NITROGEN MITIGATIONS STOCKTAKE

Dave Houlbrooke, **Stewart Ledgard,**
Ross Monaghan

agresearch

NITROGEN MITIGATIONS

Table 1. *Summary of the key 'efficiency' or 'reduced nitrogen loss risk' measures for grazed pastoral dairy systems*

Aim	Potential options
More milk per cow or per unit DM intake	• Higher genetic merit animals • Lower cow replacement rate • Better feeding to improve body condition score at the start of calving • Better quality pasture/crops/supplements (optimizing protein & metabolizable energy contents)
More DM per unit of N input	• Mop-up crop during fallow period • Improved fertilizer and manure management • Exploit spatial and temporal variability in pasture N response
Reduce N loss risk	• Nitrification and Urease Inhibitors • Restricted grazing to avoid urine deposition at high risk times • Improved irrigation efficiency to minimize over-watering • Exploit spatial and temporal variability in N losses (especially N_2O)
Edge-of-field capture	• Riparian buffers • Wetland attenuation • Denitrification walls

R. M. MONAGHAN* AND C. A. M. DE KLEIN. 2014 NITROGEN WORKSHOP SPECIAL ISSUE PAPER. Integration of measures to mitigate reactive nitrogen losses to the environment from grazed pastoral dairy systems. Journal of Agricultural Science

agresearch

from Ledgard Evidence at Horizon's hearing & FarmFacts

Management Area	Actions	Relative reduction in N loss*	Economics**
Soil	Apply DCD in autumn/winter. Effectiveness varies with winter temperature and rainfall	M	- to +
	Protect, or encourage the development of natural wetlands	L-M	0 to -
	Put in artificial wetland – highly site dependent	L-M	--
	Reduce soil erosion, including riparian planting	L	- to +
Fertiliser	Avoid or reduce N use over winter (particularly in cool regions)	L	0 to +
	Use more frequent low N rates (e.g. not more than 30 kg N/ha/application)	L	- to +
	Cease or greatly reduce annual N use	H	- to --
Effluent	Apply FDE to larger area and apply less N fertiliser	L-M	0 to +
	Avoid ponding/ runoff and loss from wet soils	L-M	0 to +
	If discharging to waterway from a two pond system, consider an upgrade to land application	L-M	Probably positive if capital costs are spread over time, balanced with $ benefit from effluent nutrients

* **Reduction in N loss:** L = low; M = medium; H = high

** **Economics:** ++ = very profitable; + or - = slightly profitable or costly; 0 = cost neutral; -- = very costly

from Ledgard Evidence at Horizon's hearing & FarmFacts

Management Area	Options	Relative reduction in N loss*	Economics**
Animal shelters, feed and stand-off pads	Avoid/reduce excreta on pasture in winter and/or autumn. Collect effluent and apply as per guidelines	M-H	- to +
Winter cows off-farm	Wintering cows off-farm. System changes required to cover costs. Transfers N loss to other areas	H	+ to ++
Management	Reduce stocking rate and increase per-cow production	L	+
	Change brought-in feed to low protein source (e.g. maize silage)	L	- to +
Waterways	Keep stock out of waterways using fencing, bridges and culverts	L	- to +
	Create riparian or buffer strips in near-stream areas to trap sediment, particularly when winter grazing forage crops	L	-
Winter crops	Minimise cropping and change to nil or reduced cultivation. Use soil N tests to optimise N fertiliser rates	H (for cropped area)	- to +

* **Reduction in N loss:** L = low; M = medium; H = high

** **Economics:** ++ = very profitable; + or - = slightly profitable or costly; 0 = cost neutral; -- = very costly

Menu

Practices to improve water quality

Dairy farms

DairyNZ

Healthy Farms Healthy Rivers
ACTIONS FOR CHANGE

Waikato Regional Council

This menu has been developed by Waikato Regional Council and the Upper Waikato Primary Sector Partnership, a group of representatives from all agricultural industry organisations working in the Upper Waikato catchment. The group aims to work together to help farmers improve nutrient efficiency and reduce losses.

Proudly supported by:

DairyNZ

Fonterra
Dairy for life

Federated Farmers of New Zealand
Waikato

Federated Farmers of New Zealand
Rotorua | Taupo

AgFirst

agri-nutrients Ballance

Headlands
minimal footprint - optimal profit

FAR

beef+lamb new zealand

Thank you for technical input from:

Ross Abercrombie, Don Harford, Blair Keenan, Alan Campbell, Jackie Fitchman and Angela Davies, Waikato Regional Council with technical writing assistance from Ange Bryant

Mike Scarsbrook, Adrian Brocksopp and Chris Glassey, DairyNZ

Richard Allen, Fonterra

Erica van Reenen, Beef + Lamb New Zealand

Diana Mathers and Mike Parker, the Foundation for Arable Research

Aaron Stafford and Ian Power, Ballance Agri-Nutrients

James Houghton, Paul Le Miere, Chris Lewis and Chris Irons, Federated Farmers Waikato and Bryan Osbourne, Federated Farmers Rotorua-Taupo

James Allen and Kate Ody, AgFirst Waikato

Alison Dewes, Headlands

Thank you to the farmers of the Waikato for their involvement in this menu.

Peer reviewed by Bob Wilcock, NIWA

May 2013

Water quality benefits

To help determine the most effective water quality improvement practices for an individual farm, each practice's likely water quality benefits are rated. The ratings are based on latest research and indicate likely effectiveness in reducing the amount of nitrogen (N), phosphorus (P), sediment and micro-organisms entering waterways.

Topography and management regimes vary from farm to farm, as does the need for and effectiveness of each practice listed. The ratings are an indicative best estimate and assume generally accepted industry good practice is followed.

Likely water quality benefits: estimated reduction (at whole farm scale) in contaminant reaching waterways

	Nitrogen (N)	Phosphorus (P)	Sediment	Micro-organisms
Low L	Less than 10%	Less than 20%		
Medium M	From 10 to 25%	From 20 to 50%		
High H	More than 25%	More than 50%		

Farm business impacts

Each practice's potential cost and economic benefit to the farm business are also rated. Individual farm circumstances will influence costs and benefits. However, the menu can help you identify a short list of practices for the farm management team and consultant to consider in more detail. Many of the practices' cost ratings are different to their benefit ratings. For example, a low cost practice may provide a high farm benefit. Also, some of the benefits may take some time to be realised.

Potential impact on farm business

	Cost	Benefit
Low $	Limited input of farmer time and expenditure. Limited practice change required.	Little change to farm profit as a result of this practice, or may require small changes to farm infrastructure.
Medium $$	Moderate input of farmer time and expenditure. Some practice change required.	Practice likely to result in a small increase in profitability or improved management.
High $$$	Significant input of farmer time and significant expenditure. Significant practice change required.	Very profitable practice or results in improved management e.g. large reduction in farm operational costs.

Tell us what you think and register for updates

This menu reflects current knowledge and future editions will be produced as knowledge develops. We value your feedback, so if you have any concerns or suggestions, please contact a Waikato Regional Council Agricultural Advisor on freephone 0800 800 401 or info@waikatoregion.govt.nz.
To automatically receive future editions of this menu, please register at www.waikatoregion.govt.nz/menus.

Dairy farms

Management area	On farm practice	Likely water quality benefit				Potential impact on farm business		Factors to consider
		N	P	Sediment	Micro-organisms	Cost	Benefit	
Whole farm planning	Whole farm business and systems analysis	Whole farm analysis will identify water quality risks. Likely water quality benefits depend on farm contour, management challenges and practices used to manage risks on farm.				$ - $$	$$$	Involves assessment of farm resources, stocking policies and farm business risks. A good starting point that will help clarify the most useful practices to consider in this menu.
Nutrient management	Do a whole farm nutrient budget	Likely water quality benefits will depend on the range of practices used to manage nutrients as a result of nutrient budget recommendations.				$	$$	Farm consultant/advisor should use OVERSEER® 6[1] to create a nutrient budget for the whole farm, with recommendations to be included in a nutrient management plan.
	Apply N fertiliser in accordance with feed budget and soil conditions, with no winter N use	H	-	-	-	$	$$$	Requires sound nutrient and feed budgeting, soil and pasture monitoring and accurate timing of N applications to avoid feed shortfalls. Achieves much better N conversion to dry matter and is more cost efficient. Fertiliser should be applied in accordance with the Code of Practice for Nutrient Management – see www.fertiliser.org.nz.
	Keep Olsen P at biological optimum using soil testing	-	M	-	-	$	$$$	Avoiding unnecessary application of P will reduce costs. To minimise run off, apply P fertiliser when soil moisture is good and no large rainfall events are forecasted. Consider use of lower solubility P fertiliser if soil conditions allow.
	Diet manipulation to reduce overall N input (use low protein supplement e.g. maize instead of high protein/ high N pasture)	M	-	-	-	$$	$$	Requires good quality maize silage, a feed pad to reduce wastage and careful feed monitoring and budgeting. Can improve overall nutrient budget compared to N boosted pasture in spring because low protein supplement is more N use efficient. The benefit of diet manipulation will be lost if the farmer continues to offer the same quantity of high protein feed as well as the new low protein feed to their herd.

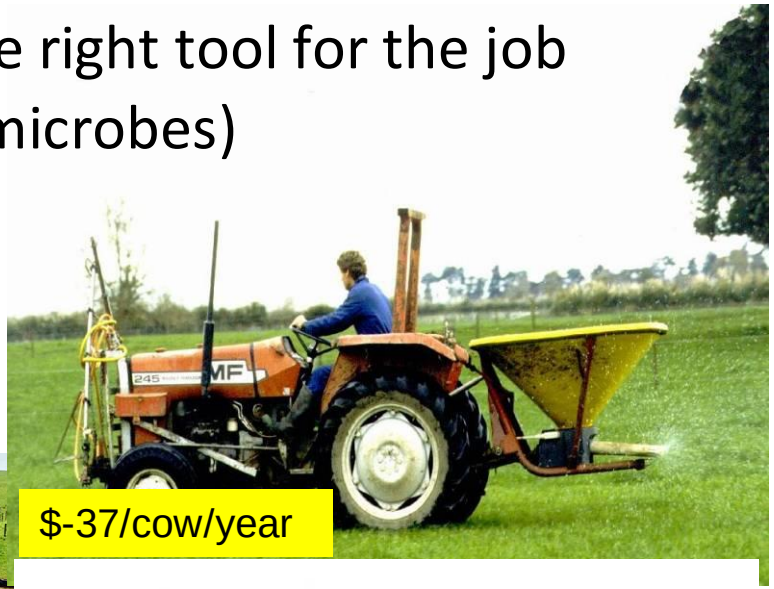
[1] The OVERSEER® nutrient budgeting programme assumes many 'low' rated practices, such as stock exclusion from waterways and following effluent management guidelines, are already in place. If these practices haven't yet been implemented, OVERSEER® is likely to underestimate nutrient losses. Making these changes over time may result in little change to your OVERSEER® nutrient budget even though you are achieving positive change on the ground.

BMP TOOL BOX

The Best Management Practice Toolbox

- selecting the right tool for the job (N, P, Faecal microbes)

- **net cost**
- **effectiveness**
- **cost-effectiveness**



CURRENT RESEARCH

- Diverse pasture
- Diuretics
- Post drought management
- Winter forage cropping – crop sequences, establishment, optimal water x N
- Urine patch and fertiliser overlap
- Zero N application – Parekarangi Trust
- N Guru (Spatial N content assessment)
- Plant growth hormones (i.e. Gibberellic acid)
- P21 farmlets – suite of mitigations incl off pasture mangagement

agresearch

RESEARCH GAPS FOR ROTORUA LAKES

- N leaching under high rainfall pumice
- N leaching from Podzolised Pumice – is there an impeded layer
- Overseer validation?
- ????

agresearch

agresearch

Cost effectiveness for N management

	Low Impact (0-10%)	Medium Impact (10-30%)	High Impact (>30%)
High Cost		• Restricted grazing • Enhanced waste water treatment systems	• Winter housing and manure management
Medium Cost	• Supplementary feeding, low N diet • High sugar grass • Improved irrigation, farming practice • Greater root activity • High tannins	• Duration control grazing • Environmental forecasting • Soil processes, new products & formulations (commercial) • Ryegrass N use efficiency	• Constructed and managed wetlands, denitrification systems • Match land to agricultural use • Diuretic supplementation • Low N pasture • Change Animal Type
Low Cost	• Optimal fertiliser management	• Effluent management • Gain in nutrient efficiencies • Precision agriculture - targeted mitigation high N areas • Optimise timing of pasture grazing / feed to lower N in diet	• Groundwater assimilative capacity

agresearch

TIER 1 BMPS
(THE "LOW-HANGING FRUIT")

BMP	Target
Improved FDE management - storage, low rate & low depth applic.	***E. coli*****,** P, NH_4-N
Stock exclusion from streams wetlands swales & wet gullies (esp on winter crops)	**Sediment**, P, *E. coli*, NH_4-N
Nutrient management plans	**N, P**
Facilitated wetlands	**N, sediment**, *E. coli*

agresearch

TIER 2 BMPS (EITHER MORE COSTLY, MORE COMPLEX, LESS PROVEN OR LESS COST-EFFECTIVE)

BMP	Target	Comment
Nitrification inhibitors (eg DCD)	**NO_3-N**	Low effectiveness in warm-wet locations; uncertainty remains
Wintering cows in Herd Shelters	NO_3-N, P, *E. coli*, NH_4-N, sediment	High capital cost; can lead to farm intensification
- with restricted autumn grazing	NO_3-N	As above
Substituting N-fertilised pasture with low N feeds	NO_3-N	Cost-effectiveness varies with payout and feed price
Tracks and lanes sited away from streams & lane runoff diverted to land	P, *E. coli*, NH_4-N, sediment	Seasonally important (but not annually)
Constructed wetlands	**NO_3-N**, *E. coli*, NH_4-N, sediment	
Limiting N fertiliser use	**NO_3-N**	Not very cost-effective
Grass buffer strips	NO_3-N, P, *E. coli*, NH_4-N, sediment	Not very cost-effective