The Impact of Nitrogen Management Strategies within Grass Based Dairy Systems

26th January, 2023

Animal & Grassland Research Innovation Centre, Moorepark

teagasc
Agriculture and Food Development Authority

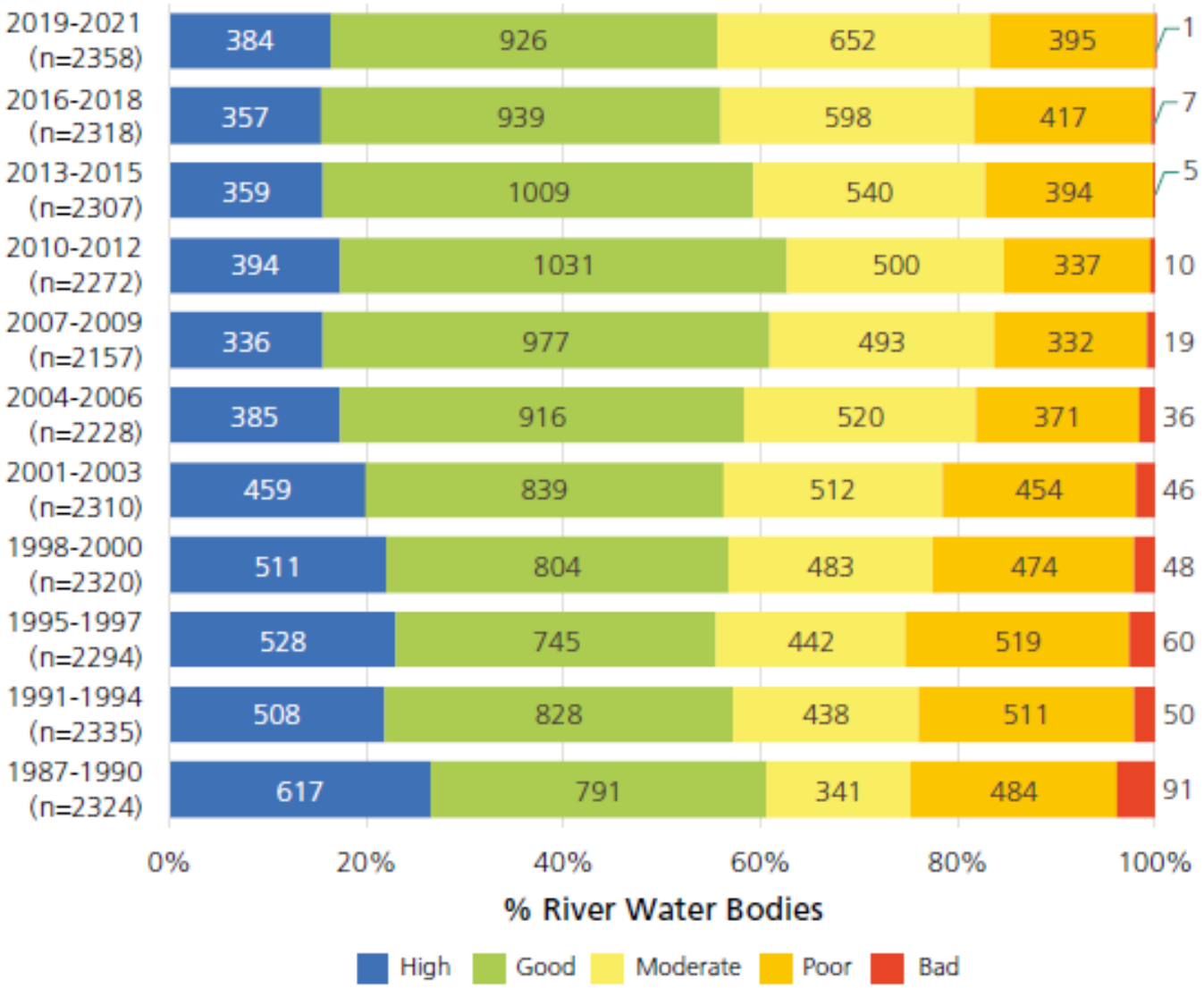


Figure 2.9 Macroinvertebrate quality of rivers (Q-value) from 1987 to 2021 (number of water bodies indicated)

Plan

- Scenarios presentations
  - Main outputs
- Cumulative impact of current policies
- Precision N management: 2018 example
- Explanation of banding

Elodie.ruelle@teagasc.ie

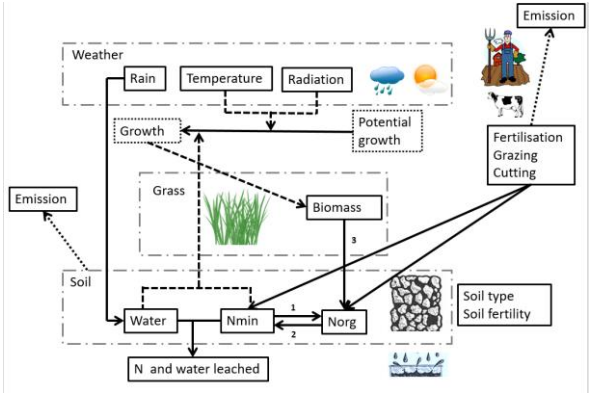
teagasc
Agriculture and Food Development Authority

Scenarios

- Requested by Department of Agricultural, Food and Marine
- Base simulation:
  - Free draining soil
  - SR of
  - 250 kg
- Chemical
  - Reduction of 10 or 20%
  - Using excessive level above 250 kg N/ha
- None compliant slurry spreading during closed period
  - 12% or 25% spread in December
- Stocking Rate (SR) variation
  - 10% reduction of SR
  - Platform SR (platform of 3.73 or 4.72 cow/ha)

tember)

18 years of weather data
-> inter year variability



Elodie.ruelle@teagasc.ie

teagasc
Agriculture and Food Development Authority

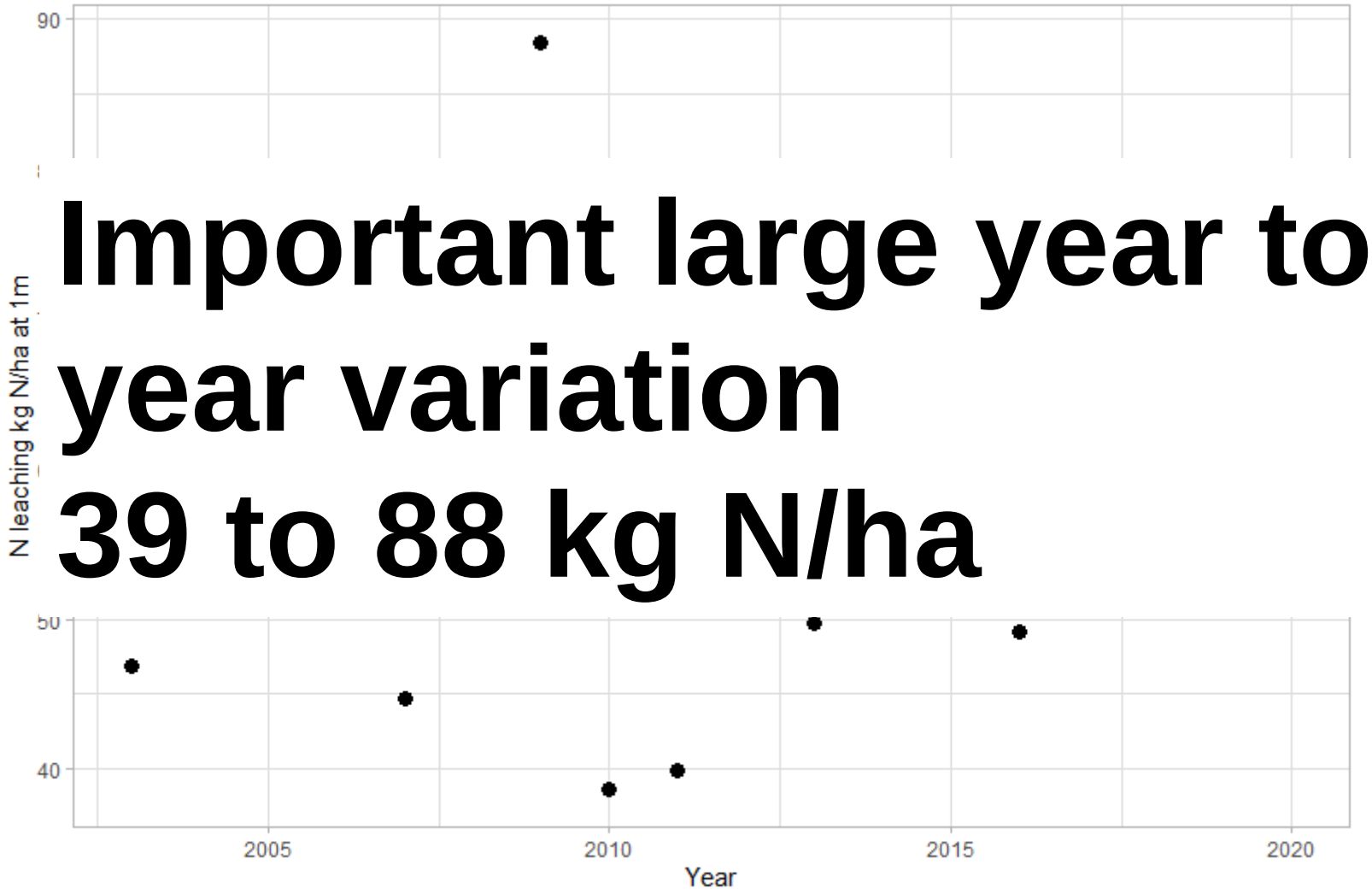
Models used and base simulation

- PBHDM model (whole farm and farm management model (Ruelle et al.,2015;2016)
  - The MoSt model (Ruelle et al., 2018) predicting grass growth and leaching

	250
January	16
February	13
March	43
April	41
May	39
June	35
July	22
August	24
September	17

- Simulation:
  - 40 ha farm
  - 18 year (2003-2020) of Moorepark weather
  - SR of 2.75 cow/ha (org N of 250)
  - 250 kg of chemical N applied (from 16 of January to 16 of September
  - Grazing season 15 of February to 15 of November

Year to year variation in N leaching



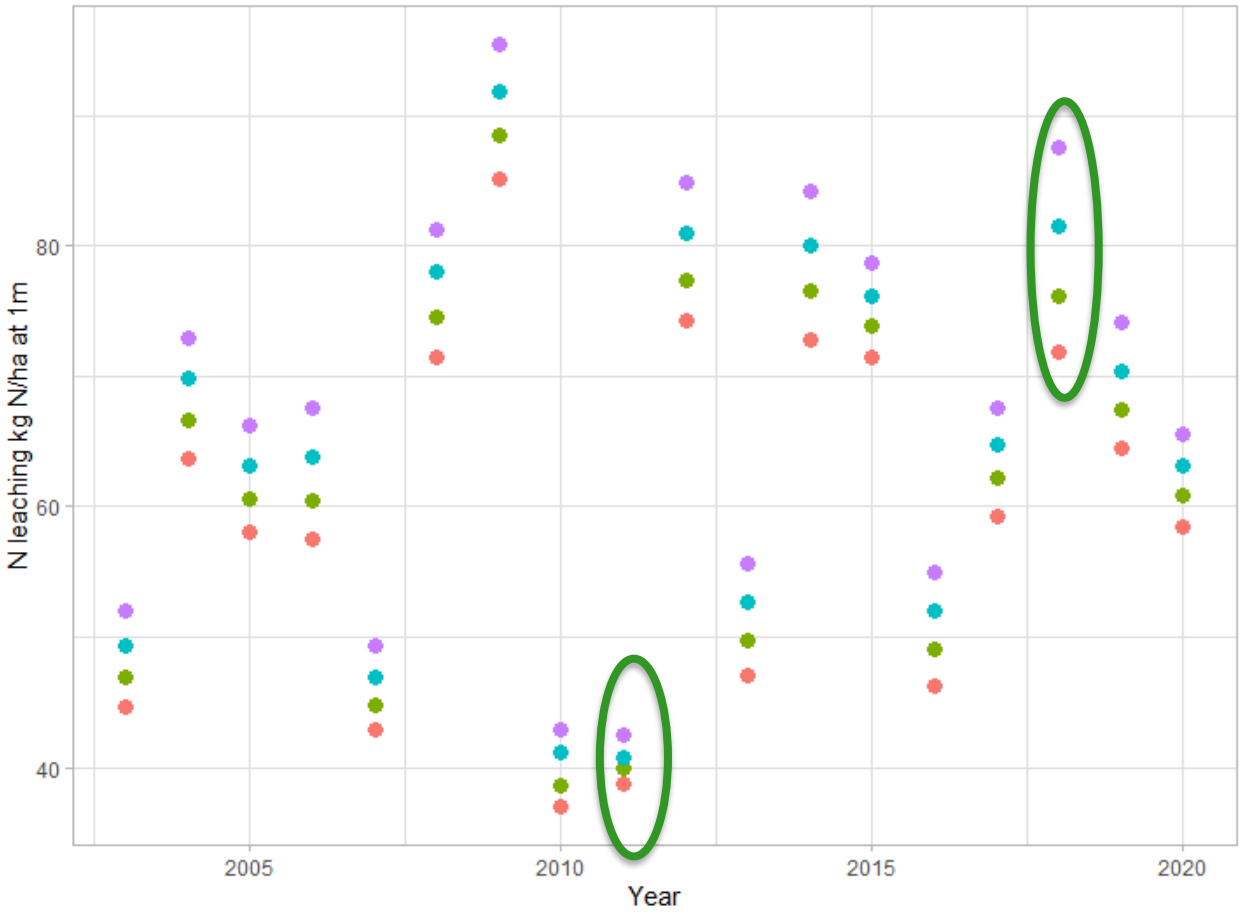
Important large year to year variation
39 to 88 kg N/ha

- Same management
- Same SR
- Same N application

Elodie.ruelle@teagasc.ie

teagasc
Agriculture and Food Development Authority

N fertiliser application



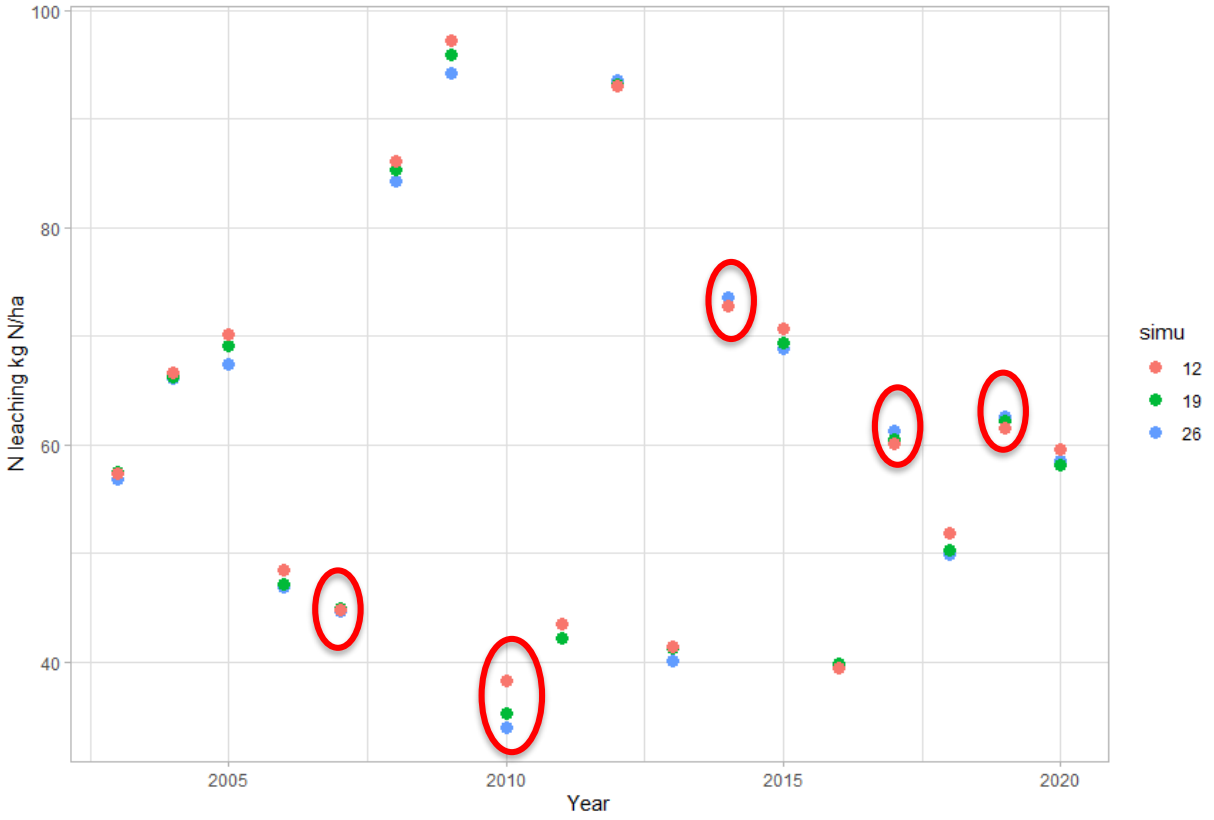
N fertiliser applied	Yearly N leaching	% reduction
200	59.1	-4.5%
225	60.5	-2.3%
250	61.9	
300	64.8	+4.7%
350	68.0	+9.9%

⚠ Reduction of 50 kg N/ha -> reduction of 0.18 cow/ha to maintain self sufficiency! (if nothing else is done!)

Impact of Timing of First Spring N Application (One paddock)

Application	Leaching
12-Jan	61.3
19-Jan	60.6
26-Jan	60.3

29 kg of N/ha applied



Elodie.ruelle@teagasc.ie

Agriculture and Food Development Authority

Influence of Slurry Spreading During Closed Period

Paddock concerned

% spread mid December	Yearly N leaching	% variation
0	61.9	
12%	65.1	+5.2%
25%	65.4	+5.7%

Elodie.ruelle@teagasc.ie

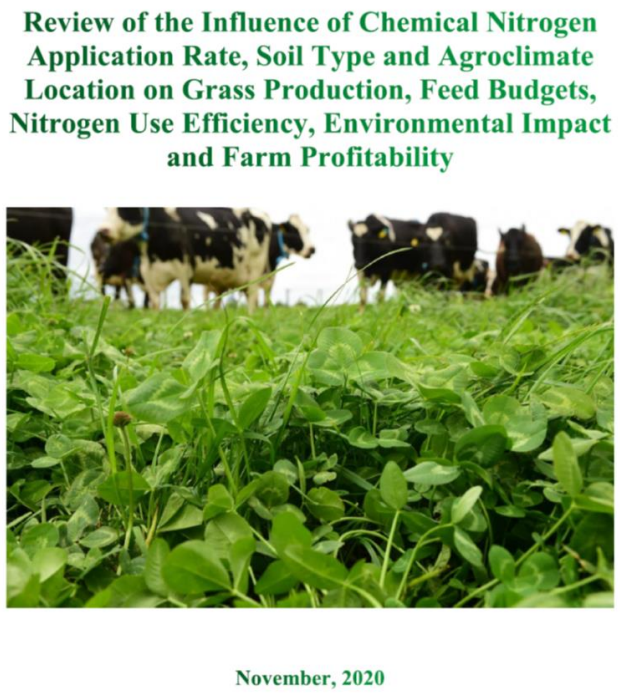
Effect of Stocking Rate on N Leaching

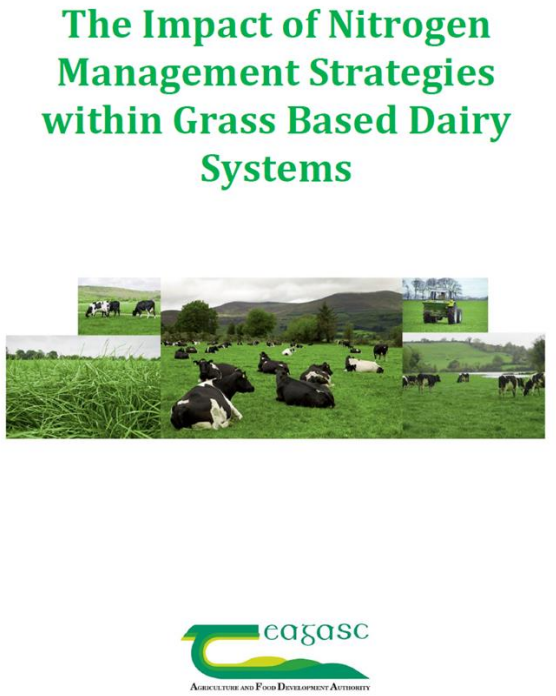
Organic N (SR)	Yearly N leaching	% variation
268 (2.95)	63.2	+2.1%
250 (2.75)	61.9	
230 (2.50)	60.2	-2.7%

Grazing Platform		
Organic N (SR)	Yearly N leaching	% variation
250 (2.75) (40 ha)	61.9	
340 (3.70) (30 ha)	67.6	+9.2%
430 (4.60) (24 ha)	73.7	+19.1%

AGASC SEARCH SIGHTS
LEADING RESEARCH FOR TOMORROW'S AGRI-FOOD SYSTEMS

eagasc
Agriculture and Food Development Authority





CUMULATIVE REDUCTION N LEACHING DUE TO THE DIFFERENT MEASURE

Elodie.ruelle@teagasc.ie

teagasc
Agriculture and Food Development Authority

Band 2: MS 432

Norg	SR	N fert	Con (kgDM/cow)	Silage balance (kgDM/ha)	N leach	
271	2.95 (118)	250*	933	-645	62.7	

5.9

Review of the Influence of Chemical Nitrogen Application Rate, Soil Type and Agroclimate Location on Grass Production, Feed Budgets, Nitrogen Use Efficiency, Environmental Impact and Farm Profitability

November, 2020

The Impact of Nitrogen Management Strategies within Grass Based Dairy Systems

teagasc
Agriculture and Food Development Authority

Band 2: MS 432

8.2

Norg	SR	N fert	Con (kgDM/cow)	Silage balance (kgDM/ha)	N leach	
271	2.95 (118)	250*	933	-645	62.7	
271	2.95 (118)	250	941	-627	62.2	-0.5
271	2.95 (118)	225	961	-853	60.8	-1.4
250	2.73 (109)	225	926	-208	59.4	-1.4
250	2.73 (109)	175	964	-727	56.8	-2.6
220	2.4 (96)	175	912	+251	54.5	-2.3

5.9

Review of the Influence of Chemical Nitrogen Application Rate, Soil Type and Agroclimate Location on Grass Production, Feed Budgets, Nitrogen Use Efficiency, Environmental Impact and Farm Profitability

November, 2020

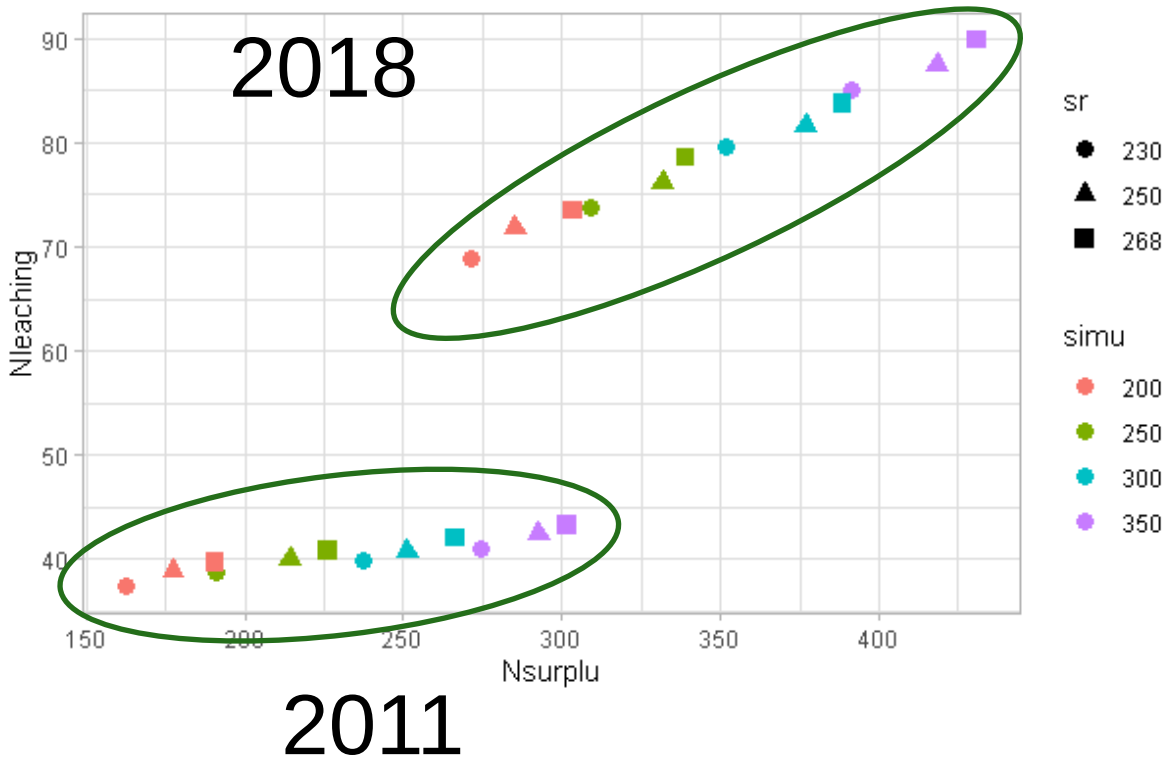
The Impact of Nitrogen Management Strategies within Grass Based Dairy Systems

Teagasc
Agriculture and Food Development Authority

PRECISION MANAGEMENT

Elodie.ruelle@teagasc.ie

Relationship N leaching/N surplus
2 contrasting years



The worst year is the year we have the most to gain!!!!

Elodie.ruelle@teagasc.ie

teagasc
Agriculture and Food Development Authority

Precision management: the 2018 example

Specific rules:

- Spring: predicted grass growth <10 kg of DM/ha; delayed N application
- Spring: rainfall in the 3 next day high; delayed N application
- 24 kg of N in March never applied (Beast from the East); no growth for almost 3 weeks,
- main grass-growing season, predicted grass growth <25 kg of DM/day end of N application

This resulted in a total chemical N application of **171** kg of N/ha for 2018 (a reduction of 79 kg of N/ha)

Year	Nitrogen (kg/ha)	Grass growth (kg DM/ha)	N leaching (1m) (kg /ha)	SurpluDeficit	Nitrogen surplus (kg N/ha)	NUE (%)
Avg.	250	13,752	62	-61	227	28.8
2018	250	8,987	77	-2,639	306	22.4
2018	171	8,728	65	-2,672	224	25.8

N response 3.3!!!!!

-12 kg N/ha

~extra 4-5 kg compare to base 175 reduction

-82

+3.4%

Elodie.ruelle@teag

BANDING SYSTEM

Elodie.ruelle@teagasc.ie

Increase in organic N/cow with time

	N Input	N Output	Gaseous Losses	Organic N
2012	126	28	10	88
2013	128	29	10	89
2014	127	29	10	88
2015	130	31	10	89
2016	129	30	10	89
2017	133	32	10	91
2018	136	32	10	94
2019	138	33	10	94
2020	139	34	11	95
2021	142	35	11	96

Increase in organic N/cow with time

	N Input	N Output	Gaseous Losses	Organic N	Ave 21-17	Ave 20-16	Ave 19-15	Ave 18-14	Ave 17-13
2012	126	28	10	88					
2013	128	29	10	89					
2014	127	29	10	88					
2015	130	31	10	89					
2016	129	30	10	89					
2017	133	32	10	91					
2018	136	32	10	94					
2019	138	33	10	94					
2020	139	34	11	95					
2021	142	35	11	96	**94**	**92**	**91**	**90**	**89**

Banding System Ireland

- Objective
  - Develop a system that is simple to operate but that reflects the differences in Nitrogen output related to animal milk yield
    - » Move between the bands as milk yield increases

Banding representation 2015-2019

Milk Yield bands	Supplier %	Milk %	Milk Yield kg	Milk Fat %	Milk Protein %	Concentrate Kg DM
<4,500	24	13	3,714	4.04	3.45	770
4,501-6,500	65	70	5,428	4.09	3.49	945
<6,501	11	17	7,155	4.01	3.44	1,432

Band categories from 2015 to 2021

		Representation					
Milk Yield bands		**Supplier %**	**Milk %**	**Milk yield kg**	**Milk fat %**	**Milk protein %**	**Concentrate Kg DM**
<4,500	2015	25	15	3,797	4.0	3.47	711
	2017	23	12	3,697	4.02	3.44	751
decrease	2019	18	8	3,687	4.11	3.50	739
	2021	15	6	3,548	4.19	3.51	666
4,501-6,500	2015	66	72	5,379	4.02	3.50	807
	2017	66	71	5,431	4.08	3.48	905
stable	2019	67	68	5,523	4.15	3.53	980
	2021	66	68	5,599	4.21	3.53	966
<6,501	2015	9	13	7,144	3.93	3.43	1,285
	2017	11	17	7,155	3.99	3.44	1,381
increase	2019	15	24	7,162	4.08	3.49	1,445
	2021	19	26	7,117	4.13	3.49	1,402

Dairy cow banding
Organic N

	N Input	N Output	Gaseous Losses	Organic N
<4,500kg	112	22	9	80
4,501-6,500kg	135	32	10	92
>6,501kg	158	41	12	106

Summary

- New Measures
  - Potential to have significant impact on N surplus and leaching
  - Impacts on water quality will be cumulative effect of numerous simultaneous changes
- Precision fertiliser application will have a significant role especially in the most extreme years

- Introduction of the 220
  - Some impact on nitrate leaching
  - Timeframe to allow current measures to work
  - Water quality changes in 2020, 2021 and expected in 2022?