Circular Economy Transition in UNECE Region

Sustainable Meat & Livestock – A Practitioner's View

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Owner, Brook Hall Estate.

29th August 2023

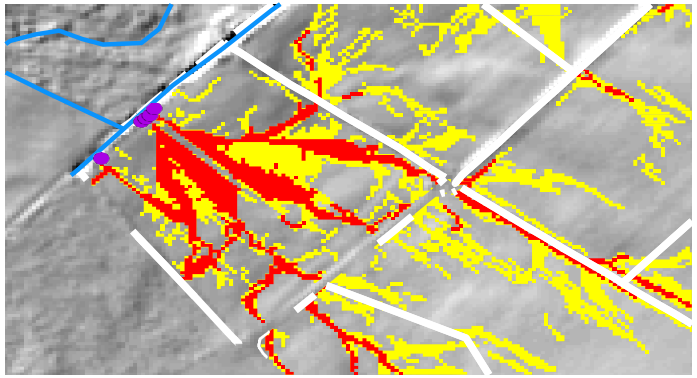
Circularity within the Farm Business

Delivering Multiple Public Goods - Not Single Agendas

Producing Nutritiously Dense & Diverse Food

Delivering Soil Improvement, Both Fertility & Health

Accelerating Carbon Sequestration, Both Above & Below Ground



Improving Water Quality by Reducing Over Land Flow of excessive Rainfall

Optimising Biodiversity, Especially Below Ground

Delivering a "Just Transition," Generating Profits

EUROPEAN UNION

Prioritising Soil Health

EU MISSIONS
SOIL DEAL FOR EUROPE

Policy context for soil protection in the EU

Policy framework: "All soils are healthy by 2050"

Soil monitoring and data reservoir

including **EUSO Dashboard**

Programme for research and innovation, citizen engagement and leveraging resources

Mission firmly embedded in 12 Green Deal strategies

- Farm to Fork Strategy
- EU Biodiversity Strategy for 2030
- Climate Adaptation Strategy
- Forest Strategy
- Zero Pollution Action Plan for air, water and soil
- Organic Action Plan
- Long term vision for EU's rural areas
- EU Soil Strategy for 2030 and upcoming Soil health Law
- Communication on sustainable carbon cycles
- Communication "Safeguarding food security and reinforcing the resilience of food systems"
- Communication "Ensuring availability and affordability of fertilisers"
- Communication on the European Citizens' Initiative (ECI) "Save bees and farmers! Towards a bee-friendly agriculture for a healthy environment"

→ **Strategies identify contribution of Mission to meeting targets and objectives**

EUROPEAN UNION

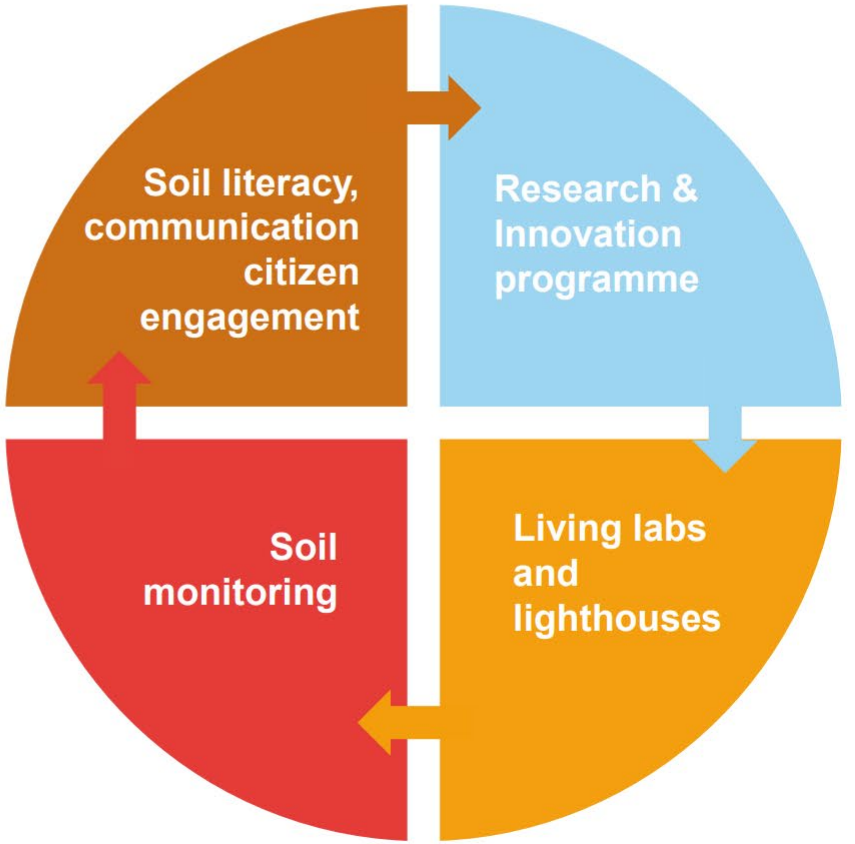
EU MISSIONS
SOIL DEAL FOR EUROPE

Mission goal – 100 living labs and lighthouses to lead the transition towards healthy soils by 2030

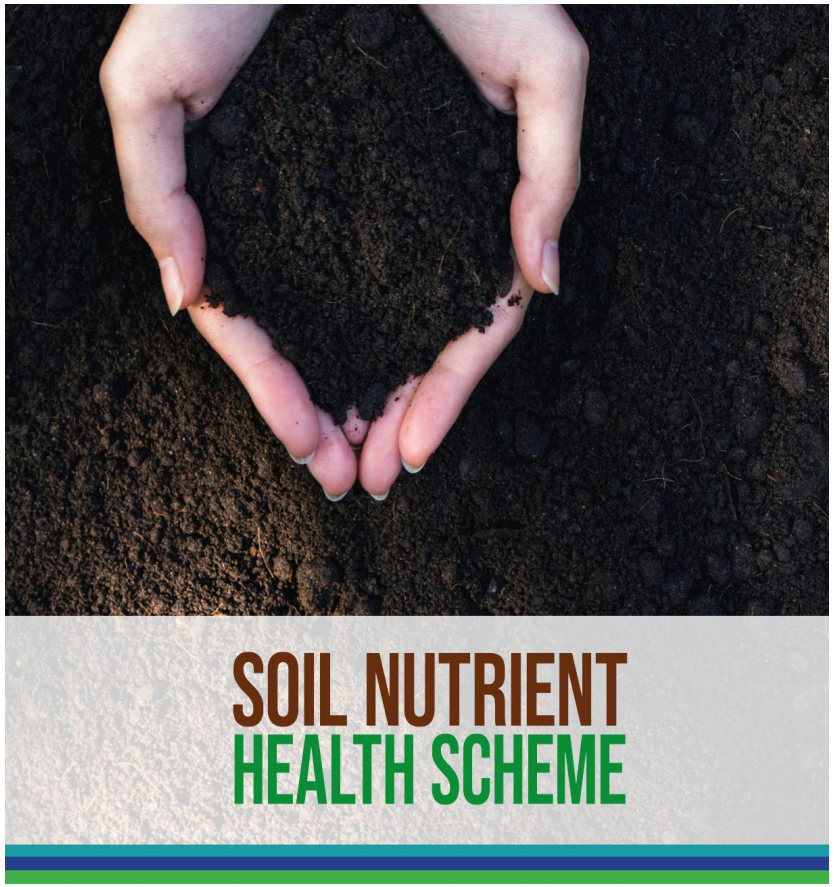
Specific objectives

Objectives apply to **all types of land use and all territories** and are relevant for a **range of sectors**.

Building blocks



Is Circular Ambition Possible at a Regional Level……



- £45m N. Ireland Scheme to base line every field, tree & hedge
- Carried out over four years, one Zone per year
- Online training, empowering farmers with their own Data
- Output - Soil Fertility, Carbon Stocks & Run off Risk Maps
- Opened May 2022, plan to repeat every five years
- 92% Farmer uptake in Zone One (25% of N. Ireland)
- Soil Nutrient Health Scheme | Agri-Food and Biosciences Institute (afbini.gov.uk)

afbi AGRI-FOOD & BIOSCIENCES INSTITUTE

Department of Agriculture, Environment and Rural Affairs www.daera-ni.gov.uk

cafre College of Agriculture, Food & Rural Enterprise

Essential…… Government Recognition…..
Measuring, Reporting & Verification is a Public Good

ARCZero
ACCELERATING FARMING TOWARDS CARBON NEUTRALITY

Delivering at the Farm Level

Accelerating Seven N. Irish Farms towards Net Zero

Roger & Hilary Bell *Sheep*
Simon Best *Arable & Beef*
Patrick Casement *Sheep & Sucklers*
John Egerton *Suckler Beef*
John Gilliland *Willow & Dry Stock*
Hugh Harbison *Dairy*
Ian McClelland *Dairy*

Department of Agriculture, Environment and Rural Affairs
www.daera-ni.gov.uk

The European Agricultural Fund for Rural Development: Europe investing in rural areas

rural Development Programme

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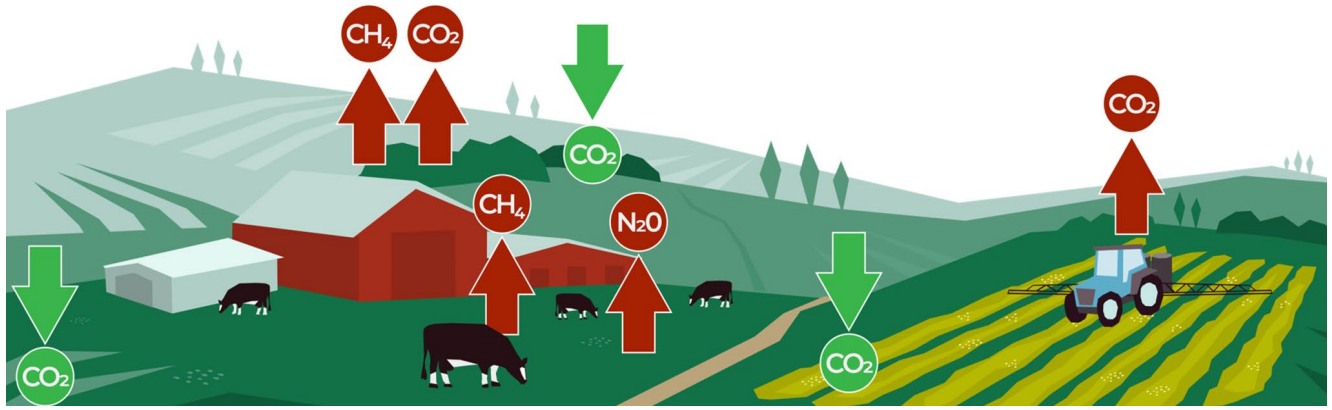
Where did we start…… Learning our Numbers…..

Baselined & Benchmarked…..

- GHG Emissions
- Carbon Sequestration
- Carbon Stocks in Soil
- Carbon Stocks in Trees
- Net Carbon Position
- Behavioural Change
- Delivering other Public Goods

Definition of "Net Zero" for a farm business

Gross Annual GHG Emissions
Less **Gross Annual Carbon Sequestration,**
Adjusted **for Renewables & Waste Management**



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Gross Emissions for the seven ARC Zero farms

Using agrecalc TIER 2 Emissions Module

2021 AgReCalc Analysis	Enterprises	Gross Emissions
Ian McClelland	Dairy	1,125t/yr
Hugh Harbison	Dairy	2,012t/yr
John Egerton	**Beef & Sheep**	1,404t/yr
Roger & Hilary Bell	Sheep with Beef	820t/yr
Simon Best	Arable with Beef	1,799t/yr
Patrick Casement & Trevor Butler	Beef & Sheep	492t/yr
John Gilliland	Willows with Dry Cows	151t/yr

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Gross Sequestration for the seven ARC Zero farms

Using agrecalc TIER 1 Sequestration Module

2021 AgReCalc Analysis	Enterprises	Gross Sequestration
Ian McClelland	Dairy	309t/yr
Hugh Harbison	Dairy	550t/yr
John Egerton	Beef & Sheep	442t/yr
Roger & Hilary Bell	Sheep with Beef	455t/yr
Simon Best	Arable with Beef	738t/yr
Patrick Casement & Trevor Butler	Beef & Sheep	549t/yr
John Gilliland	Willows with Dry Cows	156t/yr

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Net Carbon as a Percentage of Gross Emissions

Using agrecalc TIER 1 Sequestration Module

2021 AgReCalc Analysis	Enterprises	Gross Emissions	Gross Sequestration	Net Emissions	% Reduction
Ian McClelland	Dairy	1,125t/yr	309t/yr	816t/yr	27%
Hugh Harbison	Dairy	2,012t/yr	550t/yr	1,462t/yr	27%
John Egerton	Beef & Sheep	1,404t/yr	442t/yr	962t/yr	31%
Roger & Hilary Bell	Sheep with Beef	820t/yr	455t/yr	365t/yr	56%
Simon Best	Arable with Beef	1,799t/yr	738t/yr	1,061t/yr	59%
Patrick Casement & Trevor Butler	Beef & Sheep	492t/yr	549t/yr	-56t/yr	112%
John Gilliland	Willows with Dry Cows	151t/yr	156t/yr	-5t/yr	103%

No two farms are the same…..

Some farms will find the journey easier than others……

Some farms are already past Net Zero…..

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Carbon Sequestration – New Measuring Technologies

When repeated every 5 yrs. measures actual change, essential for TIER 3

Aerial LiDAR Survey
at 40 scans per metre

Soil Sampling to one
metre deep

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Total Carbon Stocks across ARC Zero farms……

Total ARC Zero CO2e Stocks	Soil Carbon	Tree Carbon	Total Carbon	% C in Soil
Ian McClelland	31,813t	1,310t	33,123t	96%
Hugh Harbison	68,054t	1,969t	70,023t	97%
John Egerton	31,813t	1,310t	33,123t	96%
Roger & Hilary Bell	50,819t	688t	51,507t	98%
Simon Best	237,915t	6,493t	244,407t	97%
Patrick Casement & Trevor Butler	54,556t	4,022t	58,578t	93%
John Gilliland	19,468t	4,937t	24,405t	80%
		Total	515,166t	

ARC Zero farms manage 515,166t of CO2e, 97% is within the Soil

In 2027, Perhaps 540,000t? Who will reward the additional carbon stored?

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The Circular Approach explored by ARC Zero

For both Mitigation & Building Carbon Stocks…

- Improving efficiency – genetics, age of slaughter, cow size, animal health
- Improving Soil pH – improving nutrient uptake & growth of clover
- Increasing the use of Legumes & Multi Species Pastures
- Reducing the use of Nitrogen fertiliser
- Planting trees & Hedgerow Management
- Grazing Willows

- Installing Renewables……..

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The Improvements Observed…..

agrecalc

Comparison between 2021 & 2023, gross emission/unit of output

GHG Reduction 2021 to 2023	Enterprises	2021	2023	% Reduction in GHGs
Ian McClelland	Dairy	1.3kg CO2e/kg FPC Milk	1.1kg CO2e/kg FPC Milk	13%
Hugh Harbison	Dairy	1.25kg CO2e/kg FPC Milk	1.2kg CO2e/kg FPC Milk	4%
John Egerton	Beef & Sheep	32.8kg CO2e/kg dwt	25.6kg CO2e/kg dwt	22%
Roger & Hilary Bell	Lamb	22kg CO2e/kg dwt	15.7kg CO2e/kg dwt	28%
Simon Best	Wheat	0.99kg CO2e/kg grain	0.47kg CO2e/kg grain	53%

Determining Factors – Price of Fertiliser
- Timing of sowing legumes
- Livestock ill health

agrecalc

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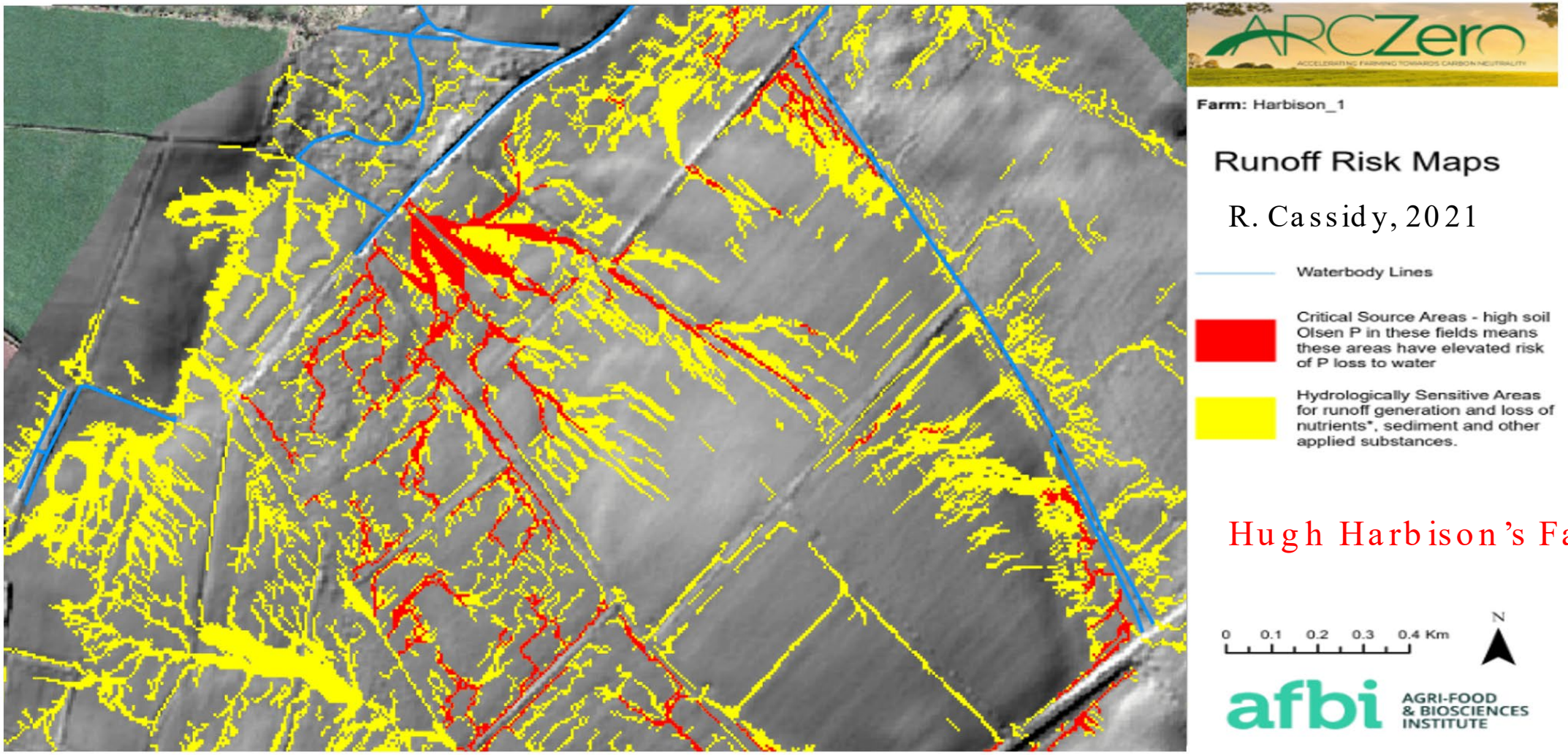
Delivering Multiple Public Goods Simultaneously

Using LiDAR & Phosphate Soil Surveys to create “Run Off Risk” Maps



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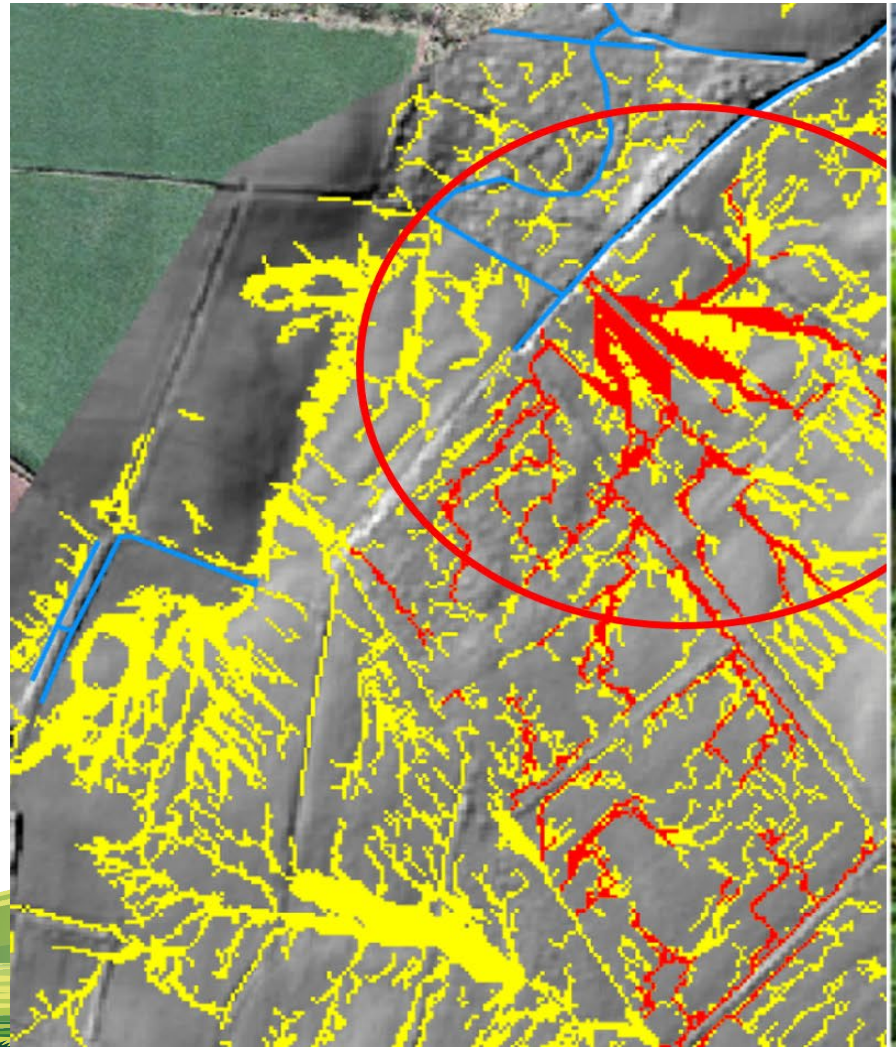
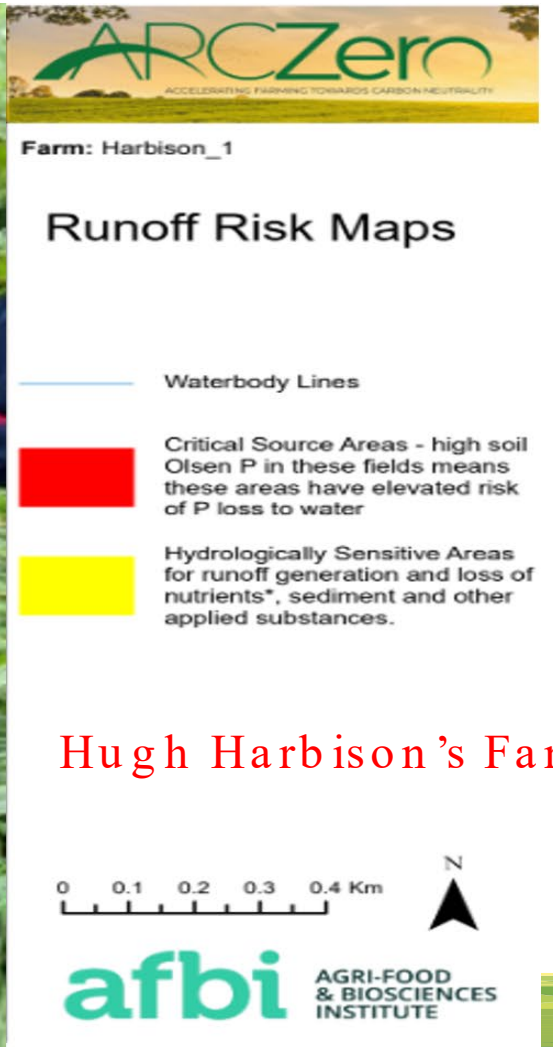
Delivering Multiple Public Goods Simultaneously

Multi Species Pastures – Water Infiltration, Biodiversity, Carbon Sequestration





COMPARING DIFFERENT LAND USES

Willow SRC (28 Yrs. Old)

Permanent Pastureland (200 Yrs. Old)

Silvopasture (120 Yrs. Old)

D. Woodland (30 Yrs. Old)

D. Woodland (250 Yrs. Old)

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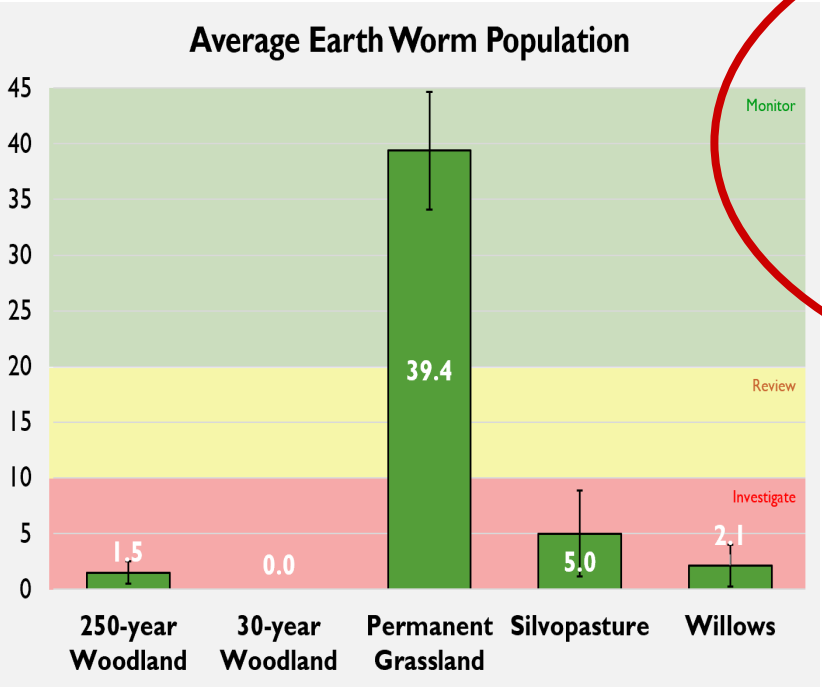
Delivering Multiple Public Goods Simultaneously

Increasing Biodiversity Under the Soil…. Role of Livestock Faeces….

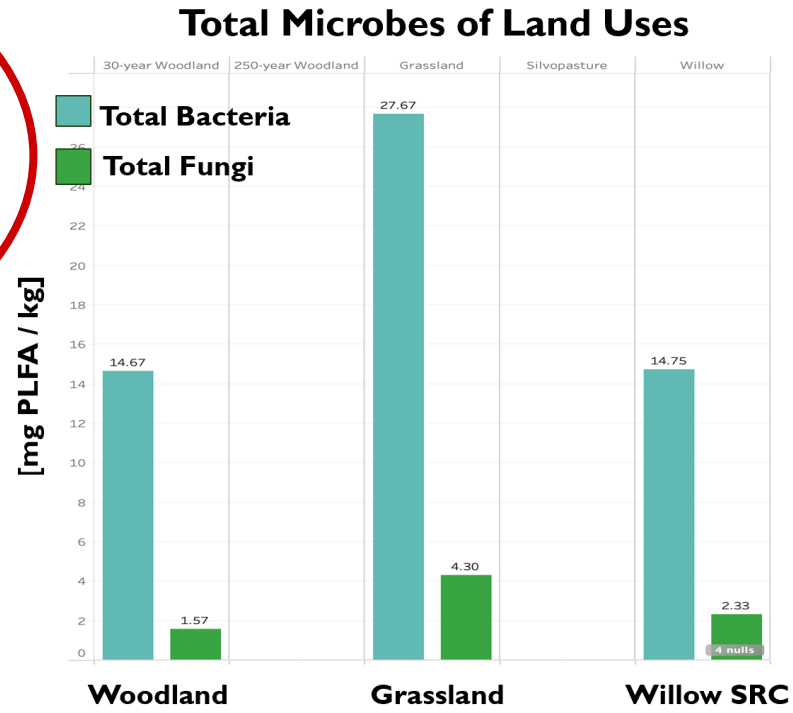


The age of extinction

More than half of Earth's species live in the soil, study finds

Soil estimated to be home to 90% of world's fungi, 85% of plants and more than 50% of bacteria, making it the world's most species-rich habitat

National Academy of Science, Aug 23



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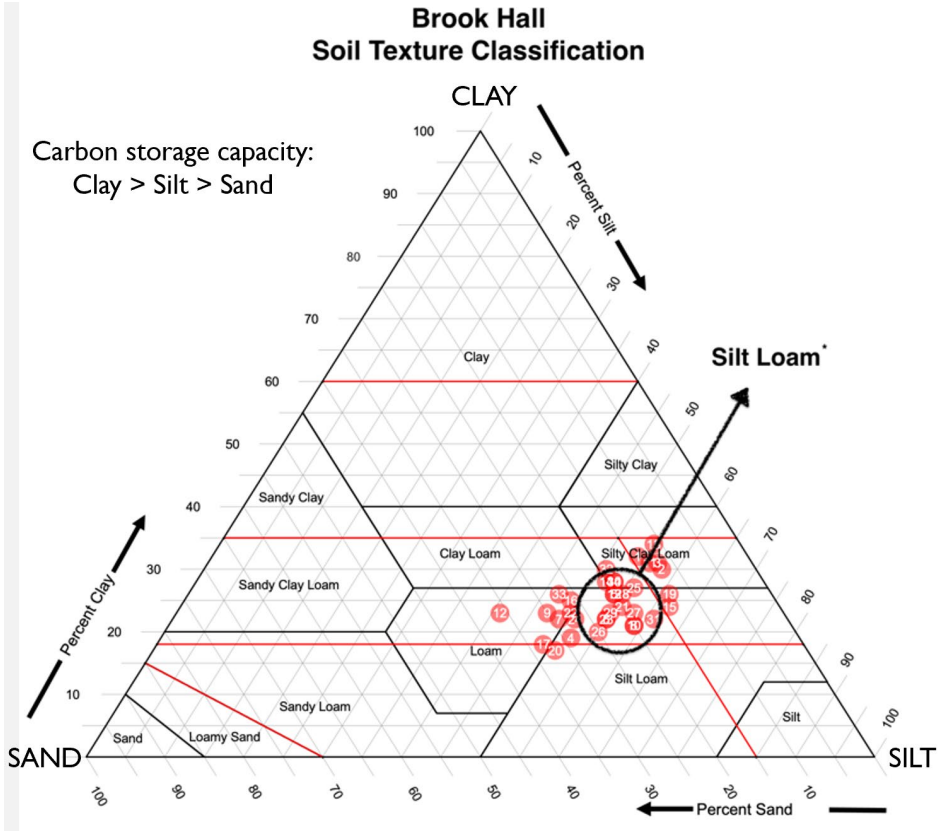
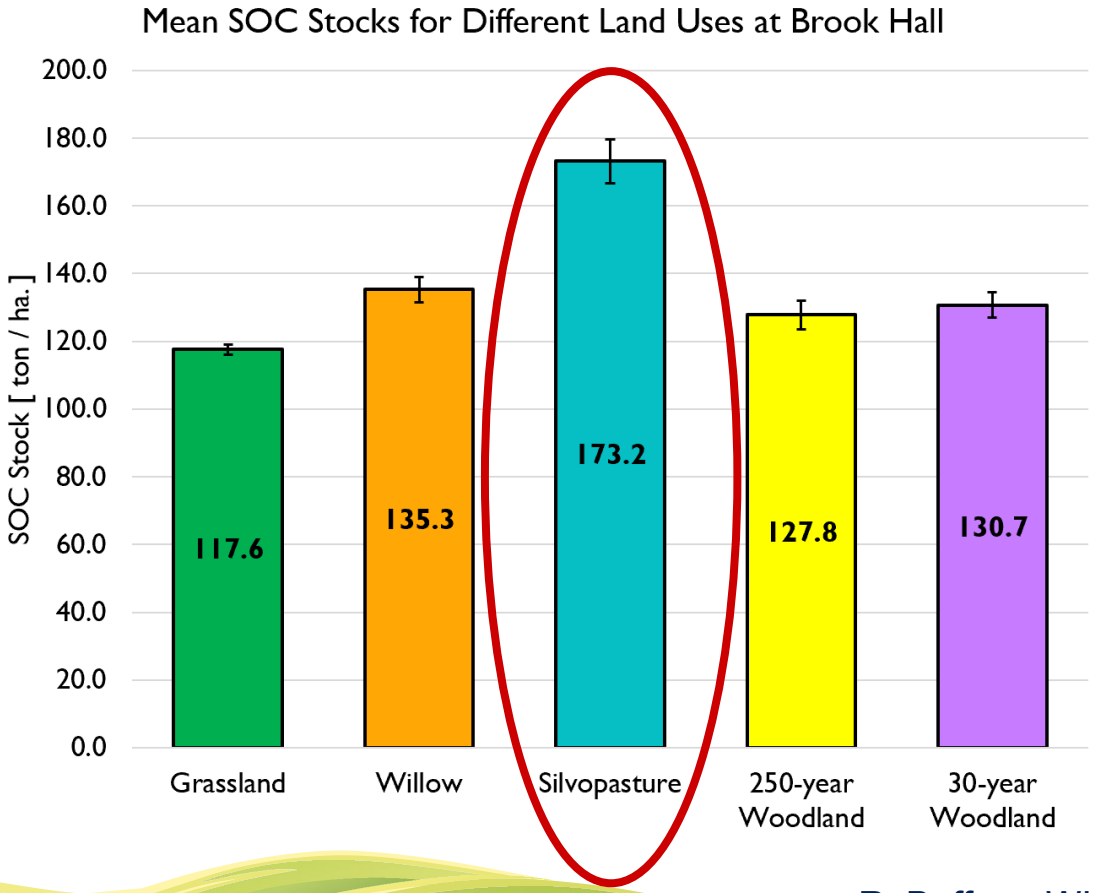
Role of different Land Uses in building Soil Organic Carbon

Diversity of root architecture is best…. Monocultures are not the right answer….





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Innovation in Circularity, e.g. Grazing SRC Willow Trees

To reduce GHGs & deliver multiple public goods

Reducing Methane & Nitrous Oxide
Increasing Carbon Sequestration & Biodiversity
Reducing the need to treat animals for Parasitic Worms

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EFFECT OF GRAZING CATTLE ON WILLOW SILVOPASTORAL SYSTEMS ON ANIMAL PERFORMANCE AND METHANE PRODUCTION

J. Thompson[1*], S. Stergiadis[2], O.C. Carballo[3], T. Yan[3], F. Lively[3], J. Gilliland[1,4] , S. Huws[1], K. Theodoridou[1]

[1]Institute of Global Food Security, Queen's University Belfast, Belfast, UK, [2]School of Agriculture, Policy and Development, University of Reading, Reading, Berkshire, UK, [3]Agri-Food and Biosciences Institute, Hillsborough, UK, [4]Brook Hall Estate, Londonderry, Northern Ireland , UK.

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BACKGROUND

- Ruminant systems are under pressure to reduce CH_4 emissions and increase carbon sequestration.
- Condensed Tannins (CTs) can bind to proteins, reducing ruminal degradation and methanogenesis
- Willow fodder contain CTs

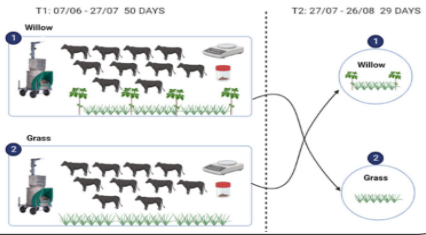
1 WAGHORN, G. C. & MCNABB, W. C. 2003. Consequences of plant phenolic compounds for productivity and health of ruminants. *Proceedings of the Nutrition Society*, 62, 383-392

2 MUKLADA, H., KLEIN, J. D., GLASSER, T. A., DVASH, L., AZAIZEH, H., HALABI, N., DAVIDOVICH-RIKANATI, R., LEWINSOHN, E. & LANDAU, S. Y. 2018. Initial evaluation of willow (Salix acmophylla) irrigated with treated wastewater as a fodder crop for dairy goats. *Small Ruminant Research*, *163*, 76-83.

OBJECTIVES

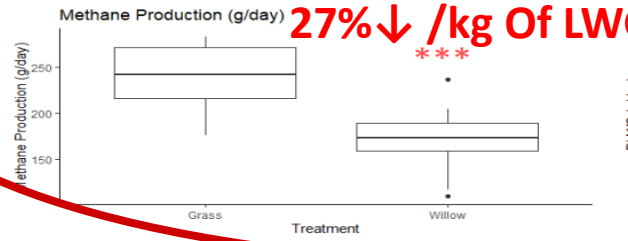
1. Can beef cattle graze Willow Fodder (WF)
2. Quantify the effect of WF on performance and CH_4
3. To explore if WF can be rotationally grazed

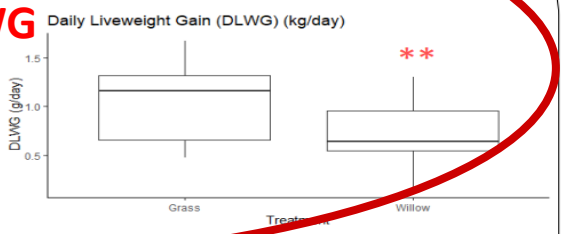
METHODOLOGY



RESULTS

27%↓ /kg Of LWG





	Forage			
	PRG	WFG	s.e.m	P-value
DM (g/kg fresh)	235	266	4.02	***
CP (g/kg DM)	167	159	10.2	0.589
ME (MJ/kg DM)	10.6	9.1	0.13	***
CT (g/kg DM)		37.2	1.24	-
Total DMI (kgDM)	10.2	11	0.217	0.0591
LWG (kg/d)	1.04	0.716	0.0605	**
CH4 (g/d)	237	173	7.18	***

CONCLUSION AND IMPLICATIONS

1. Willow Silvopastoral systems could be a grazeable forage for cattle with potential to reduce CH_4 emissions
2. Further *in vivo* trials are needed to quantify the effect on protein metabolism and quality of animal products

Department of Agriculture, Environment and Rural Affairs
Sustainability at the heart of a living, working, active landscape valued by everyone

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University of Reading

Acknowledgements: We thank Brook Hall Estate in N. Ireland for providing the Willow grazing platform and Food Foyle Food Group for the animals. Funded by DAERA and UKRI-BBSRC.

Circular Economy Transition in UNECE Region

Sustainable Meat & Livestock – A Practitioner's View

Using a Partnership of Innovation, Precision Baselines & Training to Empower farmers,
a creditable Circular Economy; a "Just Transition" for the Farming Community;
& nutritiously Dense & Diverse foods, for a Healthy Society, can be delivered.

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