479 x 3.25)

Nutrient removal *		42 kg N, 10 kg P,& 14 kg K removed per 10,000 litres milk.
Phosphorus soil factor **	25	Moderate PBI with Olsen > 25 mg/kg
Potassium soil factor ***	15	Clay loam soil type

PHOSPHORUS CALCULATIONS

INPUTS:	Per cow	DM %	t DM/cow	SR cows/ha	DM/ha tonne	P kg/tonne	P/ kg/ha
Pellets (484 tonne/DM)			1.79				
Hay (684 tonne/DM)			2.53				
			4.32	3.25	14.04	3.0	42.1
Fertilizer phosphorus inputs (average kg actual P/ha based on milking area)							Nil
						Sub total	42.1

OUTPUTS:	litres/ha	P kg/1000 l	P kg/ha		
Milk *	19815	1.0	19.8		
Soil factor **			25.0		
Dung losses 0.8 x SR			2.6	Sub total	47.4
				Negative P balance	5.3

POTASSIUM CALCULATIONS

INPUTS:	Per cow	DM %	t/ha	SR	DM/ha tonne	K kg/tonne	K/ kg/ha
Pellets (484 tonne/DM)			1.79	3.25	5.8	4	23.2
Hay (684 tonne/DM)			2.53	3.25	8.2	17	139.4
Fertilizer potassium inputs (average kg actual K/ha based on milking area)							Nil
						Sub total	162.6

OUTPUTS:	litres/ha	K kg/1000 l	K kg/ha		
Milk *	19815	1.4	27.7		
Soil factor ***			15.0		
Dung losses 0.8 x SR			2.6	Sub total	45.3
				Positive K balance	117.3

Figure 16.5 Example farm nutrient budget (Source: Fert$mart Planning Pilot).

16.2.8.1 Nutrient Budget Tool

The Ellinbank Paddock Nutrient Calculator and the Ellinbank Farm Nutrient Balance are decision support tools developed to assist farmers and advisers in making better nutrient and fertiliser decisions on dairy farms. It uses specific farm information such as soil type, stock numbers, grazing and soil test results. The Ellinbank Paddock Nutrient Calculator is designed to determine and report on within farm area nutrient movements while considering soil test results while the Ellinbank Farm Nutrient Balance is designed to report on whole farm nutrient balance.

Download Ellinbank Nutrient Budget Calculators

More on nutrient budgets (Chapter 15.6)

16.2.9 Managing Risks

Consider the risks and include recommendations to manage and reduce unacceptable risks associated with fertiliser management. The risk of nutrient loss can be assessed using tools such as the 'Farm Nutrient Loss Index' (FNLI) or 'Cracking the Nutrient Code'. These tools help to identify which farm areas and activities contribute to the highest risk of nutrient loss, and suggest management actions to reduce the potential risk of nutrient loss. Fertilizer Australia also coordinates training courses in managing environmental risks – See the Fertcare Program).

It is also important to include strategies to manage risks to human and animal health associated with fertiliser and effluent use. For more information on managing risks see the following Chapters:

More on minimising losses (Chapter 10.5)

More on using dairy effluent (Chapter 13)

16.3 Documenting the Fertiliser Management Plan

There are many suitable formats for documenting a fertiliser management plan ranging from a printed hard copy to a digital report created by fertiliser planning software. The most important sections for farm management purposes are the fertiliser program and the key farm recommendations.

Dairy farmers involved in the Fert$mart planning pilots said they preferred a concise plan with the farm fertiliser program and key farm management recommendations condensed into the first few pages, followed by more detailed management information for each FMZ. A template, including the components described in Section 16.2, was developed to meet the specific needs of farmers involved in the Fert$mart Pilots and included the following sections:

1. Fertiliser Program
2. Key farm recommendations
3. Farm details
4. Farm management zones
5. Farm nutrient budget
6. Appendix

Examples of fertiliser management plans can be found on the following links:

Fert$mart Plan example 1 (PDF)

Fert$mart Plan example 2 (PDF)

Fert$mart 'Soil and Fertiliser Management Plan' template (Word)