

Healthy Rivers Block 2

Diffuse Discharge – Nitrogen

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My evidence addresses ...

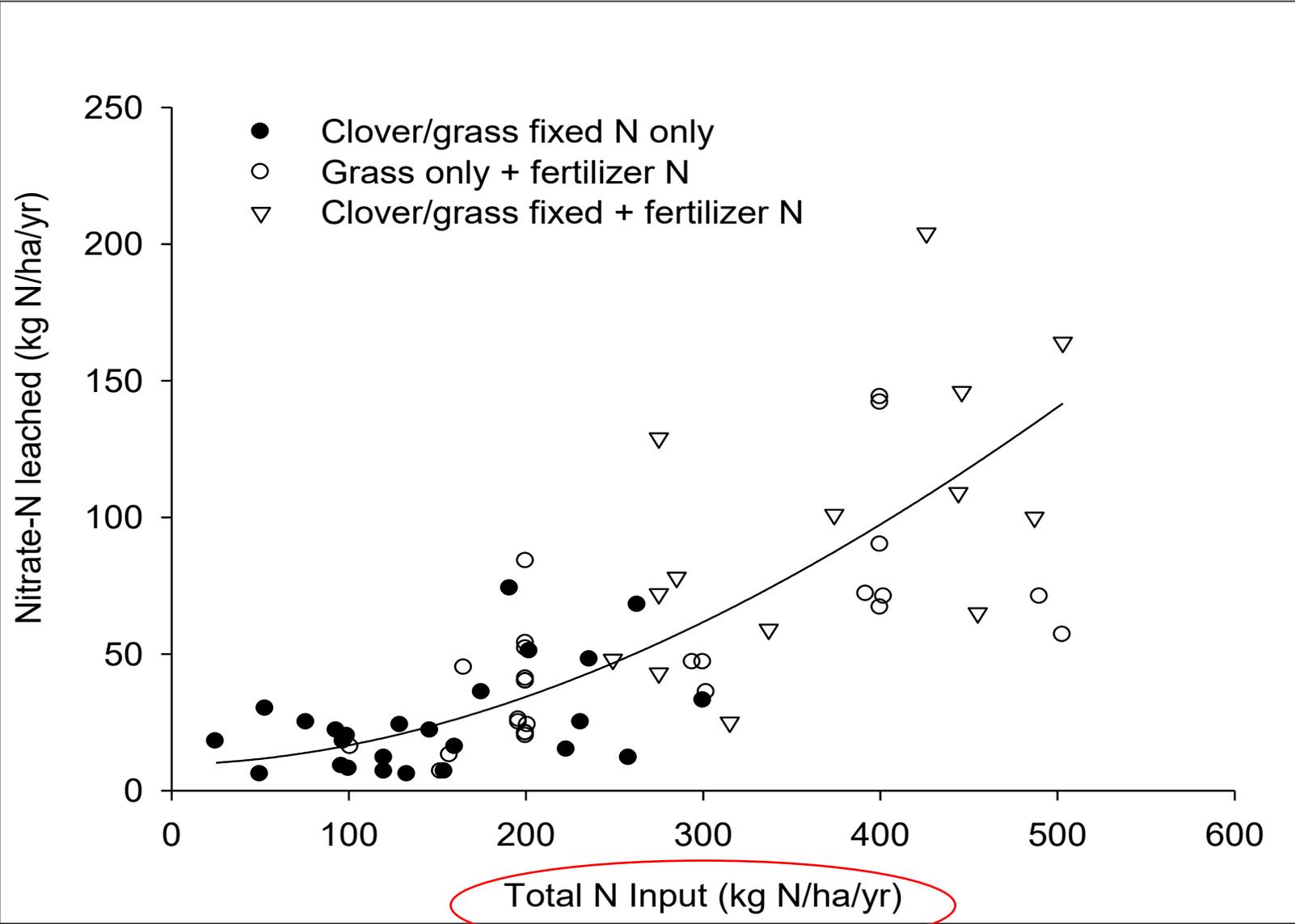
The science of how nitrogen (N) moves through NZ pastoral farming systems, explaining (in relation to N leaching); concepts of:

- N source and size of N source
- Transport of N

Implications of these for:

- On-farm mitigation measures and good farming practices
- Methods for establishing baseline positions on N status and tracking changes over time.

How Overseer models source, transfers and transport and implications for farms with high rainfall and free-draining soils



Source of nitrate in the soil

- Urine
- (Dung)
- 'Fixation' by legumes of atmospheric N
- Fertiliser
- Effluent
- Release from soil organic matter ('mineralisation')

The more nitrate sitting in the soil from these sources, the greater the leaching risk

SIZE OF **SOURCE** POOL = **POTENTIAL** RISK

NB: Other competing processes remove this soil nitrate, e.g. plant uptake, microbial processes

Managing **source** of N

- Fertiliser, effluent of soil organic matter N generally do not contribute **'directly'**
- If they are, this is generally poor management
- Most of the N supplied by these three (plus fixed N) contributes by funnelling it through the animal (contributes **'indirectly'**)



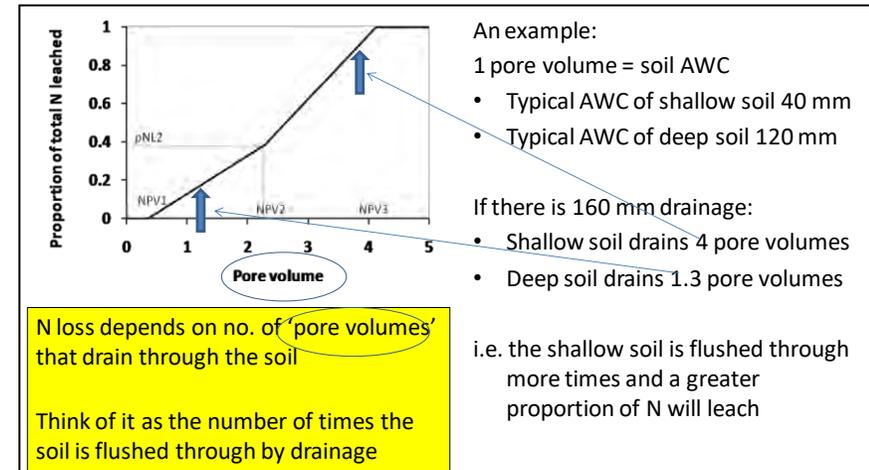
Example of urine effect

Stocking (cows/ha) and N fert rate (kg N/ha)	Dry Matter eaten (t DM/ha)			N eaten (kg N/ha)			N milk (kg N/ha)	N balance (kg N/ha)	
	Pasture	Supp.	Total	Pasture	Supp.	Total	Milk	Balance	'Urine'
A: 3.2/150	14.5	2.2	16.6	486	53	538	84	455	316
B: 2.6/50	13.0	2.1	15.1	413	49	462	82	380	256
Difference	1.5	0.1	1.5	73	3	76	2	75	60
% Change	10	3	9	15	6	14	2	16	19

c. 40% reduction in leaching

Transport of available N (leaching)

- Depends on amount of drainage (rainfall)
- Depends on water holding capacity of the soil
- Concept of ‘number of times soil is flushed’
- e.g. 7 kg N/ha per 100 mm rain



- Note: high rainfall also means the drainage season is extended and so more urine is available for leaching
- NB: denitrification on very wet soils

Mitigation measures

- Good practice (5-10%)
- Best practice (20-40%)
- Land-use change
- New research – need to capture effects

- Can break down mode of action into targeting **source** and/or **transport**

Tracking change – monitoring improvement

- I focus on the methods
- Key points from Table 2:
 - All deal with **source** –
 - good relationship between leaching and N surplus
 - because urine is the main driver
 - **Timing** and **transport** are key areas of mitigation too
 - not all methods deal with these
 - Models can – e.g. Overseer. But it does depend on the model!

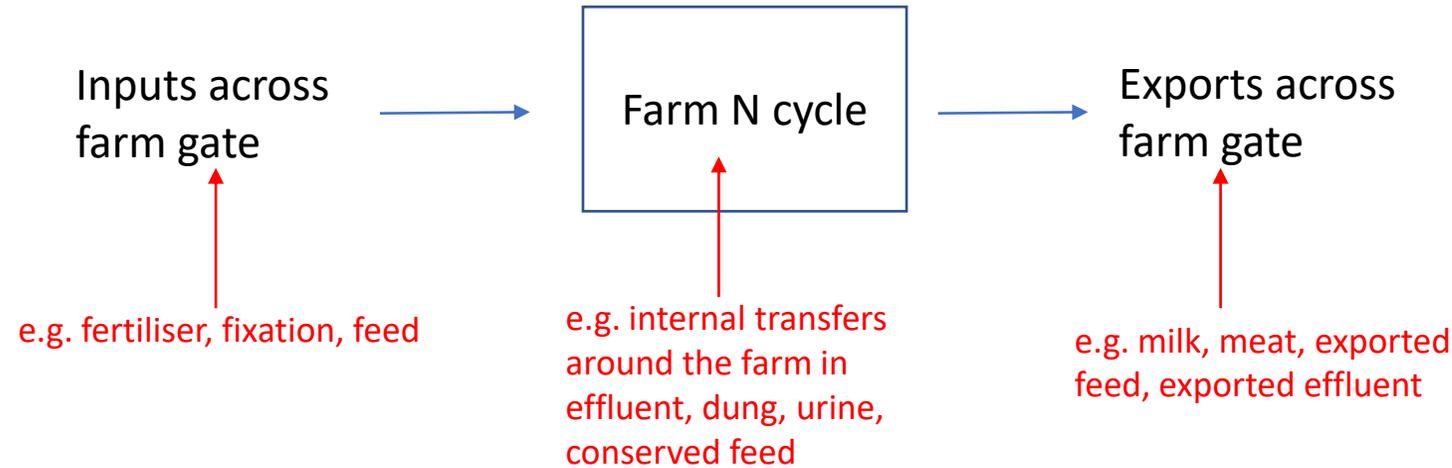
Overseer deals with both **source** and **transport** processes

- Estimates how much N is eaten and excreted (and when) - **SOURCE**
- Estimates how much mineral N accumulates from non-urine sources - **SOURCE**
- Estimates how much drainage and when it occurs – **TRANSPORT**
- Estimates how many times the soil is ‘flushed through’ to calculate N leaching risk - **TRANSPORT**

In summary

- Amount of soil mineral N in the soil drives nitrate leaching
- We have a good understanding of the **sources** of N and the factors that affect the size of these pools
- We have a good understanding of the processes that **transport** that nitrate from the soil
- This understanding allows us to:
 - Develop mitigations that target source, transport or both
 - Develop accounting methods that track changes in source, transport or both
- All methods have pros and cons

Summary of N flows and estimations



Estimates SOURCE component

Inputs across farm gate



But doesn't account for mitigations that target internal transfers around the farm

Estimates ...

N SURPLUS
as an indicator of
Potential N source
component of N loss

Method ...

Spreadsheet
Or
Model

Summary of N flows and estimations

