

Minimizing nitrogen losses in drainage at a farm scale.

Goals:

- Adhere to established Best Practices for Effluent and Fertiliser Management:
 - Application rates, timing, frequency, etc (Table 1).
- Ensure farm N inputs and outputs are in balance.
- Ensure that N is uniformly distributed around the farm.
- Determine if N losses in drainage are acceptable. Implement appropriate BMPs (Table 2) if N leaching reductions are required.

Step 1:

Complete a nutrient budget that documents all of the N inputs to (and outputs from) the farm, and assigns them to relevant blocks. A Southland dairy farm should have at least 2 blocks (effluent and non-effluent areas). Additional blocks may need to be added if contrasting soil types are present (e.g. freely- versus poorly-drained soil types). Ensure fertiliser and effluent management practices adhere to the Best Practices documented in Table 1.

Step 2:

Using this nutrient budget, ensure that N inputs are uniformly distributed around the farm. At this stage the goal is to ensure that N fertiliser inputs to effluent blocks are adjusted (i.e. decreased) to account for N returns in farm dairy effluent.

Step 3:

Determine if N losses in farm drainage are acceptable. If groundwater protection is the main objective/concern, the usual benchmark is to ensure that nitrate concentrations in farm drainage are less than 11 mg NO₃-N/L.

Step 4:

Implement appropriate BMPs (Table 2) if reductions in nitrate leaching are required. The cost-effectiveness data in Table 3 can be used as a guide to prioritise BMPs, thus ensuring farmers get the biggest “bang for their bucks”.

Table 1. Established BMPs for minimizing N losses in farm drainage

Mitigation measure	Cost \$/cow/year
1. BMPs targeting Farm Dairy Effluent (FDE) management:	
1a. Ensure N inputs (excluding clover) to the effluent block do not exceed 150 kg N/ha/yr	Nil (savings usually incurred)
1b. For soils that have much preferential flow (e.g. mole-tile drained soils) or low infiltration, ensure FDE application depths are less than Soil Water Deficits:	
• Apply as small a depth as possible by adjusting the irrigator to its fastest groundspeed setting.	1.3
• Pond storage provision (10 weeks)	7
• Apply effluent via a low rate sprinkler irrigation system such as K-Line.	3
2. BMPs that target the whole farm:	
2a. Avoid applying N fertiliser when soil temperatures are less than 5oC (spring) or 7oC (late autumn)	Nil
2b. Keep individual applications of N fertiliser to less than 50 kg N/ha.	Nil
2c. Adjust N fertiliser inputs to account for other farm N inputs such as those imported to the farm via supplemental feed.	Nil
2d. Avoid late summer or autumn cultivation of pastures. Cultivated soils can leak a lot of N to drainage water as soil organic matter breaks down, particularly if soils are left fallow over winter.	Nil

Table 2. Additional management systems for minimizing N losses in drainage from dairy farms.

Mitigation measure	Reduction in N leaching %	Cost \$/cow/year
Nitrification inhibitors	9	-40
Wintering cows out of sensitive catchments ^a	52	0
Wintering pads	39	-13
Restricted autumn grazing ^b	63	9
Change to a low input system (nil N fertiliser use)	26	67
Change to low N feed supplements	11	40
Change landuse to dry stock farming	76	79

^aN.B. this strategy transfers the winter N leaching component to somewhere else (but hopefully a less N-sensitive catchment/area).

^bthis management system assumes that cows are also wintered on a pad.

Table 3. The cost-effectiveness (\$ cost per kg of conserved N) of a range of N management systems for Southland dairy farms. Negative values indicate an increase in farm profit.

N management system	Cost
	\$/kg conserved N
Nitrification inhibitors	-45
Wintering cows out of sensitive catchments	0
Wintering pads	-2
Restricted autumn grazing	1
Change to a low input system (nil N fertiliser use)	16
Change to low N feed supplements	41
Change landuse to dry stock farming	11

Summary

- Nutrient budget analysis and adherence to established Best Practices for fertiliser and effluent management are the most cost-effective measures to take in the first instance.
- Where further N reductions are sought from a particular farm, there are a range of improved N management systems available to farm businesses.
- Although still in the early stages of field research, nitrification inhibitors and restricted grazing systems (i.e. restricted autumn and winter grazing management) appear to be cost effective options for reducing N leaching losses from dairy farms.
- From business and cost-effectiveness perspectives, the least attractive N management option is to change landuse from dairy to drystock (sheep-beef) farming.