

ARCZero

ACCELERATING FARMING TOWARDS CARBON NEUTRALITY

THE ROAD TOWARDS NET ZERO FARM WALK SERIES

#4 - Harbison Farm, Aghadowey - 01.09.22



ARCZERONI.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

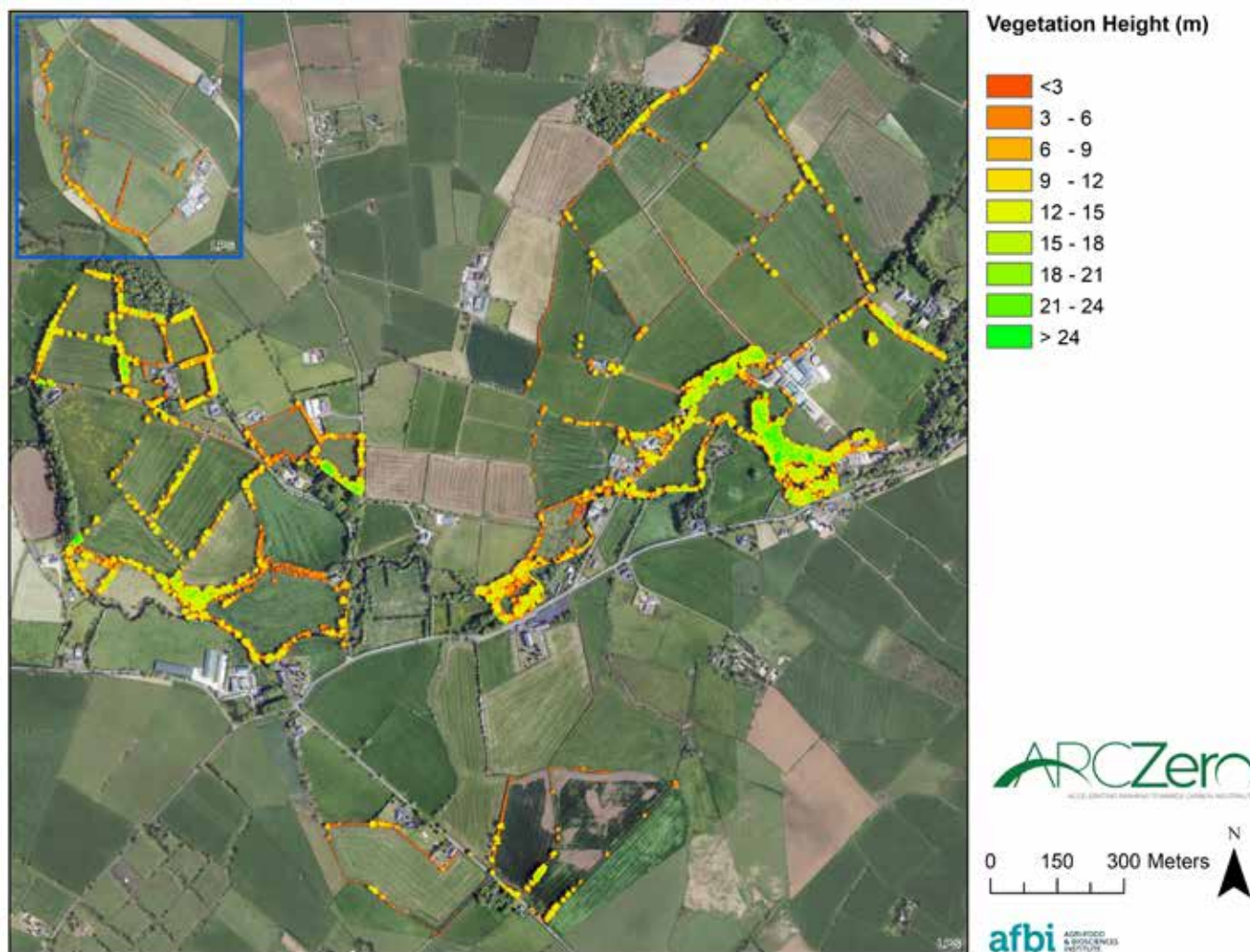
Accelerating Ruminant Carbon Zero (ARCZero) is a farmer led European Innovation Partnership project.

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%

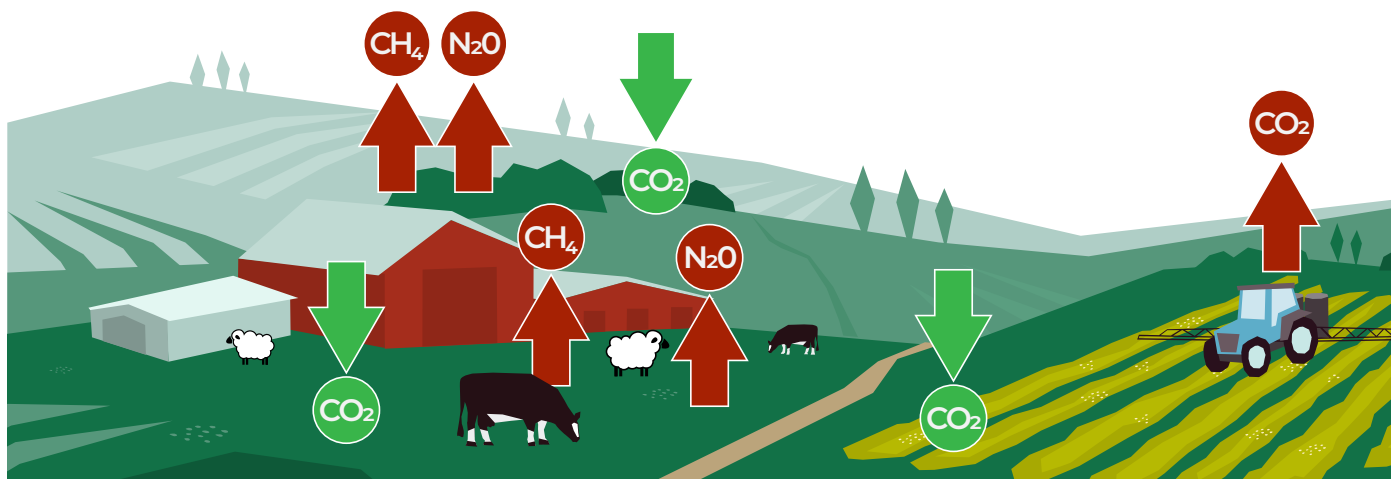


Carbon Farming

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

Why is it important?

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

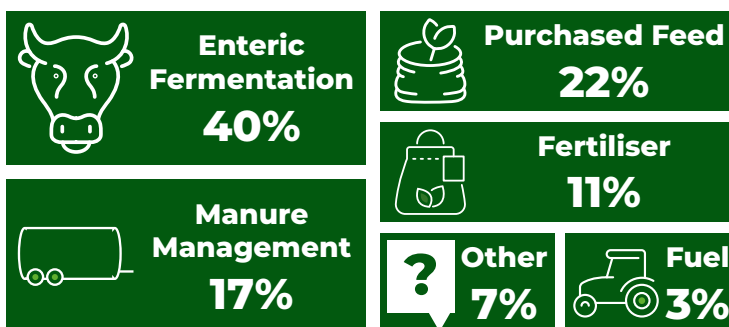


Farm: 1.20
kg/CO₂e/kg FPC milk



Average 1.28
kg/CO₂e/kg FPC milk

Sources of Emissions by %



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?

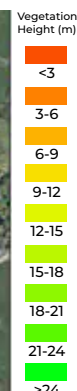
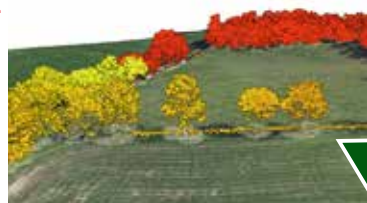
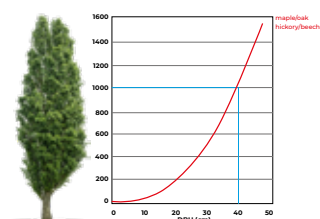
- > Production efficiency improvement
- > Cow liveweight and lifespan challenge
- > Herd fertility, calving profile and replacement rate

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

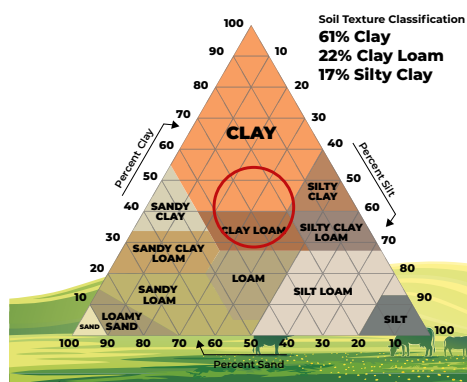
	Canopy Area (ha)	AGB (t)	C (t)	BGB* (t)	C(t)	Total C (t)
Single Trees	0.11	5.05	2.4	0.97	0.5	2.9
Deciduous Woodland	4.51	256.28	122.2	49.21	23.1	145.3
Coniferous Woodland	0	0.00	0.0	0.00	0.0	0.0
Total	4.62 ha	948t	452t	182t	86t	538t

(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

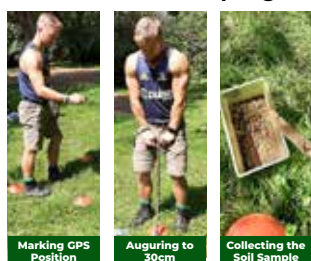
19,132t of C 3.66 = 70,023t of CO2e

Farmers are Custodians of the Nation's Carbon

DEVENISH™
Beyond Nutrition

Measuring Carbon in Soils

On Site Soil Sampling



Lab Measurement

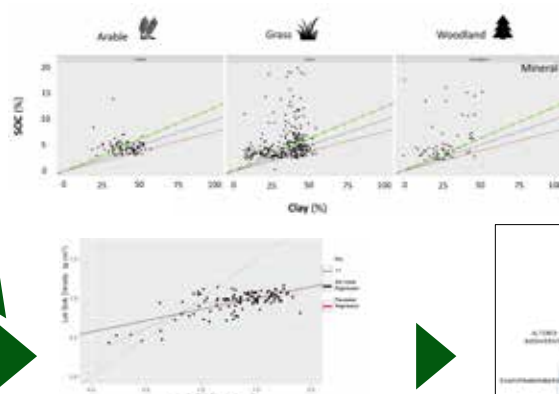
SOC + Bulk Density + Texture
 $TOC = TC - TIC$ $OM = TO C/0.58$

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**

agrecalc

Looking at Carbon Mitigation On Farm

Reducing Cow Weight down to 500kg

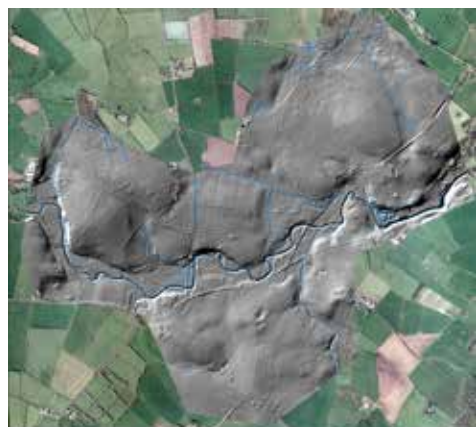


	Current Cow Size 650kg	Target Cow Size 500kg	% Change with with 500kg Cow
Annual Milk Yield	1,478,384	1,404,465	-5.0
Milk Solids	4.26% Fat, 3.56% Protein	4.5% Fat, 3.7% Protein	0.24% increase in Fat & 0.14% in Protein
Concentrate Use	429t	364t	Smaller cow, lower DMI, 2kg/hd/day less Concentrate use
Cow 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

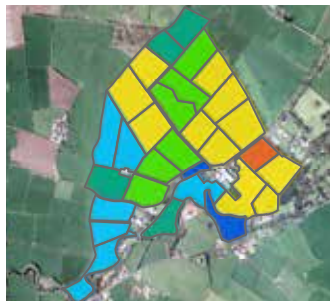
Reduces Total Emissions of CO2e from Farming by 10%

agrecalc

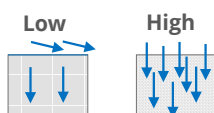
Using LiDAR to Optimise Nutrient Management and Improve Water Quality



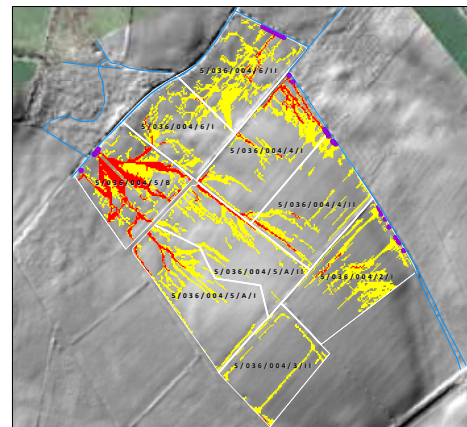
**High Resolution
Topography**



Soil P



**Soil
Permeability
(k_{sat})**



- Areas at risk of surface runoff
- Surface runoff & Soil P
- Runoff enters watercourse
- Watercourse

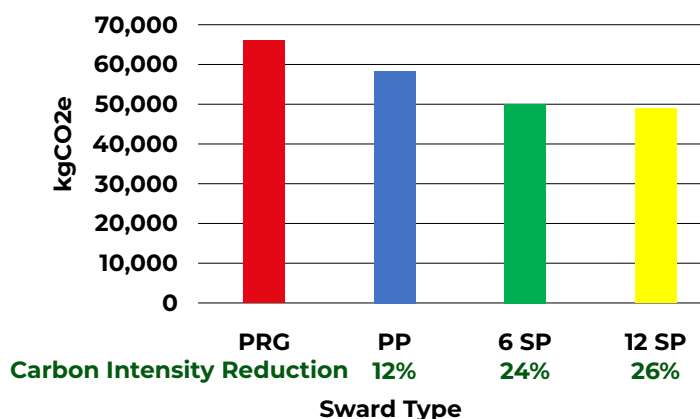
(Rachel Cassidy, 2021)

afbi AGRI-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



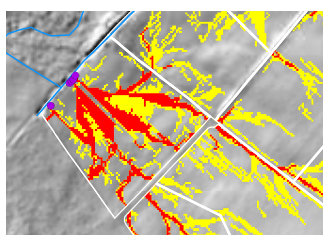
**Producing Nutritious Food
& Tackling Malnutrition**



**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

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Food Futures

DRIVING SUSTAINABILITY



**A SMART PLATFORM
DESIGNED TO ENHANCE
THE SUSTAINABILITY OF
THE NORTHERN IRELAND
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