Wise Use of N-Fertiliser on Hill Country

What is the OVERSEER® Nutrient Budget Programme (Part Two)?

Frequently Asked Questions

What is a Nutrient Budget?

- Nutrient budgets or balances are (along with soil test trend monitoring, past fertiliser history and farmer experience and objectives), a valuable tool to help fine-tune the farm fertiliser policy.
- Nutrient balances are indicators of the long-term sustainability of farm systems. They indicate where inputs of nutrients are inadequate relative to outputs, thereby leading to a decline in the soil nutrient status. Conversely, they can indicate where excessive inputs result in nutrient surplus and give an estimate of potential nutrient losses to the environment.
- Nutrient budgets also provide a method for comparing nutrient flows associated with different management practices on a farm.
- Fertiliser nutrients represent an important resource input on farms. High efficiency of nutrient use through conversion into agricultural produce is beneficial for profitable production and to reduce the nutrient surplus or potential for loss into the environment. Nutrient output in produce, as a proportion of total nutrient inputs, is an index of nutrient use efficiency and can be calculated using OVERSEER® Nutrient Budget 2 software.
- Nutrient budgets are also useful to benchmark farms in New Zealand with those in overseas countries that we trade with or compete against.
- The pastoral component of OVERSEER® Nutrient Budgets 2 was developed for New Zealand farm systems by AgResearch with funding from MAFPolicy and FertResearch. It provides average estimates of the fate of the nutrients nitrogen (N), phosphorus (P), potassium (K), sulphur (S), calcium (Ca), magnesium (Mg), sodium (Na) in kg/ha/year as well as hydrogen ions (H+), for different nutrient inputs and management practices (e.g., stocking rate, supplementary feed inputs).

- Leaching of nutrients below the root zone is estimated, including potential nitrate leaching to groundwater. Loss of phosphate from soil, fertiliser and effluent blocks is also estimated. This aspect of the model makes it a valuable tool for assessing the effects of different farm prac-

tices in relation to requirements of Regional Councils to assist in maintaining quality in at risk water bodies.

- It is a long term annual time step model intended for farm systems which have been stable through time, and because of this the OVERSEER estimates may not correlate exactly with measured data e.g., nitrate leaching in any one year.

How Do You Use the Information a Nutrient Budget Gives You?

A whole farm nutrient budget lists all nutrient inputs and outputs and shows the balance or "Change in the inorganic soil pool" as the bottom line (Figure 1). This change could be positive, negative or zero for each nutrient. If the requirement is to lift soil fertility then the change must be positive, while if soil fertility is higher than deemed desirable then the balance could be negative.

Figure 1: Whole Farm Nutrient Budget

(kg/ha/yr)	N	P	K	S	Ca	Mg	Na	H*
Inputs								
Fertiliser	65	20	0	3	2	0	0	-0.6
Effluent added	0	0	0	0	0	0	0	0.0
Atmospheric / clover N	36	0	4	8	6	14	90	0.0
Irrigation	0	0	0	0	0	0	0	0.0
Slow release	0	3	18	6	2	3	3	0.0
Supplements	0	0	0	0	0	0	0	0.0
Outputs								
Product	9	1	0	1	2	0	0	-0.2
Transfer	0	0	0	0	0	0	0	0.0
Supplements sold	0	0	0	0	0	0	0	0.0
Atmospheric	24	0	0	0	0	0	0	-0.2
Leaching/runoff	14	1	29	18	37	5	36	-0.8
Immobilisation/absorption	54	13	0	0	0	0	0	-0.3
Change in inorganic soil pool	0	8	-7	-2	-29	11	57	0.9

* acidity (affects lime requirements)

In the opposite example (Figure 1) for a large sheep and beef property close to the west coast of the North Island, P, Mg and Na are accumulating (positive balance) while K, S and Ca are declining (negative balance).

The N balance will always be at or near zero because the N that is not removed in product, lost as gases to the atmosphere or immobilised in the soil organic matter, will be lost as leaching.

Depending on soil test levels for each of the above nutrients a fertiliser management decision could be made. For example, on this farm the soil Olsen P is at or near the economic optimum of 21-23. Therefore it is not necessary to have a P 'surplus' of 8 kg P/ha which will keep the Olsen P level rising by approximately 1 unit per year. The positive value for H+ ions means that the soil is slowly acidifying and requires maintenance lime.

Environmental Impacts

On this farm, different rates of N fertiliser are applied depending on stocking rates/feed demand of different areas. This affects the N leaching losses between blocks (Figure 2).

Estimated N leaching loss for the whole farm is 14 kg N/ha which is typical of many sheep and beef farms. How

ever, due to the different amounts of N fertiliser applied to different blocks, the N leached is different for each block (Figure 2).

Regional Councils must identify sensitive catchments or water bodies and define what is acceptable in terms of N leaching losses, so that appropriate farm management practices may be used to reduce these where required.

Figure 2: Estimated N losses for the farm and separate blocks within a farm

	N in drainage* (ppm)	N leached (kg N/ha/yr)	N surplus (kg N/ha/yr)	Added N (kg N/ha/yr)
Overall farm	na	14	93	
Block name				
Urea Trial	na	28	200	200
Early Block	na	21	147	121
Super Block	na	13	65	0
Rest of Farm	na	10	67	20
Native Bush	na	2	2	0

Most farmers know that the increased use of most nitrogenous fertilisers will also contribute to the process of on-going annual soil acidification which occurs through normal pastoral farming. OVERSEER Nutrient Budgets 2 estimates the amount of lime that is required to counter the annual soil acidification for each block. In the above example farm, the Super Block (no N fertiliser) requires 70 kg good quality lime/ha, while the Urea Trial Block (200 kg N/ha) will require 160 kg lime/ha to maintain soil pH.

P losses are also estimated in the nutrient budget and for the whole farm are just less than 1 kg P/ha annually (Figure 3). While this is trivial in an agronomic sense, in sensitive water bodies this is more than enough P to cause nuisance weed and algal growth.

Figure 3: Estimated P losses for the farm and separate blocks within a farm

	P loss indices				P Lost
	Soil	Fertiliser	Effluent	Overall	(kg P/ha/yr)
Overall farm (pasture)	Medium	High	n/a	Low	0.9
Block name					
Urea Trial	Medium	High**	n/a	Medium	1.3
Early Block	Medium	High**	n/a	Medium	1.2
Super Block	Medium	Medium**	n/a	Medium	1.0
Rest of Farm	Medium	High**	n/a	Medium	1.1
Native Bush	Low	n/a	n/a	Low	0.0

This farm is easy hill country hence the P losses associated with the soil (as sediment running off) are medium. The fertiliser P losses are high on three of the blocks because DAP was applied in August (to make use of the N) and soluble P fertilisers may contribute directly to P losses in runoff generated by winter/spring rain falling on wet soils.

Summary

Nutrient management on farm is becoming increasingly important from a farm input efficiency point of view with farmers facing input cost rises greater than increases in product returns. A second and equally compelling driver for nutrient management is coming from international and domestic societal pressures which make diffuse source pollution from pastoral farms unacceptable, particularly as it applies to water quality. Nutrient budgeting is one of a number of powerful tools to assist farmers in making management decisions to help meet these two important drivers.