

Grassland Intensification And Inevitable Tradeoffs Between Multiple Ecosystem Services



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Challenges and Opportunities

Production Targets

- 2025: Global food production  50%
- 2020: N. Ireland production  60%

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



Long-Term Slurry Experiment Hillsborough, Northern Ireland



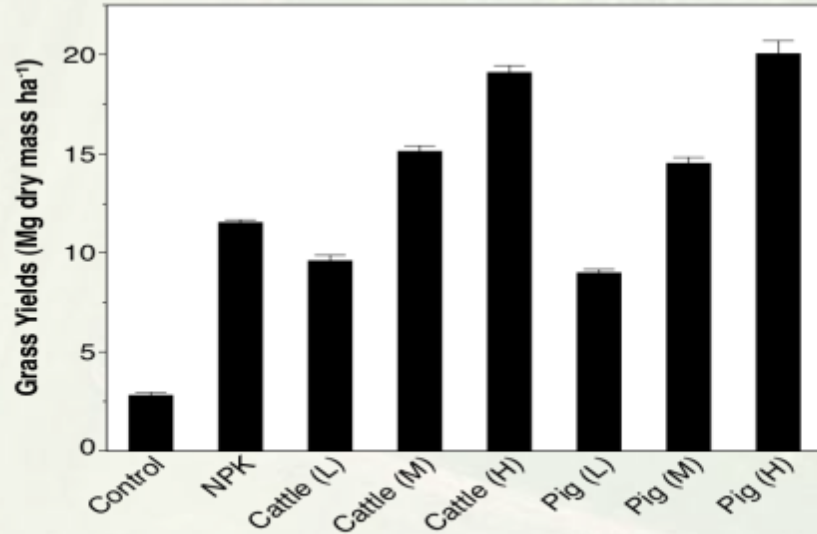
Treatments:

- Control
- NPK 200 kg N/ha/yr
- Pig slurry at 50, 100, 200 m³/ha/yr
- Cattle slurry at 50, 100, 200 m³/ha/yr

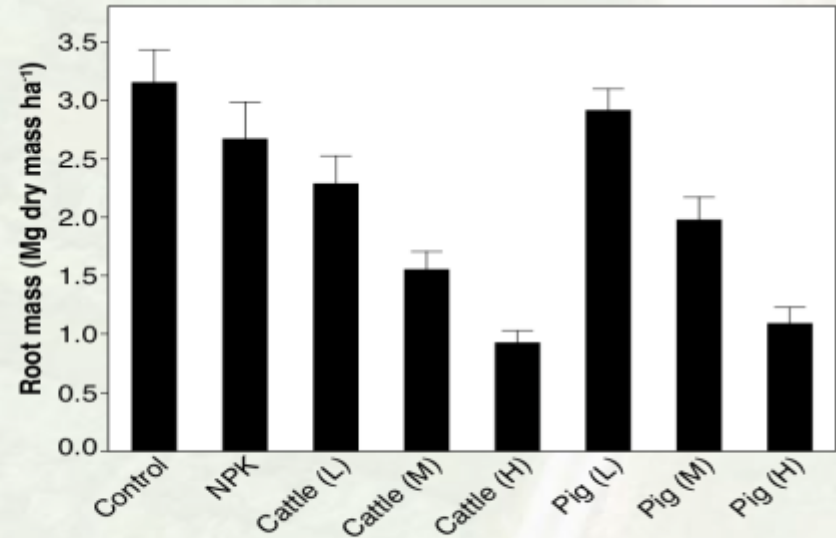


Ecosystem Services - *DM Yield*

Above-ground

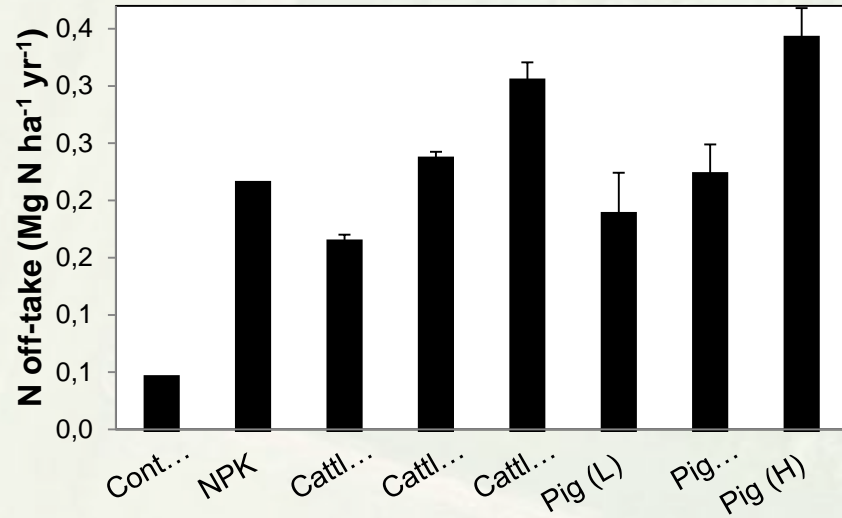


Below-ground

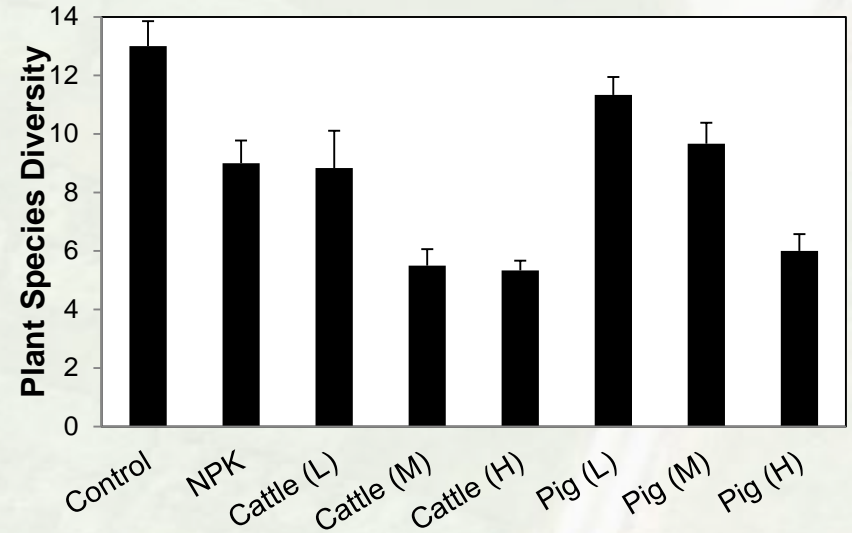


Ecosystem Services: *Off-take & Diversity*

Nitrogen Off-take

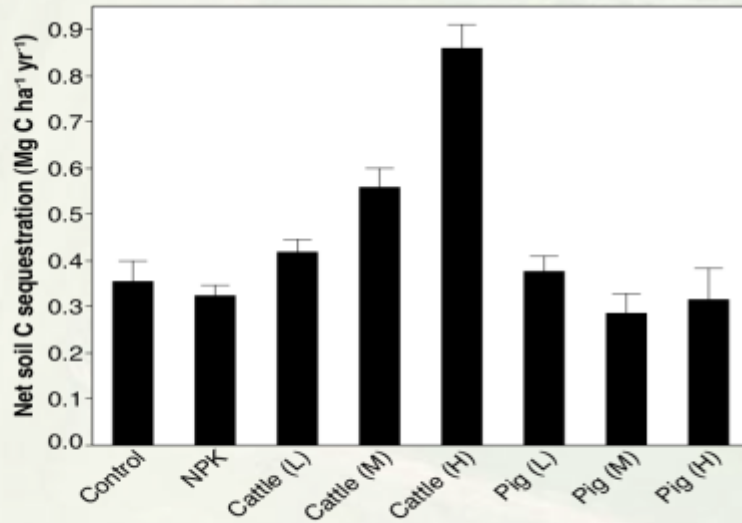


Plant Species Diversity

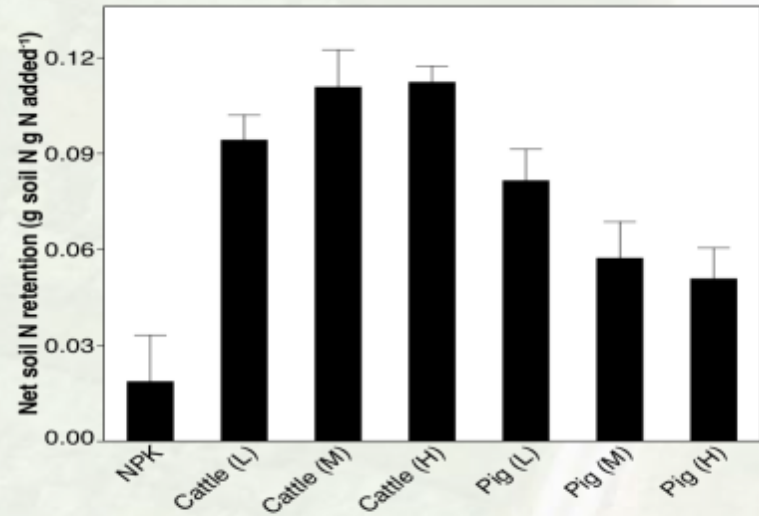


Ecosystem Services: *Sequestration*

Soil C sequestration



Soil N Retention



Sustainability and Carbon Footprint

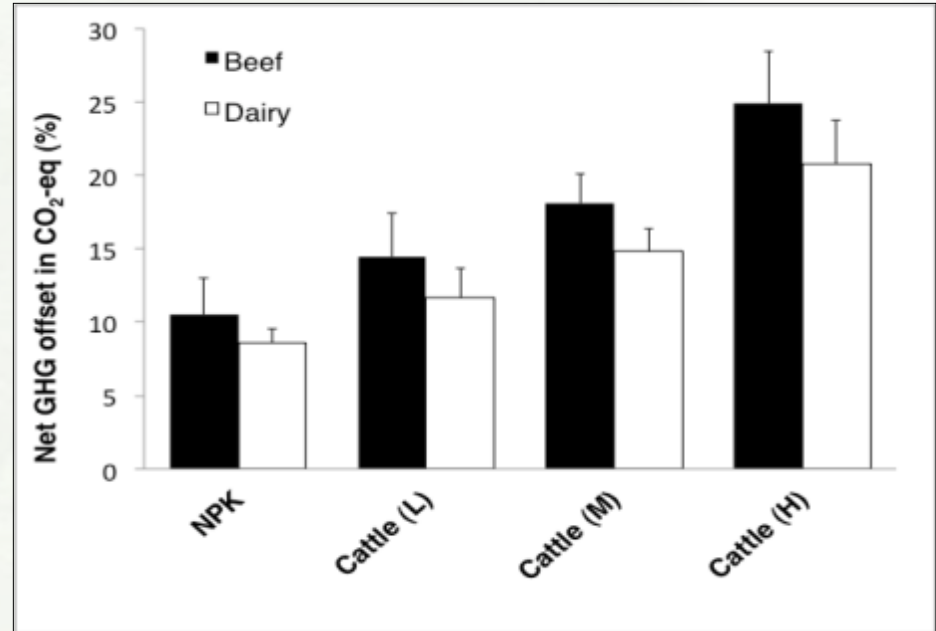
CO₂-e emissions from:

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

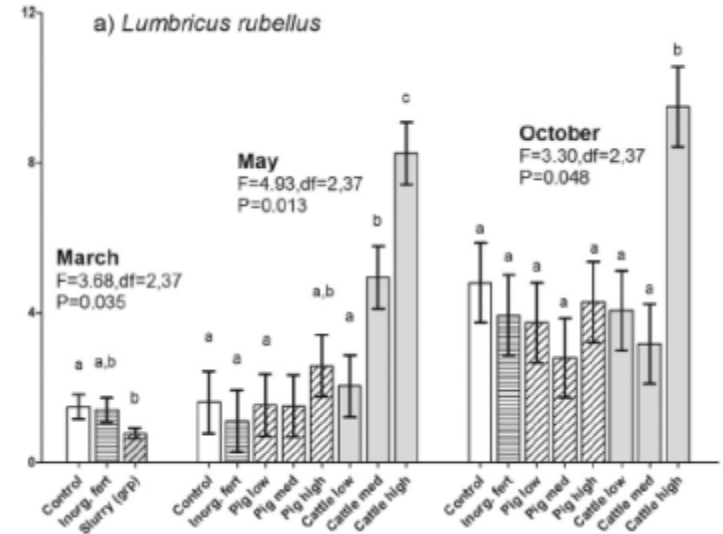
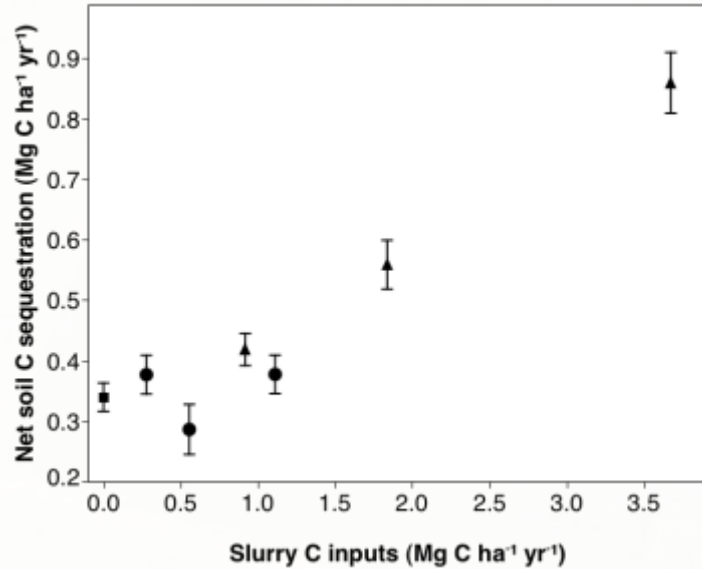
CO₂-e sequestration in soils

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 ...

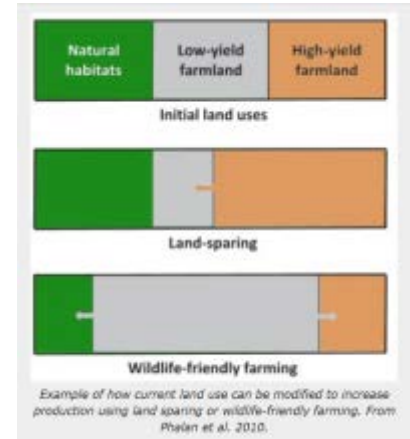


Relative to Control Treatment, i.e. "No Management"

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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