Rothamsted Research

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N budgets for beef and sheep grazing systems: The North Wyke Farm Platform

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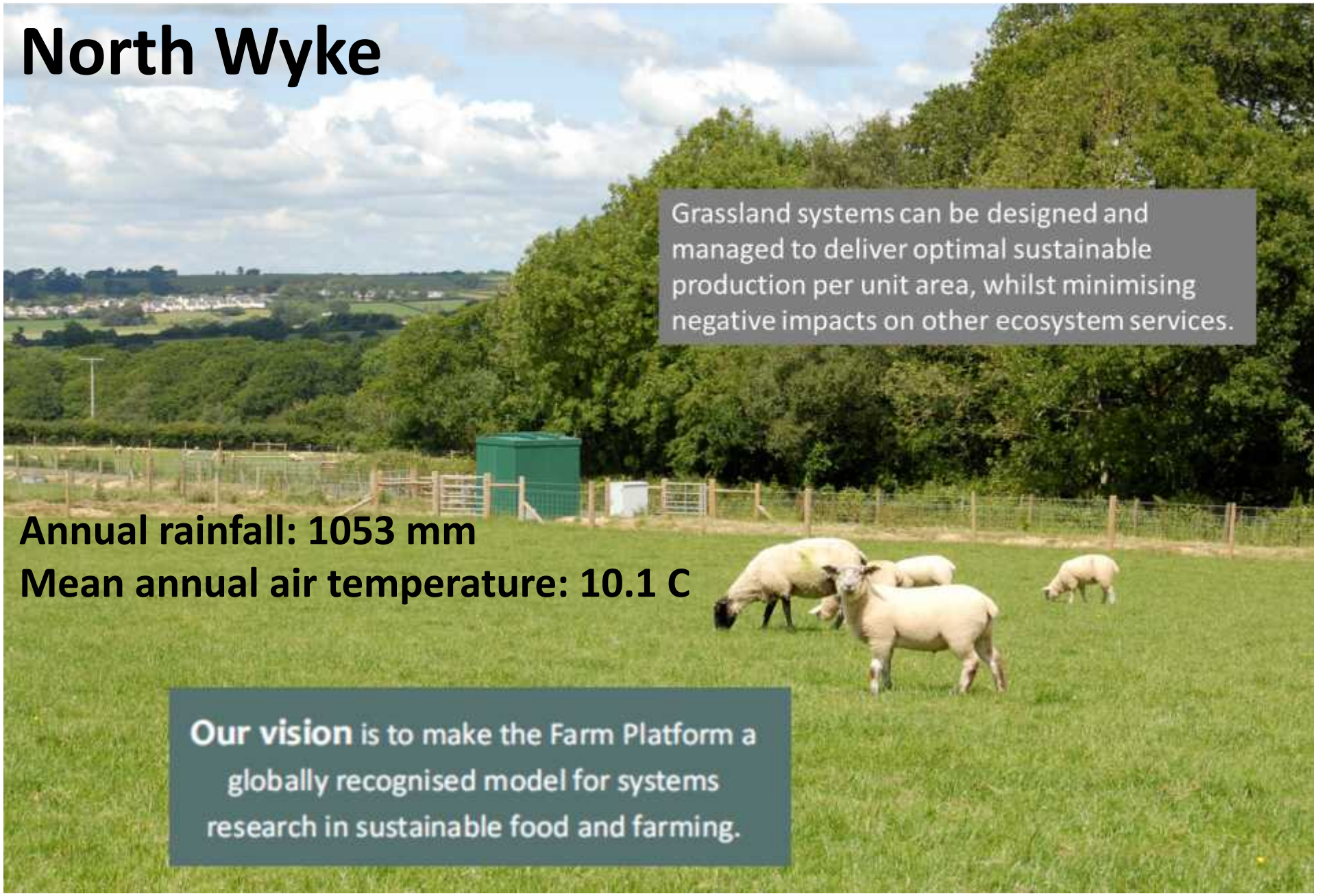
North Wyke



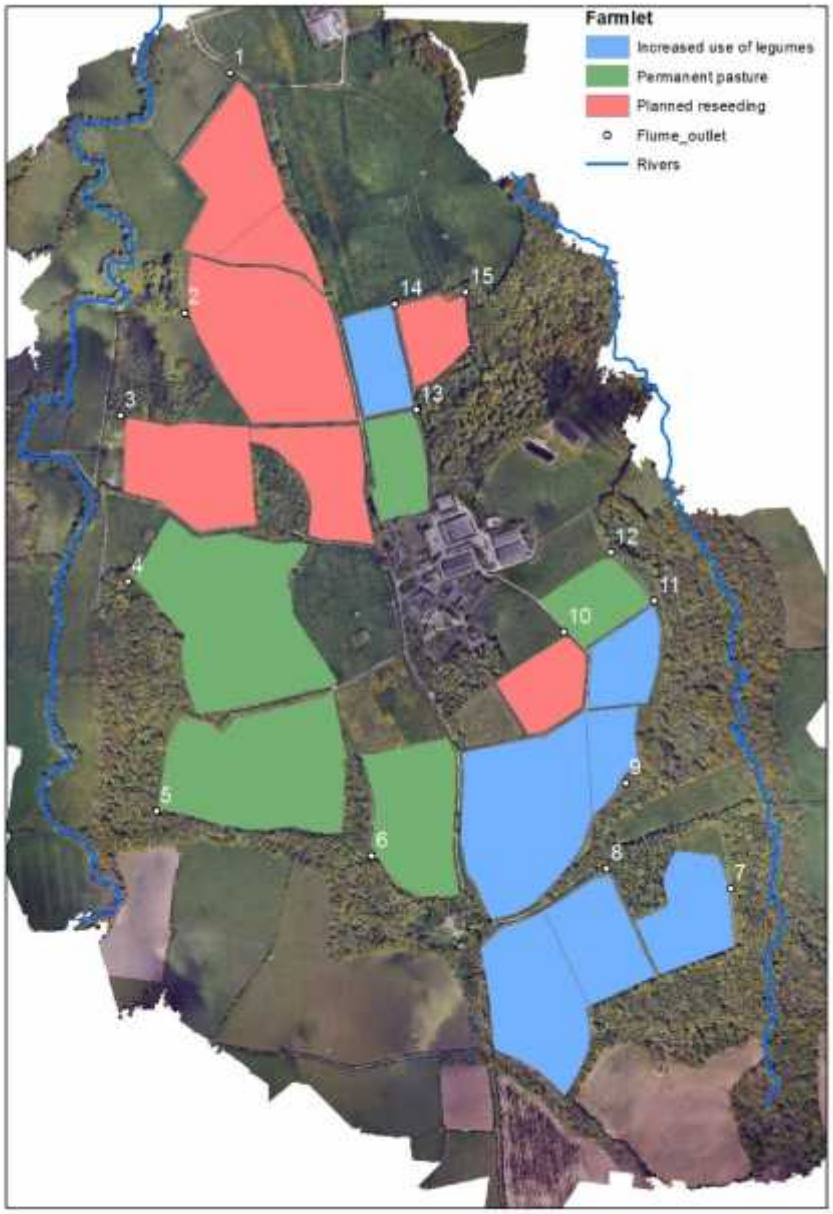
Grassland systems can be designed and managed to deliver optimal sustainable production per unit area, whilst minimising negative impacts on other ecosystem services.

Annual rainfall: 1053 mm

Mean annual air temperature: 10.1 C

Our vision is to make the Farm Platform a globally recognised model for systems research in sustainable food and farming.

North Wyke Farm Platform



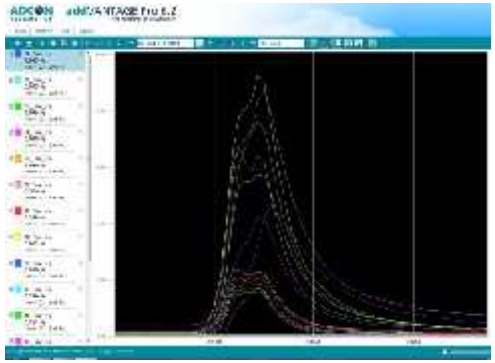
Permanent grassland

Clover-grass leys

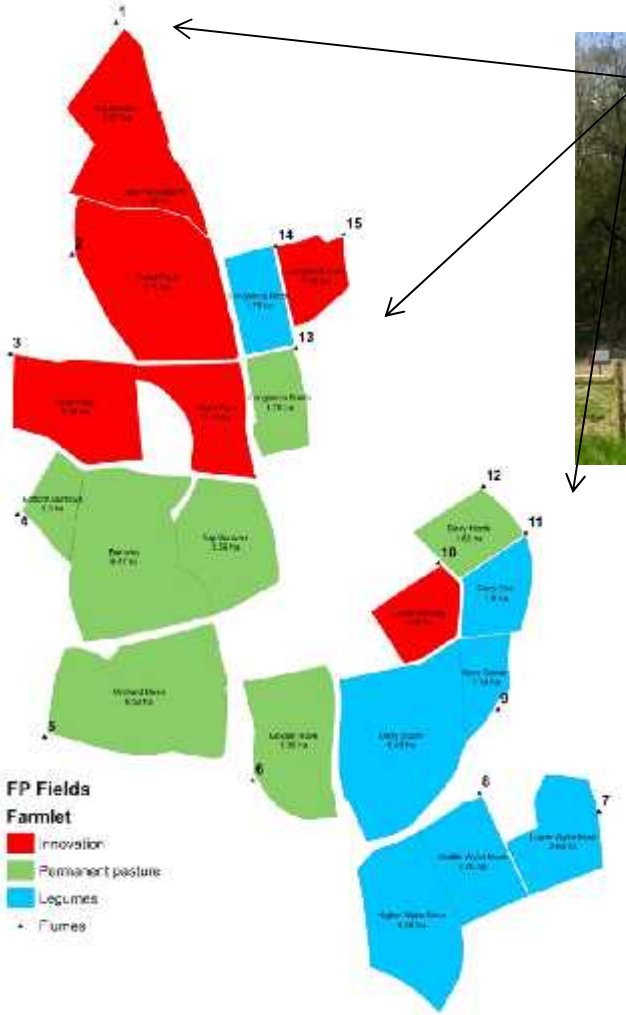
Reseeding with improved grass varieties

Reseeding 2013 - 2015

Soil	Atmosphere	Farm Management
% Moisture	Rainfall	Field inputs/outputs
Temperature	CO_2 and N_2O	Liveweight gain
pH		Farm activities
Bulk density		Labour hours
N, P & C status		Machine hours



Water
Temperature
Conductivity
Turbidity
pH
Dissolved O_2
Ammonium
Nitrate
Dissolved organic C



Sequential/composite sampler

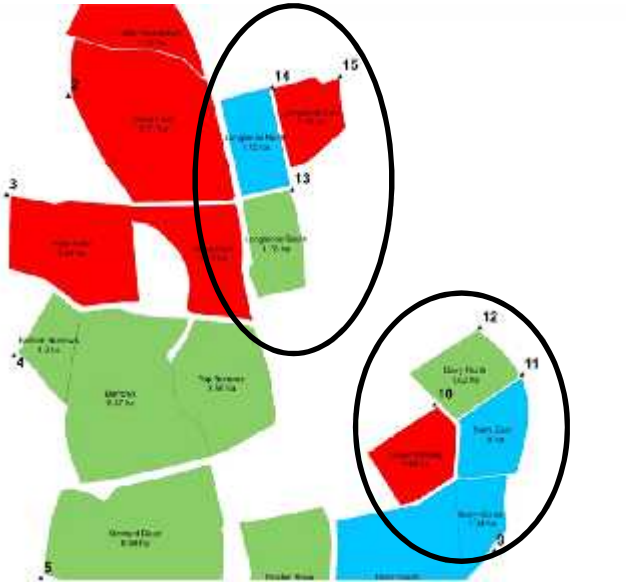
Total-P
Ortho-P

http://www.rothamsted.ac.uk/farmplatform

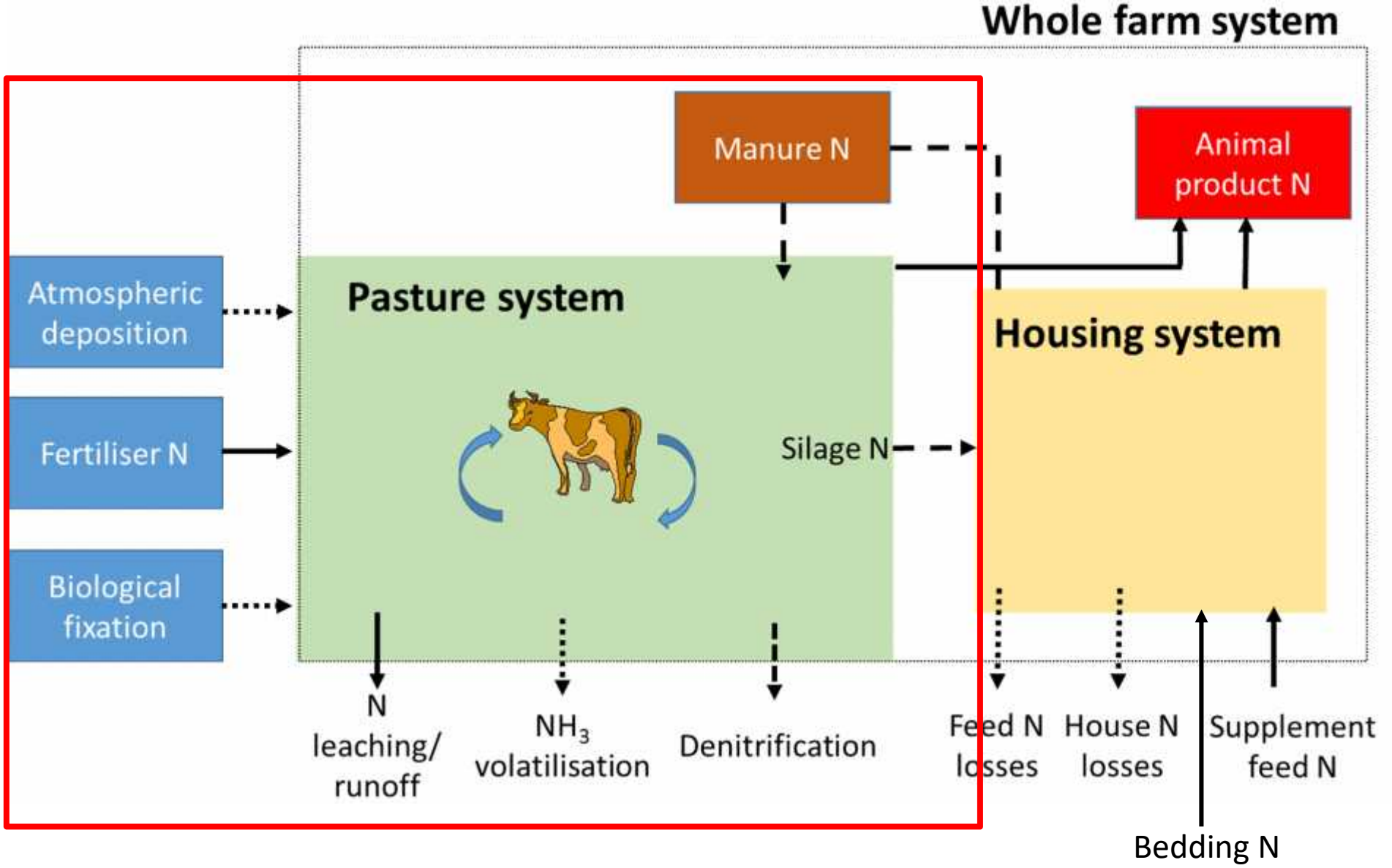
Orr et al., 2016 European J Soil Science

Management

- 25 - 30 finishing beef cattle per farmlet – grazing March/April to October
- Finishing on pasture as far as possible
- 50 - 75 ewes plus lambs
- Silage conserved for winter housed cattle
- Fields managed as ‘triplets’

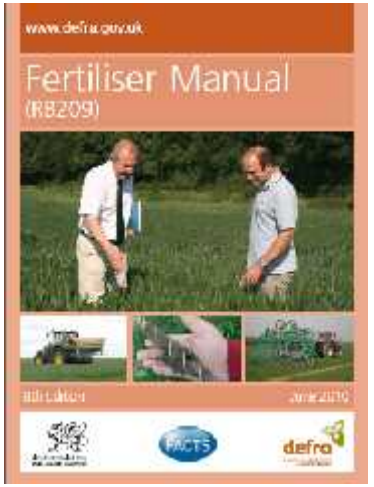


Nitrogen flows



N inputs

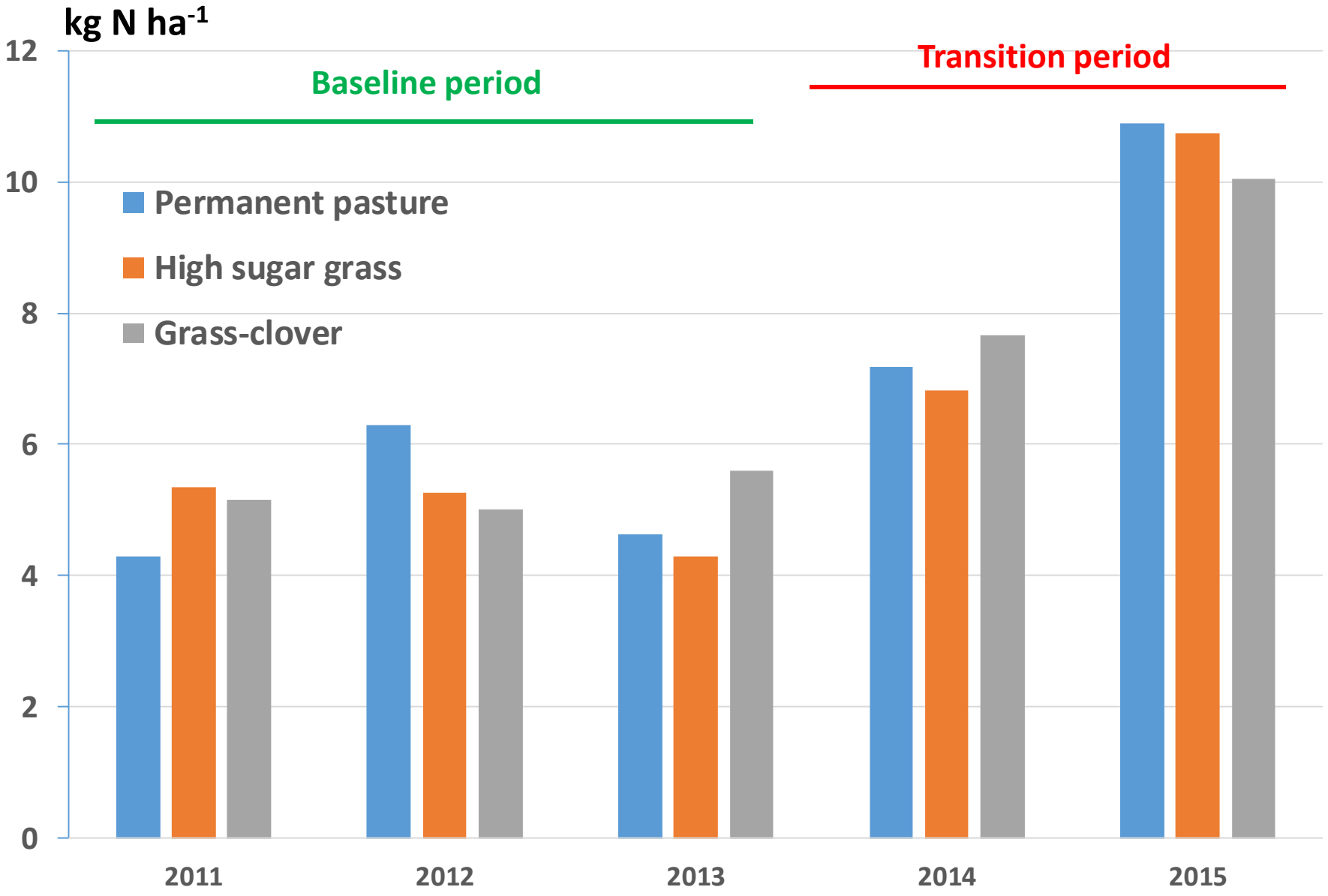
- **Fertiliser – as per recommendations for permanent pasture and reseeded grass systems (up to 200 kg N ha^{-1}); zero fertiliser for grass-clover system after establishment**
- **Farm Yard Manure from housing period**
- **Atmospheric deposition c. 20 kg ha^{-1}**
- **N fixation can be 50 – 250 kg ha^{-1}**
  - **Assume 100**
  - **Need measurements**
  - **Influence of season, age of sward (proportion of clover)**



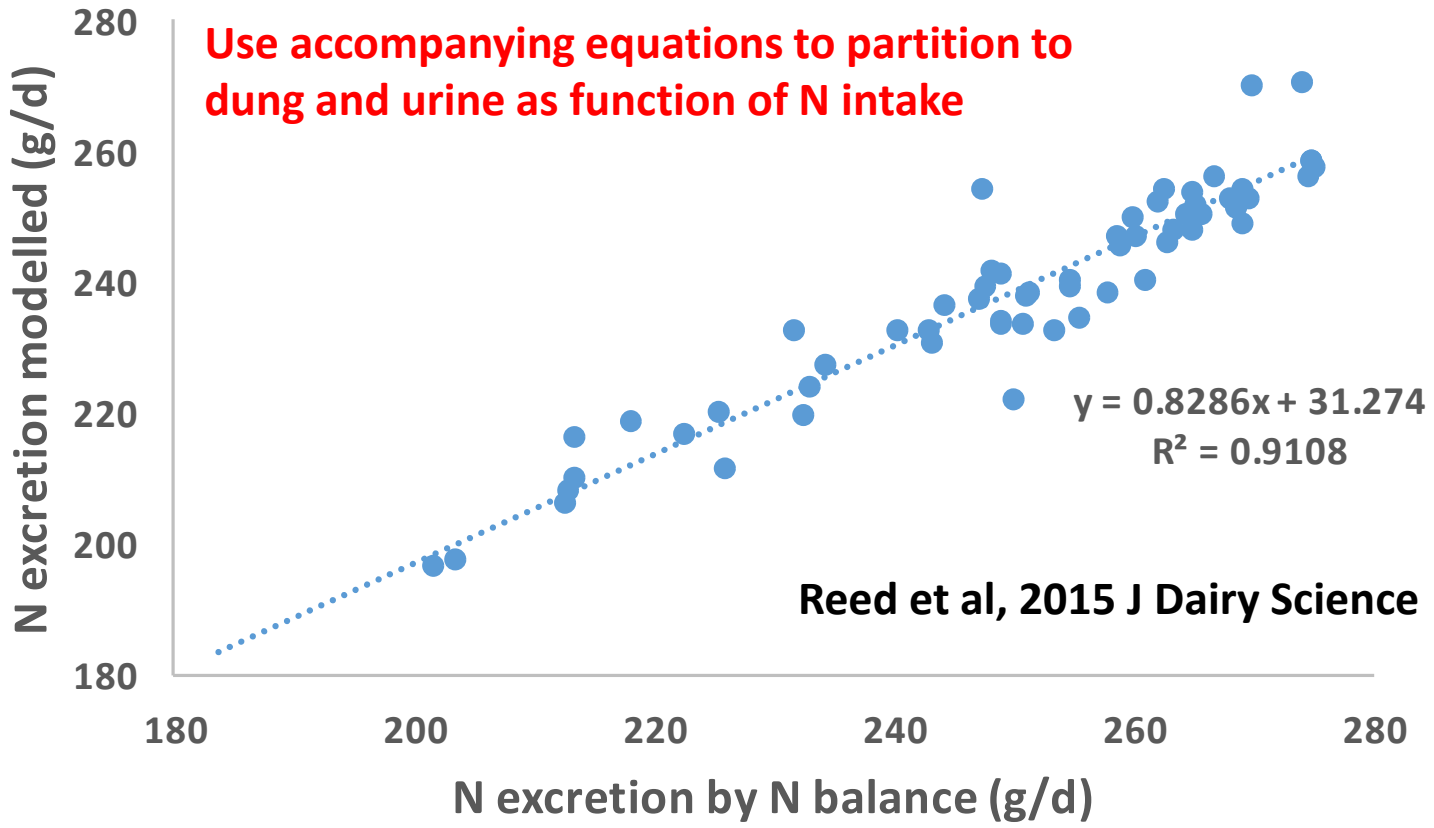
N outputs

- **Cattle LWG: energy balance equations to estimate DMI and N intake; N in LWG = c. 10% N intake**
- **Sheep LWG**
- **Silage – measured DM yield and N content direct from field**

N offtake in cattle and sheep LWG



N recycled via dung and urine



Excretal returns across farmlets:

Dung: 20 – 32 **Urine: 26 – 55 kg N ha^{-1}**

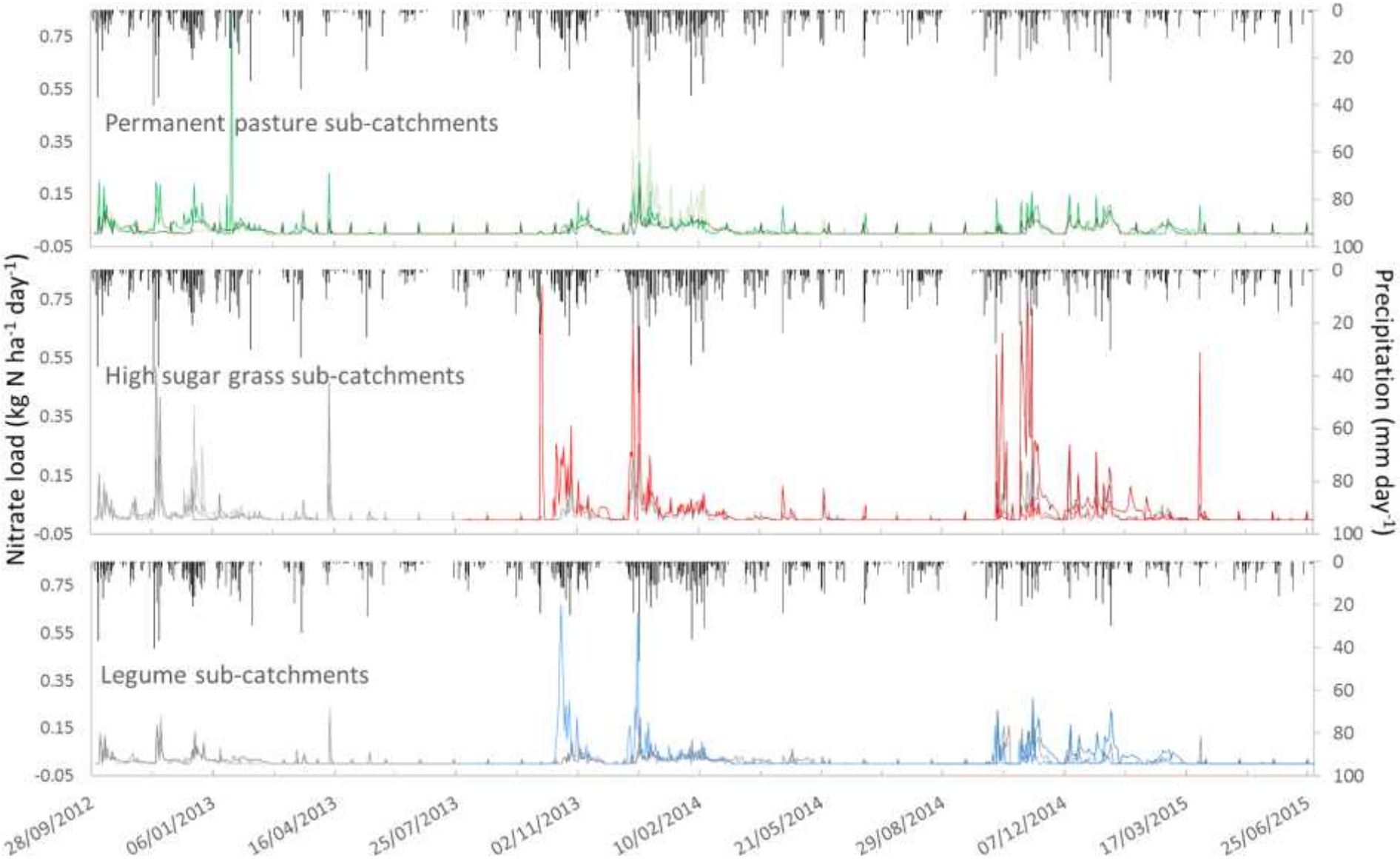
N losses

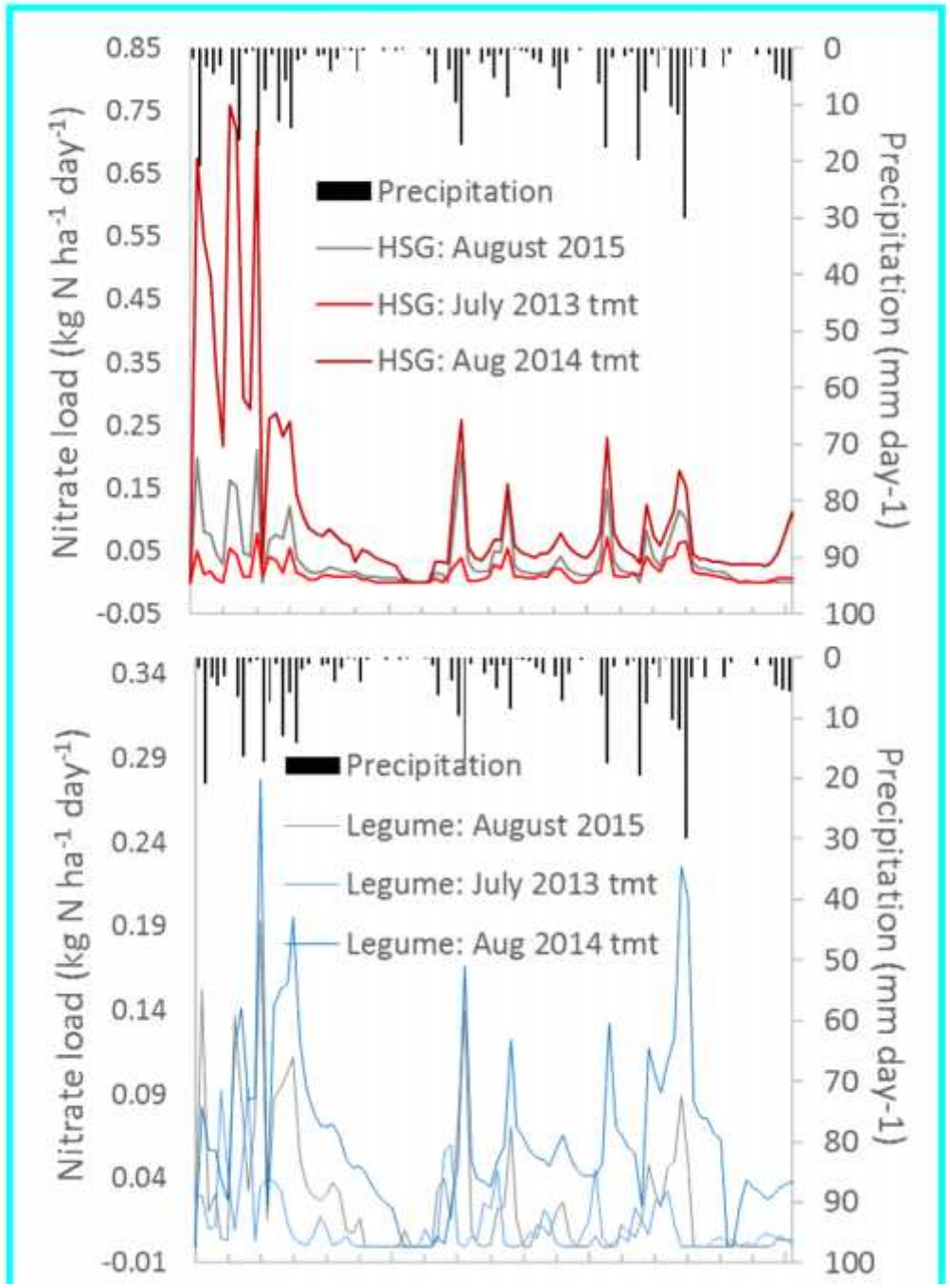
- **Leaching/runoff**
  - Nitrate and ammonium sensors in flumes
  - Need estimate of dissolved organic N, sediment bound N

- **Denitrification**
  - Based on measured EF for fertiliser, FYM, dung and urine
  - Will model using SPACSYS
  - Will measure N_2O from 1 catchment using EC (aerodyne)

- **Ammonia – country-specific EF for fertiliser and urine**

Nitrate runoff





Impacts of reseeding

High sugar grass
Catchment 8

Grass-clover
Catchment 2

System field-level N budgets (kg N ha^{-1})

	Baseline	PP	HSG	GC
N INPUTS	**161**	**217**	**196**	**180**
Fertiliser	110	166	138	99
FYM	31	31	38	40
N OUTPUTS	**61**	**105**	**106**	**104**
Beef	4	4	4	4
Lamb	1	2	2	3
Silage	56	99	100	97
N LOSSES	**42**	**52**	**53**	**46**
Leaching	6	6	11	8
Ammonia	7	8	8	8
Denitrification	30	38	34	30
BALANCE	**57**	**60**	**37**	**30**

Fate of the organic N?

Summary/conclusions

- The North Wyke Farm Platform provides an excellent facility for system-scale studies
- Little evidence yet of system N budget differences
- Increased N leaching in reseeding year
- Need to include housed period

Summary/conclusions

- **Significant 'gap' in the N balance**

Need better data on:

- **Denitrification**
- **Dissolved organic N in runoff/leaching**
- **N fixation**
- **N excretion**

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