

## **Gwahoddiad i roi tystiolaeth lafar: Cynllun Ffermio Cynaliadwy – 09 Mai 2024**

### **Invitation to give written evidence: Sustainable Farming Scheme**

John Gilliland – Professor of Practice, Queens University Belfast

- Environment Advisor to AHDB
- Chair of ARC Zero, an EIP Project in N. Ireland
- Former Chair of N. Ireland's Sustainable Land Management Strategy, Expert Working Group
- Owner, Brook Hall Estate, Londonderry

#### **An Apology :**

On the 9<sup>th</sup> of May, the evidence contained within this note was to be delivered orally by John Gilliland. John had to send his apologies at the last moment, as he was working in Australia, when his flights were changed by Qantas, and he found that he was going to be in the air, during the time of the evidence session. John would like to repeat his apologies to all concerned and hope that this note goes some way to answering the expected questions. If it does not, or if it raises some further questions, please do feel free to reach out to John again, and he will do his best to answer any further queries?

#### **Background:**

John has been an active participant in sustainable farming since 1987 when he graduated in Edinburgh. Unusually, John has worked across the breadth of sustainable farming, from being an award farmer; President of the Ulster Farmers Union; Vice Chair of the UK's Sustainable Development Commission; Chair of the UK's Rural Climate Change Forum; Non Executive Director of SRUC; ran a research farm in the Republic of Ireland; Chaired N. Ireland's expert working group on Sustainable Agriculture Land Management Strategy and ammonia emissions; been a member of the EU Commission's Soil Mission; and currently chairs the innovative, farmer led ARC Zero project in N. Ireland; and is an environmental advisor on sustainable farming for the AHDB levy board, with a remit for dairy, cereal and oilseeds farmers in Wales.

Regarding this note, John will mainly refer to his experience with ARC Zero, his experience with chairing the writing of N. Ireland's Sustainable Agriculture Land Management Strategy (SALMS) and subsequently, as a member of the Stakeholder Liaison Group to N. Ireland's Soil Nutrient Health Scheme, a product of SALMS strategy.

#### **Q&A :**

- *Can you set out key findings from your net zero work in Northern Ireland that might be relevant to agricultural policy development here in Wales?*

In 2020, the Department of Agriculture, Environment and Rural Affairs (DAERA) announced the opening of N. Ireland's EIP Innovation Partnership competition for farmer led innovation. A group of seven N. Ireland farmers came together and submitted a collective bid and secured public funding to create N. Ireland's first Carbon Smart Farming Pilot Project. One of the seven farmers was John Gilliland and due to his past long track record in climate smart farming, he was chosen by the other six other farmers to chair this two and a half years project, called ARC Zero. ARC Zero completed this initial project in July 2023, and then transitioned to become a

Community Interest Company which has subsequently secured funding from the Co-op Foundation in the UK to continue its work. In support of this written evidence, John has attached a pdf copy of the close out presentation he gave to DAERA back in July 2023.

It is important to note that this project was only a pilot, but one which was scrutinised by the funding body, DAERA, both on its rigour, but also in how it could leverage some of the findings and build them into future policy making.

In this written evidence, John will use various slides from that presentation to illustrate the answer to the question being asked.

The seven farms are a cross section of N. Irish agriculture, with different enterprises, different soil types and landscapes, and different climates.



## 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*

- GHG emissions in agriculture;

Using the accredited Life Cycle Assessment Calculator, AgReCalc, from SRUC in Edinburgh, each farm business had their total emissions calculated using Tier 2 methodology.



## 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



This alone was of little help. What was of more help was the benchmark comparison on where each of the farms were against their farming peers, with similar enterprises.



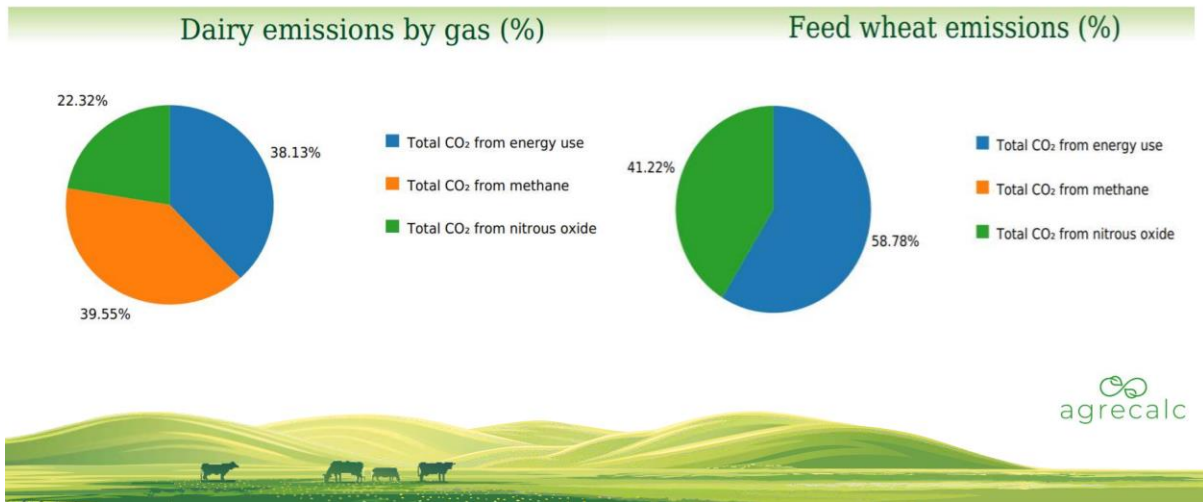
## Benchmarked farms against average ARC Zero farms were already at, or well above average

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



And in particular, where the actual GHG emissions were coming from within their different enterprises. This was particularly helpful in informing where each farm business should start to change its behaviour, as no farm was the same as any of the others. No silver bullet solution was found, each farm had to tailor its solutions to its own circumstances.

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



- carbon sequestration;

As was the case with measuring GHG emissions, the LCA AgReCalc was used to work out each farms sequestration, but this time using the less accurate, but approved methodology of Tier one, as the UK does not have enough accurate sequestration data to allow UK LCA calculators to use the Tier two methodology. The following was what was observed

## Gross Sequestration for the seven ARC Zero farms Using 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



As with emissions, on their own, the sequestration figures meant little to the seven of us, until they were set against each farm's emissions.



## 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



The most informative presentation of the results was where there was a comparison between Gross Emissions and Net Emissions.



## 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.....

**Some farms are already past Net Zero.....**



What was found that in all cases, the Net Emissions position was less than the Gross Emissions; that no two farms were the same; that some farm businesses would find the journey to Net Zero easier than others and should be encouraged to go “beyond net zero” as some farms would never get to net zero. Finally, what we saw was that some farms were already “beyond net zero,” even where they had ruminant livestock on them. This was a revelation to all seven farmers and energised the five that were not already at net zero.

- carbon stocks in soil;

As mentioned above, carbon sequestration could only be worked out using the basic Tier one methodology. To aid the process of improving the methodology for sequestration calculation, taking it to Tier 2, as is the case with emissions, and with the eventual aim of getting it to the most accurate Tier 3 methodology, ARC Zero used the latest in measurement technologies, accurate enough to pick up the consequence of positive behaviour management change on farm; to baseline every field, tree and hedge on the farm. The technologies used were as follows



## 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**



For measuring soil organic carbon, a soil coring technique was used, going down to one metre deep, or the bedrock, whichever ever one came first. This then was sent to the lab, where soil organic carbon percentages, soil bulk densities and total soil carbon stocks were measured at four different depths, 0-15cm, 15-30cm, 30-60cm and 60-100cm. This allowed a detailed examination of both how much carbon was in the soil and where it lay within the soil.

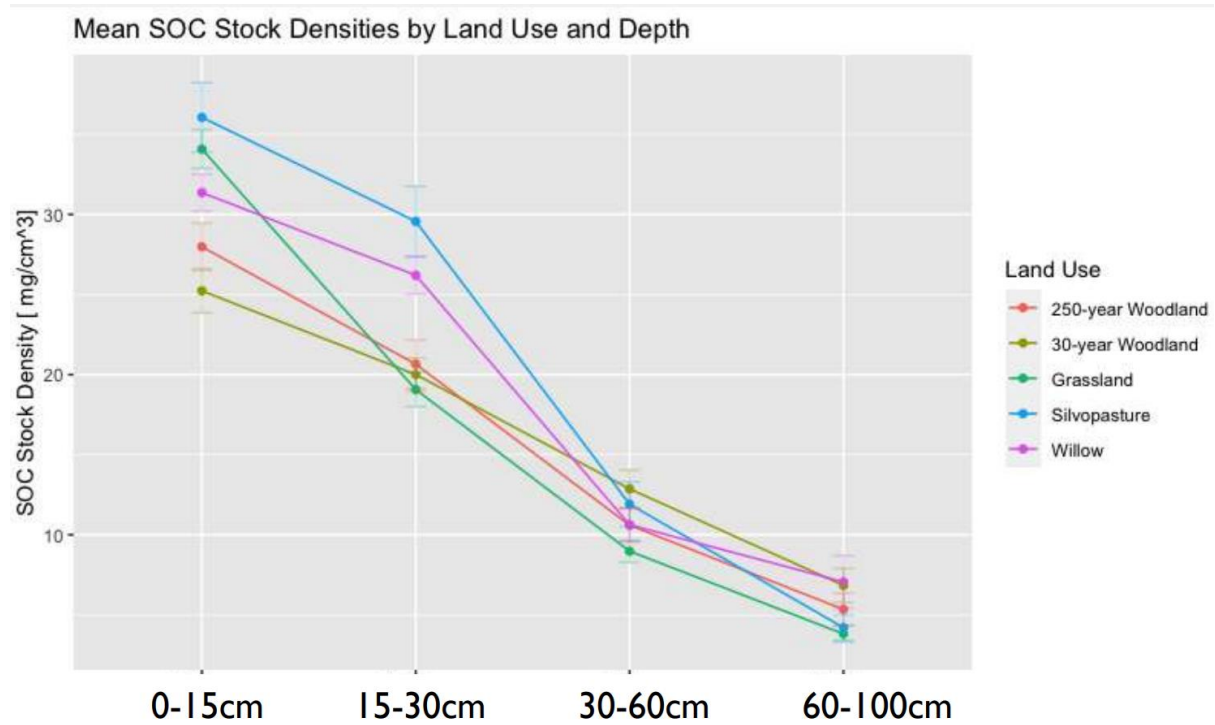
36% of all soil organic carbon, on the ARC Zero farms was found deeper than the commonly used 30cm depth for soil carbon testing, highlighting the essential need to measure to one metre depth, or to the bed rock, whichever ever came first.

The company used to provide this detailed survey was Scottish company, AgriCarbon.

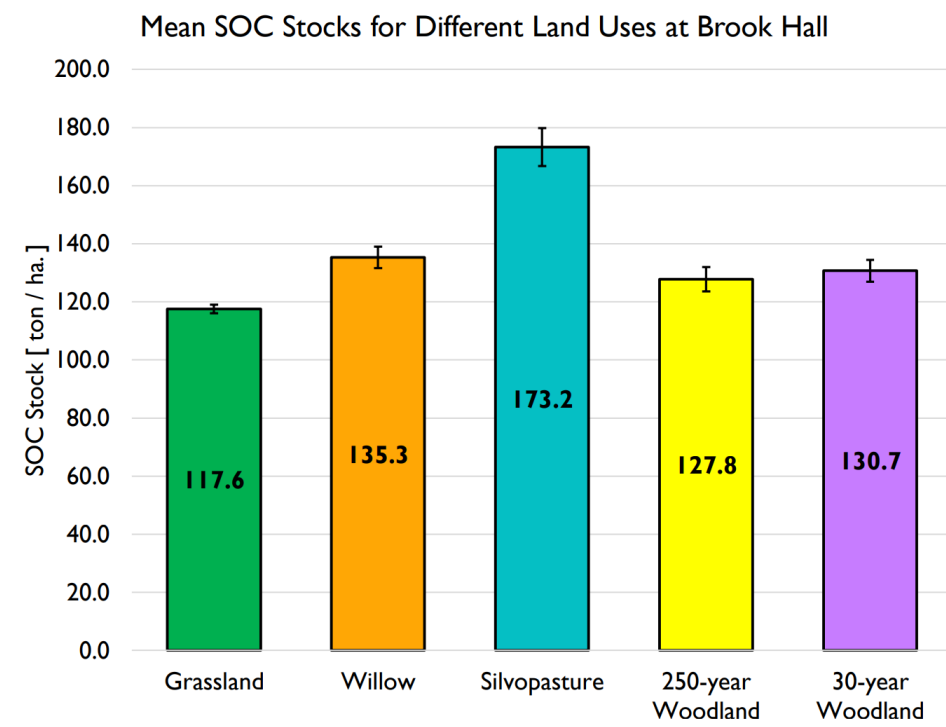
Sampling was also carried out across different long term, land uses, where there were similar soil texture classifications. What was interesting, when the different land uses were examined, the lowest soil organic carbon content was seen under mono cultures, whether that be of grass, cereals, or trees. The best was seen where trees and food production co existed in agro forestry or silvo pasture. This was also seen in fields where a monoculture of grass had been replaced by a herbal ley, or multi species sward of grasses, herbs and legumes, all mixed together. This results in a complexity of root architecture, down to different depths, where different plants' roots, all laying new carbon down through sequestration, were laying it down across the full depth the soil profile, and doing it simultaneously.

The plan is to repeat this sampling every five years and to measure actual change in soil organic carbon stocks, on each farm, rather than rely on very crude modelling in the current soil carbon assessments. This will allow, over time, really accurate data to be collected and to build a

knowledge base accurate enough to secure approval to switch to the most accurate Tier 3 sequestration methodology.



On John's own farm, Brook Hall Estate, the following quantities of soil organic carbon were observed.



- carbon stocks in trees;

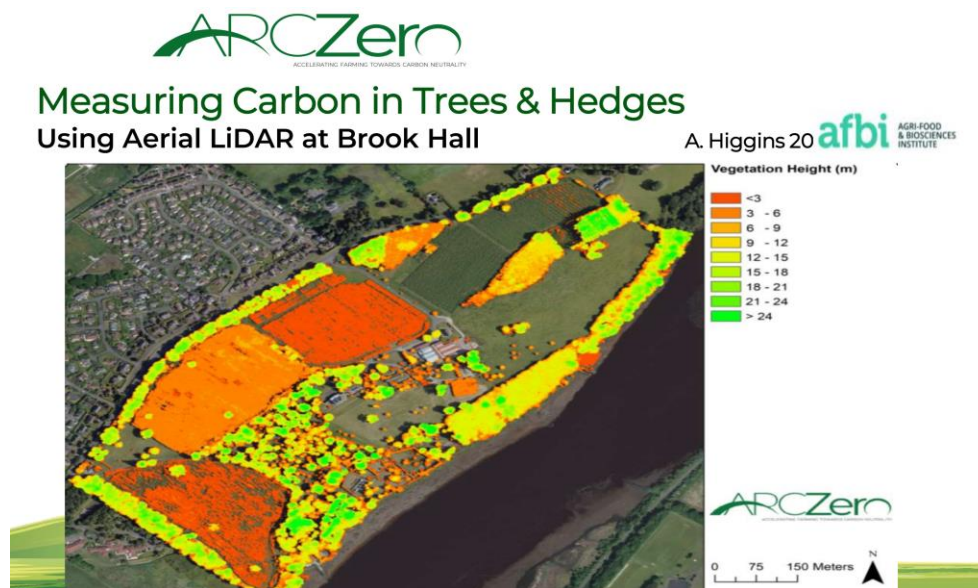
In looking to measure carbon stocks in trees and hedges across the seven farms, a different technology was used. This time ARC Zero used an aerial digital survey technology called LiDAR.

A similar technology to the well known radar technology, a LiDAR survey uses lasers instead of radio beams, to give a very detailed 3D digital data set, of the complete above ground landscape.

Scanning at between 16 and 40 scans per square metre, LiDAR is far more accurate than satellite (normally one scan per ten square metres). The data set derived from an aerial LiDAR survey can also be used for many other purposes, such as looking at habitat interconnectivity (vital for biodiversity adaptation), creating “run off risk” maps (vital to educate farmers on where their farm’s impact on the quality of water that leaves their farm during extreme rainfall), and flood risk management.

With help from N. Ireland’s AgriFood & Bioscience Institute (AFBI), who analysed ARC Zero’s LiDAR data, the carbon stocks in the above ground trees and hedges were calculated for each farm.

Below is the actual LiDAR image for John Gilliland’s farm, showing the different heights (colours) of the five different land uses John has on his own farm.



From this image, an above ground carbon asset register was created

Vegetation type	Brook Hall Estate Totals					
	Hedge Length (km)	AGB (t)	C (t)	BGB* (t)	C (t)	Total C (t)
Hedge 0-4m	0.78	14.92	7.1	2.86	1.3	8.5
Hedge 4-7m	0.35	6.36	3.0	1.22	0.6	3.6
Hedge 7-10m	0.25	10.32	4.9	1.98	0.9	5.9
Hedge >10m	1.00	156.17	74.5	29.99	14.1	88.6
<b>Total Hedges</b>	<b>2.38</b>	<b>187.77</b>	<b>89.5</b>	<b>36.05</b>	<b>16.94</b>	<b>106.49</b>
	<b>Canopy Area (ha)</b>					
Single Trees	1.87	494.78	236.0	95.00	44.6	280.6
Deciduous Woodland	17	1352.74	645.1	259.73	122.1	767.2
Coniferous Woodland	0.09	6.17	2.9	1.27	0.6	3.5
Biomass	28.96	337.61	161.0	64.82	30.5	191.5
<b>Total</b>	<b>47.92</b>	<b>2,379.07</b>	<b>1,134.6</b>	<b>456.8</b>	<b>214.7</b>	<b>1,349.3</b>

When added together with the Soil Organic Carbon results, a total baseline for carbon stocks was composed.



## Measuring Carbon in the Soil Stratified for different Land Uses & Land Managements at Brook Hall

Land Category	Total ha	Soil pH	Av. LOI/SOM	No. of Soil Cores	No. of Samples	Av. C. 0-10cm	Av. C. 0-30cm	Av. C/ha	Av. C/Category
<10% Soil Org. Matter, Short Rotation Willow Coppice	34.2ha	pH 6.2	7.60%	55	11	4.20%	3.20%	87.1t	2,978.8t
<10% Soil Org. Matter, Permanent Grass, no slurry/FYM, only grazed	1.4ha	pH 6.3	9.30%	15	3	4.90%	3.10%	87.3t	122.2t
<10% Soil Org. Matter, Deciduous Woodland	0.5ha	pH 5.3	9.10%	15	3	5.80%	4.10%	114.7t	57.4t
10-20% Soil Org. Matter, Permanent Grass, no slurry/FYM, only grazed	12.9ha	pH 6.1	13.70%	30	6	5.50%	3.40%	93.7t	1,208.7t
10-20% Soil Org. Matter, Silvopasture, no slurry/FYM	4ha	pH 4.8	14.80%	25	5	5%	2.80%	81.6t	326.4t
10-20% Soil Org. Matter, Deciduous Woodland	4.6ha	pH 5.3	13%	25	5	6.90%	4.90%	136t	625.6t
<b>Totals</b>	<b>57.6ha</b>			<b>165 Soil Cores</b>	<b>33 C. Samples</b>			<b>92.3t/ha</b>	<b>5,319.1t of C.</b>

**Soil Carbon** 5,319 tonnes of C  
**Above Ground Carbon** 1,349 tonnes of C  
**Total Carbon Stocks** 6,668 tonnes of C, or 24,405 t of CO<sub>2</sub>e



The plan is to repeat this measurement exercise every five years and measure change accurately enough to allow for Tier 3 methodologies be used for reporting progress on increasing carbon stocks.

When all seven ARC Zero farms were measured, the following results were found



## Total Carbon Stocks across ARC Zero farms.....

Total ARC Zero CO <sub>2</sub> e Stocks	Soil Carbon	Tree Carbon	Total Carbon	% C in Soil
<b>Ian McClelland</b>	31,813t	1,310t	33,123t	96%
<b>Hugh Harbison</b>	68,054t	1,969t	70,023t	97%
<b>John Egerton</b>	31,813t	1,310t	33,123t	96%
<b>Roger &amp; Hilary Bell</b>	50,819t	688t	51,507t	98%
<b>Simon Best</b>	237,915t	6,493t	244,407t	97%
<b>Patrick Casement &amp; Trevor Butler</b>	54,556t	4,022t	58,578t	93%
<b>John Gilliland</b>	19,468t	4,937t	24,405t	80%
		<b>Total</b>	<b>515,166t</b>	

ARC Zero's 7 farms manage 515,166t of CO<sub>2</sub>e..... 97% is in Soil, not in Trees...



On just seven farms in N. Ireland, over half a million tonnes of existing carbon stocks reside, being managed by farmers, without any recognition. Most interestingly, 97% of that carbon was

in the soil and not in the trees. Even in John Gilliland’s farm, which has a very large percentage of its land planted with some form of trees, 80% of his carbon, was still in the soil and not in trees.

- behavioural change.

- From your research experience what works in terms of supporting farm business to deliver multiple public goods, while remaining viable?

Key to positive farmer behavioural change is empowering farmers with really precise, good quality knowledge which is relevant to their own farm, not their neighbours. This starts with a robust baseline of, not just their emissions, but their natural capital/carbon stocks; then benchmarking them against their peers so that they can see where they are good and where they need improvement; and finally showing them the tool box of solutions, from which they will pick the tools that suit their farm, not their neighbour’s farm.

ARC Zero achieved the following behavioural change over just two years by following this pathway.



### The Resultant Improvements Observed over two years.....

LCA comparison between 2021 & 2023, gross emissions/unit of output

<i>GHG Reduction 2021 to 2023</i>	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
- Sowing legumes
  - Health of Livestock
  - Weather



It achieved this by focusing on the following

## Empowered, ARC Zero Farmers made the following Changes

Focusing on the most Cost Effective Solutions 1<sup>st</sup>....

- 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

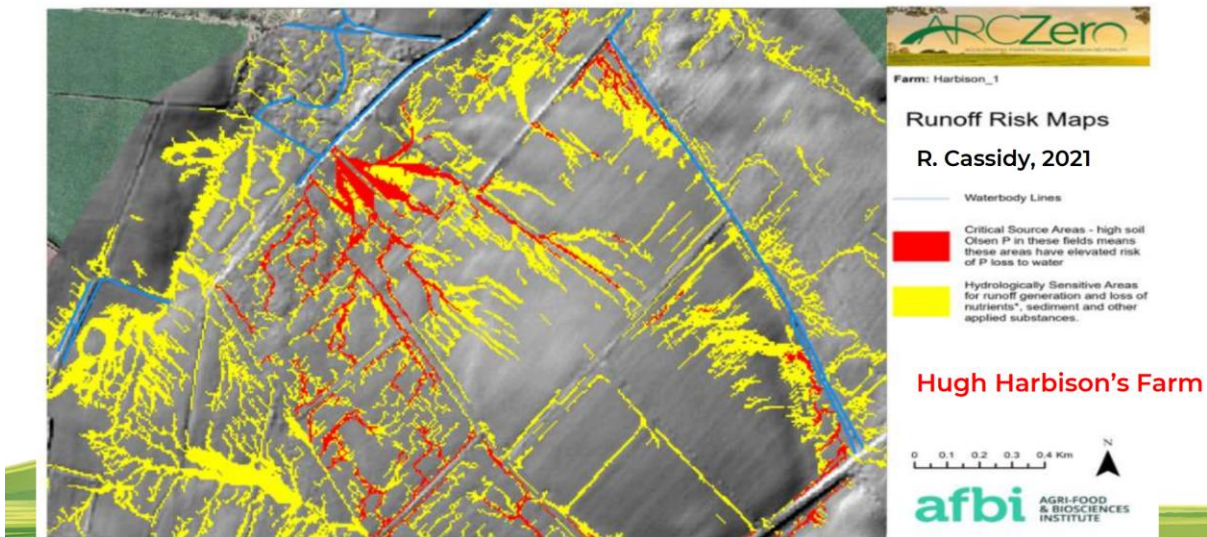
- Installing Renewables.....



But it achieved its best results where just one behavioural change deliver six public goods....

## Delivering Multiple Public Goods Simultaneously

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



The above is a “run off risk” map for one field on one of the ARC Zero farms. It clearly shows where nutrient runs off agriculture land into a neighbouring river, during excessive rainfall.

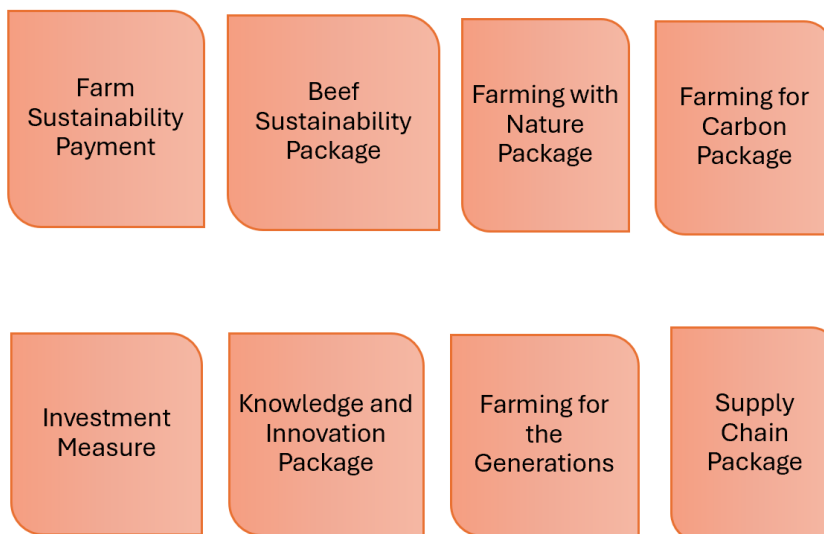
By choosing to prioritise this field for the conversion from a monoculture of perennial ryegrass to a multi species sward of grass, herbs and legumes, the following public goods were achieved

- Reduction of nitrogen fertiliser thus reducing nitrous oxide emissions

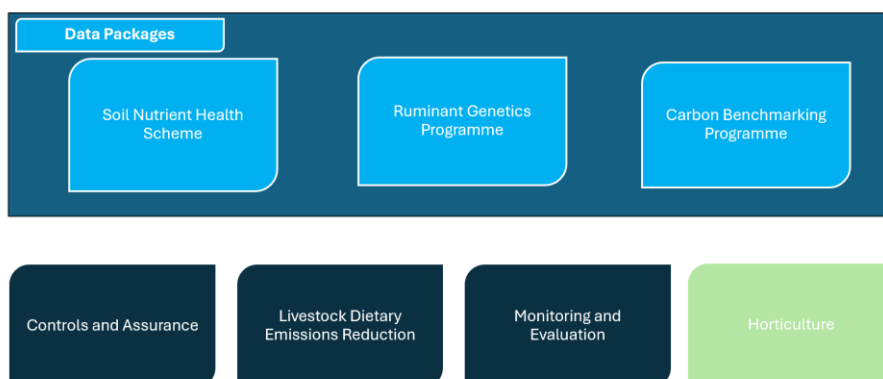
- Improving water infiltration rates allowing nutrient to be washed into the soil and not into the river, thus improving river water quality.
  - Increase in soil biodiversity with up to a 300% increase in earth worm population.
  - The increase of soil organic carbon and at deeper depths
  - Making the soil more resilient to the ever increasing extreme weather events (adaptation).
  - Increasing profitability of the farm.
- *What can be learned from agricultural support schemes in Northern Ireland that could be useful for Wales?*

Like Wales, N. Ireland has been building it's new, post BREXIT, Agriculture and Environment policy. Key in this has been the very valued use of co creation, which has secured the wider stakeholder approval for the direction of travel.

The new framework is based on the following new schemes

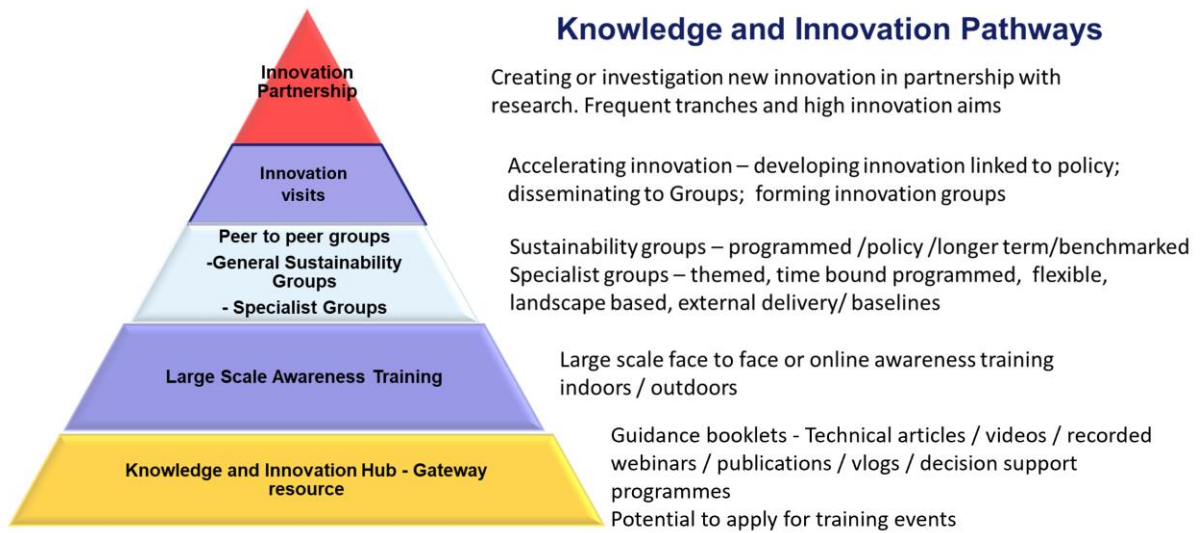


With key cross cutting schemes and programmes, embraced in packages of data, key for the interconnectivity needed for the carbon benchmarking programme



A key foundation for this journey is the improvement of knowledge and how it can be used to drive innovation.

## Knowledge and Innovation Pathways



The scheme which is leading the way, is N. Ireland’s world leading “Soil Nutrient Health Scheme,” a £38m voluntary scheme which was the main recommendation of the Sustainable Agriculture Land Management Strategy Expert Working Group, chaired by John Gilliland. It recommended that if you could not measure, you could not manage, nor measure impact nor behavioural change.

The scheme was set up to provide for the ability to base line every field, tree and hedge in N. Ireland, with precision granularity using LiDAR and soil sampling. The resultant information is being returned, with mandatory training to each individual farm business, with the understanding that it is planned to repeat the baselining in five years, so change can be measured.

The scheme is now completing its second of four years. Currently the scheme is open to 50% of N. Ireland and unprecedentedly, some 92% of farm businesses have taken up the opportunity to join the scheme.

The flyer for the scheme can be seen below.



# SOIL NUTRIENT HEALTH SCHEME

**afbi** AGRI-FOOD  
& BIOSCIENCES  
INSTITUTE

 Department of  
Agriculture, Environment  
and Rural Affairs  
[www.daeira-nl.gov.uk](http://www.daeira-nl.gov.uk)

 **cafre**  
College of Agriculture,  
Food & Rural Enterprise

## Background

The Soil Nutrient Health Scheme (SNHS) is a comprehensive regional soil sampling and analysis programme, that will enable Northern Ireland's farmers to optimise crop nutrient applications, assess on-farm carbon (C) stocks and build farm resilience. Simultaneously it is expected that the scheme will provide a baseline to develop strategies for improving the sustainability of the region-wide soil resource, agriculture, and the natural rural environment. The Department of Agriculture, Environment and Rural Affairs (DAERA) is funding the £45m scheme, which runs from 2022-26 and is managed by the Agri-Food and Biosciences Institute (AFBI).

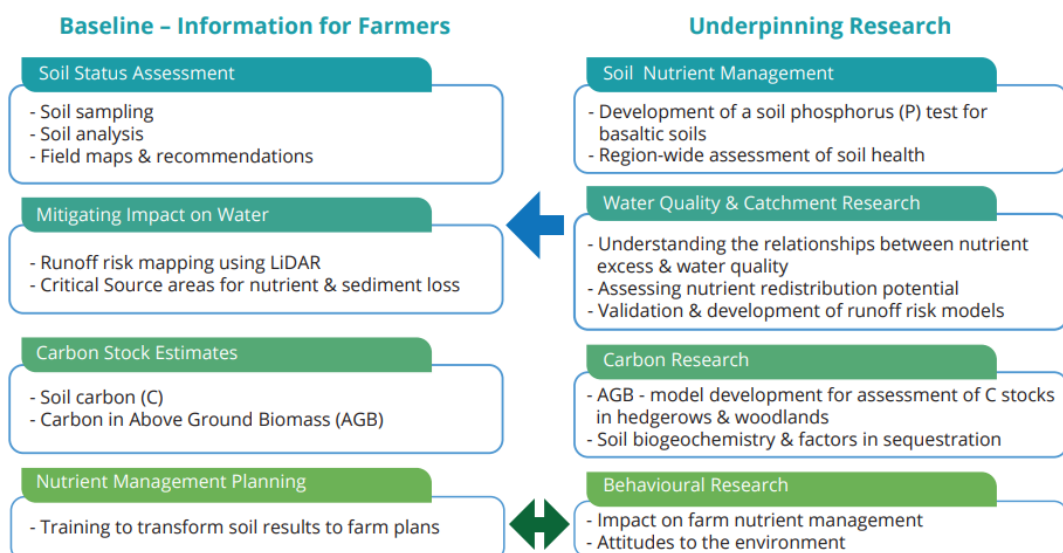
## Benefits to Farmers

Comprehensive testing of all fields on each participating farm in SNHS will enable farmers to optimise the application of crop nutrients to their soils and help increase farm profitability.

Farmers participating in the scheme will receive:

1. Detailed information on the nutrient and pH status for each field, and crop-specific recommendations for the year of application
2. LiDAR-derived runoff risk maps highlighting sub-field scale hot-spots with potential for nutrient loss to waterbodies
3. Estimates of C stored in soils and as above ground biomass on each farm
4. Training on the interpretation of soil nutrient reports and generation of farm nutrient plans (provided by the College of Agriculture, Food and Rural Enterprise - CAFRE).

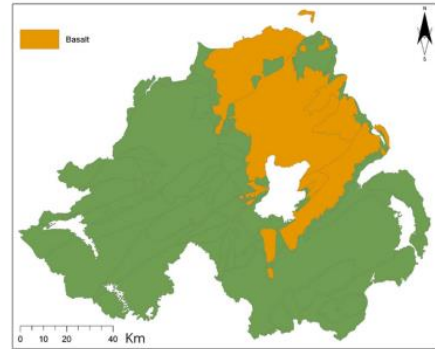
All work on the scheme is supported by a comprehensive programme of research led by AFBI and with partners at both Ulster and Leeds Universities.



## Soils Research

Basaltic soils cover nearly a third of the landscape of Northern Ireland and are characterised by high levels of Fe, Al, Ca, Mg, Cu, Cr and Ni. Research indicates that the Olsen P soil test, when applied to these soils, may be underestimating plant-available Phosphorus (P)

As a result, SNHS encompasses a body of research dedicated to assessing nutrient interactions and grass nutrient uptake specific and uniquely to these basalt soils through plot experiments on farms across the northeast. The soil test developed from this work will be used to provide recommendations to farmers when this area is soil tested in Year 4 of the scheme.



*Areas with basalt soils in NI.*

## Water Quality and Catchment Research

Nutrient enrichment of freshwaters by P is a primary cause of water quality impairment in NI, with agriculture a key source. In catchments with high rainfall, impermeable soils and steep slopes overland flow, or runoff, is the primary pathway by which nutrients and sediment are transferred to surface waters. High-resolution LiDAR digital elevation data provides the basis for modelling hydrological connectivity in the landscape, and identifying, in conjunction with soil permeability, those areas most prone to runoff and erosion. A programme of water quality monitoring in agricultural sub-catchments across each Zone will be used to develop and relate soil nutrient status and runoff risk potential to water quality and contribute to the development of strategies for achieving water quality improvements. (AFBI & Ulster University)



*Stream monitored for water quality within SNHS*



*Runoff risk map showing high risk areas for nutrient and sediment loss*

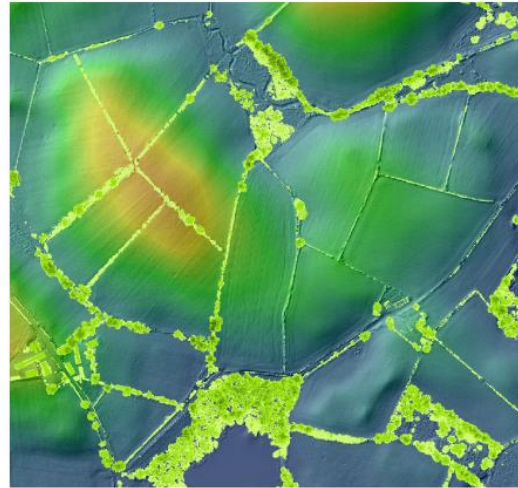
## Carbon Research

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A high-resolution LiDAR scan of Northern Ireland will provide a basis of modelling activities to estimate above ground biomass held in trees, woodlands and the 120,000 km of hedgerows in the region.

SNHS is also gathering information on rates of soil C sequestration in grassland fields on selected commercial farms and along undisturbed field boundaries on different soil types in Northern Ireland (involving radio-carbon dating and soil microbiological assessments). Ongoing research will investigate how fungal and bacterial communities are affected by management and elucidate mechanisms and processes governing changes in soil C storage in grassland and hedgerow soils.

Information arising from this research will be used to update the UK soil C inventory, and to identify management strategies which enhance C capture by soil and above ground biomass.



*High-resolution LiDAR scan to estimate above ground biomass held in trees, woodlands and hedgerow*

## Behavioural Research

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An assessment of the extent to which participation in the various components of the SNHS scheme has influenced farmer awareness, attitudes and behaviour is an important component in monitoring and evaluation of overall impact.

Research will apply a mixed-method approach using a questionnaire-based survey and qualitative semi-structured, in-depth interviews to explore farmers' awareness of the link between soil testing, improved productivity and water quality, and the role of experiential learning in adoption of best management practices for farm management.

Work will also examine how access to real-time water quality monitoring data from local rivers may serve to alter farmers' attitudes and behaviour toward water resources. (Leeds University, AFBI & Ulster University).

### For more information:

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