Challenges and new developments in nutrient use efficiency: land and manure management

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Drivers for improved nutrient use efficiency

GLOBAL POPULATION IS SET TO RISE TO OVER

9.5 BILLION

BY 2050[1]

United Nations 2015

Drivers for improved nutrient use efficiency

GLOBAL POPULATION IS SET TO RISE TO OVER

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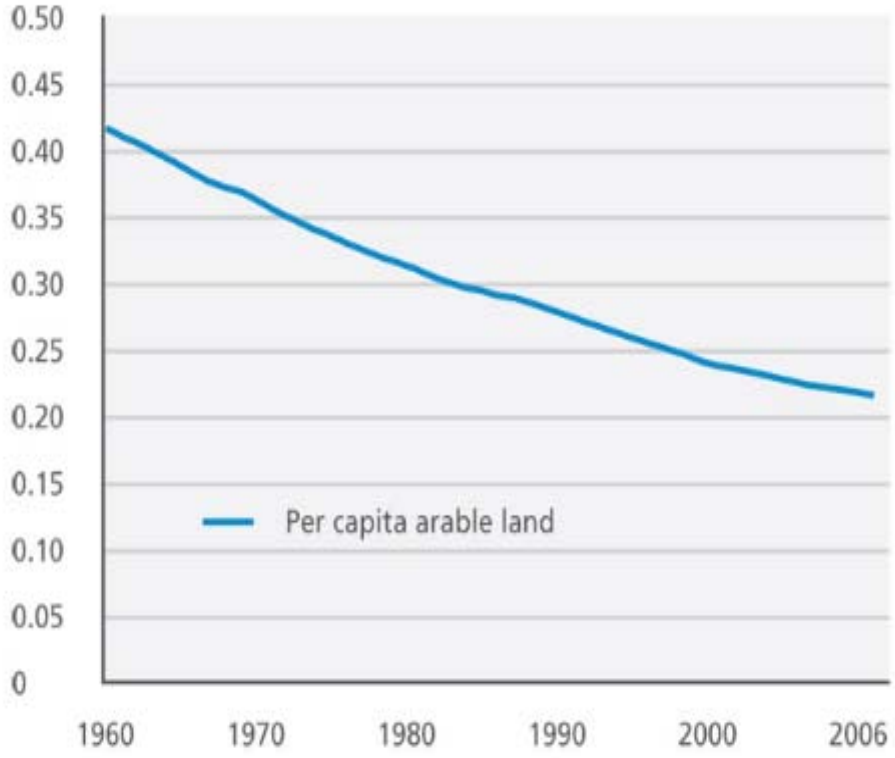
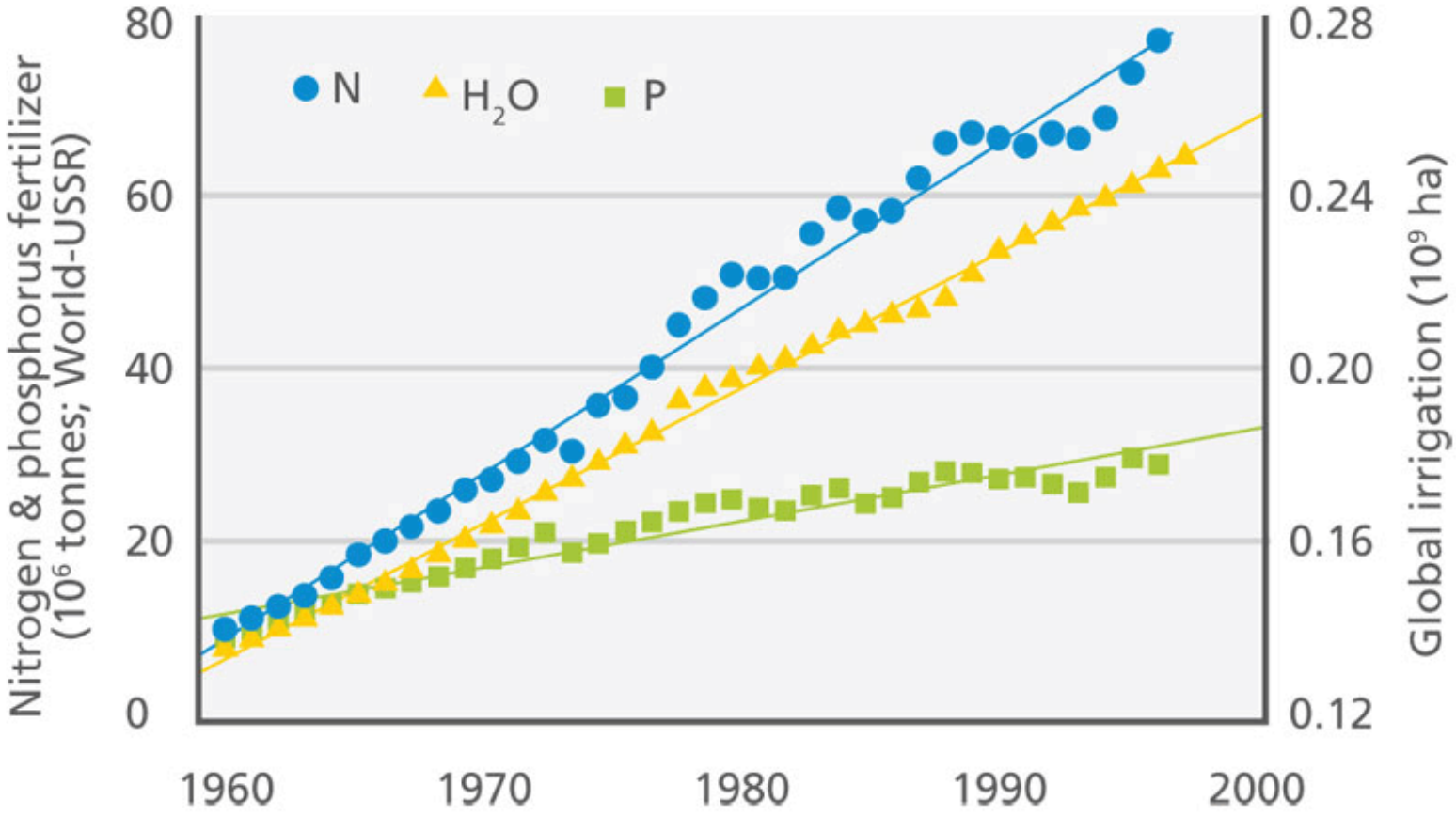


Increasing demand on land to support a growing population

United Nations 2015

Land Commodities Research 2010

Drivers for improved nutrient use efficiency



Inputs of N and P supported improvements in agricultural productivity

Drivers for improved nutrient use efficiency: Environmental

Assessing and Managing Agricultural Nitrogen Losses to the Environment

S. J. Smith, J. S. Schepers, L. K. Porter

doi:10.2134/jeq1998.00472425002700020004x

The Role of Phosphorus in the Eutrophication of Receiving Waters: A Review

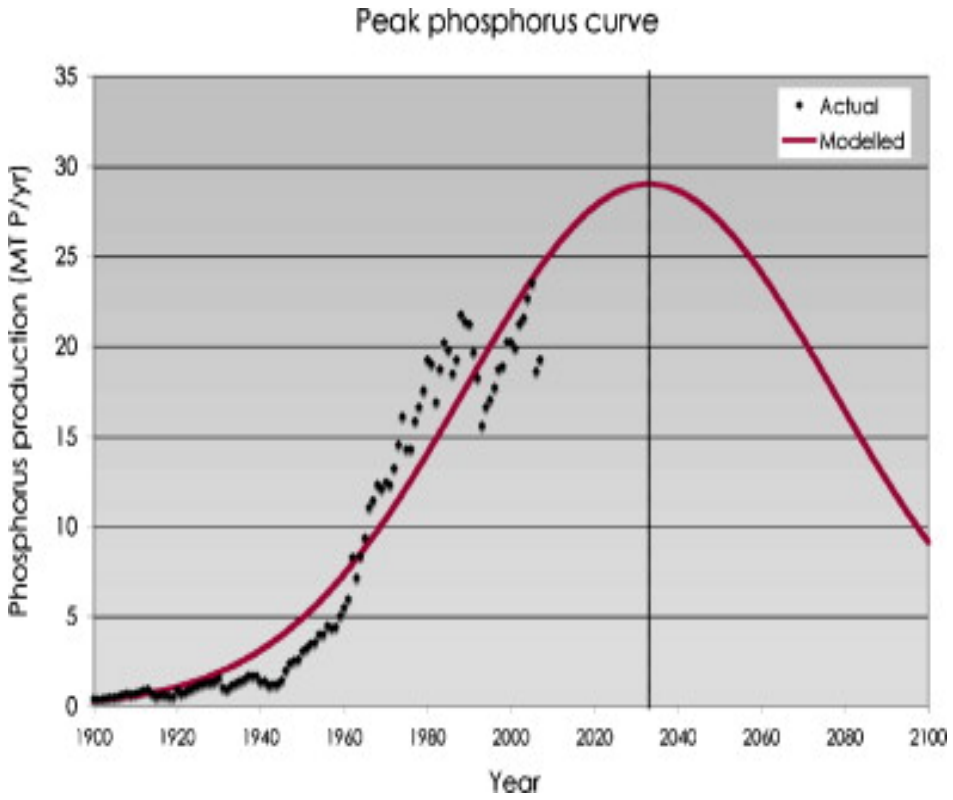
David L. Correll *

Global environmental impacts of agricultural expansion: The need for sustainable and efficient practices

David Tilman

Managing Agricultural Phosphorus for Protection of Surface Waters: Issues and Options

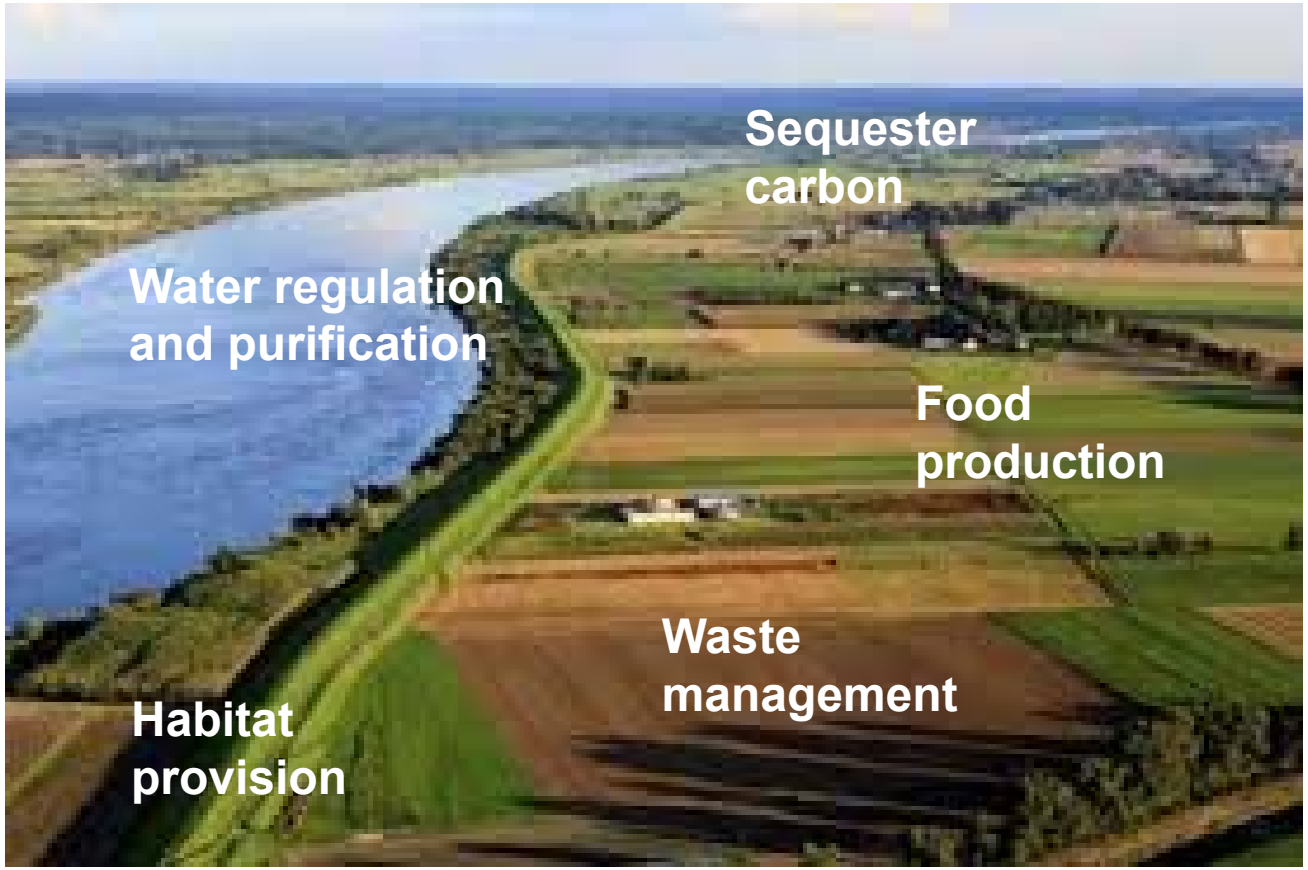
Andrew N. Sharpley *, S. C. Chapra, R. Wedepohl, J. T. Sims, T. C. Daniel and K. R. Reddy



Challenge: Increasing awareness of agricultural impacts on the environment alongside concerns over long term security of global fertiliser supply

Cordell et al. 2009

Drivers to improve nutrient use efficiency: Land management



Challenge: No longer managing land solely for agricultural production

Schulte et al. 2015

Drivers to improve nutrient use efficiency: Legislative

From 1990 increasing number of measures across Europe aimed at improving water quality:

- Nitrates Directive 1991
- Drinking Water Directive 1998
- Water Framework Directive 2000
- Nitrates Action Programme 2005+

- COGAP and QA incentives

The Telegraph

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Bavarian farmer puts nappies on his cows in EU protest

Bavarian farmer puts nappies on his cows in anger at EU nitrates directive that bans fertiliser on any mountain slope with a gradient of more than 15 per cent

3K 448 0 2 3K Email

Farmer Johann Huber presents his cows Ami (left) and Doris, in a diaper, in Gmund am Tegernsee, Germany Photo:

Challenge: Increasing regulatory mechanisms aimed at improving nutrient use efficiency

Drivers to improve nutrient use efficiency: Social

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Science & Environment

Beef environment cost 10 times that of other livestock

Environmental Issues > Water Main Page > All Water Documents

Pollution from Giant Livestock Farms Threatens Public Health

Waste lagoons and manure sprayfields -- two widespread and environmentally hazardous technologies -- are poorly regulated.

theguardian

Winner of the Pulitzer prize

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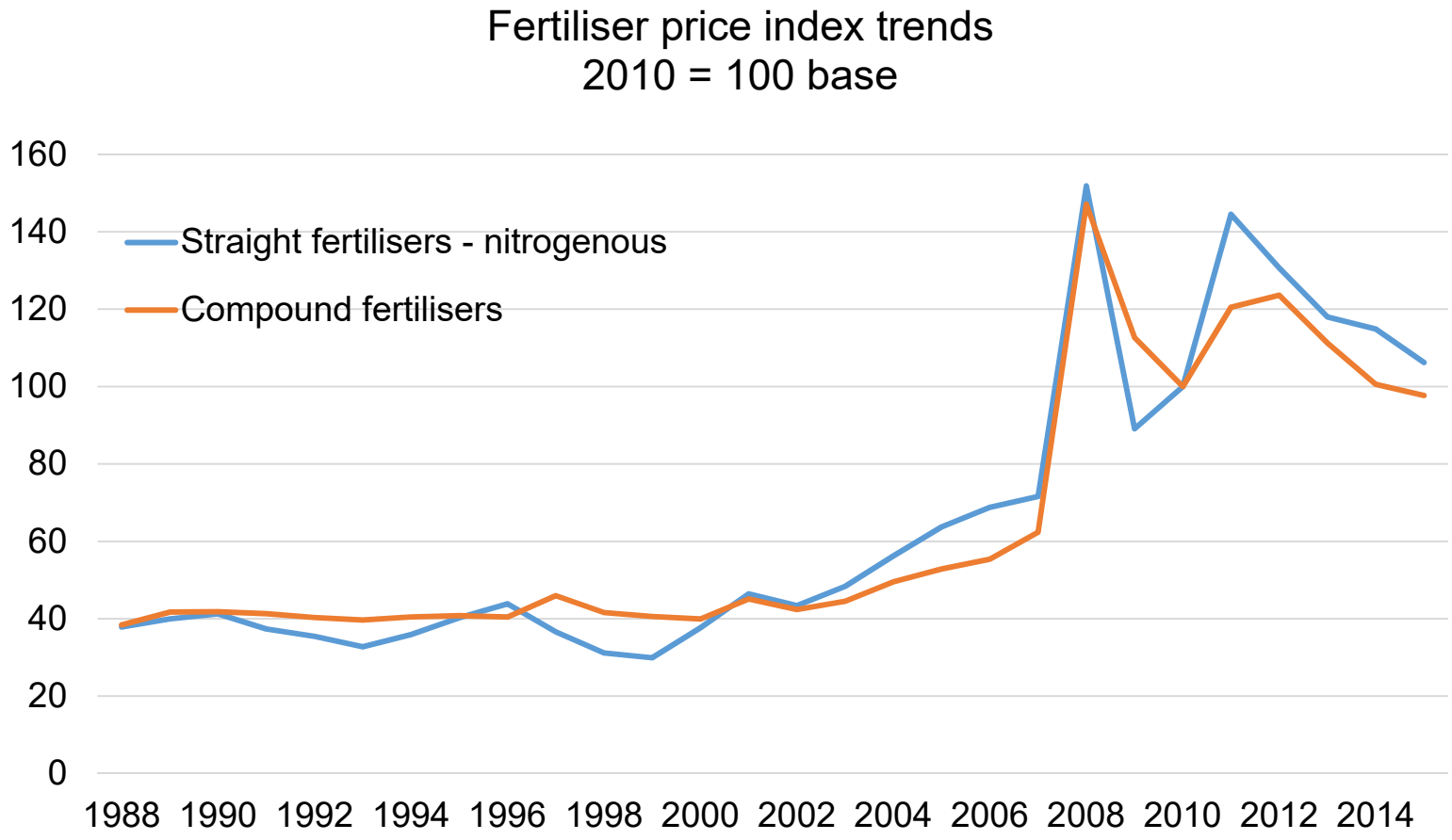
UN urges global move to meat and dairy-free diet

Challenge: Greater public demand for environmentally conscious food production

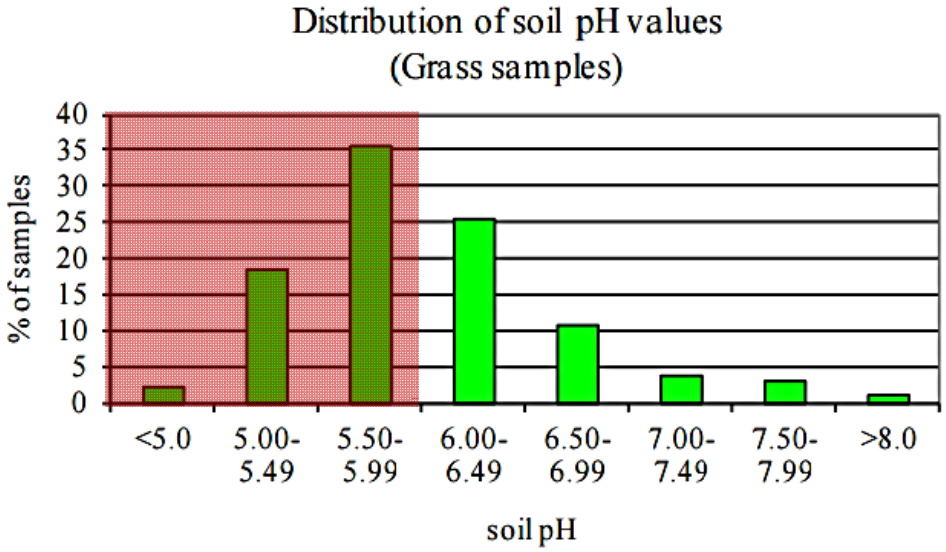
AHDB DAIRY

Drivers to improve nutrient use efficiency: Economic



Challenge: Increasing volatility in fertiliser prices placing pressure on farm profitability

Trends in nutrient management on grassland farms in GB



57% of grassland soils below pH 6.0

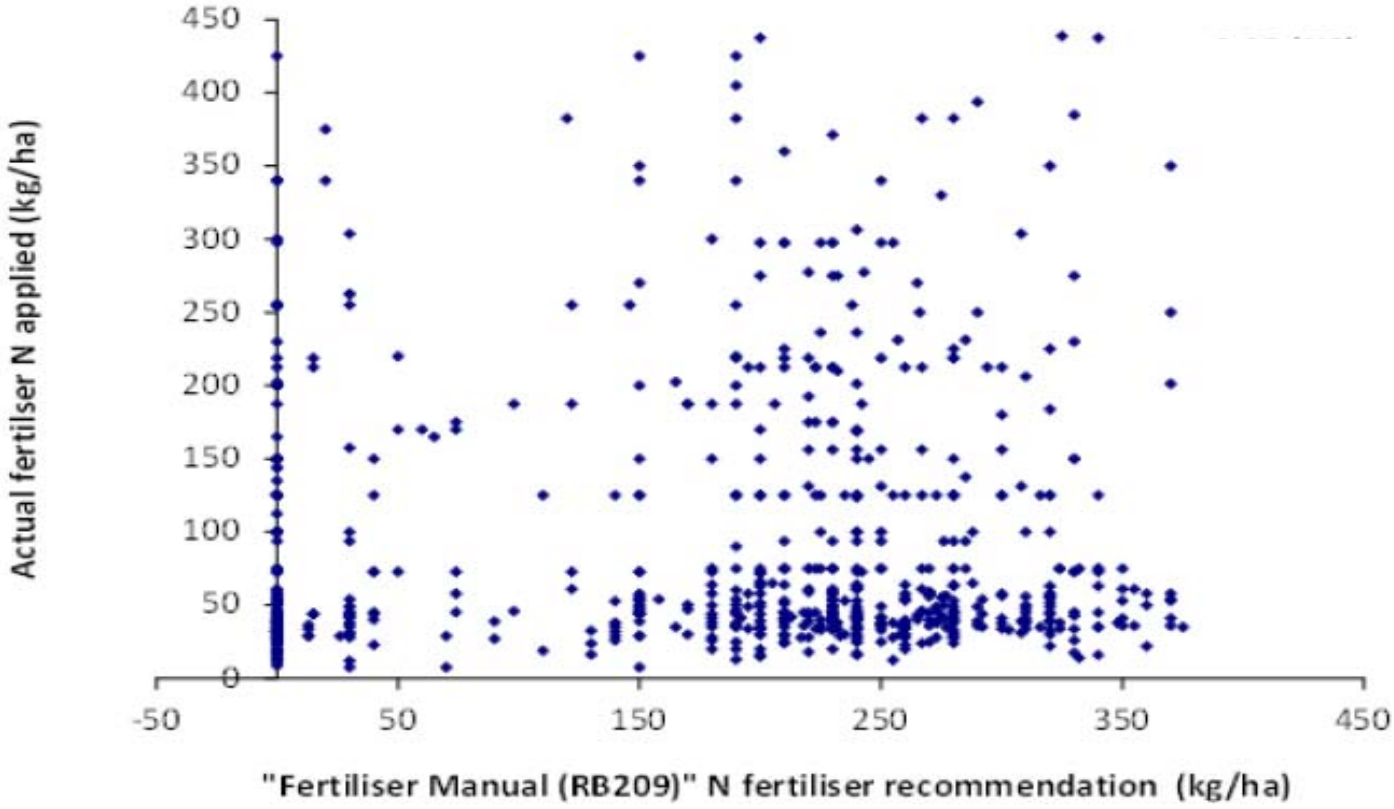
Only 9% of soils at target for P and K

	P Index		
K Index	<target	target	>target
<target	19	13	9
target	10	9	9
>target	7	10	15

Challenge: Messages on good nutrient management haven't changed but there remains a lack of uptake on farm

PAAG Report, 2014

Trends in nutrient management on grassland farms in GB



Challenge: Messages on good nutrient management haven't changed but there remains a lack of uptake on farm

Newell-Price et al. 2014

Challenges

- Greater fluxes of N and P in agriculture – negative effects on environment
- Increased legislative and societal pressure to improve nutrient use efficiency
- Increasing volatility in input prices and concerns over long term fertiliser reserves

Opportunities

Using the latest R&D and technology

Knowledge exchange opportunities

1. Soil
2. Nutrient

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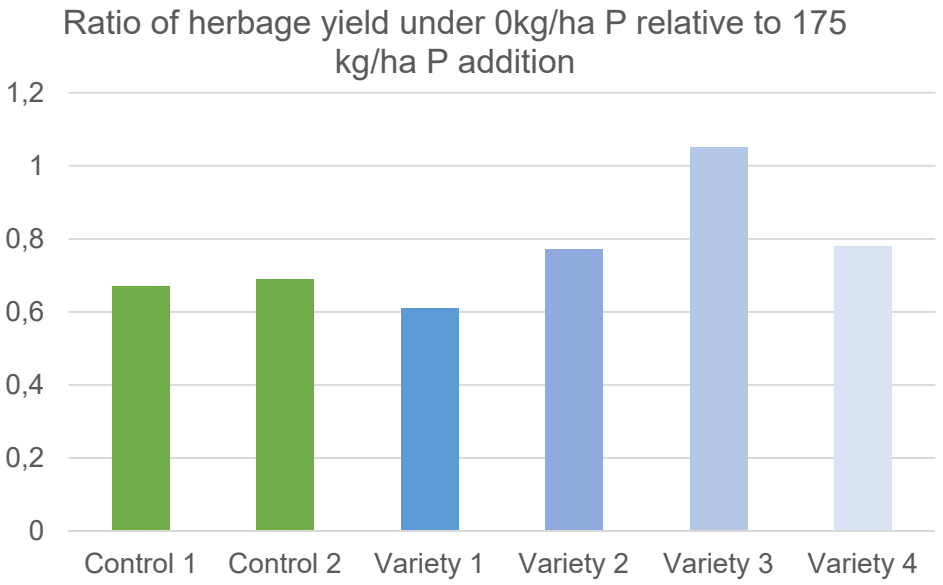
Breeding programmes – nutrient efficient forages

- Breeding programme to improve NUE and PUE in grass-clover swards

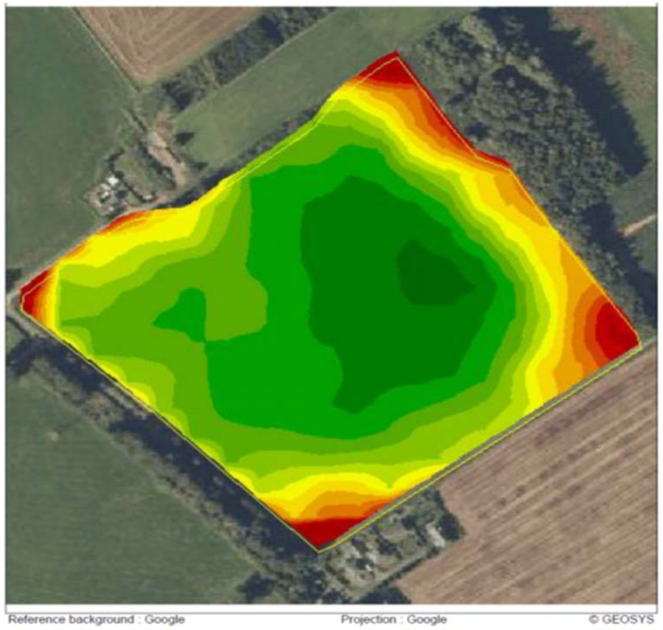
- Clovers from low P environments can improve yields of grass + clover under 0 P fertilisation

Opportunity: Further integration of nutrient efficiency traits into breeding programmes



Lloyd et al. 2014, Breeding LINK Project

Technology development – grassland productivity



Within field variation in grass dry matter (DM) in a grassland silage field

	DM yield t/ha	
	Mean	Range
First cut silage	3.7	1.1 – 6.3
Second cut silage	4.1	2.3 – 5.4
Third cut silage	2.4	1.1 – 4.0
Total yield	10.2	6.8 – 13.2

Opportunity: Development of technology for measurement of grass biomass and nutrient offtake

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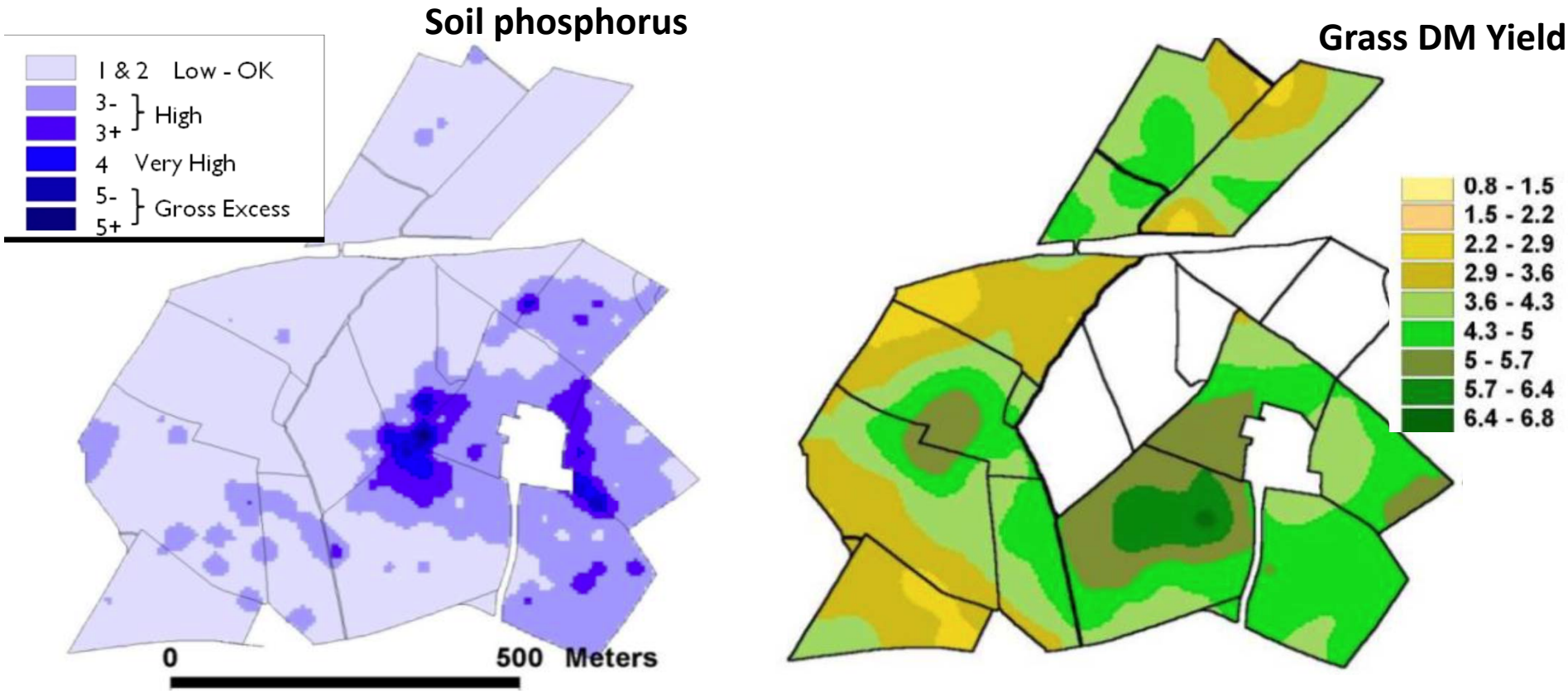
AHDB Dairy Precision Farming Project (SRUC, 2013)

Technology development – nutrient distribution across grassland



Opportunity: Development of variable rate application technology for grassland

Bailey et al. 2015

Technology development - nitrogen sensors

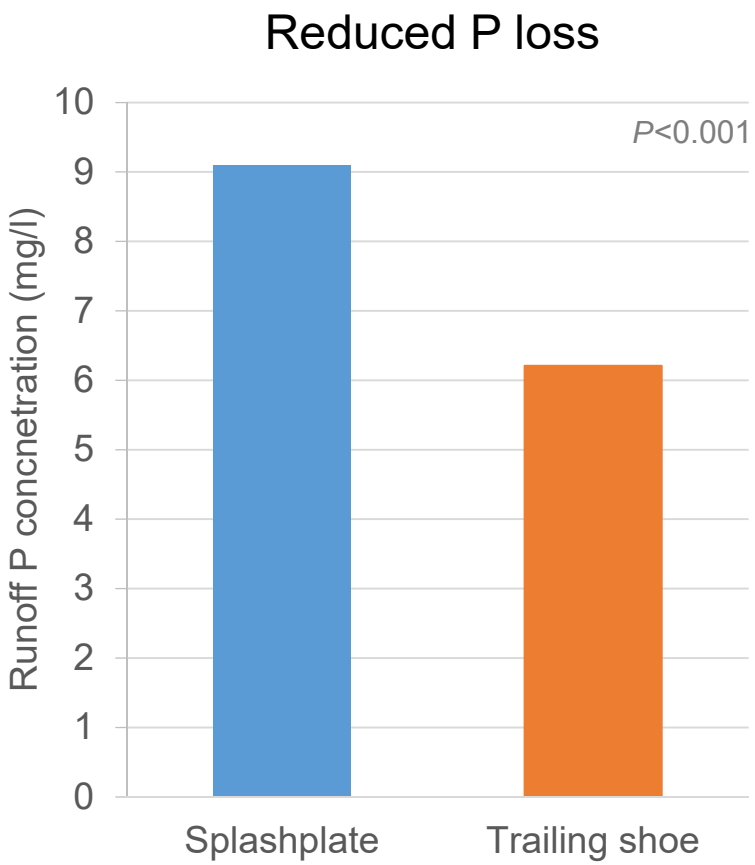
- Development of sensor capacity for better measure of:
  - Growth patterns
  - Nutrient uptake

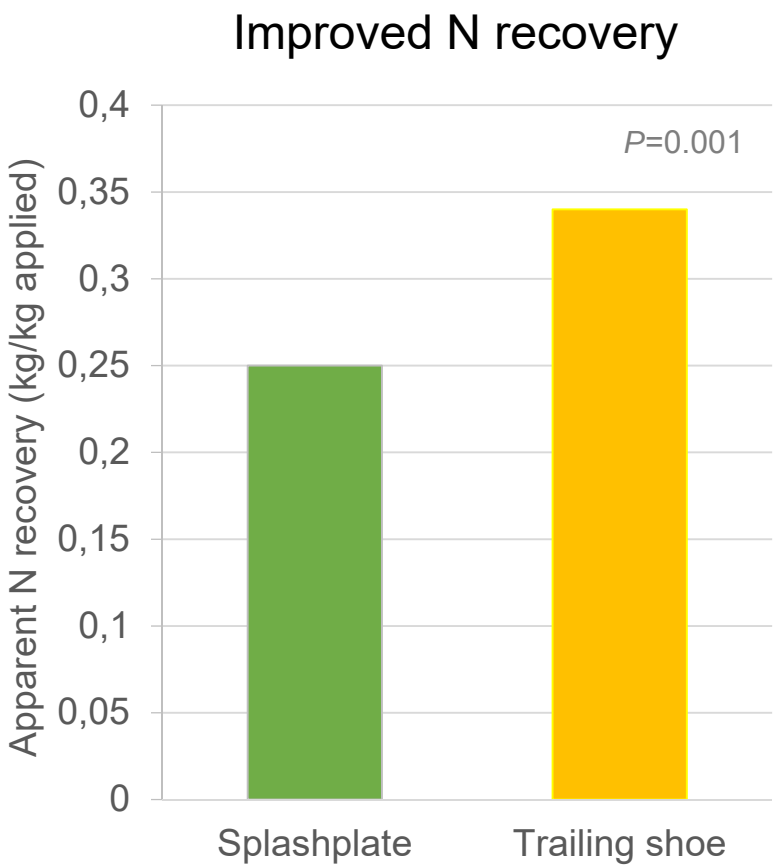
- Need to address:
  - Spatial variability across fields
  - Robustness of sensors
  - Cost-benefit

Opportunity: Development of sensors and decision support tools to optimise timing and uptake of nutrients

Shaw et al. 2015

Technology uptake – manure application





Opportunity: Low emission slurry spreading techniques reduce nutrient loss and improve nutrient use efficiencies

McConnell et al. 2011, Lahlor et al. 2011

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Knowledge exchange - Soil

- 70% of grassland soils exhibiting signs of compaction in England and Wales

- Yield losses of 20 – 30% caused by compaction from animal treading and machinery traffic

- Also impacts on nutrient use efficiency

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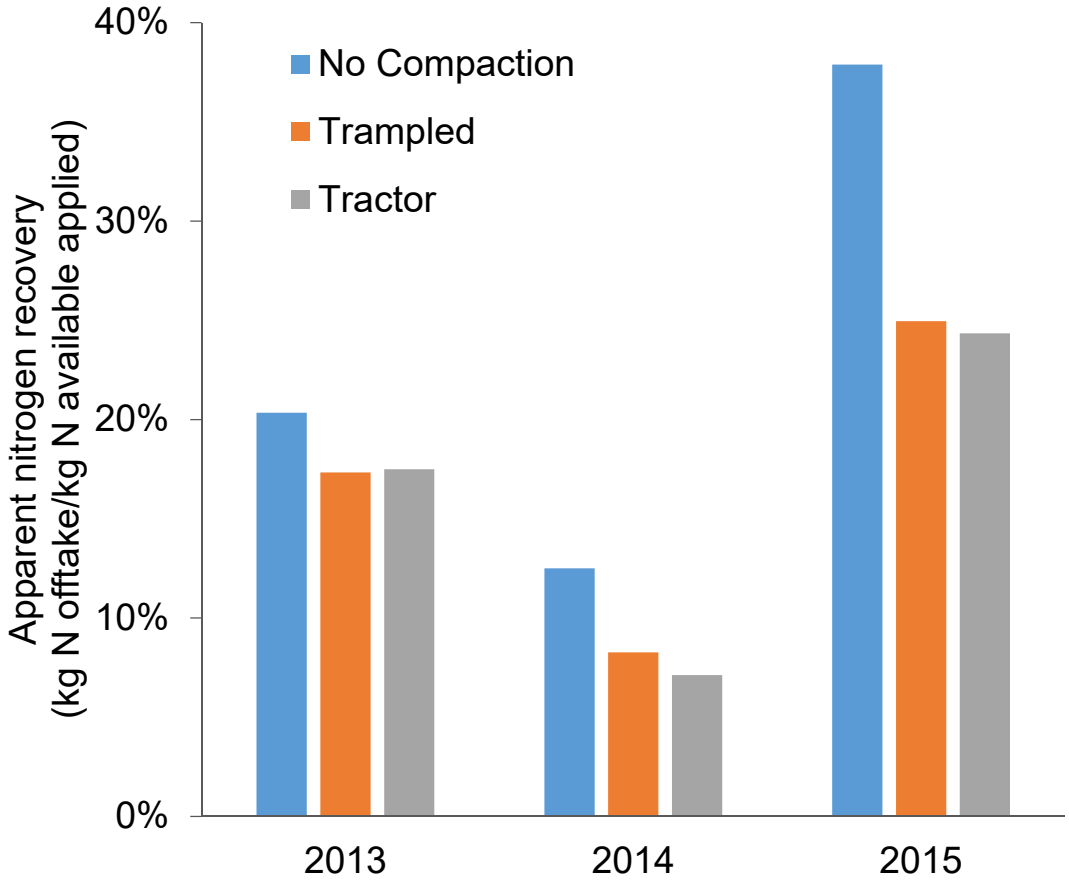
AHDB Dairy Soil Compaction Project 2016
Newell-Price et al. 2013

Knowledge exchange - Soil

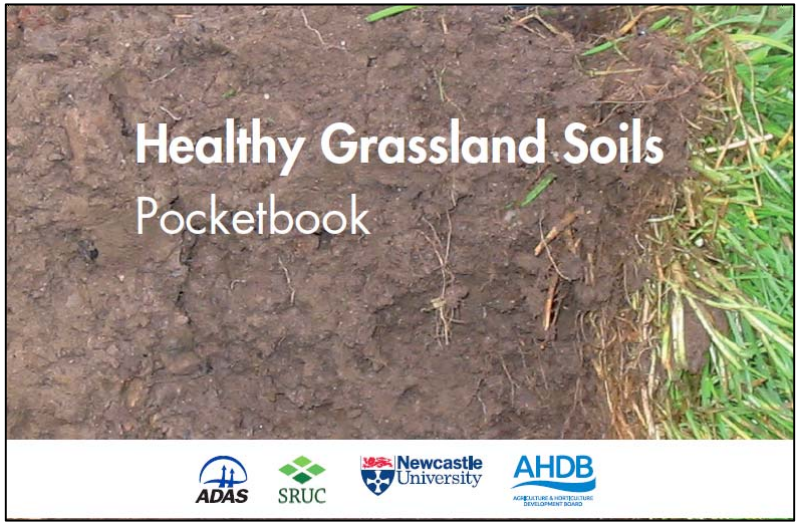
	Nitrous oxide flux (g/ha)
No compaction	89.3
Tractor	122.1
Animal	96.7

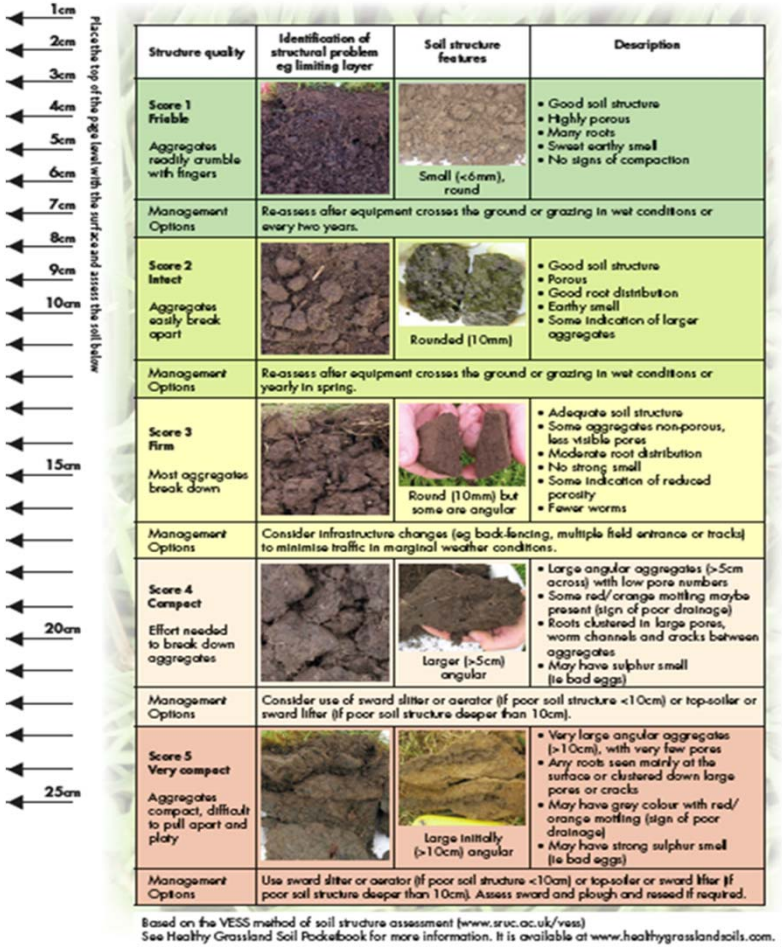


Improving soil structure reduces gaseous N losses and increases N recovery

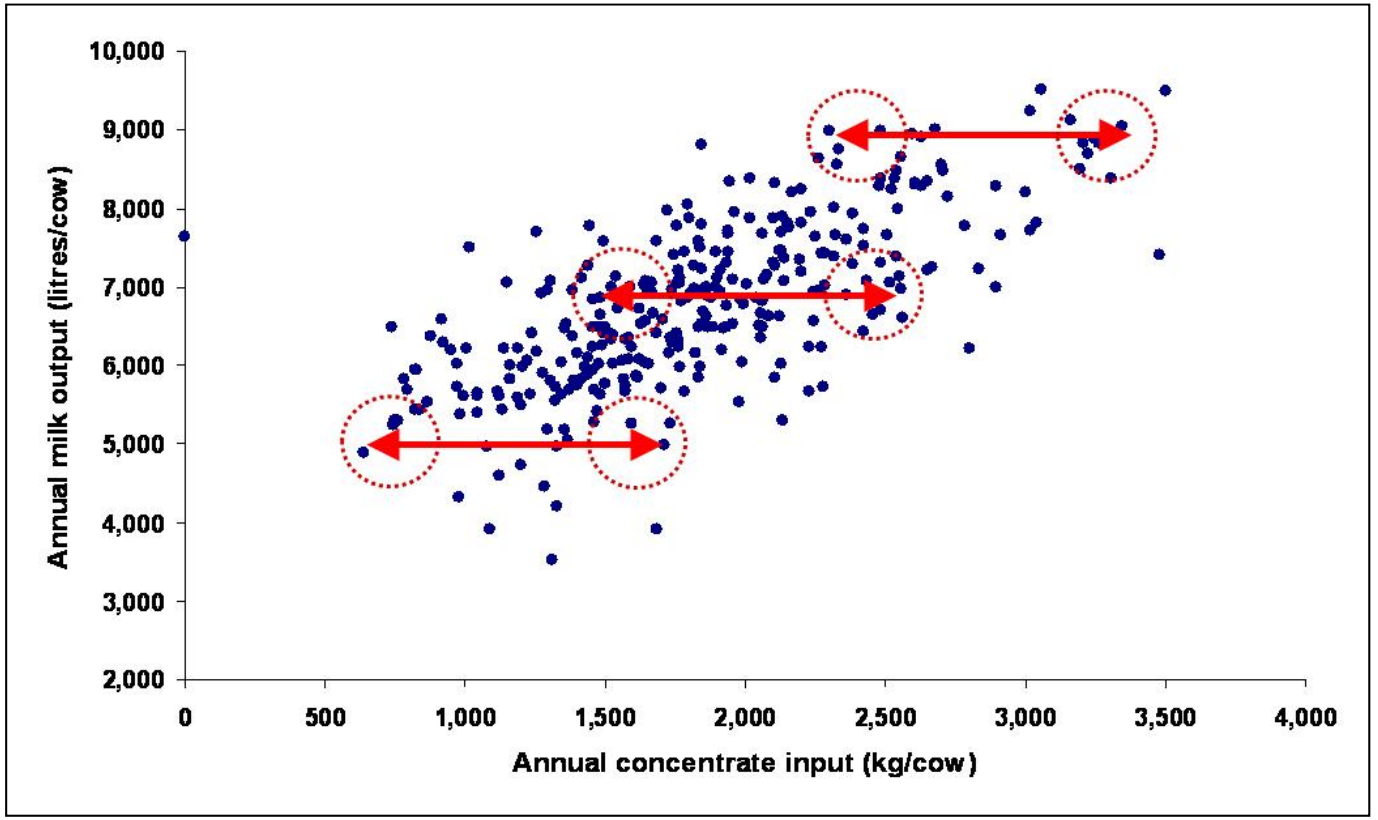
AHDB Dairy Soil Compaction Project 2016

Knowledge exchange - Soil





Knowledge exchange – Improving forage efficiency



Wide range in concentrate input and milk from forage across farms in N.I.

Dale et al. 2015

Knowledge exchange – improving forage efficiency

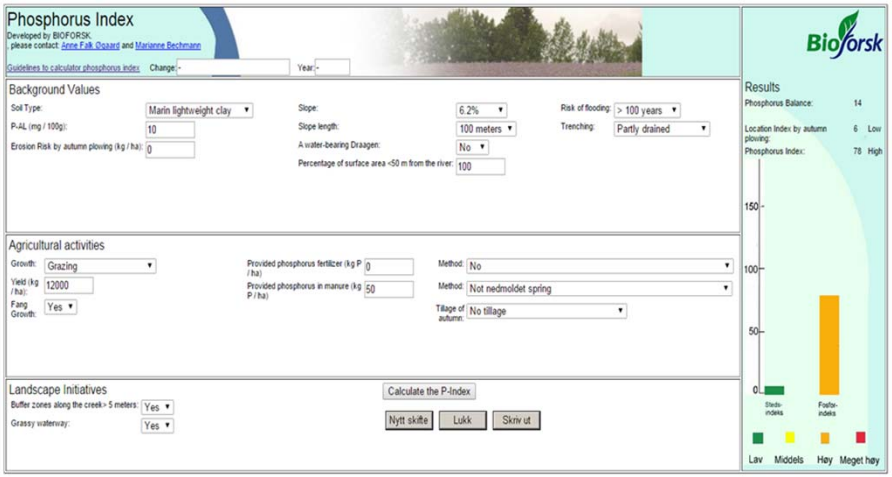
Yield (litres per cow per annum)	Calculated P balance on benchmarked dairy farms (kg P per ha)	
	Most efficient	Least efficient
6000 – 7000	3.6	12.6
7000 – 8000	6.4	16.5
8000 – 9000	9.0	17.9
9000 - 10000	12.7	19.8

Opportunity: Better utilisation of forage improves P use efficiency, regardless of system

Ferris et al. 2015

Knowledge exchange – Nutrient management

Norway: Land management DST to determine risk of P loss



Netherlands: Phosphorus efficiency benchmarking tools

	P efficiency (%)
My farm:	
Current	26.5
Increased grazing	33.7
Other farms:	
In my region	29
Similar system	32
2013 target	31

YouTube

AgroTechnologyATLAS

ATLAS of technologies | ATLAS of biomasses | Knowledge base

Separation

DAIRYMAN

Opportunity: Sharing of decision support tools and expertise across European countries

AHDB DAIRY

Summary

- Considerable societal and policy pressure to improve nutrient efficiency in livestock production systems.

- Need to use breadth of tools in armoury to improve NUE on farms – simple nutrient management messages (back to basics) to cutting edge technology.

- Greater sharing of research findings and knowledge transfer expertise across European countries is key.

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