

ARCZero

ACCELERATING FARMING TOWARDS CARBON NEUTRALITY

CLOSE OUT CONFERENCE & FARM WALK

Brook Hall, Derry/Londonderry



Department of
**Agriculture, Environment
and Rural Affairs**

www.daera-ni.gov.uk



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





Londonderry



Antrim



Tyrone

Fermanagh



n

Conference Schedule

Registration & Tea/Coffee

Welcome

Dr Jonathan Birnie, Birnie Consultancy

Keynote

Professor John Gilliland, ARCZero Farmer

Panel Session

ArcZero Farmers Ian McClelland, Hugh Harbison, John Egerton & Patrick Casement, led by John McClenaghan, Ulster Farmers Union

Break

Panel Session

ArcZero Farmers Simon Best, Roger Bell & John Gilliland, led by John McClenaghan, Ulster Farmers Union

Reflections

Norman Fulton, DAERA

Summary

John McClenaghan, Ulster Farmers Union

Thanks & Acknowledgements

Professor John Gilliland, ARCZero Farmer

Close & Lunch

You are invited to join us for Lunch followed by a farm walk at 2pm

WELCOME



John Gilliland
ARCZero Chair

Whether you've joined us at a farm walk, come across us online or at a conference, or this is your first introduction to ArcZero, you are very welcome!

ARCZero is a farmer-

led European Innovation Project co-funded by the European Agricultural Fund for Rural Development (EAFRD) and the Department of Agriculture, Environment and Rural Affairs (DAERA).

We have been on a three year journey to understand not only what greenhouse gases are emitted on farm, but just as importantly how farms capture carbon too, ensuring a balanced future for the current and next generation.

We would like to thank the many experts who have helped us on our journey, especially Rachel

Cassidy and Alex Higgins from AFBI, Nigel Scollan and Paul Williams from Queen's University, Belfast and Riccardo Buffara who joined the project as an intern from Wageningen University.

Today you will hear about the progress ARCZero has made in accelerating the seven project farms towards net zero. You'll hear directly from the farmers themselves about their experience of the journey - both good and bad and at the end, I hope you'll stick around to experience what we've managed to do here at Brook Hall.

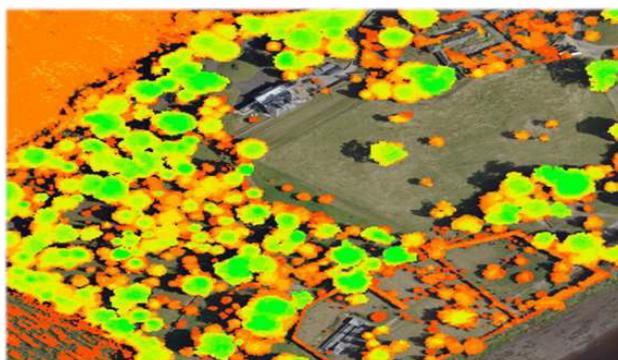
Keynote Booklet Download

You can now download the booklet containing notes and slides from today's Keynote Address by scanning the QR code or visiting the link below
www.arczeroni.org/blog



Keynote Presentation

Below are the slides from the Keynote Presentation given by John Gilliland, ArcZero Chair at the close-out conference on 20/06/23 at Brook Hall, Derry/Londonderry.



John Gilliland
Chair
ARC Zero Close Out Conference
20th June 2023





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*



A farmer led European Innovation Project co-funded by



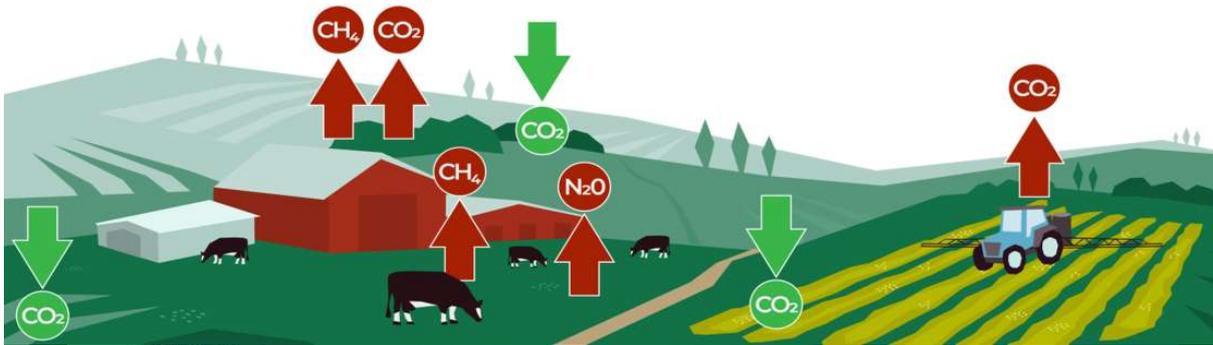
Grant Support	- £120,000
Farmers' funds	- £80,000
Farmers' time	- £87,500
Total Spend	- £287,500

Supported by :-



ARC Zero's definition of "Net Zero" for a farm business

**"Net Zero" for a farm =
Gross Annual GHG Emissions
Less Gross Annual Carbon Sequestration,
Adjusted for Renewables & Waste Management**



Where do you start..... Know your Numbers.....

Baseline & Benchmark.....

- GHG Emissions
- Carbon Stocks in Soil
- Carbon Stocks in Trees & Hedges
- Understand the Costs of Positive Change on Farm





Choosing a Life Cycle Assessment Calculator...

Is it..... Does it....

- Independent
- Accredited to BSI PAS2050 Standard
- Report Methane Emissions to both GWP₁₀₀ & GWP* methodologies
- Include Carbon Sequestration
- Backed by a Globally Credible Science based Institute



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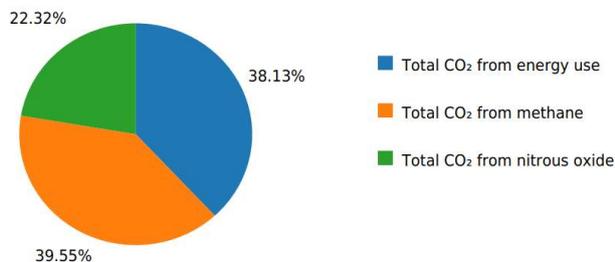
Gross Emissions for the seven ARC Zero farms

<i>2021 AgReCalc Analysis</i>	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

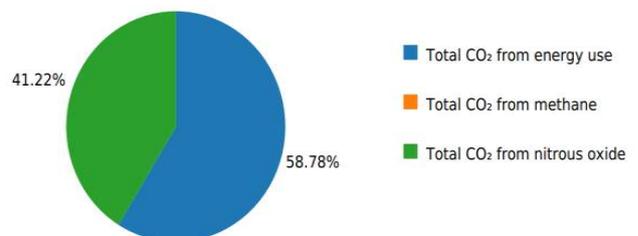


The sources of Emissions for different Enterprises Determined by type of Enterprise

Dairy emissions by gas (%)



Feed wheat emissions (%)



Benchmarked farms against average

ARC Zero farms were already at, or well above average

<i>2021 AgReCalc Analysis</i>	Enterprises	Actual Emissions	Benchmark Average
Ian McClelland	Dairy	1.3kgCO ₂ e/kg FPC Milk	1.3kgCO ₂ e/kg FPC Milk
Hugh Harbison	Dairy	1.25kgCO ₂ e/kg FPC Milk	1.3kgCO ₂ e/kg FPC Milk
John Egerton	Beef & Sheep	32.8kgCO ₂ e/kg dwt	37.6kgCO ₂ e/kg dwt
Roger & Hilary Bell	Sheep with Beef	21.9kgCO ₂ e/kg dwt	28.4kgCO ₂ e/kg dwt
Patrick Casement & Trevor Butler	Beef & Sheep	24.6kgCO ₂ e/kg dwt	41.9kgCO ₂ e/kg dwt



Gross Sequestration for the seven ARC Zero farms

Using TIER 1 Sequestration Module

<i>2021 AgReCalc Analysis</i>	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



Net Carbon for the seven ARC Zero farms

Using TIER 1 Sequestration Module

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



Net Carbon as a Percentage of Gross Emissions

Using TIER 1 Sequestration Module

<i>2021 AgReCalc Analysis</i>	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.....



Net Carbon as a Percentage of Gross Emissions

Using TIER 1 Sequestration Module

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No two farms are the same.....
 Some farms will find the journey easier than others.....
 Some farms are already past Net Zero.....



Striving for Better Accuracy in Carbon Sequestration

Developing TIER 3 factors to recognise “actual” farmer change

The use of “Averaging,” in LCAs is a disincentive to positive change

- TIER 1 – factors are Internationally averaged & give least accuracy
- TIER 2 – factors are Nationally averaged
- TIER 3 – factors are Locally averaged & give best accuracy





Striving for Better Accuracy in Carbon Sequestration Developing TIER 3 factors to recognise “actual” farmer change

The use of “Averaging,” in LCAs is a disincentive to positive change

TIER 1 – factors are Internationally averaged & give least accuracy

TIER 2 – factors are Nationally averaged

TIER 3 – factors are Locally averaged & give best accuracy

Currently LCAs use TIER 1 for Sequestration & TIER 2 for Emissions

If farmers are to make positive changes, their changes must be picked up & recognised



Carbon Sequestration – New Measuring Technologies When repeated every 5 yrs. measures actual change, essential for TIER 3



Aerial LiDAR Survey
at 15 scans per metre



Soil Sampling to one
metre deep





Total Carbon Stocks across ARC Zero farms..... Farmers are Custodians of much of the Nation's Carbon.....

<i>Total ARC Zero CO2e Stocks</i>	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



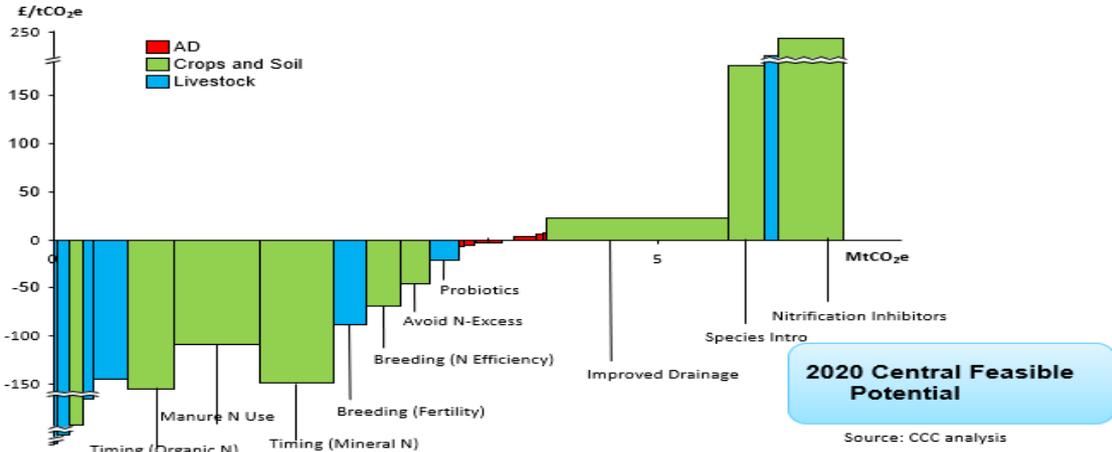
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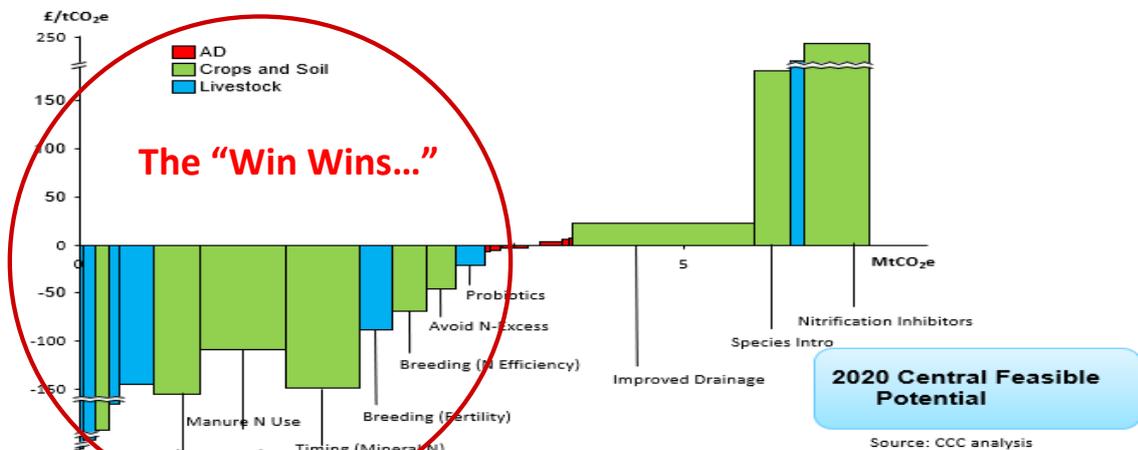
ARC Zero farms manage 515,166t of CO2e, 97% is within the Soil
In 2027, Perhaps 540,000t? Who will pay for the additional carbon?



Accelerating towards Net Zero.... How do we do it? Understand the costs of the different Mitigation Options.... MACC Curve

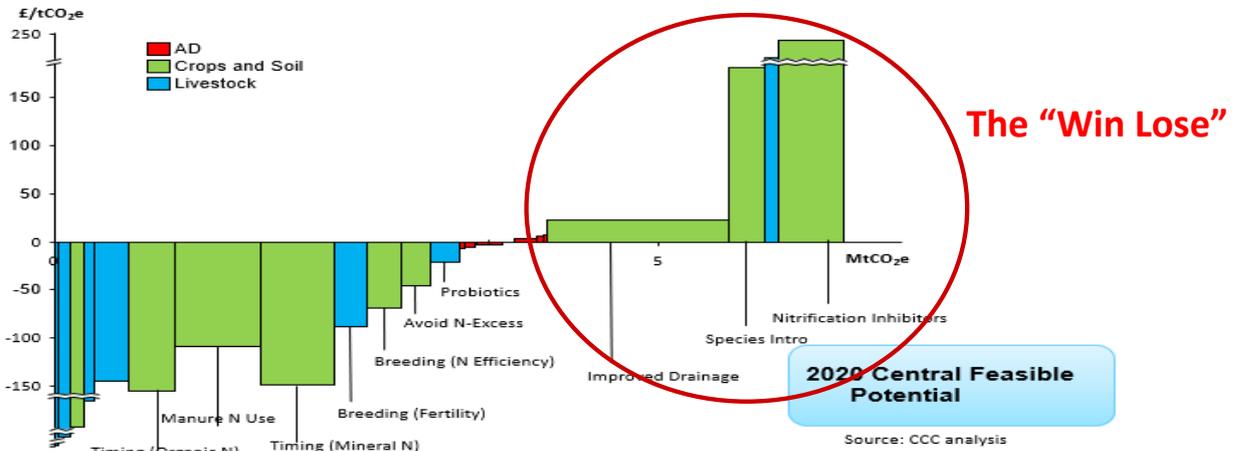


Accelerating towards Net Zero.... How do we do it? Prioritising the “Win Win” Mitigation Options first....



Accelerating towards Net Zero.... How do we do it?

Exploring who will pay for the “Win Lose” Mitigation Options....??



Options 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 Swards
- Reducing the use of Nitrogen fertiliser
- Planting trees & Hedgerow Management
- Grazing Willows
- Installing Renewables.....



Emission Reductions Observed....



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 CO ₂ e/kg FPC Milk	1.1kg CO ₂ e/kg FPC Milk	13%
	Hugh Harbison	Dairy	1.25kg CO ₂ e/kg FPC Milk	1.2kg CO ₂ e/kg FPC Milk	4%
	John Egerton	Beef & Sheep	32.8kg CO ₂ e/kg dwt	25.6kg CO ₂ e/kg dwt	22%
	Roger & Hilary Bell	Lamb	22kg CO ₂ e/kg dwt	15.7kg CO ₂ e/kg dwt	28%
	Simon Best	Wheat	0.99kg CO ₂ e/kg grain	0.47kg CO ₂ e/kg grain	53%

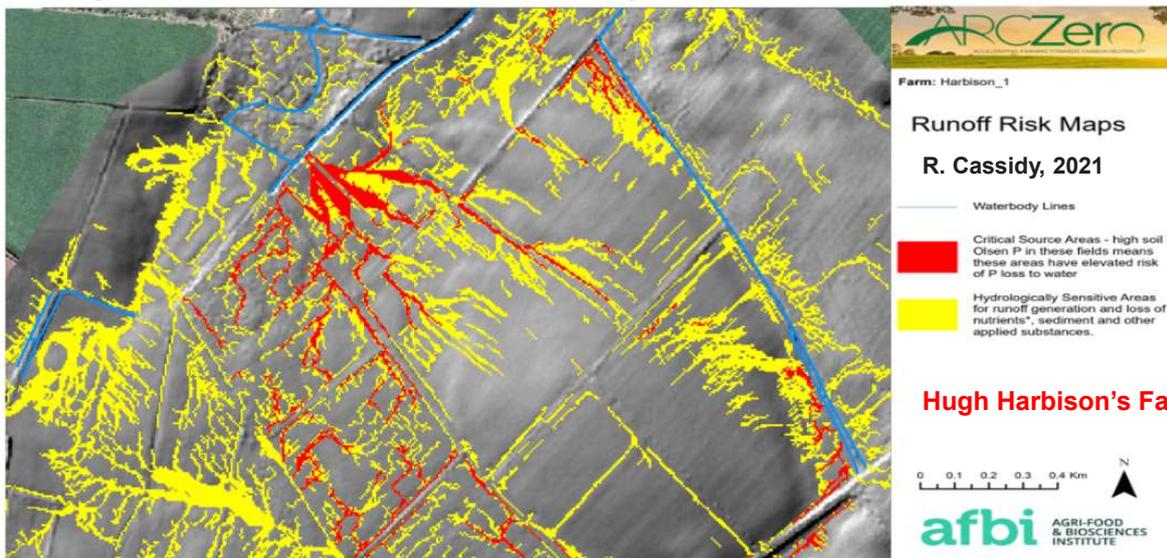
Determining Factors – Price of Fertiliser

- Timing of sowing legumes
- Livestock ill health



Delivering Other Public Goods Simultaneously

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



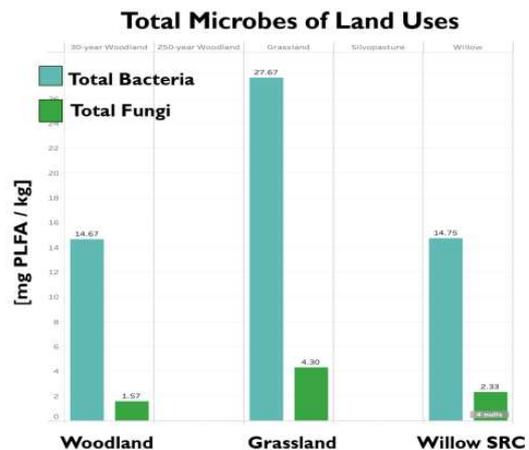
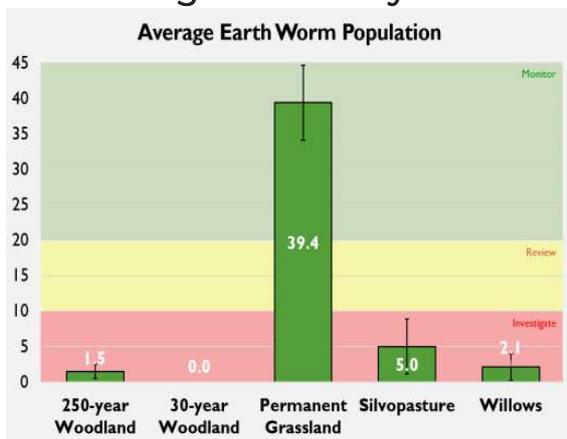
Delivering Other Public Goods Simultaneously

Multi Species Swards – Water Infiltration, Biodiversity, Carbon Sequestration



Delivering Other Public Goods Simultaneously

Increasing Biodiversity – Under the Soil..... At John Gilliland's Farm



R. Buffara, WUR, 2023



Sharing ARC Zero's Journey

Seven Public Farm Walks – Over 1,000 Visitors, from Six Countries



Thanks to AgriSearch & Cafre

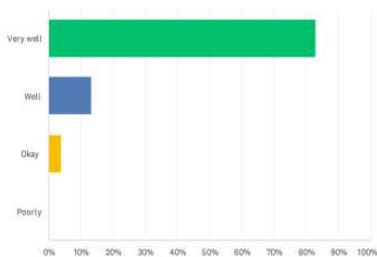


Feedback on the Farm Walks

Post Event email questionnaire

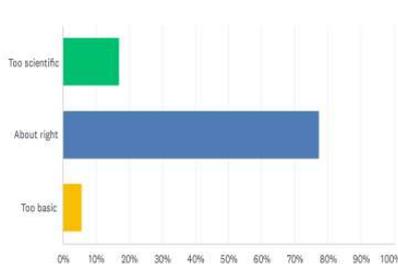
Q3 How well do you think the event was organised and run?

Answered: 53 Skipped: 0



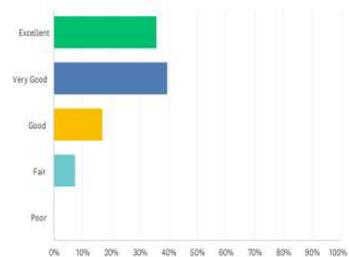
Q4 Please rate the content of the event?

Answered: 53 Skipped: 0



Q5 Please rate the delivery of the event content e.g. the speakers

Answered: 53 Skipped: 0



“Found the walk to be very current, interesting & informative. Speakers were clear to the point, no waffles, helped by having a host who is walking the walk and not talking the talk. Excellent farm walk.”



Sharing ARC Zero's Journey

Through writing articles or giving presentations, local & abroad

IN NEWS

IRISH FARMERS JOURNAL
93 16
Saturday 24 September 2022

Digging deep for soil carbon stocks in Fermanagh



FARMER WRITES:
New soil samples have been taken across the farm to sample for carbon down to 10cm, writes John Egerton

If there I went on to talk about the work that we are doing on the ArcZero (Accelerating Farming Towards Carbon Neutrality) project, alongside six other 10 farms.

To be honest, I think they were shocked at the amount of detailed information that we have already gathered and how far down the road we are in relation to a proper, verifiable balance sheet for our farms that accounts for both carbon emissions and sequestration. I think many were a little cautious of what we have already achieved.



Soil carbon being sampled down to 10cm on the Egerton farm.

The morning that I found this horse was when I had found that soil sampling over a range of carbon in the top 10cm of soil, as well as in my trees and hedgerows. Very few farmers anywhere in the world know how much carbon they are storing.

Soil cores
Last spring, we had a young man come out and take soil cores to prove it multiple locations from every field that I own. Every time he took a sample, he GPS marked it

manually, the whole farm. Our intention is to come back to the same place to re-sample in a few years down the line. It was a very labour intensive operation, as he had to physically hammer in each cylinder and dig the sample out. The samples were then sent away to a specialist lab to measure carbon was stored in the soil.

We could then multiply up to get a total carbon figure for each field, and ultimately the whole farm.

It was actually quite something to say.

They told a case-study of the five acres of the field which gave me a lovely view of what I see beyond the fence. The first place they started with in one of my worst fields, which I have tried to drain on these separate occasions. I could see clearly

same sites as before and it was certainly a big question that the minimal sampling there is now.

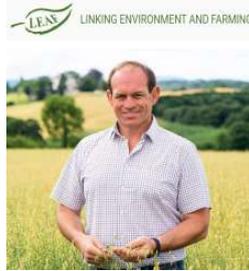
They told a case-study of the five acres of the field which gave me a lovely view of what I see beyond the fence. The first place they started with in one of my worst fields, which I have tried to drain on these separate occasions. I could see clearly

why my attempts at draining had failed. I had been told that it was just a matter of time as it was a complete impermeable clay area.

There we were to watch only get down around 20cm before it hit rock and couldn't get any deeper. I am certain to see a long term, my water will have the potential to store more carbon than the other soil. The guys that took the samples told me it was the first time they had operated on a farm in 10.

Parting thought
Back in the conference in Kesh, I got there with a parting thought. We farmers are looking after the country's carbon without our farms. We need to be rewarded for the amount of being added but also our own carbon when they are trying to digest under hedges.

It seems to be getting lost in the whole environmental debate, but the farmers are not the problem. Instead we are very much part of the solution.



LINKING ENVIRONMENT AND FARMING

GLOBAL NETWORK OF LIGHTHOUSE FARMS



The Farmers Journal, LEAF, Global Network of Lighthouse Farms & UN



What's Next...

We have a desire to keep going....

- Build on the "Win Wins....."
- Secure funding to explore the "Win Lose....."
- Repeat or the 3rd time in 2025
- Secure funding to repeat the baseline of Carbon Stocks in 2026
- To continue to be Entrepreneurial, Innovative & Improve Soil Health
- To continue to prove that farmers will deliver on their responsibilities, if given a chance



Thank You
www.arczeroni.org



Roger & Hilary Bell



Location: Co. Antrim
Enterprise: Sheep & Beef
Size: 78 hectares

Roger & Hilary, run 500 lowland and upland ewes along with a herd of 70 beef cattle for finishing on their 78 hectare farm, where they operate a rotational grazing system.

The Bell's are recognised as very high performing grassland managers. They are currently involved in the Co-Op Lamb group and programmes such as GrassCheck, Ecosward and another European Innovation Partnership Scheme projects in addition to ARCZero.

Roger & Hilary are no strangers to passing on their knowledge, having hosted a wide range of groups in their roles as Technology Demonstration Farmers.

Simon Best



Location: Co. Armagh
Enterprise: Arable & Beef
Size: 486 hectares

Simon, along with his father John and brother Rory, manages 1200 hectares of arable land and an Aberdeen Angus beef herd.

His sustainable approach to farming focuses on nature-based solutions, such as refraining from insecticide use, creating environmental habitats, and prioritizing soil health. This commitment allows Simon's arable farm to produce high quality food while maintaining high environmental standards.

Simon's dedication to farming earned him the prestigious title of UK Arable Farmer of the Year in 2021, awarded by Farmers Weekly.

Patrick Casement



Location: Co. Antrim
Enterprise: Sheep & Beef
Size: 87 hectares

Patrick farmed suckler cows and sheep for 30 years before retiring some years ago. The farm now runs Blackface ewes producing mule lambs from Blue Leicester tups, has a pedigree Blue Leicester flock alongside a herd of suckler cows.

Patrick's primary interest has always been in the natural environment, and has been involved in a range of roles, including Chairman of the National Trust in NI, Chairman of NI Environment Link, and Chairman of the NI Inquiry of the Food, Farming and Countryside Commission. In addition, he has been a member of the Expert Working Group on Sustainable Land Management.

John Egerton



Location: Co. Fermanagh
Enterprise: Beef & Sheep
Size: 74 hectares

John manages a 74 hectare farm in Co. Fermanagh alongside his wife and sons.

A truly mixed enterprise, they have 90 Simmental, Limousin and Saller cows on an autumn-spring calving system, a flock of 200 ewes and a blade calf-rearing unit of 500 calves in partnership with ABP.

John was named Ulster Grassland Farmer of the Year in 2018, has a regular, well respected column in the Farmers Journal and was recently awarded awarded Fellowship of the Council of Royal Agricultural Societies at the Balmoral Show.

John Gilliland



Location: Co. Londonderry
Enterprise: Dry Stock & Willow
Size: 67 hectares

John's farm, Brook Hall Estate, is a 68ha drystock and willow coppice, mature estate, farmed in partnership with his son David.

The farm consists of 34ha of short rotation coppice willow for renewable fuel, 11ha permanent grass for grazing and 17 ha in trees.

John has been an award winning farmer in Ireland & the UK, President of the Ulster Farmers Union; a Non Executive Director of the Scottish Rural College (SRUC), Vice Chair of the UK's Sustainable Development Commission, and a Professor of Practice at Queen's University, Belfast.

Hugh Harbison



Location: Co. Londonderry
Enterprise: Dairy
Size: 100 hectares

Hugh runs a Dairy farm in partnership with his father Thompson. They currently have 180 autumn calving cows on a 12 week block calving system supplying to Dale Farm.

Throughout the course of the ARCZero project, Hugh has sought to reduce his carbon footprint through seeing what can be done with Multi-Species Swards on a dairy platform, as well as the benefits of breeding a lighter weight cow which maintains the milk solids and proteins of its heavier counterparts.

Ian McClelland



Location: Co. Down
Enterprise: Dairy
Size: 52 hectares

Ian is a high performing dairy farmer from County Down, supplying Lakeland. He runs a 52 hectare farm hosting 96 Autumn calving cows.

He has had great success stitching clover into swards to help reduce the amount of manufactured nitrogen (N) fertiliser applied to his land, as well as working to increase his hedgerows and rapairian strips.

A more recent entrant into Dairy, Ian converted his beef and youngstock enterprise in 2015 and has gained recognition for the progress he has made in the last seven years.

Thank you for your support

John Gilliland
ARCZero Chair

There are many people and organisations, without whom, ARCZero would not have been possible, or the success it is today.

ARCZero was only possible by our bid being accepted for funding from the European Innovation Partnership (EIP) scheme. The scheme is part of the Northern Ireland Rural Development Programme (NIRDP), jointly funded by the European Agricultural Fund for Rural Development (EAFRD) and the Department of Agriculture, Environment and Rural Affairs (DAERA), and I would like to extend a huge thank you to both organisations for putting their faith in us, to spend their money wisely.

Within the EIP Scheme, we would like to specifically thank our CAFRE mentoring and administration team, of Norman Wetherup, Katherine Neeson, Russell Forester and Nigel Murphy whose help was greatly appreciated and

kept us on our toes!

In addition, I would like to thank the wider CAFRE team, who gave us unstinting support for our Farm Walks, especially Gary Haslem, Michaela Tenor and the team of CAFRE farm advisors, who independently of ARRZero, have continued to give wider support for each of our businesses.

I would also like to thank the many guest speakers, particularly from the other EIP Projects, who lent us their expertise and gave up their time to help ensure our farm walks were as useful and interesting as possible for those attending.

From Queen's University Belfast's Institute for Global Food Security, I would like to extend our thanks for the invaluable help that we received from Prof. Nigel Scollan, who has quietly advised ARCZero through out our journey along with Paul Williams, who mentored and steered seen amateur soil advocates.

Without Rachel Cassidy and Alex Higgins, from the Agri-Food & Biosciences Institute (AFBI), we never

would have understood the relevance of all the landscape data we gathered. Thank you for your time and dedication making nutrient and run-off risk maps fun, and defining each farms carbon stocks in trees and hedgerows in such a meaningful way.

Jason Rankin and the team at AgriSearch have been relentless in our outreach. The extraordinary leveraging and outreach of our journey could not have delivered the impact it has, without all their hard work providing comms support and organising the farm walks, many thanks.

Birnie Consultancy, and especially Ashley Hassin, for their project management, but more importantly, their patience having to listen to me. Again a huge thanks.

Other service providers, AgreCalc, AgriCarbon, NRM, SAC Consultancy, RPS, who in their own way, really allowed us freedom to push their services, out of their comfort zone, but who all delivered in a very professional and obliging way. Thank you.

To Owen Brennan, who as Chair of Devenish,

allowed me the freedom to take the knowledge that Devenish had created, sprinkle some magic on it, and leverage it to show, that if you can't measure, you will never be able to manage; and if you empower farmers with really good and precise knowledge about their own farm, they will make the right decisions about their business's and their environment's future, a very personal and huge thank you from me.

And finally, to my fellow six ARCZero farmers..... you have put up with so much pushing and prodding from me.... but to watch how you all blossomed, particularly when you hosted your own ARCZero farm walk, not only brought immense satisfaction to me, but to all of those who made the time to come and learn from your own journeys... ARCZero could never have delivered what it has, without you, your transparency, your passion and your desire to show that farmers can take on the responsibility of farmer led innovation, rub the corners off it, and make it work. Thank you.

Farm Walk Boards

Below are the boards from the Farm Walk conducted after the ARCZero close-out conference on 20/06/23 at the Gilliland Farm, Brook Hall, Derry/Londonderry.



Welcome to the Gilliland Farm, Brook Hall



- 67ha Farm
- 34ha in Short Rotation Coppice Willow
- 11ha in Permanent Grass Grazing
- 17ha in Land in Trees
- Dry Cows, in Calf Heifers & Calves



BROOK HALL
Estate & Gardens

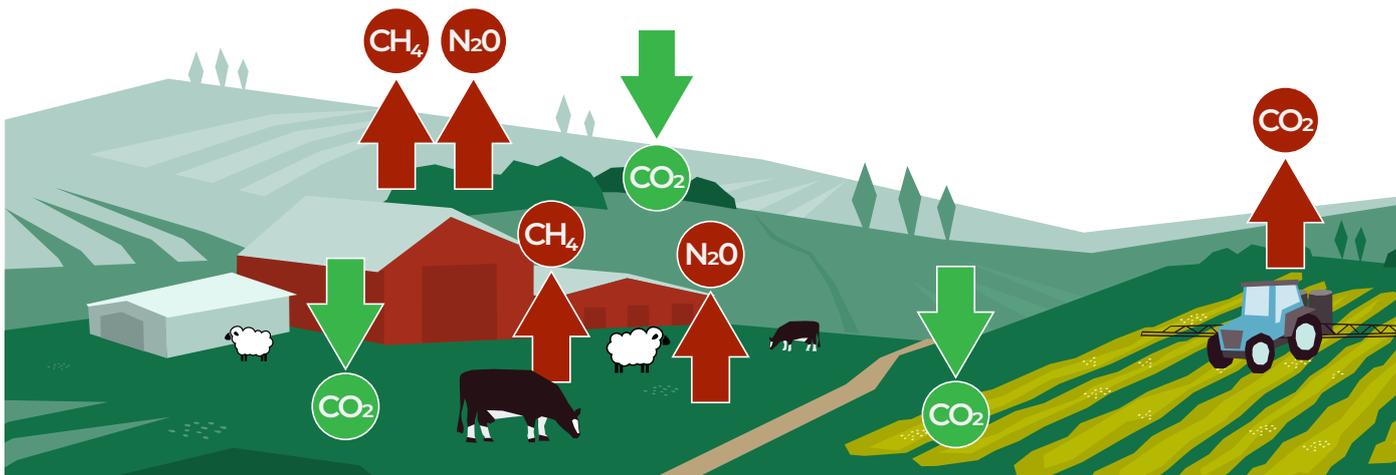


Carbon Farming

If you can't measure, how can you manage?

Net Farm Carbon =
Gross Annual GHG Emissions
Less Gross Annual Carbon Sequestration,
Adjusted for Renewables & Waste Management

Using "Net" not "Gross" Emissions to get
a complete business picture on the
best journey to Net Zero



Carbon Footprinting as a Management Tool

Brook Hall Case Study

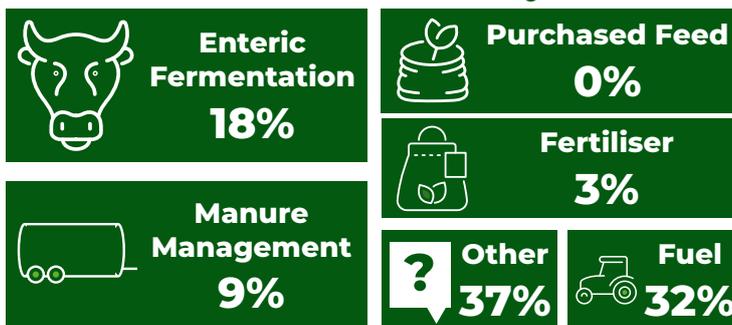
" A Carbon Footprint is the total greenhouse gas emissions caused by an individual, organisation, service or product, within a given year, expressed as carbon dioxide equivalent, CO₂e"
Carbon Trust

Why is it important?

- > Understanding of GHG emissions
- > Farm business sustainability
 - > Market food products
- > Slow the rate of climate change



Sources of Emissions by %



Moving Towards Net Zero Mitigation tools



**Genomics
& Genetic
Selection**



**Feed
Additives**



**Slurry
Additives &
Amendments**



**Renewable
Energy**



**Alternative
Fuel Vehicles**



Short Rotation Willow Coppice Grown Initially for the Production of Renewable Fuel



A Mixture of eight different types of willows
selected for disease & pest resistance; yield & ease of harvesting

Harvested every three years, yielding 60-72t of wet woodchip, planted 1996



Short Rotation Willow Coppice

Now, accelerating livestock production to Net Zero



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

GreenFeed for Measuring Methane Emissions from Cattle and Sheep

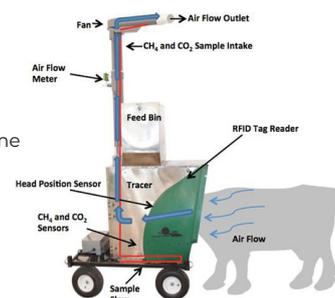
OmarCristobal.Carballo@afbini.gov.uk, Xianjiang.Chen@afbini.gov.uk, Tianhai.Yan@afbini.gov.uk

GreenFeed

"GreenFeed" (automatic head-chamber) estimates gaseous exchange (CH_4 , CO_2 and O_2) in cattle and sheep through measuring breath samples during a few short time visits per day to a "baiting" location to receive a small amount of food.

Features

- Measure the mass-fluxes of CH_4 , CO_2 , H_2 and O_2 in breath samples
- Animals voluntarily visit a baiting station periodically throughout a day for at least five minutes in each time
- 'Baiting' feed rates for each animal can be controlled using a radio-frequency identification (RFID) tag system
- Nondispersive infrared (NDIR) sensors are used to quantify metabolic gases
- Gas emissions data is logged and automatically processed
- Pasture trailer and integrated solar panels, batteries, and generator systems for autonomous operation
- Auto calibration system for gas sensors calibration
- Weather station for outdoor measurement and data calibration
- Integrated, remotely operated camera



Experiments

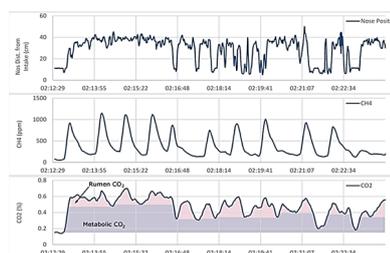


Grazing studies with dairy cattle



Indoor studies with sheep

Results



A set of data obtained from a GreenFeed

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

J. Thompson^{1*}, S. Stergiadis², O.C. Carballo³, T. Yan³, F. Lively³, J. Gilliland^{1,4}, S. Huws¹, K. Theodoridou¹

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

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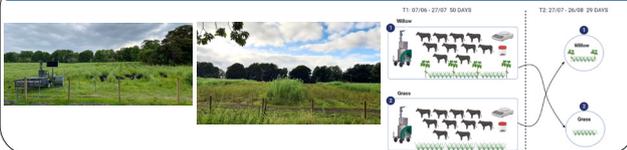
BACKGROUND

- Ruminant systems are under pressure to reduce CH₄ emissions and increase carbon sequestration.
- Condensed Tannins (CTs) can bind to proteins, reducing ruminal degradation and methanogenesis
- Willow fodder contain CTs

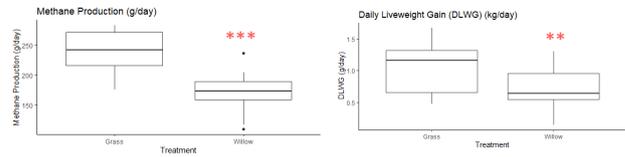
OBJECTIVES

- Can beef cattle graze Willow Fodder (WF)
- Quantify the effect of WF on performance and CH₄
- To explore if WF can be rotationally grazed

METHODOLOGY



RESULTS



	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	**
CH ₄ (g/d)	237	173	7.18	***

CONCLUSION AND IMPLICATIONS

- Willow Silvopastoral systems could be a grazeable forage for cattle with potential to reduce CH₄ emissions
- Further *in vivo* trials are needed to quantify the effect on protein metabolism and quality of animal products

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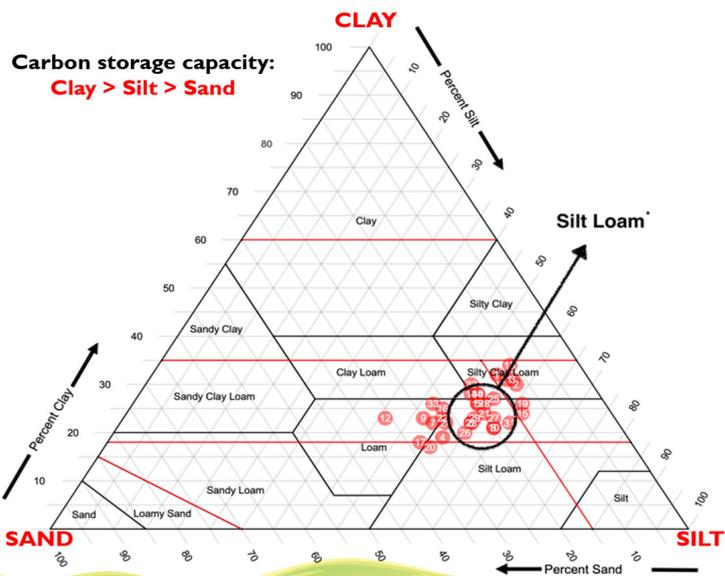
Acknowledgements: We thank Brook Hall Estate in N. Ireland for providing the Willow grazing platform and Food Foyle Food Group for the animals. Funded by DAERA and UKRI-BBSRC.



Knowing our Soils - Carrying out our Baseline



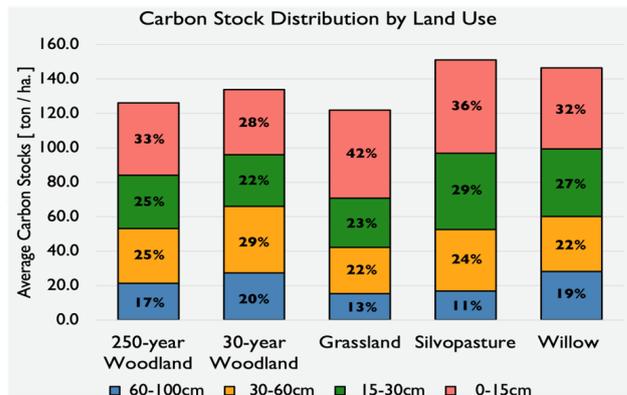
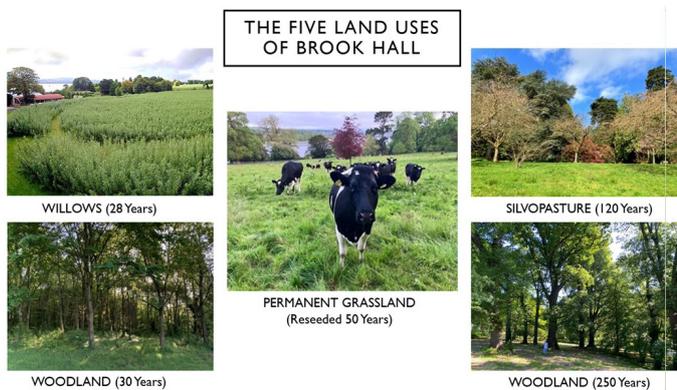
Soil Texture Classification



Soil pH, Soil Organic Matter & Soil Texture Classification



Impact of Land Uses on Soil Organic Carbon

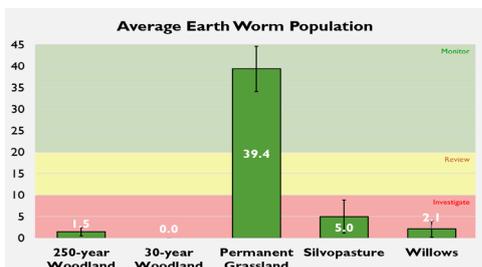


180 Soil Cores, created 565 Samples, all were tested
At 17.6 Samples per Hectare, to an Average Soil Depth of 0.86 metres, R. Buffara, WUR, 2023

Trees & Grass together, better than trees, or grass, on their own
Total Soil Organic Carbon at Brook Hall : 19,468 t of CO₂e



Impact of Land Uses on Soil Health



30yr Woodland
VESS Score: 1
Color: 10YR 3/3

Grassland
VESS Score: 3
Color: 10YR 4/2

Willow
VESS Score: 5
Color: 10YR 4/3



R. Buffara, WUR, 2023

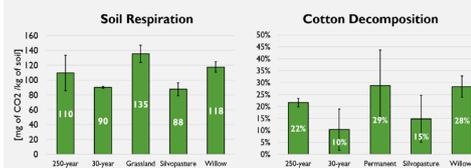


"SOILED UNDIES"

- Degree of decomposition is indicative of Microbial Activity in soils.
- Decomposition is assessed by % of mass lost of Cotton.



SOIL RESPIRATION VS. DECOMPOSITION



Assessing Good Soil Health is a combination of Metrics & not just Soil Organic Carbon

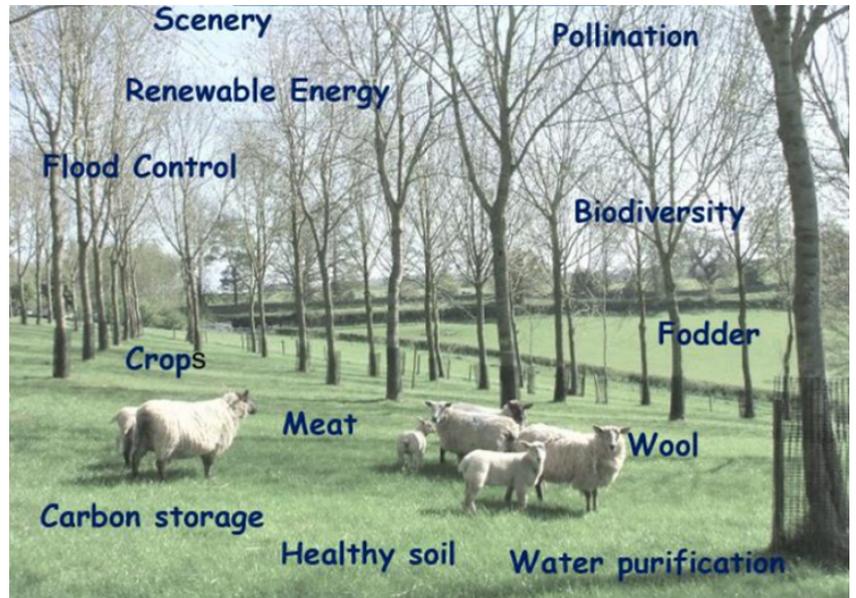


Benefits of Trees in the Food Producing Landscape

Total Sequestration rates

	Tonnes of CO ₂ e/ha/yr
Broadleaf woodlands	9.20
Conifer forest	15.96
Agroforestry (5m spacing, 400 trees/ha)	13.50
Hedgerows	1.04 CO ₂ e/km/yr
Grassland soils (no slurry)	1.28
Grassland Soils (with slurry)	3.16

Source: CAFRE



Source: Jim McAdam



Brook Hall's Soil Phosphorous



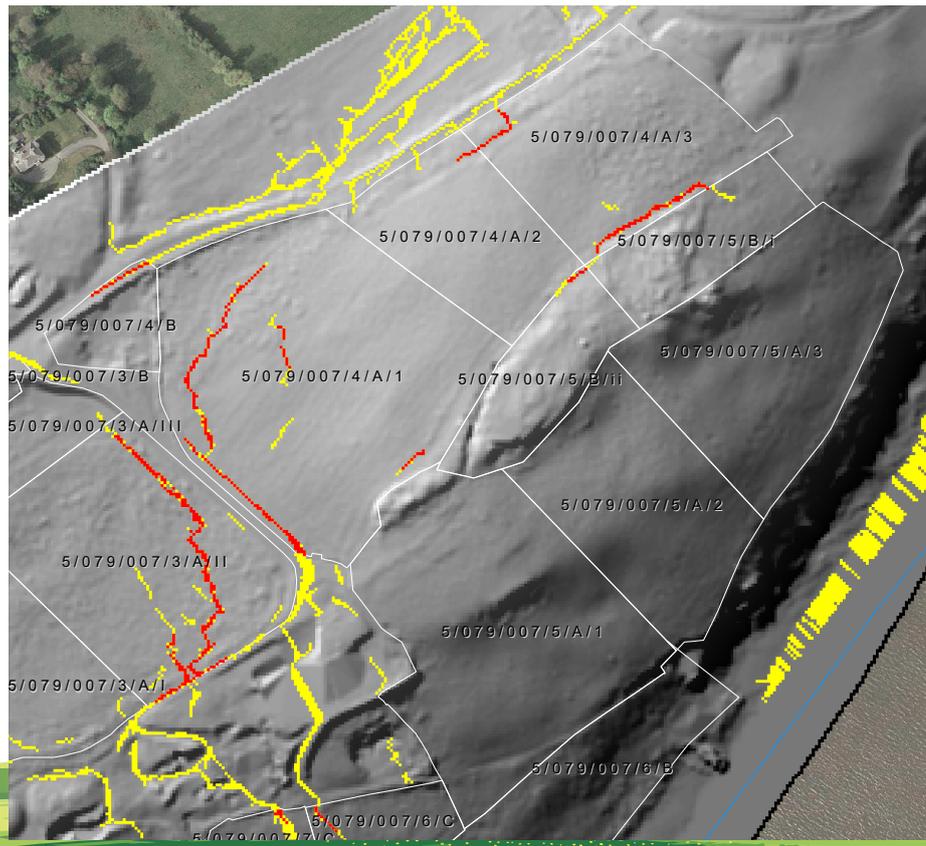
Role of Heritage in Soil Phosphate Level

Olsen P

- Index 0
- Index 1
- Index 2-
- Index 2+
- Index 3
- Index 4
- Index 5

0 0.1 0.2 Km





Improving Water Quality Creation of Run Off Risk Map

- Runoff discharges to waterbody
 - Waterbody Lines
 - Critical Source Areas - high soil Olsen P in these fields means these areas have elevated risk of P loss to water
 - Hydrologically Sensitive Areas for runoff generation and loss of nutrients*, sediment and other applied substances.
- * applied nutrients including slurry, manure and chemical fertiliser.*

Rachel Cassidy, 2021

afbi AGRIFOOD & BIOSCIENCES INSTITUTE

The Role of Renewables in Net Zero

1988 - 1st of Eight Biomass Bomass Boilers installed at Brook Hall to dry grain & the house



Installed Big Bale & Timber, manually loaded, boiler. Cost £20,000
Annual saving of £6,000. Pay Back in 3.6 years

No mention of the word "Carbon" or "RHI"



The Role of Renewables in Net Zero

Brook Hall's Net Farm Carbon Position



100 kW KWB Boiler



	Gross Emissions	Gross Sequestration	Beyond Net Zero	% of Gross Emissions
Brook Hall, without Renewables	15t/yr	156t/yr	5t/yr	103%
Brook Hall, with Renewables			206t/yr	236%
Brook Hall, with Renewables & 3rd Party Benefit			655t/yr	534%

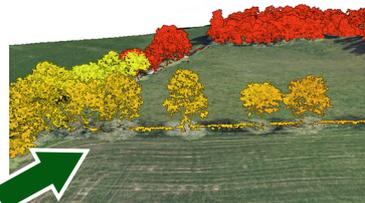
The use of Renewables has the ability to accelerate farm businesses to Net Zero & Beyond



Vegetation Height (m)

- <3
- 3-6
- 6-9
- 9-12
- 12-15
- 15-18
- 18-21
- 21-24
- >24

Measuring On-Farm Biomass Carbon Stock using LiDAR



Total Farm Carbon Stocks: CO₂e

Top 30 cm Soil	19,468 tonnes
Above Ground Biomass	4,154 tonnes
Below Ground Biomass	787 tonnes
TOTAL	24,405 tonnes

(Alex Higgins, 2021)

Sustainable Farming

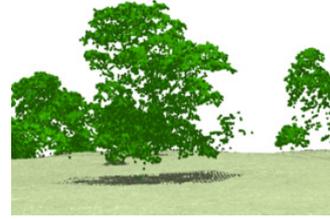
Delivering Multiple Solutions - Not Single Agendas



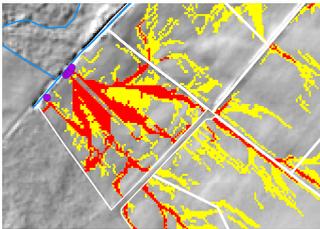
Producing Nutritious Food
& Tackling Malnutrition



Delivering Soil Improvement
Both Fertility & Health



Accelerating Carbon Sequestration,
Both Above & Below Ground



Improving Water Quality by
Reducing Over Land Flow



Optimising Biodiversity,
Especially Below Ground



Generating Profits



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A whole farm approach
26th June**

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