Smart farms for the future

Bob Rees,
SRUC, Edinburgh, UK

Leading the way in Agriculture and Rural Research, Education and Consulting

TRUE General Assembly meeting, Athens, 16-20 April 2018

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Legumes in European agriculture

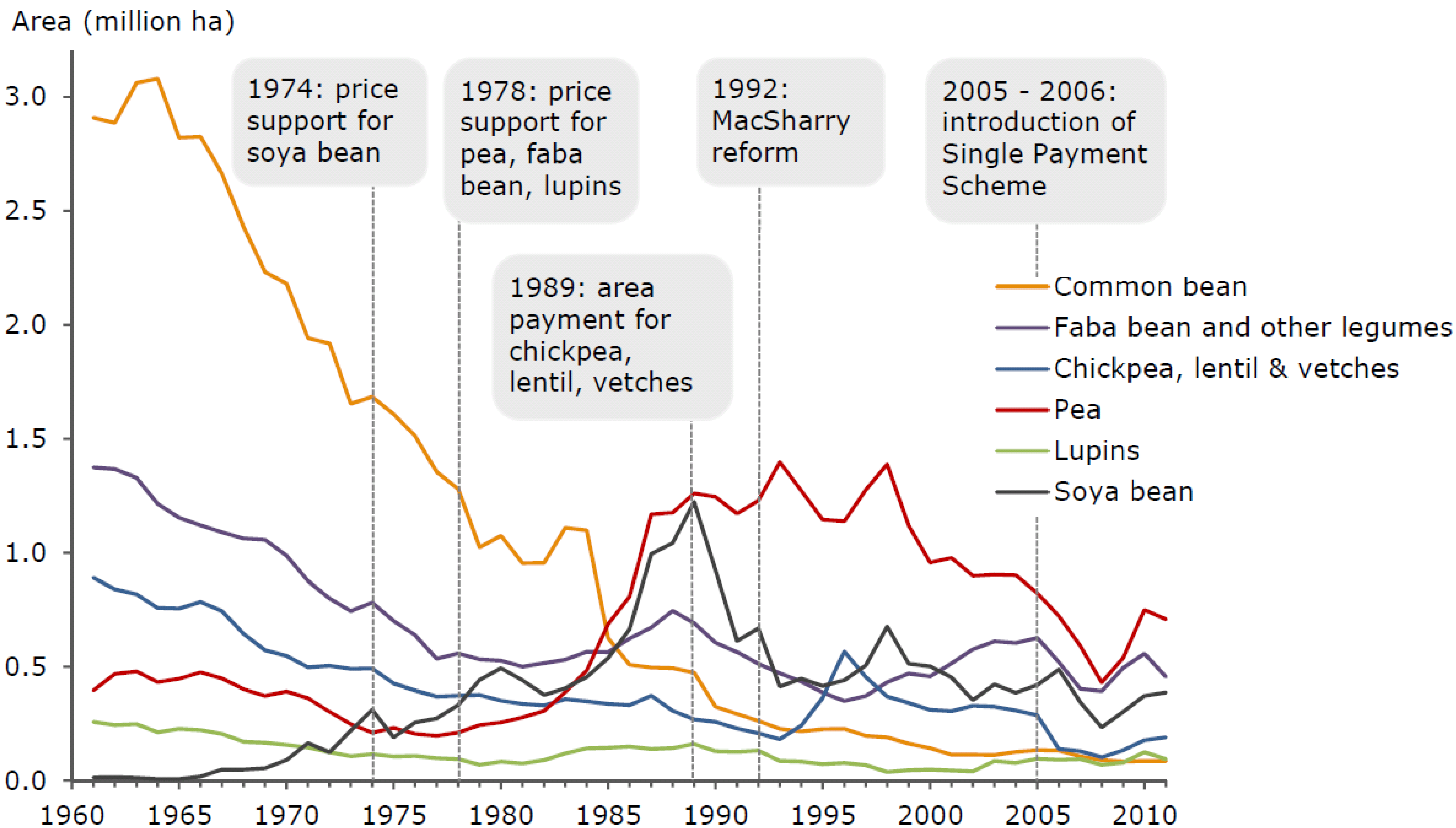
SRUC

- In 2013 grain legumes were produced on 1.8 M ha of land (less than 2% of the arable area)
- Grain legume production has shown a continuing decline in Europe over the past 50 years despite increasing consumption
- The inclusion of legumes within farming systems provides a wide range of benefits

- *What is the problem?*

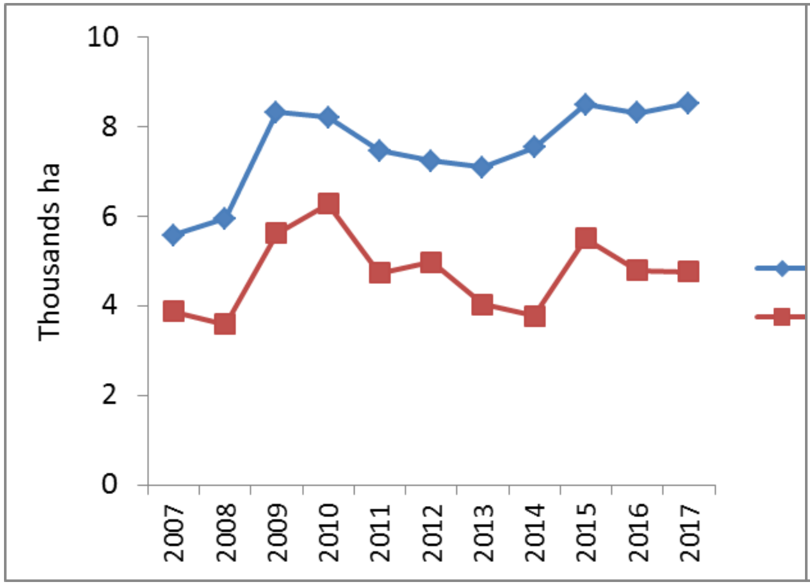
Changes in areas planted with selected European legume crops

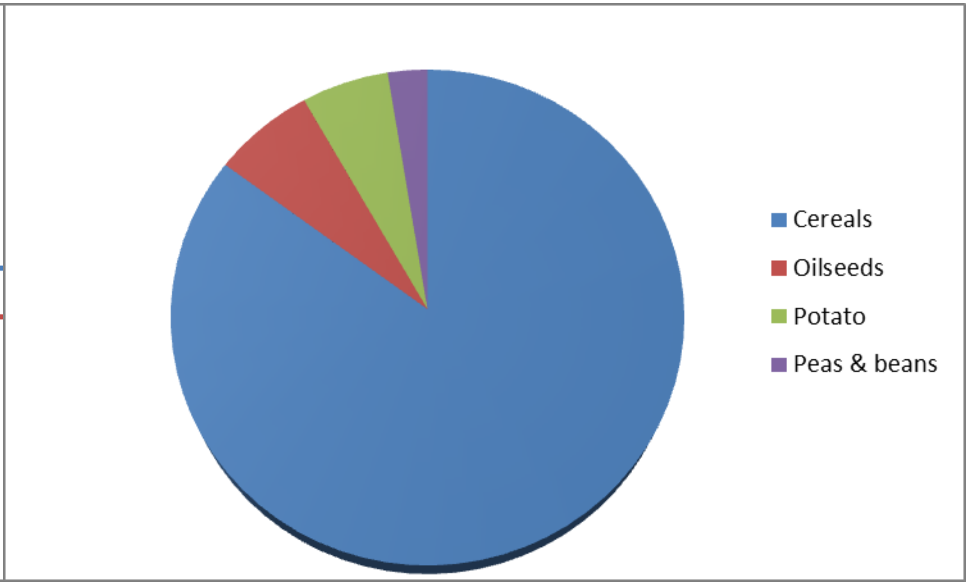
SRUC



FAOStat, 2013

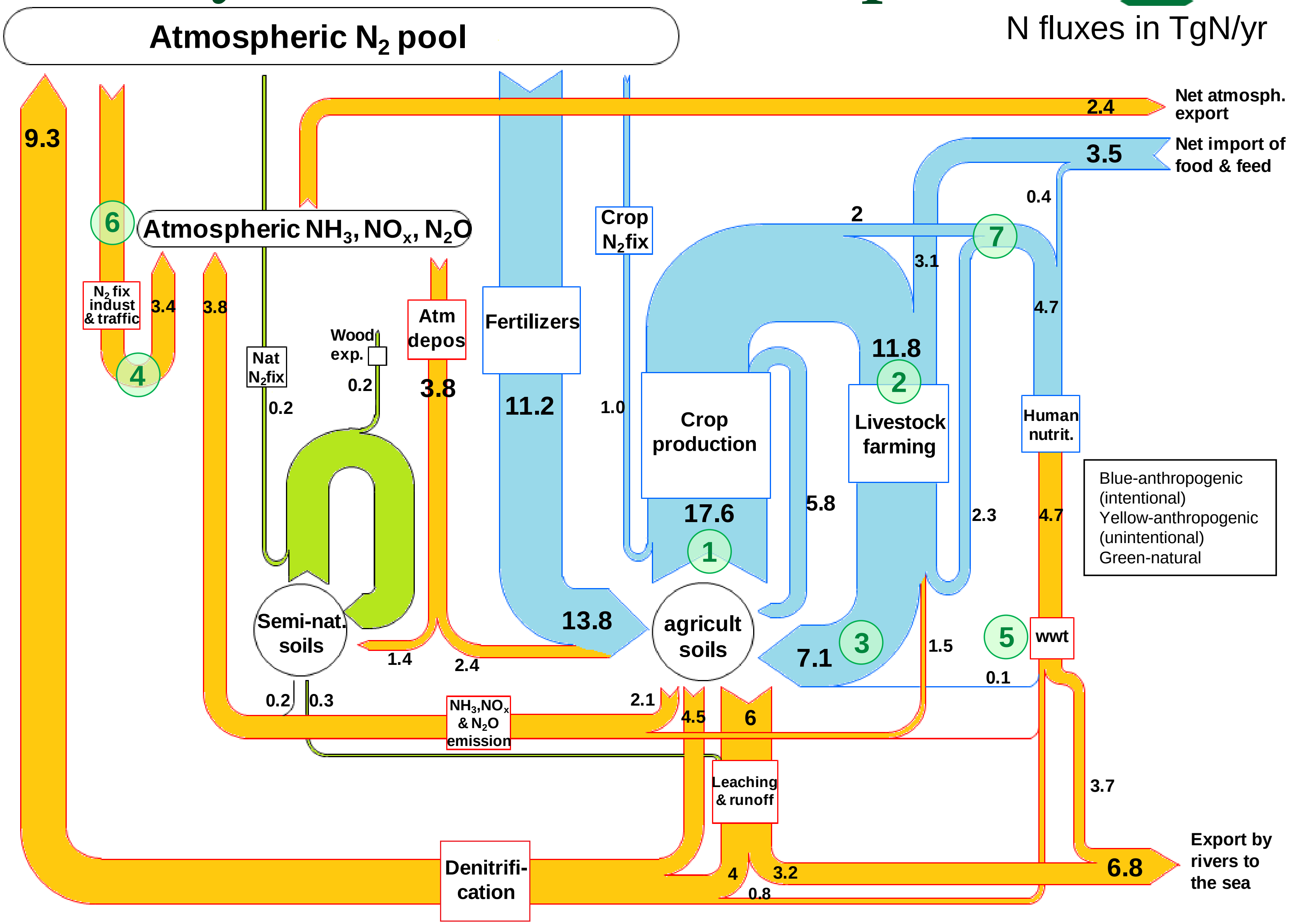
Scottish cropping





Summary of N flows in Europe

N fluxes in TgN/yr



Sutton et al 2011, European Nitrogen Assessment

European Strategy for the promotion of Protein Crops

- It is time to implement a major strategic European vegetable protein supply plan based on the sustainable development of all the crops grown throughout the EU
- This change implies a substantial alteration of our production systems to meet the requirements of the circular economy and of agroecology

Report by the EU’s Committee on Agriculture and Rural Development, 2017

Barriers to increased legume cultivation in Europe

SRUC

•**Some reflections from the Legume Futures Community**

- Yield stability and cost
- Lack of understanding of long-term benefits vs short-term gain
- Lack of adapted cultivars - Winter-hardy, autumn-sown crops desired in Oceanic, Boreal and Continental. Earliness needed in grain legumes for Mediterranean, Boreal and Oceanic
- Different crops suit different soil types, but this conflicts with feed industry's desire for uniformity
- Need for knowledge exchange

The need for smart solutions

- Develop an integrated understanding of the social, economic and environmental impacts of legume supported cropping
- Develop improved supply chains
- Develop locally tailored solutions

Crop rotation comparisons (selection)

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Country, Region	Non-legume rotation	Gross margin (Euro)	N leaching (kg/ha)	N_2O (kg/ha)	Legume rotation	Gross margin change	Leaching change	N_2O change
Romania	Rapeseed Maize Wheat	432	13	3.5	Soybean Maize Wheat Rapeseed	+86	+1	-0.7
Sweden	Rapeseed Wheat Linseed Wheat S barley	644	34	3.7	Rapeseed Wheat Fababean Wheat S barley	-51	0	-1.3
Germany	Rapeseed Wheat S barley	130	28	4.7	Rapeseed Wheat Rye Rye Pea	-19	-8	-1.2

Zander et al, 2014

Scotland

Rotations	GM without all pre-crop effects	add. revenue pre crop effect		GM with all pre-crop effects
		winter rape	legume	
	[€/ha]	[€/ha]	[€/ha]	[€/ha]
winter rape - winter wheat - spring barley - spring barley - spring barley	390	38		428
winter rape - winter wheat - spring oat - winter wheat - spring barley	380	38		417
winter wheat - spring barley - spring oat	285			285
winter rape - winter wheat - faba bean - winter wheat - spring barley	355	38	38	430
winter rape - winter wheat - spring barley - pea - winter wheat - spring barley	350	31	31	413

Zander et al, 2014

Utilising biological N fixation

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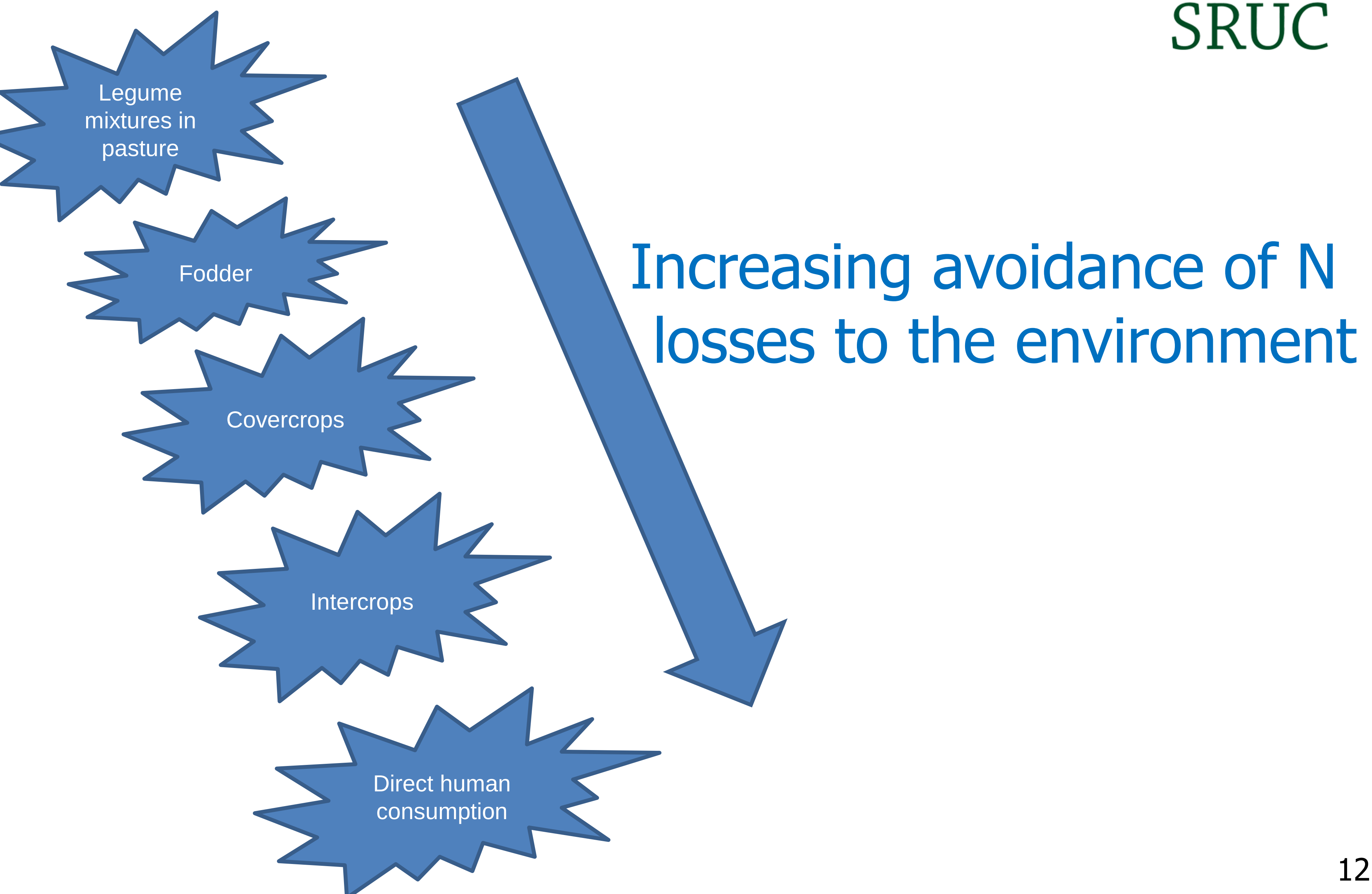
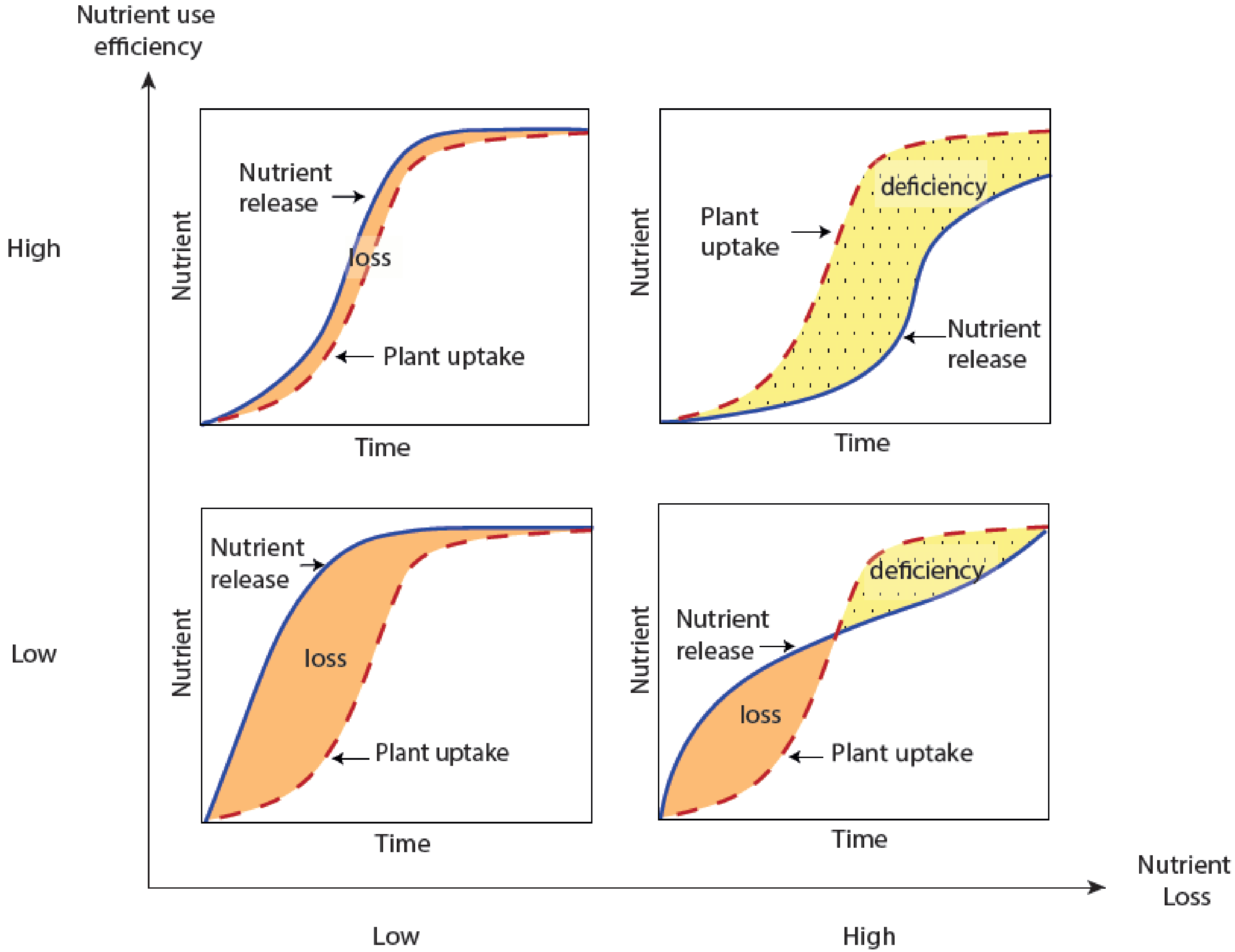


N transfers from crop mixtures



Legume forages have a high but variable N content

Black Medic *(Medicago lupulina)*	White Clover *(Trifolium repens)*	Trefoil *(Lotus pedonculatus)*
3.8% N	*3.9% N*	*5.4% N – high tannins*
		

Nitrous oxide losses from forage mixtures

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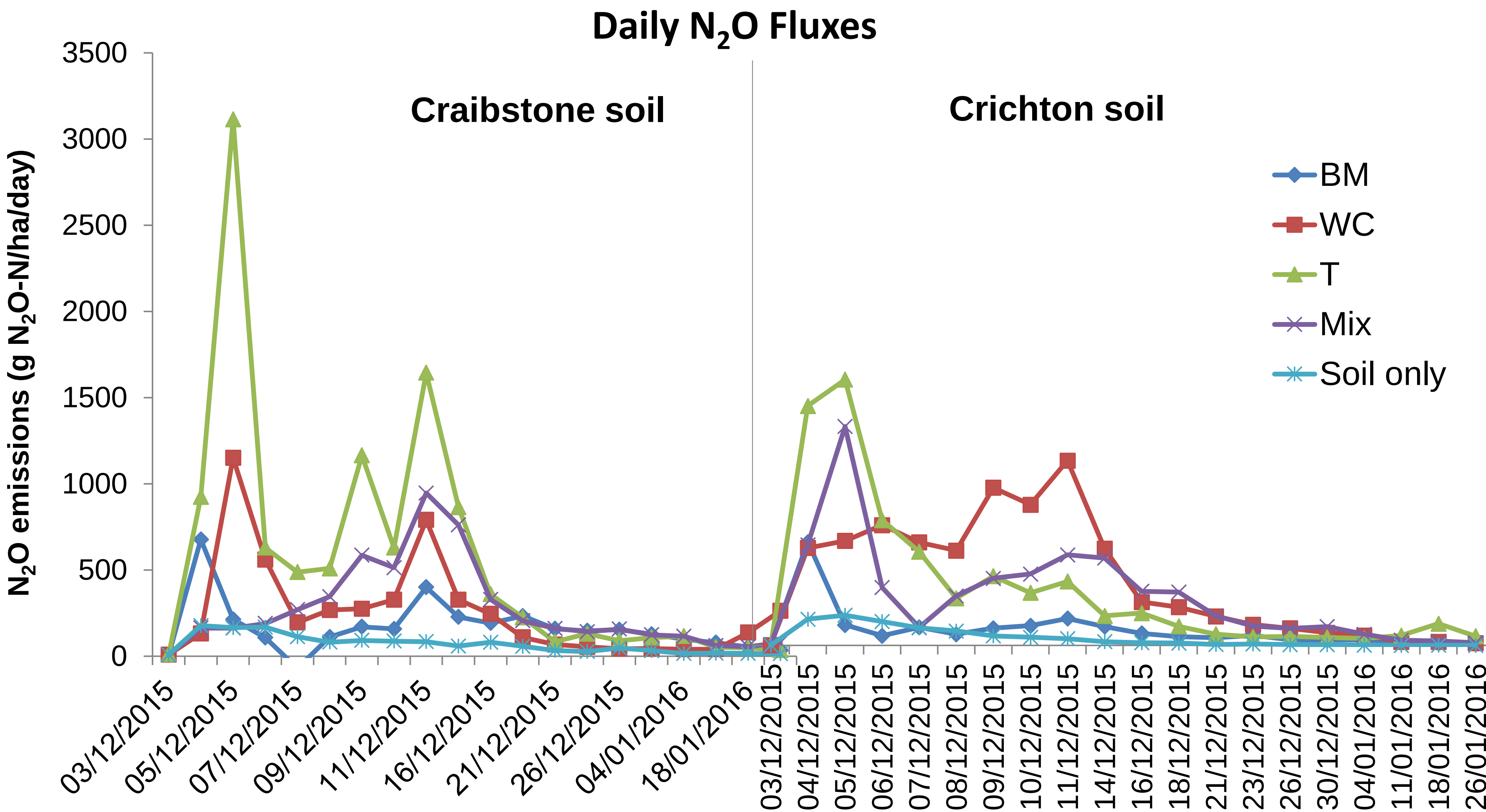
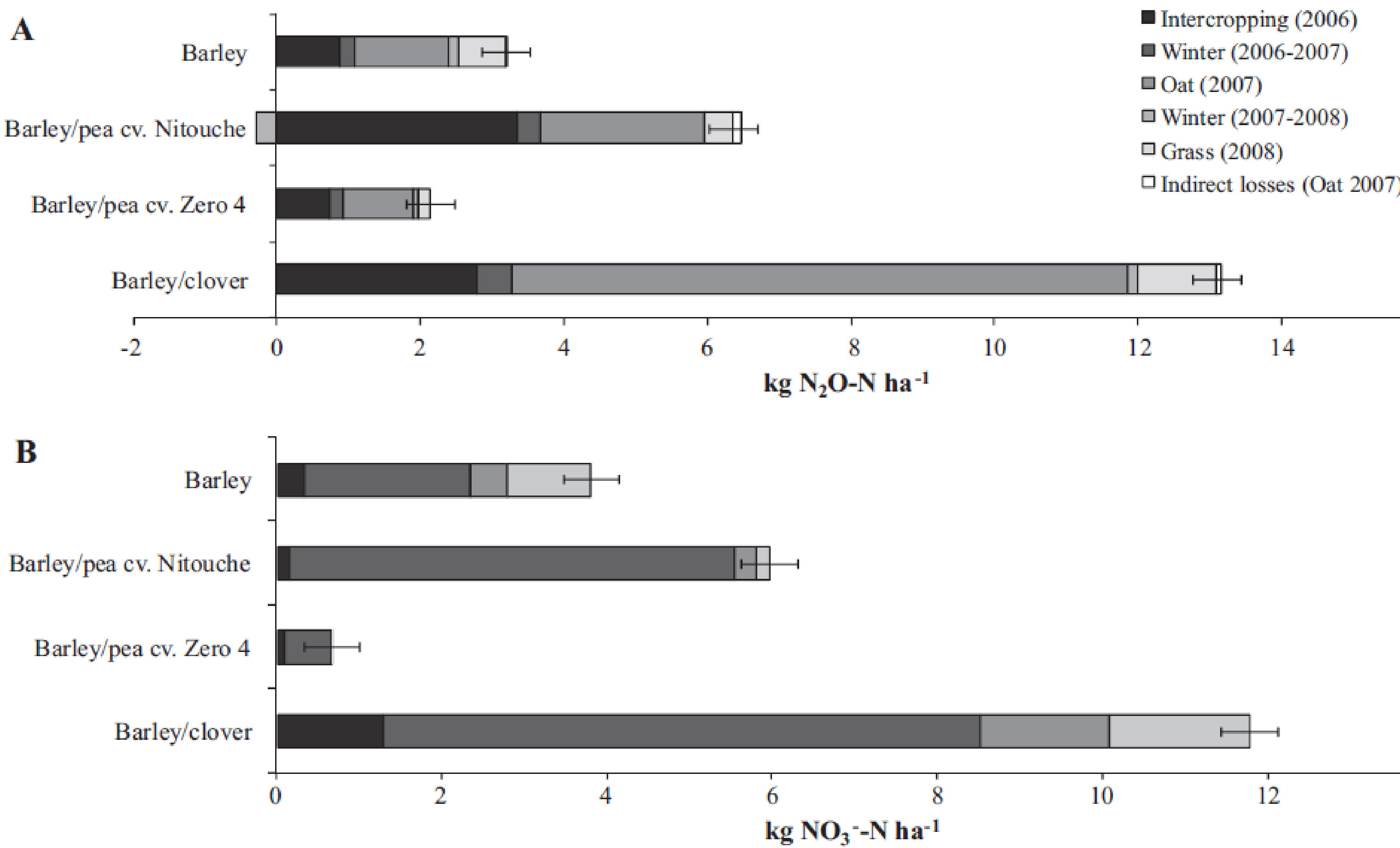


Cloy et al, unpublished

Intercropping

- Offers benefits of increased resource use efficiency, reduced nutrient loss and disease burdens
- But the choice of crop mixtures and their management can have a big impact on the outcomes

N losses from a legume-cereal intercrop



Pappa et al, 2011

Case Study 4:Legumes and leguminous by-products within dairy farming systems

High Production merit UK Average merit

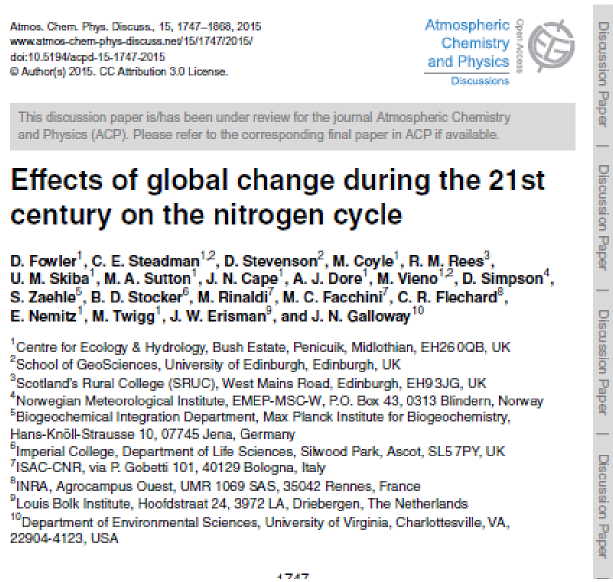
By-product feeds
Housed

Homegrown feeds
Grazing

Parameters	Units	
On and off farm land use	ha	ha /LSU
Harvest	tonnes/ha	DM %
Milk yield	litres/cow	litres/ha
Protein & Butterfat	%	
Dry matter intake	kg / cow	
Live-weight	kg / cow	
Sprays & Fertilisers	kg / ha	litres/ha
Purchased feed & bedding	tonnes FW	Dry matter %
Nitrogen surplus	kg/litre	kg/litre ECM
Carbon footprint	kg CO2 e / kg output	

- By-product system feed components are imported onto the farm
- Home-grown system feeds are provided by crops grown on the farm
- Leguminous products represent 10% of the by-product ration and include soya bean meal.
- Legumes grown include spring beans, red clover and lucerne (alfalfa), accounting for up to 15% of the ration.

Future of the global N cycle



Atmos. Chem. Phys. Discuss., 15, 1747–1868, 2015
www.atmos-chem-phys-discuss.net/15/1747/2015/
doi:10.5194/acpd-15-1747-2015

Atmospheric Chemistry and Physics
Discussions

Effects of global change during the 21st century on the nitrogen cycle

D. Fowler[1], C. E. Steadman[1,2], D. Stevenson[2], M. Coyle[1], R. M. Rees[3], U. M. Skiba[1], M. A. Sutton[1], J. N. Cape[1], A. J. Dore[1], M. Vieno[1,2], D. Simpson[4], S. Zaehle[5], B. D. Stocker[6], M. Rinaldi[7], M. C. Facchini[7], C. R. Flechard[8], E. Nemitz[1], M. Twigg[1], J. W. Erisman[9], and J. N. Galloway[10]

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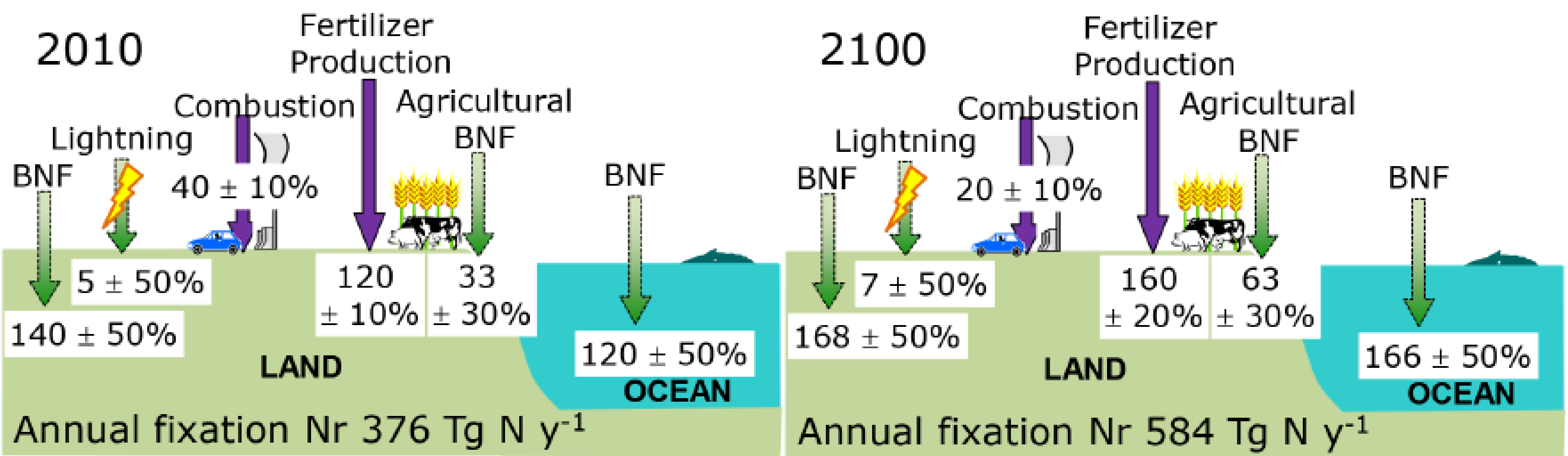

BNF – Biological Nitrogen Fixation

Fowler et al , 2015

Conclusions

- There is an urgent need to increase legume production in Europe
- To achieve this we need to understand social, technical and economic barriers
- Solutions will involve innovation in the supply and processing of legume products by development of innovative new production pathways
- TRUE is well placed to support this process