

# USE IT OR LOSE IT: PUT THOSE NUTRIENTS TO WORK

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## Why should I use my nutrients more efficiently?

### Increased Profitability

- More efficient use of fertiliser inputs
- More effective use of effluent as a nutrient source
- Improved farm performance
- Impact on land value
- Strategic growth of the business

### Environmental protection

- Be a responsible steward of the land
- Reduce nutrient loads to waterways
- Protect groundwater drinking water quality
- Leave the farm in good shape for future generations

## What is the industry vision?

The NZ dairy industry has expanded rapidly over the past few decades. Cow numbers and production have increased, and general trends show us that environmental footprint has also increased, especially when talking about N loss). The NZ dairy industry has a challenge ahead. On one hand we want to grow milk production and improve farm profitability, while on the other hand we want to reduce or maintain our environmental footprint. One way to do that is through improving nutrient use efficiency. That is, using N and P inputs productively to grow feed and produce milk while minimising losses from the system.

## Why are Nitrogen (N) and Phosphorus (P) important?

The addition of nutrients and healthy, fertile soil is important to maintain or improve farm productivity. However the mismanagement of nutrients can have adverse affects, both on farm profitability and the environment. Nitrogen and phosphorus are the basis for discussion in this paper because they are nutrients that are essential for plant growth and function, as well as being the subject of much attention when it comes to water quality. It is important to note that other nutrients such as potassium, sulphur, and trace elements are also important for plant growth.

A proportion of the N entering soils from dairy farms may end up leaching through the soil into ground water. An increase in N concentration in groundwater generally happens slowly and may not be noticed for some time, but once groundwater is polluted it is very difficult to

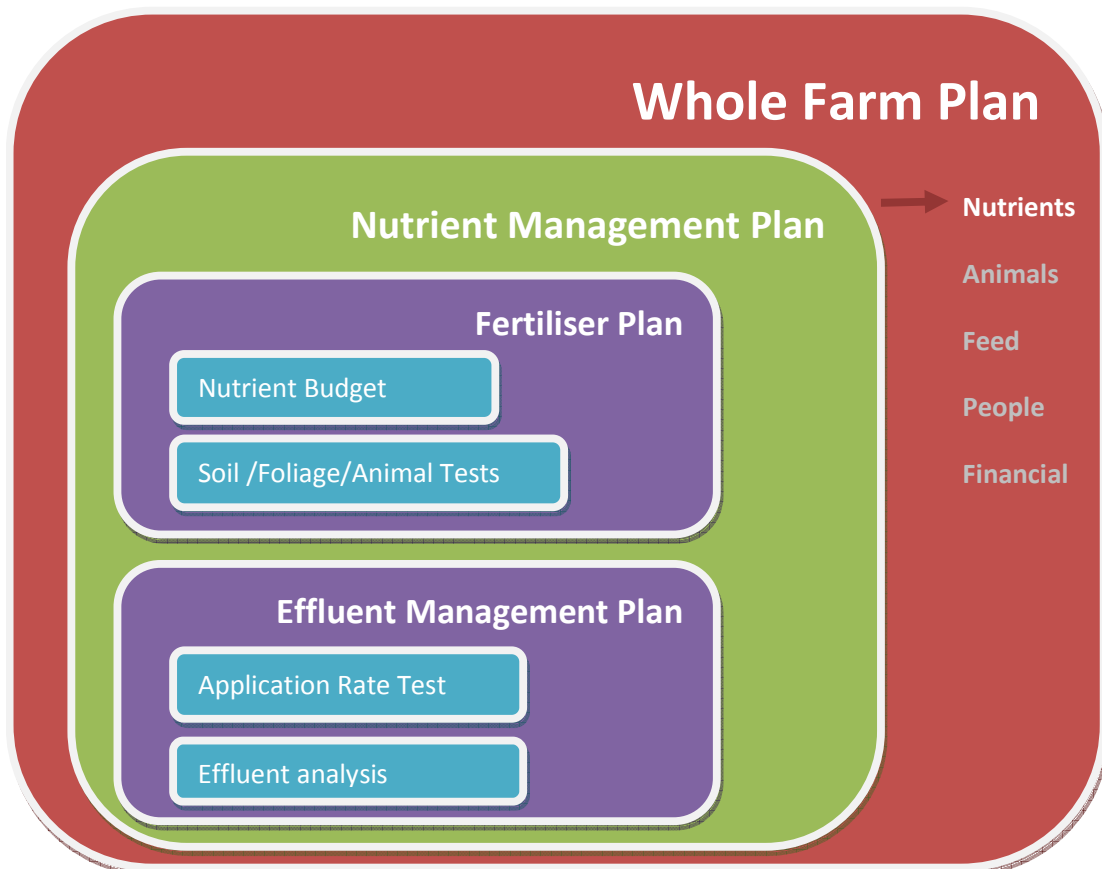
clean up. In soil, P behaves very differently to N. Almost all the P that does not go off the farm in product is held by the soil. P doesn't readily leach into ground water, but when soil is washed into streams and rivers it carries with it precious P supplies via soil erosion and surface runoff.

The loss of P and N into waterways will support weed and algae growth, effecting stream life and making water unpleasant for drinking and swimming.

## What is an NMP and how would a farmer use it to improve nutrient use efficiency?

### *What is an NMP?*

A nutrient management plan identifies current farm nutrient management practice, outlines goals for the future and sets out an action plan for reaching these goals. The nutrient budget within the nutrient management plan outlines total nutrient inputs such as fertiliser and supplements brought onto a farm, and total nutrient outputs via milk produced and leaching losses. This helps assess the environmental impact of nutrient use on the farm and assists with decisions such as timing of fertiliser applications, effluent management, and potential mitigation actions to reduce nutrient losses.



### ***Where do I get one?***

Your fertiliser representative or farm advisor should be able to provide you with an NMP.

### ***How do I go about understanding and using it?***

In the same way that a cash flow budget will not solve money problems, the NMP itself will not make your farm more efficient. It is only a tool to help you make decisions. It is the decision making processes and acting on this information that will provide the most value. Without your thought and action the NMP is useless.

There are some simple pieces of information that may be useful in assisting your thought processes and actions to become more efficient. These include soil test trends over time, effluent block information and a fertiliser plan.

### ***Indicators of nutrient use efficiency***

There are some numbers you can look at to see how well you are doing at utilising your nutrients. These can be found in your NMP and include:

- N conversion efficiency (%): An indication of your farms efficiency at converting N inputs into N contained in product (milk & meat). Average NZ farms range from 25-40%.
- N leaching loss (kg N/ha/yr): Modelled estimate of the amount nitrogen leached and lost from the farm from soil and drainage water below the plant root system. Average NZ farms range from 30-50 kg N/ha/year.
- N Surplus (kg N/ha/yr): Estimate of the amount of nitrogen excess in the farm system. Calculated as Total N inputs – N in Product. Average NZ farms range from 100-180 kg N/ha/year.
- P loss (kg P/ha/yr): Estimate of the amount of P lost from the farm via surface runoff. Average NZ farms range from 0.5-0.8 kg P/ha/year.

### **Improving nutrient use efficiency**

It is important to understand that most things you do to improve the efficiency of converting farm inputs into milk, for example having more efficient cows, will help improve your nutrient use efficiency. This paper however focuses on the parts of the farm system relating specifically to nutrients.

Of course, improved profitability should also be achieved alongside improving nutrient use efficiency. It makes sense that putting more nutrients into product and losing less from leaching also has benefits for the bank balance. Doing the numbers in terms of weighing up the costs and benefits of strategies to improve nutrient use efficiency is important.

There are some basic things you can do to improve nutrient use efficiency. These should be considered in your NMP and include:

### **1. Keep effluent nutrients in the root zone**

Applying the right amount of effluent at the right time will ensure the nutrients in effluent are kept and utilised in the root zone.

#### *Examples:*

Alan and Alison Grant are growing their Mid Canterbury irrigated dairy conversion property and want to do so in a sustainable way. They upgraded their effluent system voluntarily to ensure future compliance and to make the most out of effluent nutrients. The system went from applying effluent via travelling irrigators applying 16 mm, to applying via the centre pivot at 8 mm. Two large lined ponds were installed (1650 m<sup>3</sup> and 2250 m<sup>3</sup>) and the effluent block was extended from 92 ha to 135 ha. These changes resulted in N conversion efficiency of 35% and N losses of 26 kg N/ha/year. Fertiliser inputs on the effluent block were reduced and significant savings made.

Dipton farmers Chris and Charleen Withy recently completed a sheep to dairy conversion, and had the advantage of starting from scratch with their effluent system. They installed a weeping wall to separate solids, built a large storage pond, and have replaced the travelling irrigator system with a low application rate system using Irripods. The farm N conversion efficiency is 40% and N loss is 11 kg N/ha/year.

### **2. Optimise soil fertility**

Making sure your soil fertility levels are in the target range for optimum plant growth, and applying fertiliser only where necessary to keep them there.

#### *Examples:*

Willy and Jeanet Leferink wanted to optimise soil fertility in a profitable way on their farm in Mid Canterbury. All paddock soil testing showed that the Olsen P ranged from 16 on some paddocks to 37 on others, along with quite a range in pH between paddocks. This allowed

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Notes:

them to apply P and lime only to paddocks that need it, and to ensure they are getting optimum growth from every paddock. The farm also moved away from a heavy reliance on artificial N, going from historical application rates of around 300 kg N/ha to 143 kg N/ha in the 09/10 season. This saved thousands in fertiliser and with no losses in pasture performance. The farm N conversion efficiency is 37% and N leaching loss is 29 kg N/ha/year.

Waikato farmers John and Jill Bluett wanted to understand more about nutrient management after experiencing bloat and milk fever problems from high K levels. They used their nutrient budget to identify changes in inorganic soil pool status. Fertiliser application are now tailored to get nutrients within target soil test ranges, including mining their soil Olsen P levels from 67 to 38 over 3 years by applying less P fertiliser. They also consider the form of fertiliser N applied at different times of the year to minimise losses, and grow maize silage on the effluent block to utilise excess K and capture N leached below the pasture rooting zone. The farm N conversion efficiency is 41 %, N leaching loss is 22 kg N/ha/year and soil P loss risk has changed from extreme to low.

### **3. *Smart N application***

Smart N application is about applying the right amount of N at the right time based on regular feed planning. The N decision tree can help (see figure 1 on page 260).

### **4. *Use mitigation options***

There are other practices and technologies to consider for further improving nutrient efficiency. Some of these require significant capital expenditure should be considered in conjunction with cost-benefit analysis. Your farm advisor should be able to help you with looking at your options. These include:

- Standoff and feed pads
- Winter management
- Nitrification inhibitors
- Impact of irrigation practices on N and P loss

#### *Examples:*

Wyndham couple Alan and Julie Maxwell found ways to improve profitability while reducing nutrient losses, by fine tuning their wintering system. Wintering cows in Southland is no easy feat, and this can be a difficult time of year for cows, people and the environment. This led the Maxwell's to develop a system where they have a large concrete pad for a self-feeding silage stack, with a larger wood chipped cow loafing and bedding area. The liquid and solid effluent is then captured in separate ponds and stored until weather conditions are suitable for

land application. The N loss from this system is only 21 kg N/ha, as well as providing a cost effective wintering system that is easy on staff and cows.

Stephen and Rhonda Kortweg faced the challenges of wintering on a high water table in the Clutha River delta. Climatic conditions meant that there were large yield variations for winter crops, feed utilisation was a problem, and there were challenges with damage to soil structure and animal welfare. This led the couple to build two 60 m herd homes to house 400 cows over the winter period. The result was a reduction in wintering feed costs (feeding grass silage instead of home grown forage crop equals \$0.12/kg DM vs \$0.21 kg DM), better utilisation of feed, cows in better condition, reduced soil damage, better pasture growth in spring and a 50% reduction in fertiliser inputs (from \$0.34 c to \$0.17 per kg MS). Deferred irrigation of winter manure and effluent helps achieve an N conversion efficiency of 32 %, N loss of 15 kg N/ha/year and P loss of 0.4 kg P/year.

For more information on these and other case studies visit the nutrient management section of the DairyNZ website ([www.dairynz.co.nz](http://www.dairynz.co.nz)).

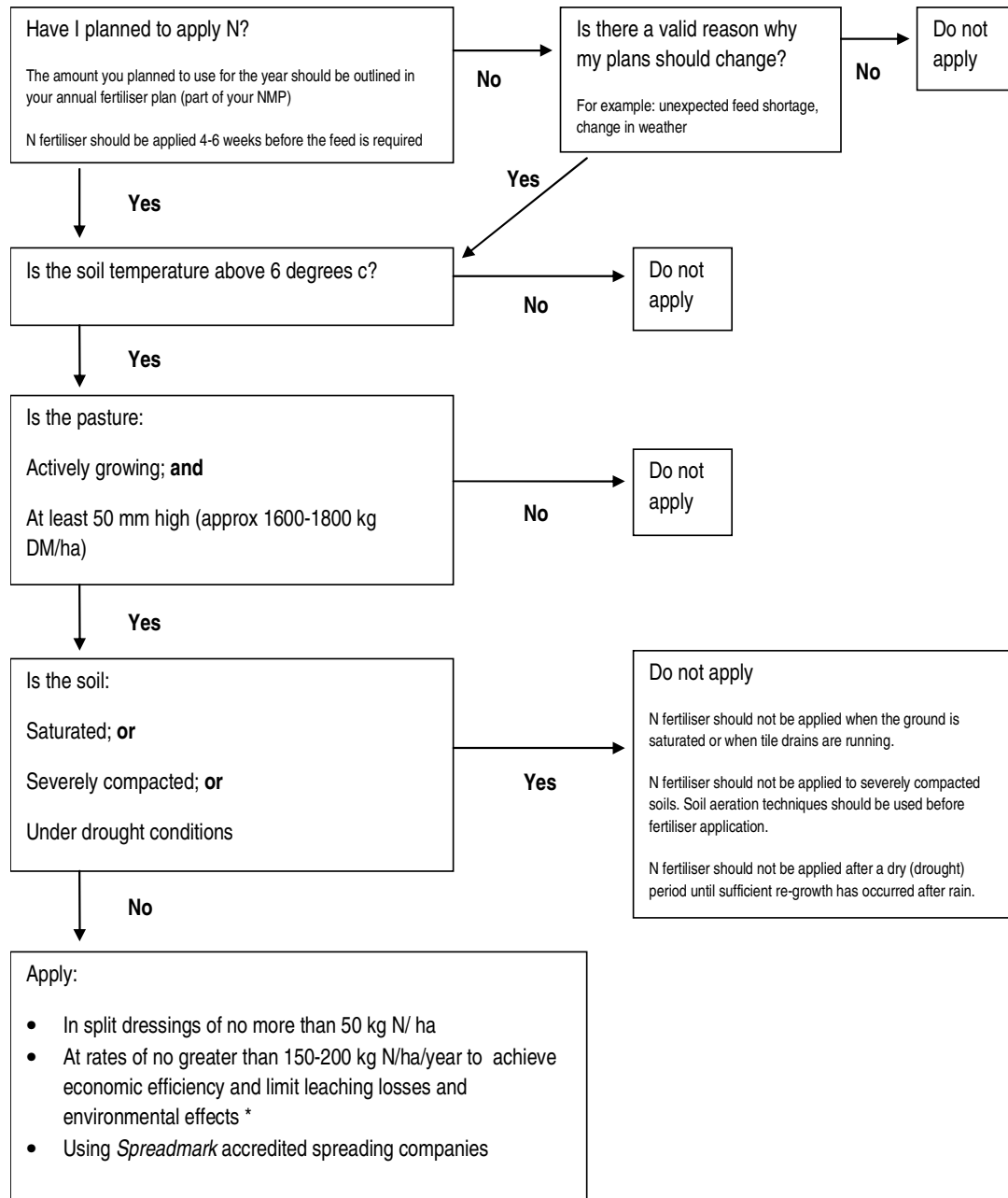
## **Acknowledgements**

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Thank you also to the case study farmers for their participation and valuable input.

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Notes:



\* Total N fertiliser applications of 200 kg N/ha/year or more should only be implemented after referring to the Code of Practice for Nutrient Management (New Zealand Fertiliser Manufacturers' Research Association Inc, 2007) and obtaining the advice of an accredited farm advisor. This may also be restricted in some regions, so check your Regional Council rules first.

The above recommendations are outlined in the Code of Practice for Nutrient Management (New Zealand Fertiliser Manufacturers' Research Association Inc, 2007).

**Figure 1.** Decision Tree for Nitrogen Application