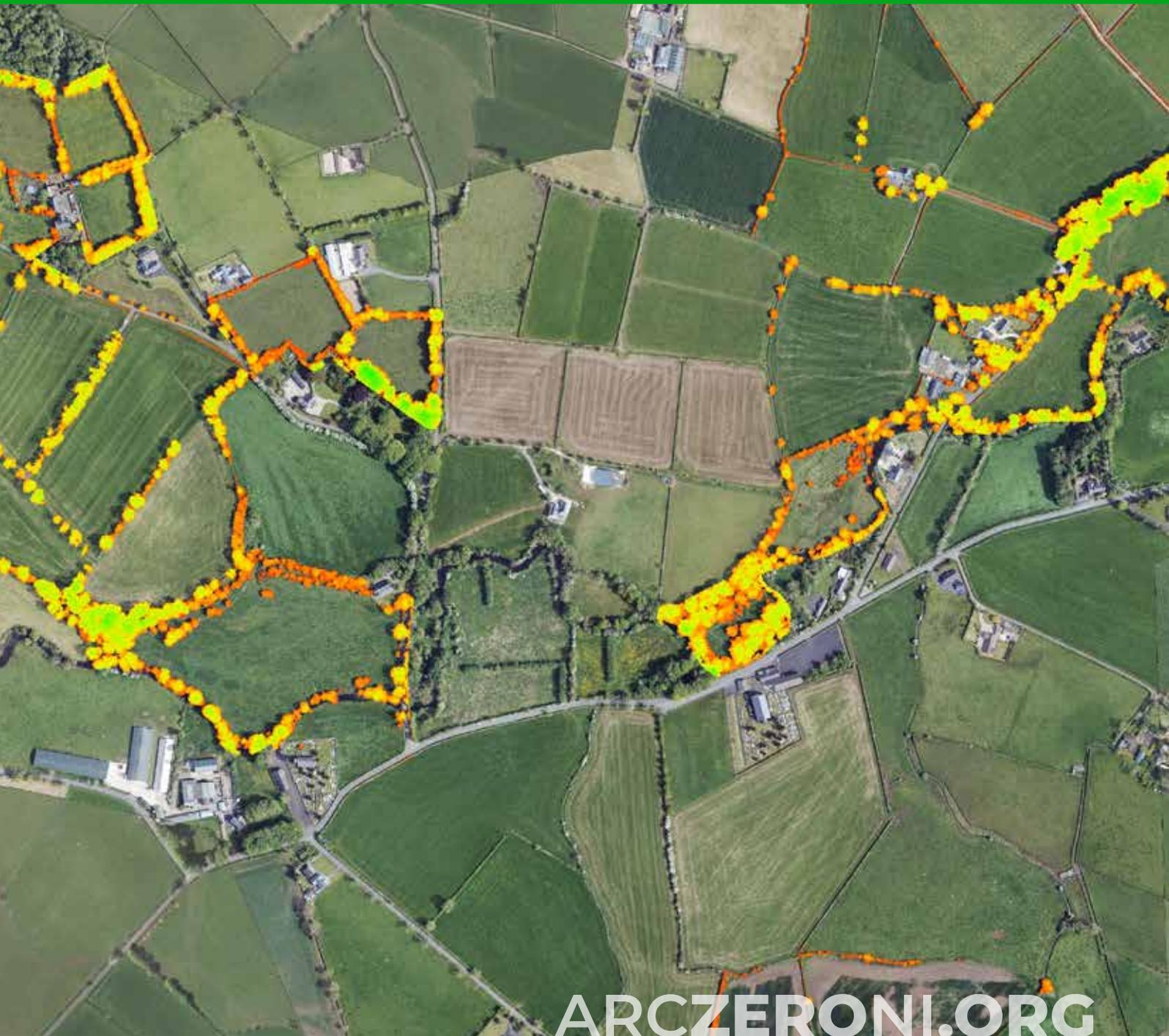


ARCZero

ACCELERATING FARMING TOWARDS CARBON NEUTRALITY

THE ROAD TOWARDS NET ZERO FARM WALK SERIES

#4 - Harbison Farm, Aghadowey - 01.09.22



ARCZERON.I.ORG



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

www.daera-ni.gov.uk



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



The journey towards Net Zero



John Gilliland
ARCZero Chair

Whether these are your first tentative steps, or part of an ongoing journey towards NetZero I want to thank you for taking some valuable time out to join us at this ARCZero Farm walk.

With the Climate Change bill now law, it's essential that we understand not only what carbon is emitted on farm, but just as importantly how farms capture it too, ensuring a bright future for the next generation.

The recently announced

Soil Health & Nutrient Scheme will provide some of the information you'll see here today and will be an essential tool to help every farmer in the country to improve both their environmental and production efficiency. We hope today will help you understand just how powerful having such detailed information at your fingertips can be.

I would like to take this opportunity to thank the speakers from Queen's University and CAFRE who have given up their time to be a part of today's walk as well as Dale Farm who provided sponsorship for the catering.

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).

ARCZero Farmers

**Roger &
Hilary Bell**
Co. Antrim

Simon Best
Co. Armagh

**Patrick
Casement**
Co. Antrim

John Egerton
Co. Fermanagh

John Gilliland
Co. Londonderry

Hugh Harbison
Co. Londonderry

Ian McClelland
Co. Down



The ARCZero Team

ARCZero: the journey so far

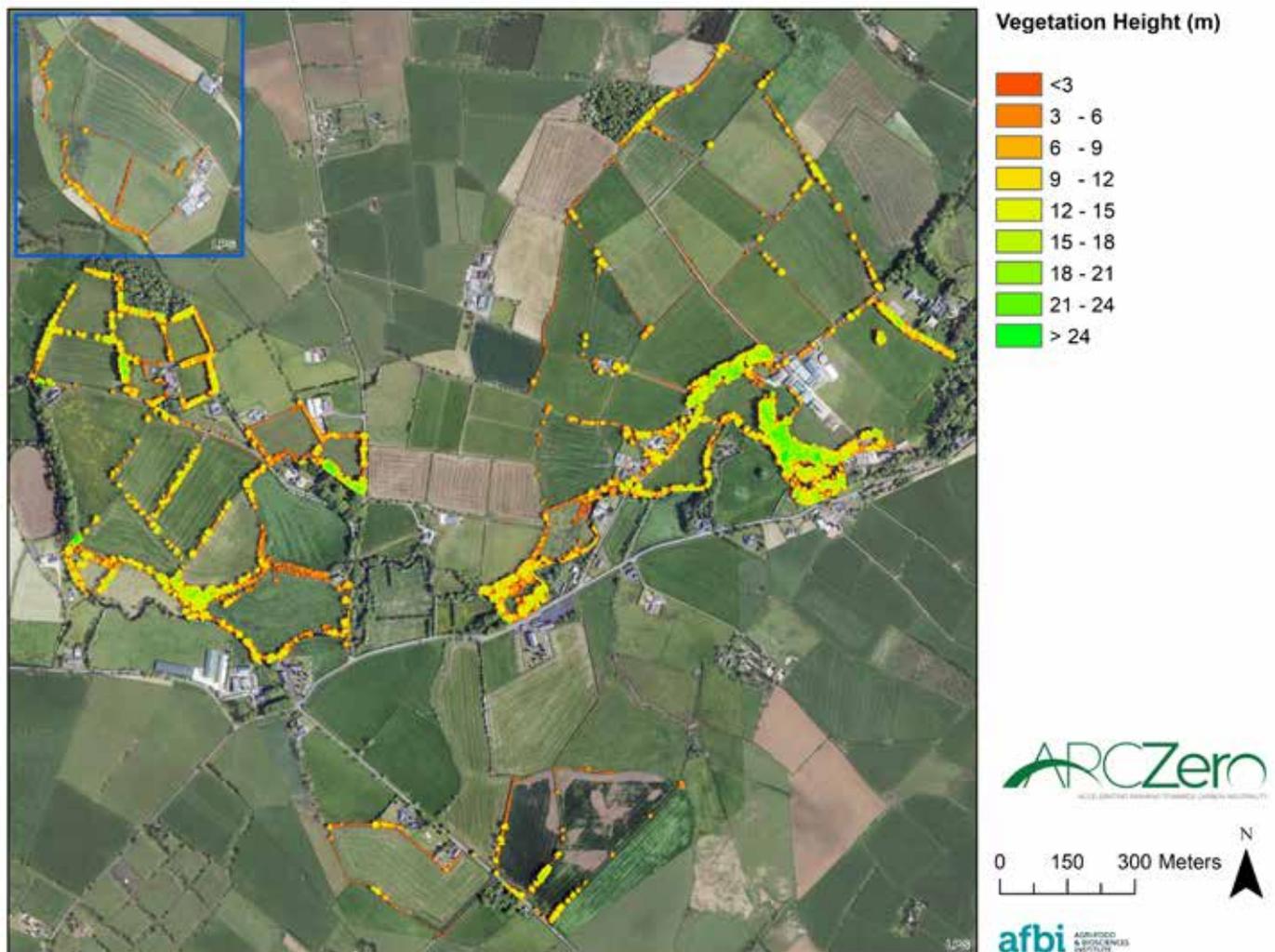
Accelerating Ruminant Carbon Zero (ARCZero) is a farmer led European Innovation Partnership project.

The project is led by John Gilliland of Brook Hall Estate and of Devenish Nutrition, alongside six other N. Ireland farms. Partners include Agrisearch, Birnie

Consultants, Devenish and Queens University Belfast, supported by AFBI, CAFRE, NRM, RPS and SRUC

ARCZero is designed to accelerate the pathway to carbon zero farming by measuring and managing carbon flows at individual farm level, and empowering farmers to make positive change.

The project aims to deliver actual individual net farm GHG footprints, carbon stocks and their potential for annual carbon sequestration, enterprise specific life-cycle analysis (LCA) calculators, and a whole farm carbon balance sheet through the precise measurement of the on-farm carbon



Aerial Lidar coverage of Ballydevitt Farm.

stocks within soils, trees and hedges. The project is designed to enable participating farmers to change practice to accelerate their farm's progress to carbon zero by bringing transparency to their current footprint.

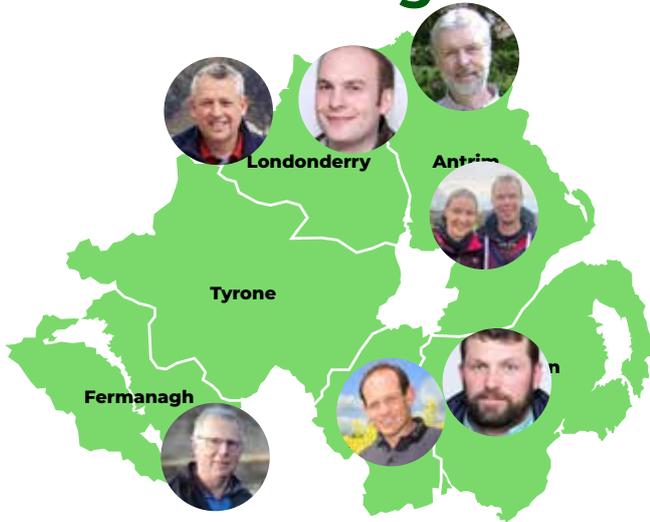
To date, the project has conducted two sets of soil sampling for each farm, the first to obtain information on pH (in water, 1:2.5 volume ratio of soil to water), Phosphorus (Olsen) (1:20 volume ratio of soil to sodium

bicarbonate), Potassium (1:5 volume ratio of soil to ammonium acetate or ammonium nitrate), Magnesium (1:5 volume ratio of soil to ammonium acetate or ammonium nitrate) and Organic Matter by Loss on Ignition (LOI).

The second sampling was a Soil Carbon Audit, sampled to 10cm with information on Bulk Density, Inorganic Carbon, Total Carbon, Total Nitrogen, C:N Ratio,

Organic Matter, Soil Organic Carbon, Active Carbon (mg/kg) and Active Carbon (% of SOC). Alongside soil sampling, a full LiDAR survey was conducted with leaf off the trees, from which carbon stocks of all the trees and hedgerows on each farm was calculated. Using SRUC's 'AgReCalc' tool, this allowed a full carbon balance sheet for each farm to be divided from both the inputs and outputs.

Accelerating 7 NI Farms towards Net Zero



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



Welcome to Ballydevitt Farm



- **100 hectare Family Partnership** run by Hugh & Thompson Harbison
- **180 Autumn calving cows**
 - Crossbred cow
 - 12 week block calving
 - 8,626 litres/cow
 - 2,509 kgs feed
 - 4.40% fat, 3.54% protein
 - 6 week in-calf rate 73%
 - Empty rate 12%

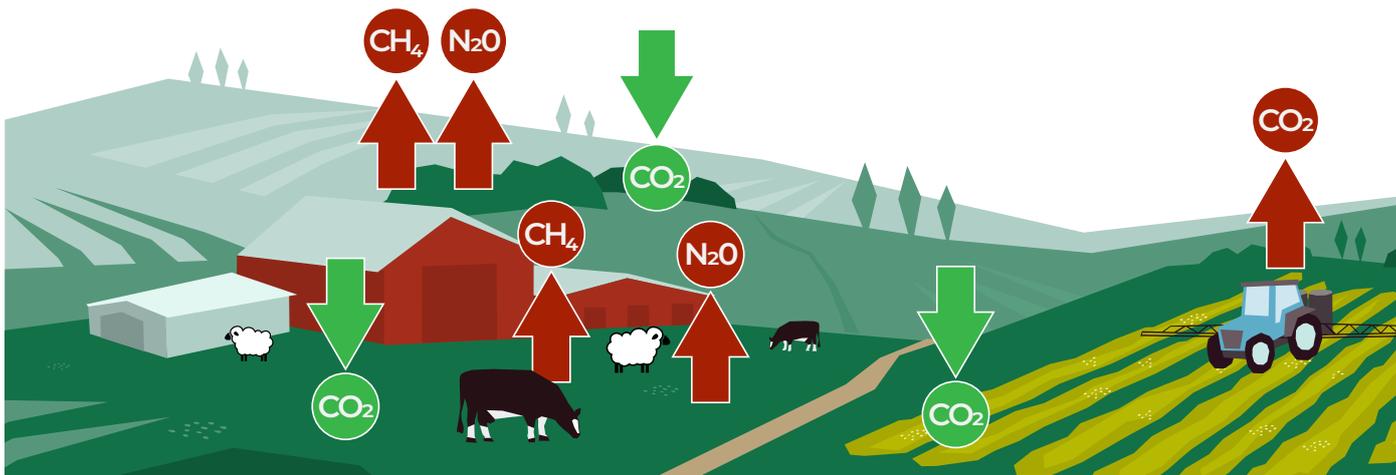


Carbon Farming

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

Gross Annual GHG Emissions
Less Gross Annual Carbon Sequestration
= Net Farm Carbon

“Net” not “Gross” Emissions to get real farmer buy-in to positive change



Carbon Footprinting as a management tool Ballydevitt Farm 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



Farm: 1.20
kg/CO₂e/kg FPC milk



Average 1.28
kg/CO₂e/kg FPC milk

Sources of Emissions by %



- Why is it important?**
- > Understanding of GHG emissions
 - > Farm business sustainability
 - > Market food products
 - > Slow the rate of climate change



Ballydevitt Farm moving Towards Net Zero

Mitigation tools



Genomics & Genetic Selection



Feed Additives



Slurry Additives & Amendments



Renewable Energy



Alternative Fuel Vehicles

Why are genetics important?

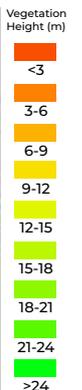
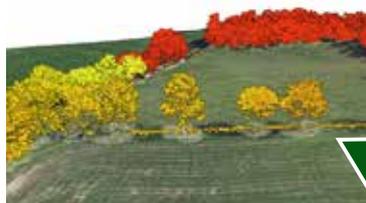
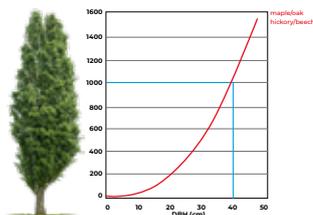
- > Production efficiency improvement
- > Cow liveweight and lifespan challenge
- > Herd fertility, calving profile and replacement rate

Harbison herd
8,600l @ 4.3% fat & 3.5%pro.
2,500kgs concentrate



Measuring On-Farm Biomass Carbon Stock

Trees, Hedges & Woodlands



| Vegetation Type | Hedge Length (km) | AGB (t) | C (t) | BGB* (t) | C(t) | Total C (t) |
|---------------------|-------------------|-------------|-------------|-------------|------------|-------------|
| Hedge 0-4m | 10.34 | 154.52 | 73.7 | 29.67 | 13.9 | 87.6 |
| Hedge 4-7m | 2.42 | 45.59 | 21.7 | 8.75 | 4.1 | 25.9 |
| Hedge 7-10m | 2.13 | 88.59 | 42.2 | 17.01 | 8.0 | 50.2 |
| Hedge >10m | 3.89 | 398.23 | 189.9 | 76.46 | 35.9 | 225.9 |
| Total Hedges | 18.78 km | 687t | 328t | 132t | 62t | 390t |

| Vegetation Type | Canopy Area (ha) | AGB (t) | C (t) | BGB* (t) | C(t) | Total C (t) |
|---------------------|------------------|-------------|-------------|-------------|------------|-------------|
| Single Trees | 0.11 | 5.05 | 2.4 | 0.97 | 0.5 | 2.9 |
| Deciduous Woodland | 4.51 | 256.28 | 122.2 | 49.21 | 23.1 | 145.3 |
| Coniferous Woodland | 0 | 0.00 | 0.0 | 0.00 | 0.0 | 0.0 |
| Total | 4.62 ha | 948t | 452t | 182t | 86t | 538t |

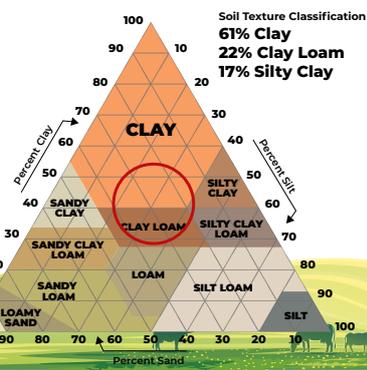
(Alex Higgins, 2021)



Total Farm Carbon Stocks

Working out Total of Soil Carbon, per land category

| Land Category | Total ha | Av. LOI/SOM | No of Soil Cores | No of Samples | Av. C. 0-10cm | Av. C. 0-30cm | Av.C/ha | Av. C/Category | C.0-30cm Variation | Av. pH |
|-----------------------------------------------------------------------|--------------|-------------|-----------------------|----------------------|---------------|---------------|----------------|---------------------|--------------------|--------|
| 10-20% Soil Org. Matter, Rotational Grass, Slurry, Only Cut | 13.7ha | 16.10% | 35 | 7 | 5.80% | 4.10% | 133t | 1,825t | 3.1 - 5.1% | 6 |
| 10-20% Soil Org. Matter, Rotational Grass, Slurry, Cut & Grazed | 6.7ha | 17.30% | 25 | 5 | 6.40% | 4.80% | 153t | 1,032t | 3.8 - 5.3% | 6.2 |
| 10-20% Soil Org. Matter, Rotational Grass, Slurry, Only Grazed | 30.9h | 17.20% | 50 | 10 | 7.70% | 5.20% | 162t | 4,998t | 4.4 - 5.3% | 6.4 |
| 10-20% Soil Org. Matter, Permanent Grass, Slurry, Only Grazed | 2.2ha | 17.90% | 15 | 3 | 5.50% | 4.7% | 159t | 346t | 4.0 - 6.1% | 6.7 |
| 20-30% Soil Org. Matter, Rotational Grass, Slurry, Only Cut | 4.2ha | 21.10% | 15 | 3 | 7.60% | 4.40% | 144t | 605t | 2.6 - 5.9% | 5.8 |
| 20-30% Soil Org. Matter, Permanent Grass, No Slurry, Only Grazed | 2.2ha | 21.20% | 15 | 3 | 10.50% | 5.70% | 168t | 370t | 5.1 - 6.7% | 6 |
| 20-30% Soil Org. Matter, Rotational Grass, Slurry, Cut & Grazed | 1.6ha | 23.10% | 15 | 3 | 15.40% | 9.40% | 247t | 395t | 5.7 - 15.8% | 6.2 |
| 20-30% Soil Org. Matter, Rotational Grass, Slurry, Only Grazed | 32.7ha | 22.60% | 60 | 12 | 8.80% | 6% | 183t | 5,984t | 3.4 - 9.8% | 6.3 |
| >30% Soil Org. Matter, Rotational Grass, Slurry, Only Grazed | 7.7ha | 40% | 25 | 5 | 16.90% | 13.90% | 344t | 2,649t | 7.2 - 23.2% | 6.4 |
| 10-20% Soil Org. Matter, Deciduous Woodland | 1.5ha | 15.70% | 15 | 3 | 8.20% | 6% | 167t | 228t | 3.6 - 10.7% | 6.1 |
| 20-30% Soil Org. Matter, Scrubland | 0.8ha | 21.60% | 15 | 3 | 10.30% | 8.80% | 210t | 162t | 7.9 - 9.6% | 5.9 |
| Sampling Density, 1 composite sample per 1.8ha or 2.7 coles/ha | 104ha | | 285 Soil Cores | 57 C. Samples | | | 179t/ha | 18,594t of C | | |



Total Soil Carbon 18,594 of C
Total Carbon in Trees & Hedges 538t of C
Total Farm CO2e Stocks 19,132t of C 3.66 = **70,023t of CO2e**

Farmers are Custodians of the Nation's Carbon



Measuring Carbon in Soils

On Site Soil Sampling



Lab Measurement

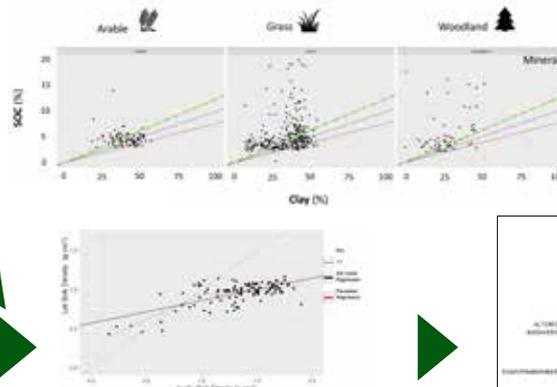
SOC + Bulk Density + Texture
 $TOC = TC - TIC$ $OM = TOC/0.58$

C. Stock

$$BD = \frac{\text{Dry Matter Weight of Soil Core}}{\text{Volume of Core}}$$

$$\text{Stock} = \text{SOC} * \text{Depth} * \text{Bulk Density}$$

SOC/clay



Benefits



Looking at Carbon Mitigation On Farm

Reducing Nitrogen by using more Clover or Multi Species Swards



| | Baseline: (25% clover pasture/silage) | 60% reduction in N, 35%/30% clover, all urea |
|-----------------------------------|---------------------------------------|----------------------------------------------|
| | Currently 181 units on Grazing | Percentage Change (%) rel to baseline |
| Sward Clover Content (%) | 25 | 20.0 |
| CO2 Emissions | 686,945 | -9.5 |
| Methane Emissions | 925,993 | 0.1 |
| Nitrous Oxide Emissions | 398,942 | -14.3 |
| Total CO2e Emissions from Farming | 2,011,880 | -6.0 |
| Whole farm CO2e Emissions | 1.20 | -5.8 |
| Emissions per hectare* | 20,145 | -6.0 |

Reduces Total Emissions from Farming by 6%, retrospectively Saving £15,838 annually, at today's fertiliser prices



Looking at Carbon Mitigation On Farm

Reducing Cow Weight down to 500kg

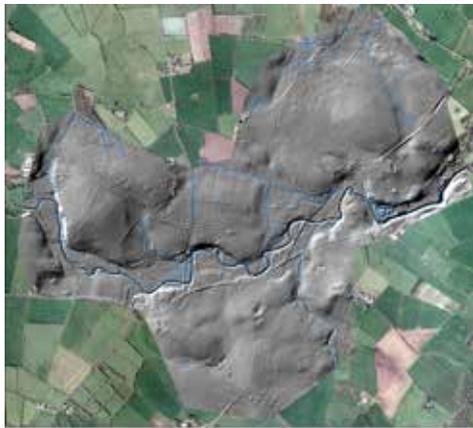


| | Current Cow Size 650kg | Target Cow Size 500kg | % Change with with 500kg Cow |
|-------------------------------------------|--------------------------|------------------------|---------------------------------------------------------|
| Annual Milk Yield | 1,478,384 | 1,404,465 | -5.0 |
| Milk Solids | 4.26% Fat, 3.56% Protein | 4.5% Fat, 3.7% Protein | 0.24% increase in Fat & 0.14% in Protein |
| Concentrate Use | 429t | 364t | Smaller cow, lower DMI, 2kg/hd/day less Concentrate use |
| Cow Deaths | 6 | 4 | Smaller Cows, easier to manage, 2 less deaths |
| CO2 Emissions | 686,945 | 618,963 | -9.9 |
| Methane Emissions | 925,993 | 824,524 | -11.0 |
| Nitrous Oxide Emissions | 398,942 | 370,572 | -7.1 |
| Total CO2e Emissions from Farming | 2,011,880 | 1,814,032 | -9.8 |
| Whole farm CO2e Emissions per kg/FPC Milk | 1.20 | 1.11 | -7.5 |
| Emissions per farm per hectare* | 20,145 | 18,164 | -9.8 |

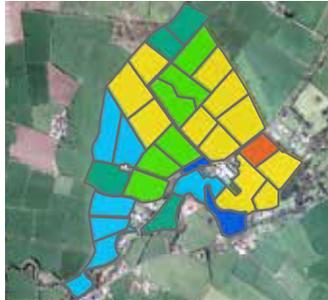
Reduces Total Emissions of CO2e from Farming by 10%



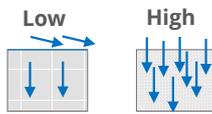
Using LiDAR to Optimise Nutrient Management and Improve Water Quality



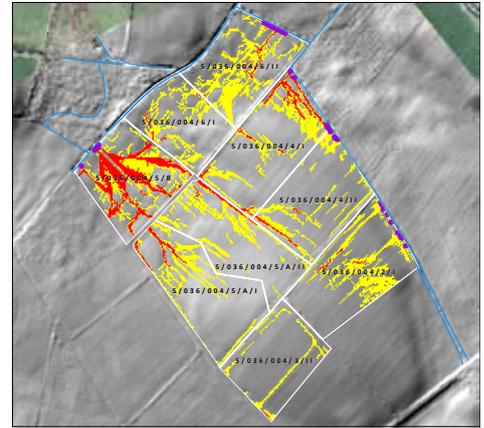
High Resolution Topography



Soil P



Soil Permeability (k_{sat})



■ Areas at risk of surface runoff
■ Surface runoff & Soil P
● Runoff enters watercourse
— Watercourse

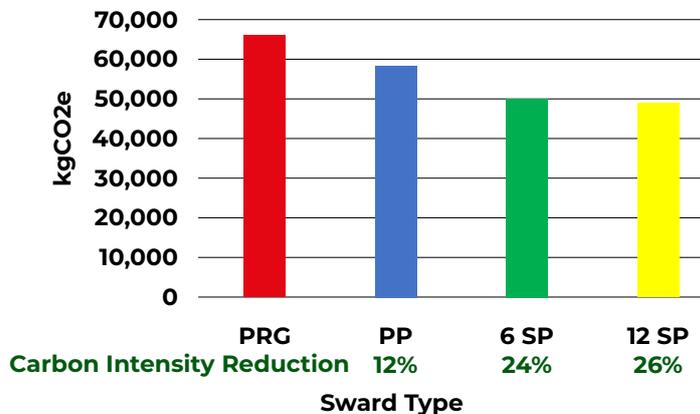
(Rachel Cassidy, 2021)

afbi AGRIL-FOOD & BIOSCIENCES INSTITUTE

Delivering Multiple Goods by switching to Multispecies Swards



Carbon Intensity of Beef & Lamb per Sward Type



65% Reduction in Nitrogen

20% Improvement in ADWG

300% Increase in earthworms

14 times faster water infiltration of soil

A 26% reduction in GHG intensity per kg of meat, without recognition of increases in soil carbon...

DEVENISH™
Beyond Nutrition

Sustainable Farming

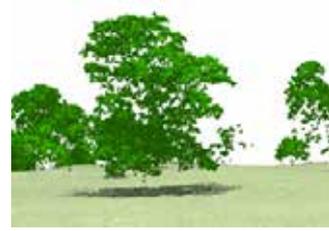
Delivering Multiple Solutions - Not Single Agendas



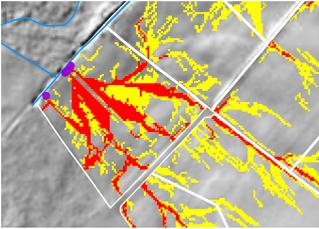
Producing Nutritious Food
& Tackling Malnutrition



Delivering Soil Improvement
Both Fertility & Health



Accelerating Carbon Sequestration,
Both Above & Below Ground



Improving Water Quality by
Reducing Overland Flow



Optimising Biodiversity,
Especially Below Ground



Generating Profits



DEVENISH™
Beyond Nutrition

ARCZero

ACCELERATING FARMING TOWARDS CARBON NEUTRALITY

Keep up to date with ARCZero and find out about our 2023 farm walks at



facebook.com/ARCZeroNI



@ARCZeroNI



ARCZeroNI



arczeroni.org



Food Futures

DRIVING SUSTAINABILITY



**A SMART PLATFORM
DESIGNED TO ENHANCE
THE SUSTAINABILITY OF
THE NORTHERN IRELAND
AGRI-FOOD SECTOR**

Find out more at food-futures.org