



Increasing Nitrogen efficiency - Curtins research farm experience

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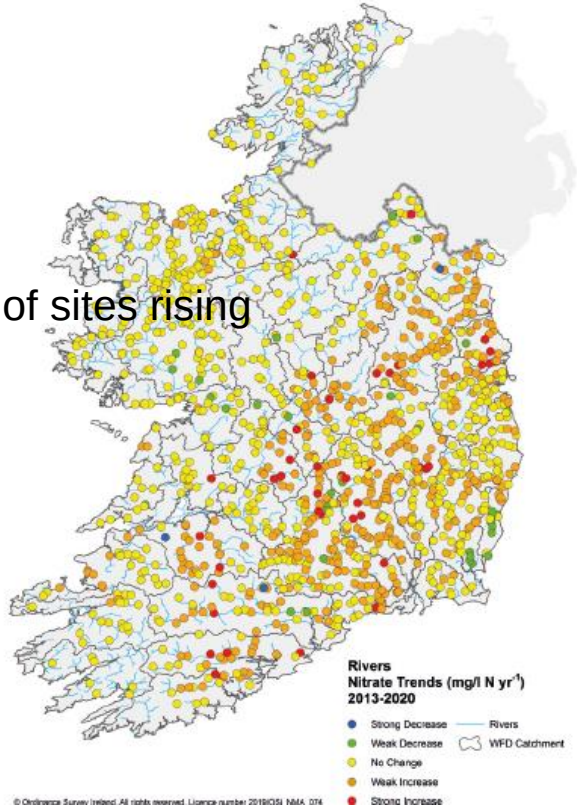
Context for N efficiency focus

Water Framework Directive

- At least good ecological status in all water bodies (2027)
- 57% of rivers presently have good ecological status
- 47% of rivers have unsatisfactory nitrate concentrations & 38% of sites rising

EU Farm to Fork

- 50% reduction in nutrient losses by 2030

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Impact of agronomic practices of an intensive dairy farm on nitrogen concentrations in a karst aquifer in Ireland

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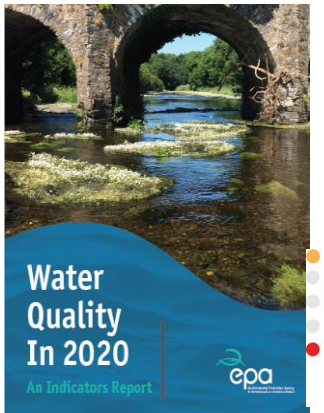

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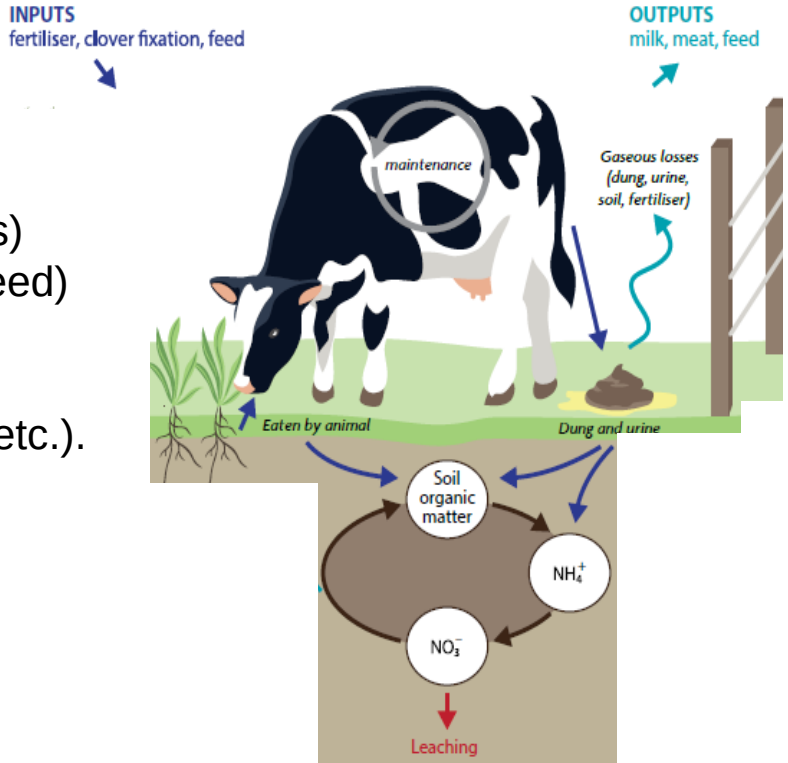
Definitions in N efficiency

- Total N surplus/balance (kg/ha) = (Total N inputs – Total N outputs)
- Total N Use Efficiency (NUE; %) = (Total N outputs/ Total N available)
- Farm-gate or Purchased N surplus/NUE
  - excl. fixation & soil N cycling

The N cycle for Grazing Systems (DairyNZ, 2020)



N efficiency improvements:

- reduce N surplus via
  - less N in (more effective feeds & fertilisers)
  - and/or more N out (more efficient cows; feed)

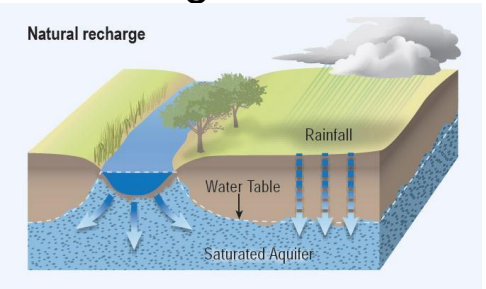
- reduce N leaching pathway losses (fertiliser timings, grazing practices, inhibitors, etc.).

Objective

To describe the spatial and temporal trends in groundwater nitrate concentrations and relationships with site characteristics, climate and farm management

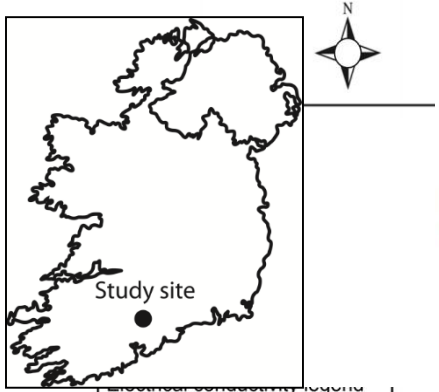
Data collection (2001-2011)

- Monthly NO_3-N concentrations from 9 -12 borehole wells
- Paddock specific management data: Fertiliser/ slurry/ grazing/ reseeding etc.
- Climatic data (rainfall, evaporation, drainage)
- Detailed site specific physical and geological information



The study site

- Nitrate loss is primarily a problem for free draining soils
- Curtins farm represents the most free draining 1% of Irish grasslands



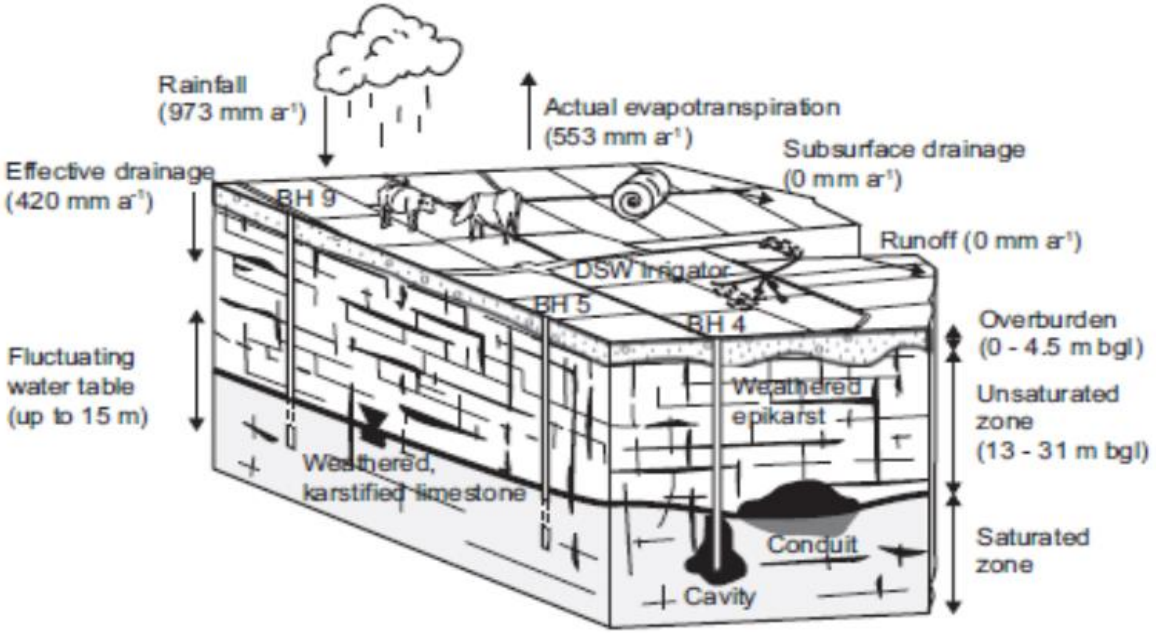


Fig. 3. Conceptual site model using data from 2005 as an example.

a)

0 200 400 [m]

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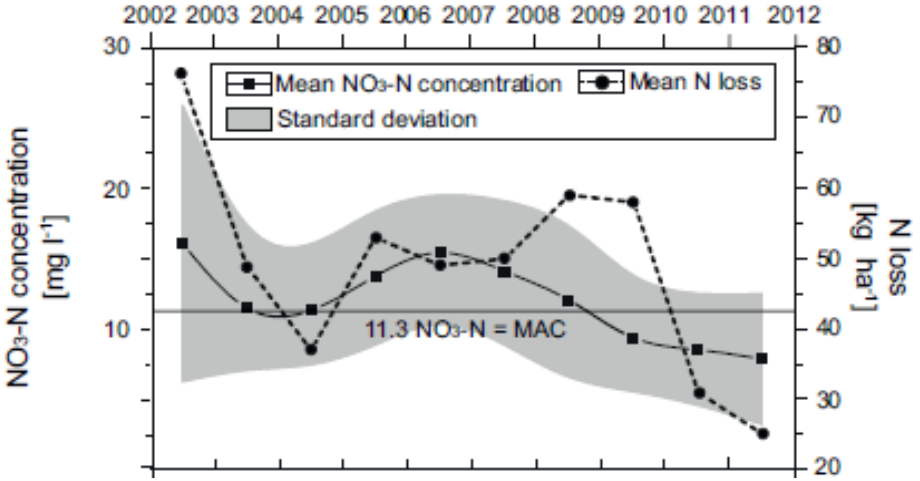
Climate and Nitrate loss 2001 -2011

- Climatic conditions were on average similar to long term averages
- Measured NO3-N concentrations in groundwater reduced from 2002-2010

Table 3
Mean monthly rainfall and effective drainage for the study site during the study period (2001–2011) compared to the 30-year average.

Month	Rainfall (mm)		Effective drainage (mm)	
	30-Year average	2001–2011	30-Year average	2001–2011
January	111	109	90	89
February	79	61	57	38
March	83	79	48	39
April	67	61	27	18
May	65	78	15	19
June	71	75	13	10
July	65	86	9	19
August	86	69	27	23
September	75	74	26	13
October	113	108	72	62
November	105	115	80	89
December	101	81	80	59
Total annual	1021	996	544	478



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Farm Management Practices and Nitrate loss 2002 -2010

N efficiency on free draining soils can be increased by optimising farming practices

Imposition of EU Nitrate Directive

Year	2001	2003	2005	2007	2009	2011
Stocking rate (cows/ha)	2.3	2.4	2.6	2.7	2.9	2.9
Grazing season length (d)	231	293	295	306	301	285
Fertiliser N (kg/ha)	294	289	331	244	248	249
Milk fat plus protein (kg/ha)	930	1,160	1,210	1,130	1,180	1,280
Total N inputs (kg/ha)	335	328	368	267	277	274
Total N exports (kg/ha)	75	92	93	93	92	98
Total N surplus (kg/ha)	**260**	**236**	**275**	**174**	**180**	**174**
Total N use efficiency (%)	**22**	**28**	**25**	**27**	**35**	**36**

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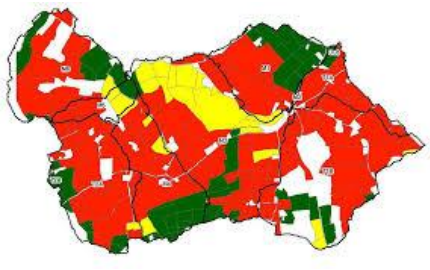
Practice change for N efficient systems

- Reduce fertiliser N application
- Reduced concentrate use level and CP contents
- Increased milk from pasture (calving rate, genetics, grazing management)
- Min-till cultivation reseeding
- Improved distribution of slurries
- Preferential management of high risk areas



Conclusions...

- Climate & physical site charateristics are influencial components
- N losses reduced and milk production increased over 10 years
- Farm management practices had a significant impact
    - Reduce N surplus - Feed & Fertiliser
    - Improved utilisation of slurry and dirty water
    - Minimum cultivation reseeding
    - Good basics : appropriate stocking rates & good soil fertility

Kasten et al., 2013 http://dx.doi.org/10.1016/j.agee.2013.08.021

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