



Grassland Intensification And Inevitable Tradeoffs Between Multiple Ecosystem Services

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Challenges and Opportunities

Production Targets

- 2025:Global food production \$\to\$50\%
- 2020: N. Ireland production 160%

EU Legislation Commitments

• 2030: EU GHG emissions 40%

29% of Northern Ireland's GHG from agriculture in 2012 92% of Northern Ireland's agricultural land is grassland

Sustainable intensification is required to meet demand





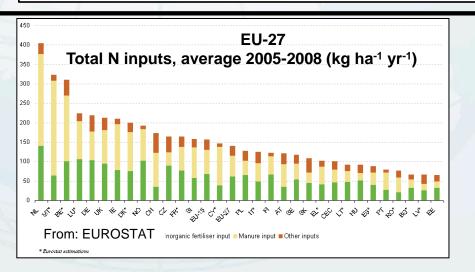
Sustainable Intensification

Grasslands are multi-functional & provide key ecosystem services:

- Food and Forage
- Pollination
- Soil Fertility
- •Climate Change Regulation

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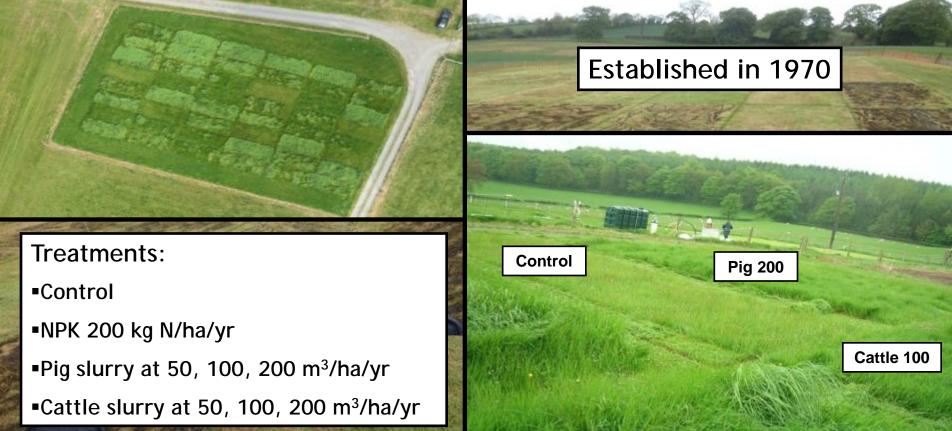
But, ability to do so is influenced by management ...



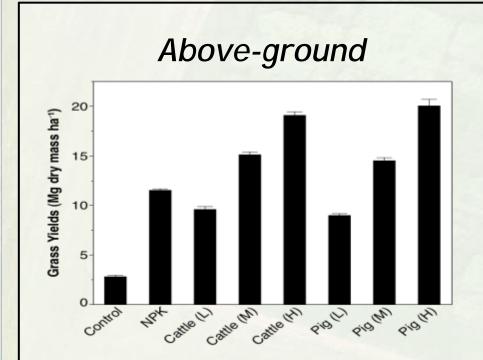
Questions

- 1) How many ecosystem services can be delivered by agricultural grasslands?
- 2) What kind of trade-offs exist between these services?
- 3) What are the ecological mechanisms behind these trade-offs?

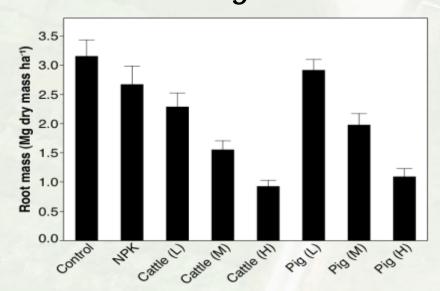
Long-Term Slurry Experiment Hillsborough, Northern Ireland



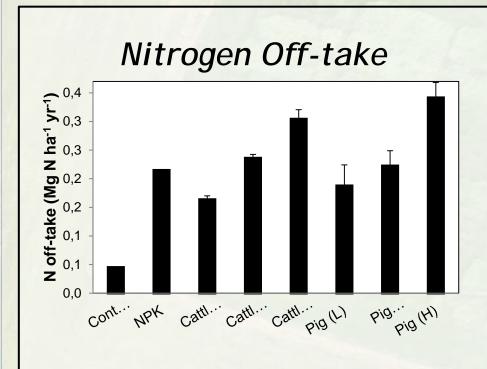
Ecosystem Services - DM Yield



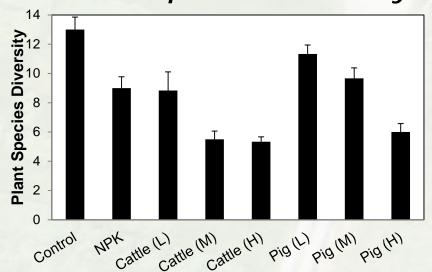
Below-ground



Ecosystem Services: Off-take & Diversity

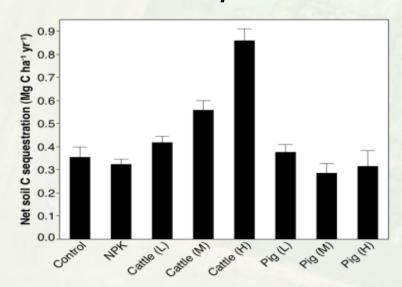


Plant Species Diversity

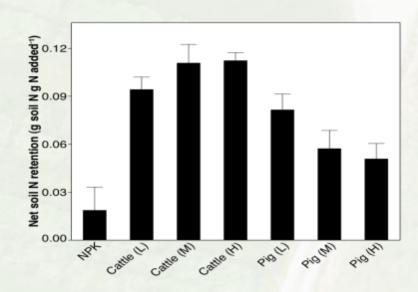


Ecosystem Services: Sequestration

Soil C sequestration



Soil N Retention



Sustainability and Carbon Footprint

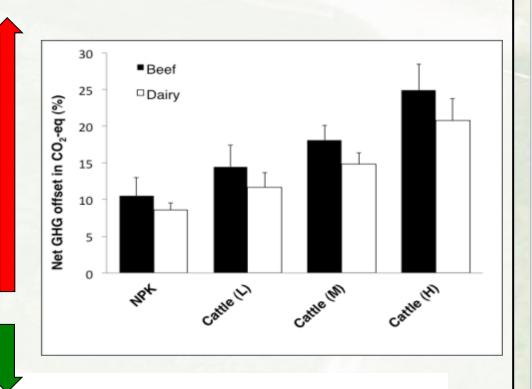
CO₂-e emissions from:

- 1. Liming applications
- 2. Liming production & transport
- 3. Enteric fermentation-ruminant (CH₄)
- 4. Manure management (CH₄ & N₂O)
- 5. Managed soils (CH₄ & N₂O)
- 6. Feed concentrate production/transport
- 7. Milk yields
- 8. Production of NPK
- 9. Fertilizer transport and application
- 10. Machinery use

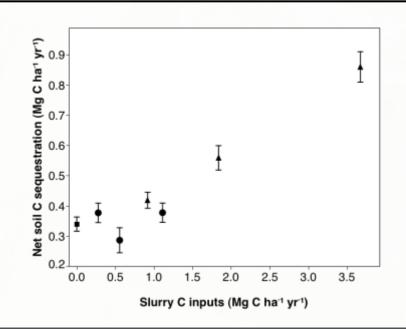
CO₂-e sequestration in soils

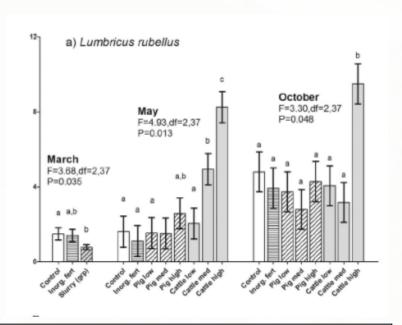
Assumptions:

1. 2 LU (2 animals/hectare); 2. No animal age specifications; 3. IPCC EF CH4; 4. No fodder purchased



Ecological Mechanisms





It depends on how long-term management influences key functions and processes between above-ground and below-ground compartments ...

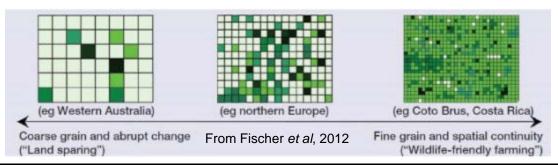
Trade-offs ...

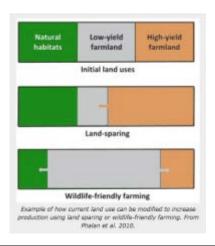
Relative to Control Treatment, i.e. "No Management"

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Plant Diversity	30% 🖶	33%	10%
DM Yield	380% 👚	260%	220%
N Off-take	160%	110%	140%
Root Biomass	16% 🖶	22%	3%
Carbon Seq.	9% 🖶	17%	8%
Nitrogen Seq.	2%	10%	8%
	NPK only	Cattle (L)	Pig (L)

Conclusions

- Finding the balance between increased productivity and environmental trade-offs is complex but essential
- Further research on GHGs, microbes, soil fauna etc. required
- Do we need to move beyond the grassland scale?
- Is Land Sharing / Land Sparing an option?





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