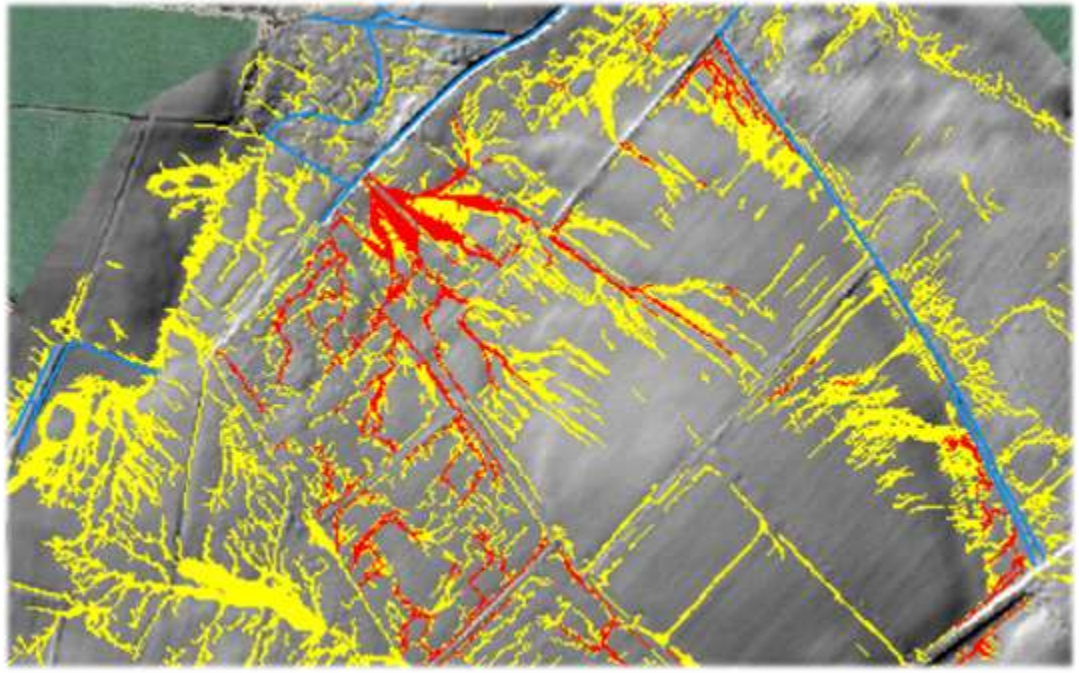
Delivering Multiple Public Goods – A Farmer's Perspective

The Experience from N. Ireland, at the Farm & Regional Level



John Gilliland

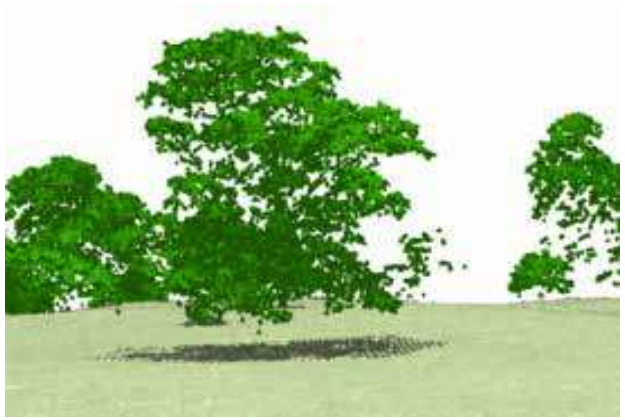
Professor of Practice, Queens University Belfast; Chair, ARC Zero
Special Advisor, AHDB; Owner, Brook Hall Estate.

29th February 2024

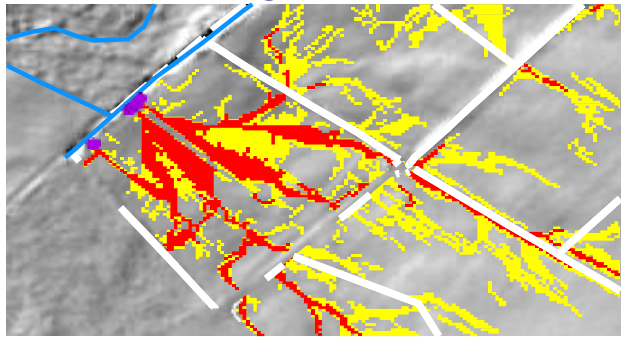
Farming Delivers Multiple Public Goods - Not Single Agendas

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

2014, Asked to Chair N. Irish, Independent Expert Working Group
Inclusive of Farmers, NGOs, Policy & Food Chain

Inspirational Ideas

NEWSLETTER FEBRUARY 2017

eip-agri

AGRICULTURE & INNOVATION

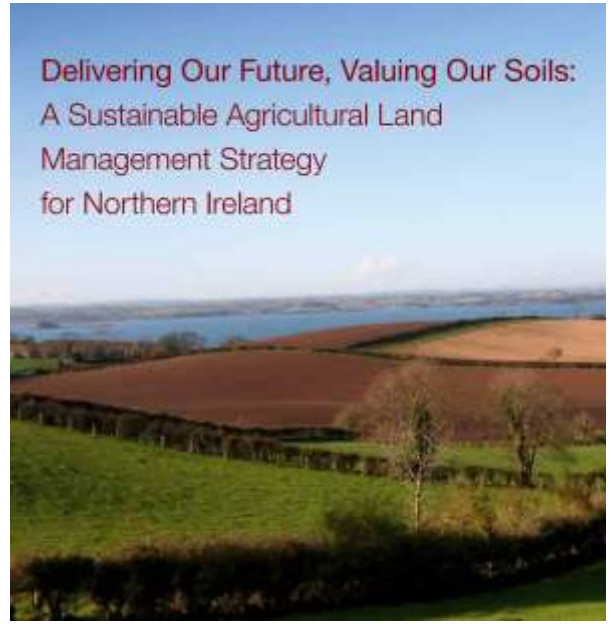
Delivering Farm Profitability and Better Environmental Performance using multi-functional technologies: Ingredients for a Sustainable Agriculture Strategy for Northern Ireland

Sustainable Agriculture Land Management Strategy Launched, 2016

With Soil & Water at its core, with written support of Farmers Union & NGOs

Observations

N. Ireland Environmental Performance, 2016



Since 2004 – N balance down 10%; N efficiency up 12%

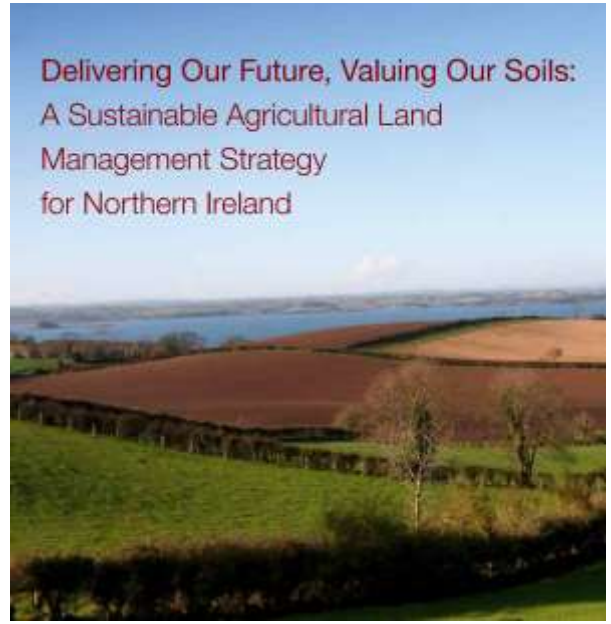
P balance down 32%; P efficiency up 28.5%

N levels in Water, Good, 15-20mg

But

- 62% of Water Bodies failing Good Quality Status
- 80% of P was entering rivers by “Over Land” flow of excessive rainfall
- The “Tail” of our Phosphate legacy was greater than 50 Years….

Observations on Farming Production
N. Ireland Farm Efficiencies & Practices, 2016



- Grass Dry Matter Utilisable Yields – Average, 5.1t/ha/yr
  - Top 5%, 16t/ha/yr
- Soil Analysis – Only 2% of acreage analysed on an annual basis
- Soil pH – 64% land below pH 6, ??% land at pH 6.5 (optimal for legumes)
- Soil optimal fertility – 18%
- Land planted in trees – 6%
- Land rented on a 11 month lease (conacre) – 30%

Key Recommendation - If you can't Measure you can not Manage…

The use of New Measuring Technologies on all farms, at individual field scale

Aerial LiDAR Survey
at 40 scans per metre

Soil Sampling to one
metre deep

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

Government Response – A Pilot in Three River Catchments
Plus, “light touch” in N. Ireland wide pilot

Level of Farmer Participation – 73% in Catchments

River Bann – 513 farms, 7,340 fields, 11,547 ha
Colebrooke – 289 farms, 5,059 fields, 13,108 ha
Strule - 289 farms, 4,677 fields, 16,989 ha

Rest of NI. - 522 farms, 12,629 fields, 22,220 ha

Total: 1,613 farms, 63,000 ha, £2.3m of EU & NI Public Funding

Training – 50% in Catchments attended, 90% in “light touch” Pilot

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

cafre College of Agriculture, Food & Rural Enterprise

Research in DAERA Soil Pilot and Nutrients Action Programme

Research has shown a strong positive relationship between soil P excess and water quality.

Science of the Total Environment 687 (2019) 277–286

Contents lists available at ScienceDirect

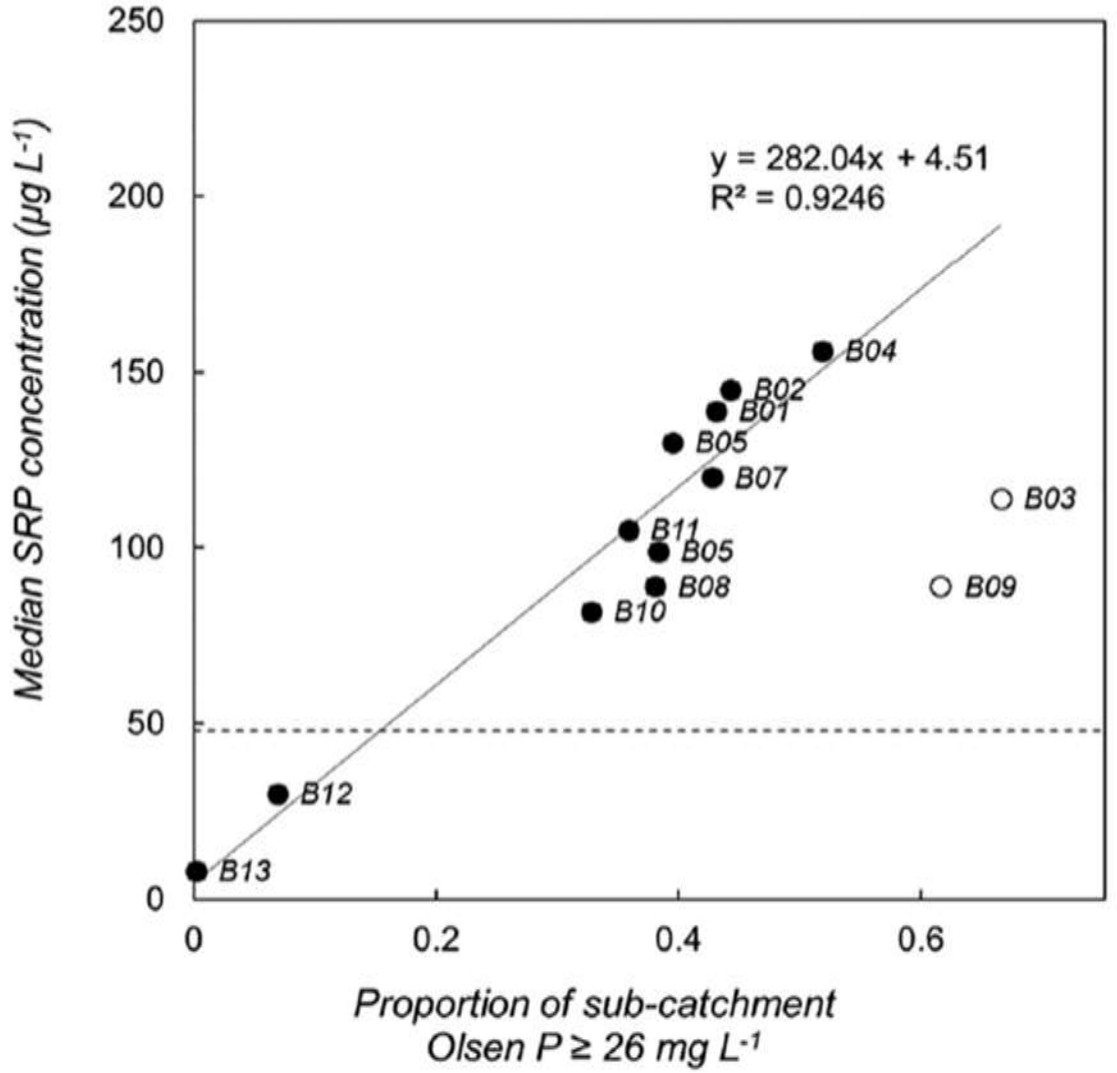
Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

A carrying capacity framework for soil phosphorus and hydrological sensitivity from farm to catchment scales

Rachel Cassidy [a,*], Ian A. Thomas [a,b], Alex Higgins [a], John S. Bailey [a], Phil Jordan [c]

[a] Agri-Environment Branch, Agri-Food and Biosciences Institute (AFBI), Newforge Lane, Belfast BT9 5PX, Northern Ireland, UK
[b] UCD Dooge Centre for Water Resources Research, School of Civil Engineering, University College Dublin, Belfield, Dublin 4, Ireland
[c] School of Geography and Environmental Sciences, Ulster University, Coleraine, Northern Ireland, UK



https://doi.org/10.1016/j.scitotenv.2019.05.453

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Ulster University

Results from Pilot in Three River Catchments
Including the N. Ireland wide pilot

Behavioural Change Survey by Leeds University

86% - Changed fertiliser type used
80% - Increased lime usage
68% - Changed fertiliser quantity
28% - Changed quantity of slurry imported or exported

“Run off” Risk Maps were particularly useful

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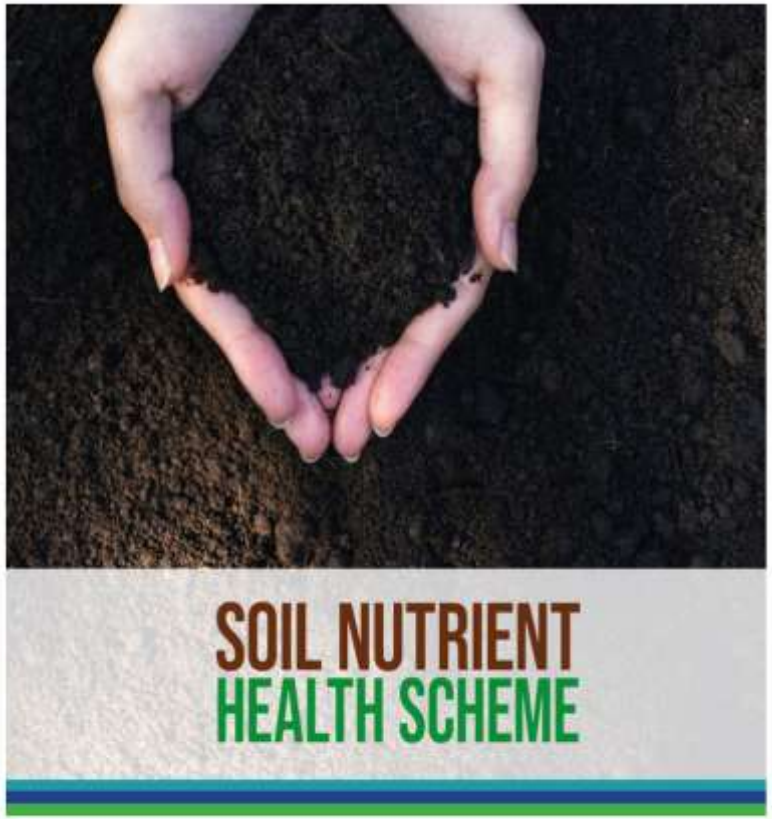
Is Improving Soil Health & Water Quality Possible, Regionally?

Is Improving Soil Health & Water Quality Possible, Regionally?



- £38m Scheme opened May 2022
- Baseline every field, tree & hedge, over 4 Yrs.
- Independent Soil Sampling & LiDAR Surveys

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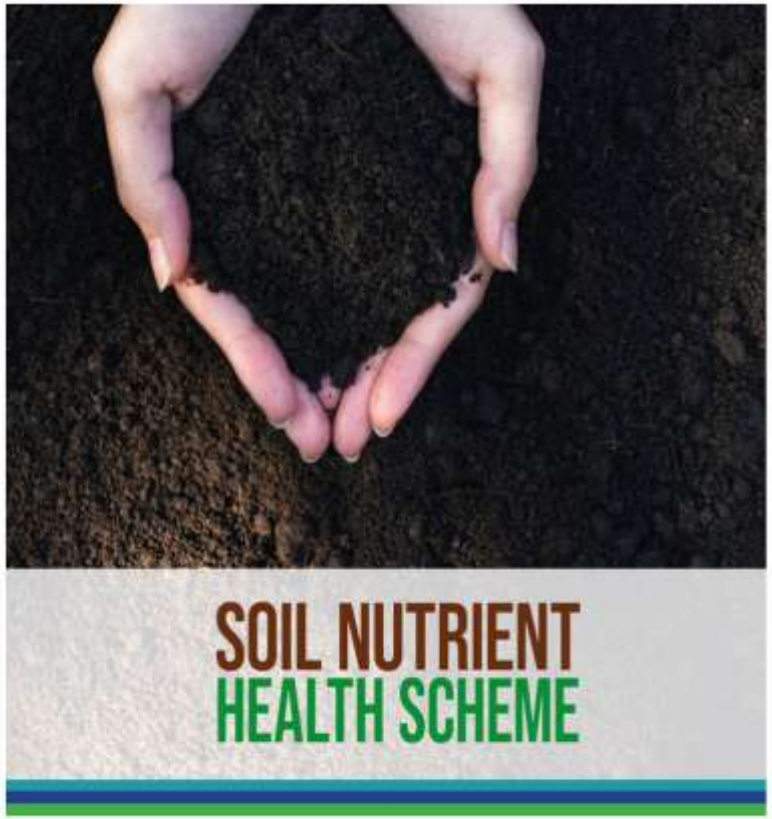
Is Improving Soil Health & Water Quality Possible, Regionally?



- £38m Scheme opened May 2022
- Baseline every field, tree & hedge, over 4 Yrs.
- Independent Soil Sampling & LiDAR Surveys
- Voluntary Scheme (Carrot & Stick….)
- Hope to repeat in Five Years' time
- Results returned to Individual Farmers
- Soil Fertility, Carbon Stocks & Run Off Risk Maps
- Mandatory online Training

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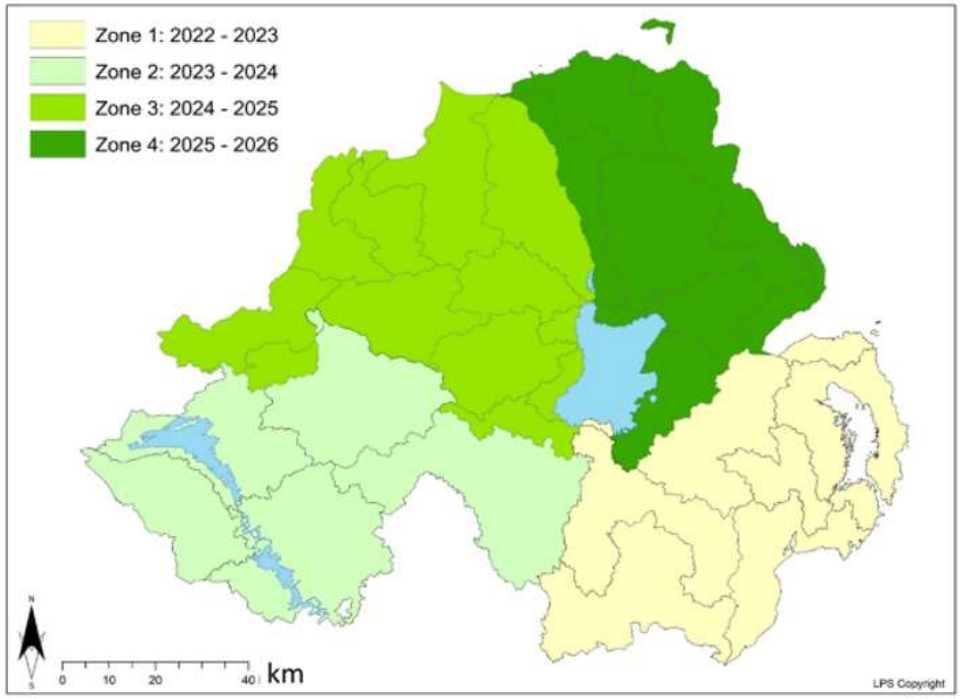
SOIL NUTRIENT HEALTH SCHEME

Farmer Engagement

- Zone 1, 95% Uptake, 150k fields
- Zone 2, 92% Uptake, 190k Fields



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ARCZero
ACCELERATING FARMING TOWARDS CARBON NEUTRALITY

An EIP Operational Group - Accelerating Seven N. Irish Farms towards Net Zero

Roger & Hilary Bell *Sheep*

Simon Best *Arable & Beef*

Patrick Casement *Sheep & Sucklers*

John Egerton *Suckler Beef*

John Gilliland *Willow & Dry Stock*

Hugh Harbison *Dairy*

Ian McClelland *Dairy*

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

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

rural Development Programme

AgriSearch
Driving Excellence & Innovation

BIRNIE CONSULTANCY

DEVENISH
Beyond Nutrition

QUEEN'S UNIVERSITY BELFAST | IGFS

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Where did we start…… We Learnt our Numbers…..

Baselined & Benchmarked…..

- GHG Emissions
- Carbon Sequestration
- Carbon Stocks in Soil
- Carbon Stocks in Trees
- Net Carbon Position
- Behavioural Change
- Delivering other Natural Capital

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Net Carbon as a Percentage of Gross Emissions

Using agrecalc TIER 1 Sequestration Module

2021 Agrecalc Analysis	Enterprises	Gross Emissions t CO2-e/yr	Gross Sequestration t CO2-e/yr	Net Emissions t CO2-e/yr	% Reduction
Ian McClelland	Dairy	1,101	309	792	28%
Hugh Harbinson	Dairy	2,009	549	1,459	27%
John Egerton	Beef & Sheep	1,475	444	1,031	30%
Roger & Hilary Bell	Sheep with Beef	754	456	298	60%
Simon Best	Arable with Beef	1,799	738	1,061	41%
Patrick Casement & Trevor Butler	Beef & Sheep	492	548	-56	111%
John Gilliland	Willows with Dry Cows	151	156	-4	103%

No two farms are the same…..

Some farms will find the journey easier than others……

Some farms are beyond Net Zero already…..

agrecalc

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Measuring Carbon in Trees & Hedges

Using Aerial LiDAR at BROOK HALL Estate & Gardens

A. Higgins 202

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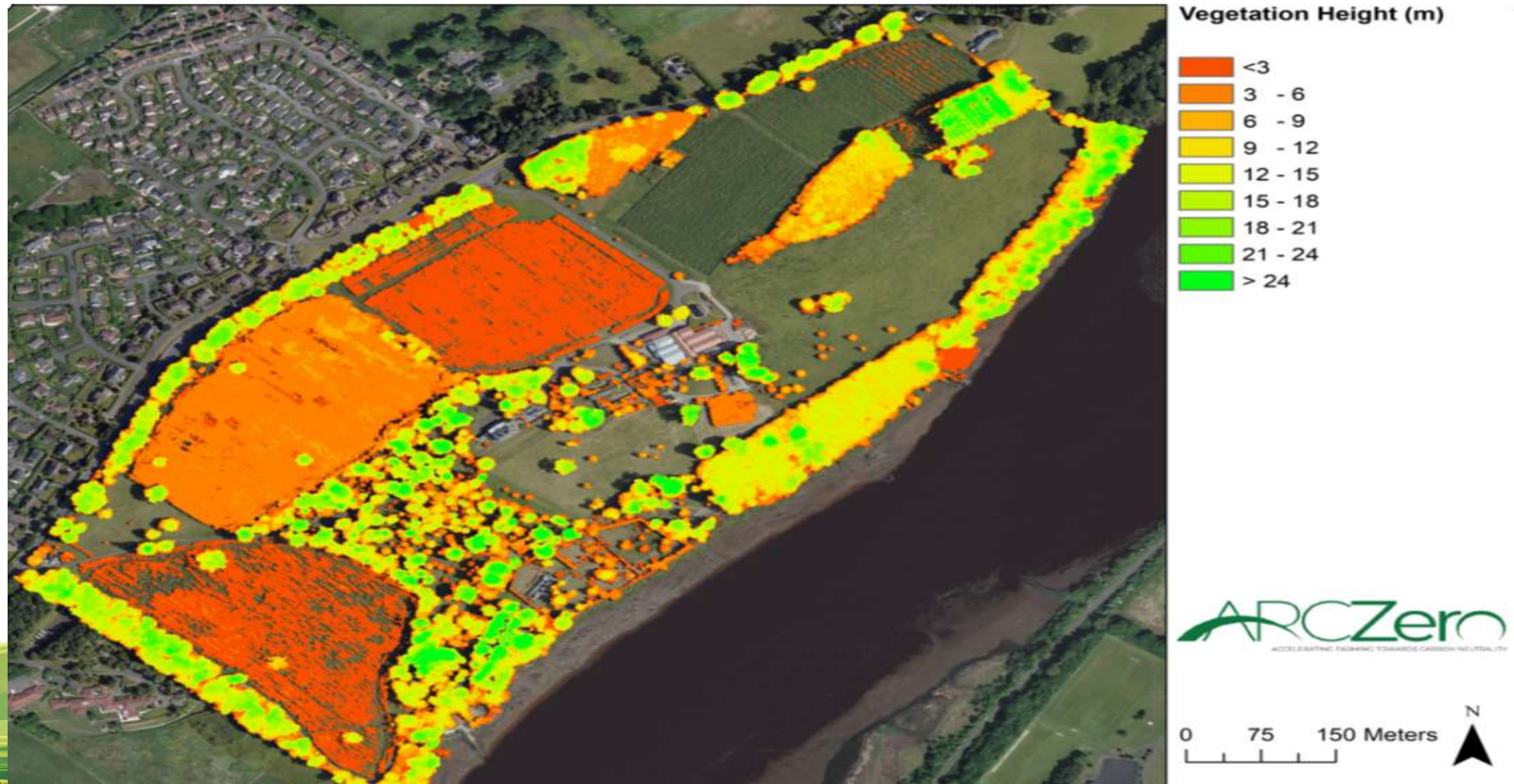

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Measuring Carbon in Trees & Hedges

Using Aerial LiDAR at BROOK HALL Estate & Gardens

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	Brook Hall Estate Totals					
Vegetation type	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**
Total Hedges	**2.38**	**187.77**	**89.5**	**36.05**	**16.94**	**106.49**
	Canopy Area (ha)					
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**
Total	**47.92**	**2,379.07**	**1,134.6**	**456.8**	**214.7**	**1,349.3**

AGB
Above Ground Biomass

BGB
Below Ground Biomass

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ACCELERATING FARMING TOWARDS CARBON NEUTRALITY

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, Decideous 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, Decideous Woodland	4.6ha	pH 5.3	13%	25	5	6.90%	4.90%	136t	625.6t
Totals	**57.6ha**			**165 Soil Cores**	**33 C. Samples**			**92.3t/ha**	**5,319.1t of C.**

Soil Carbon at Brook Hall = 5,319 t of C, or 19,468 of CO2e

ACCELERATING FARMING TOWARDS CARBON NEUTRALITY

Total Carbon Stocks across ARC Zero farms……

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

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

Target for 2026, 530,000t…. But how do we build carbon stocks…..???

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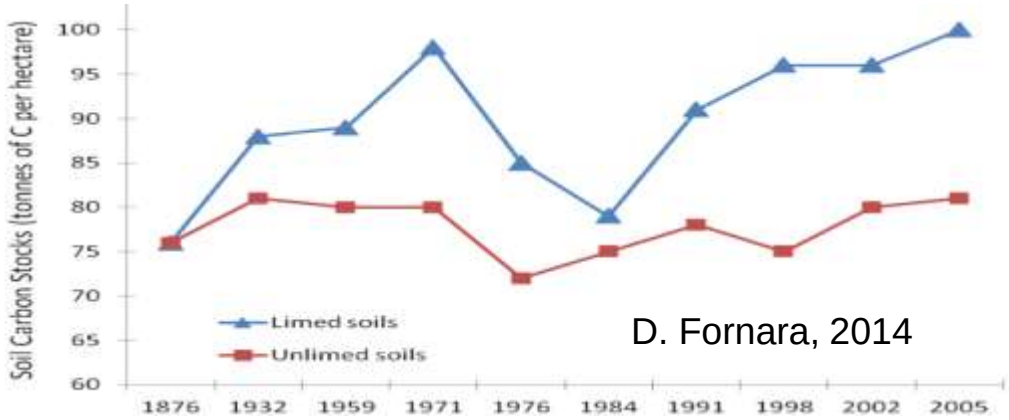
Building Carbon Stocks & Multiple Public Goods, Simultaneously

Correcting Soil pH – Nutrient Uptake Efficiency



D. Fornara, 2014

Soil pH	Nitrogen Utilisation	Phosphorus Utilisation	Potassium Utilisation	% of Fertiliser Wasted
5.0-5.5	77%	48%	77%	32%
5.5-6.0	85%	52%	100%	21%
6.0-6.5	100%	100%	100%	0%

Teagasc Green Book 2017

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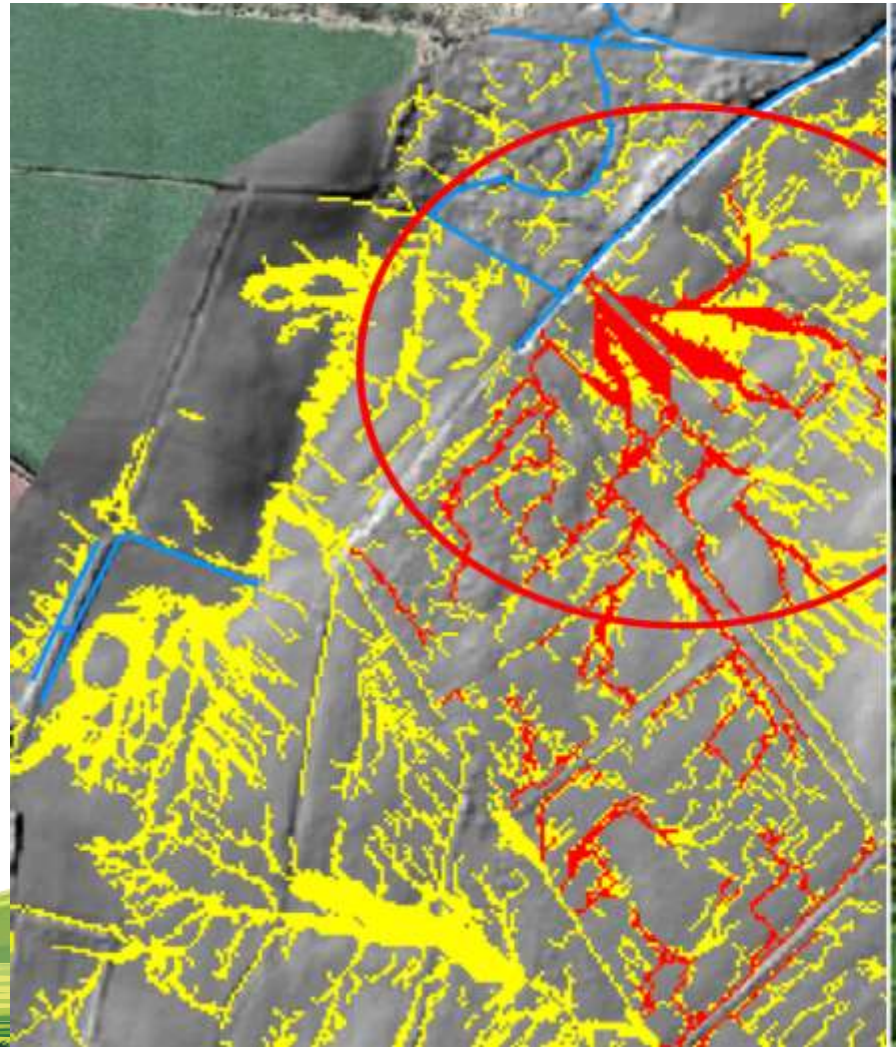
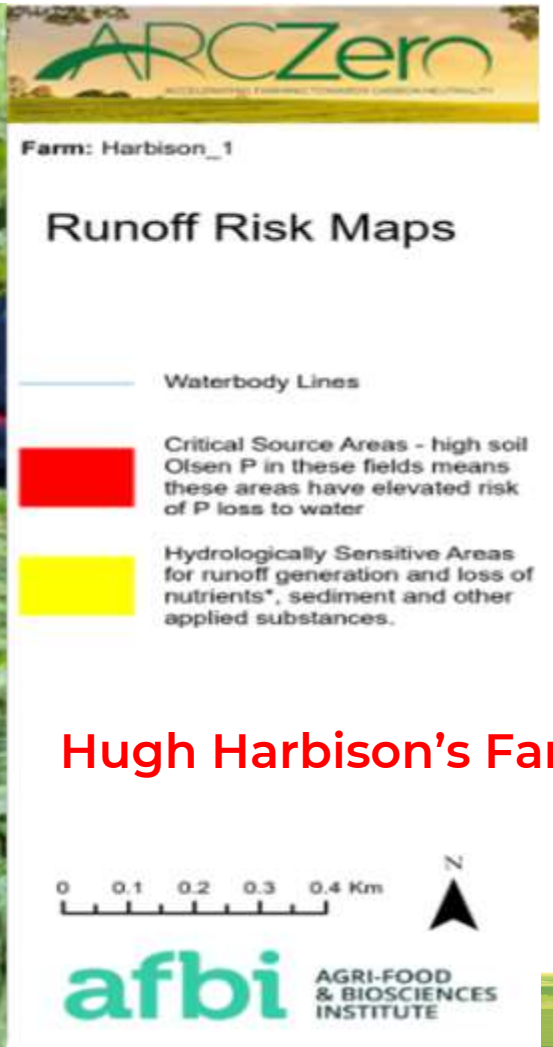
ACCELERATING FARMING TOWARDS CARBON NEUTRALITY

Building Carbon Stocks & Multiple Public Goods, Simultaneously

Multi Species Pastures – Water Infiltration, Biodiversity, GHG Mitigation





Hugh Harbison's Farm

COMPARING DIFFERENT LAND USES

Willow SRC (28 Yrs. Old)

Permanent Pastureland (200 Yrs. Old)

BROOK HALL
Estate & Gardens

R. Buffara, WUR, 2023

Silvopasture (120 Yrs. Old)

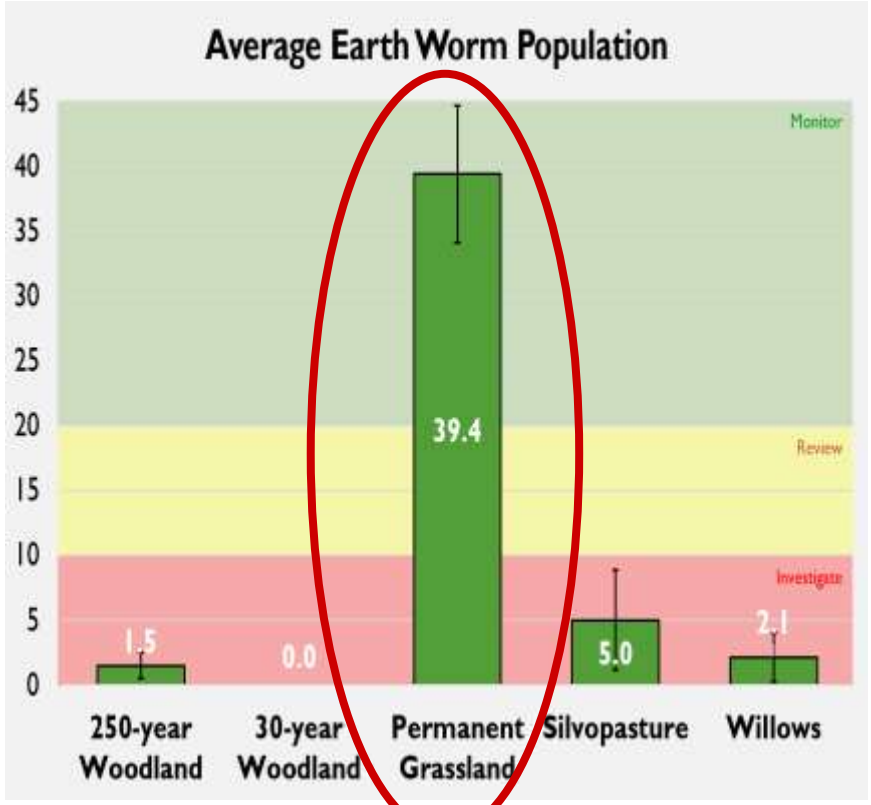
D. Woodland (30 Yrs. Old)

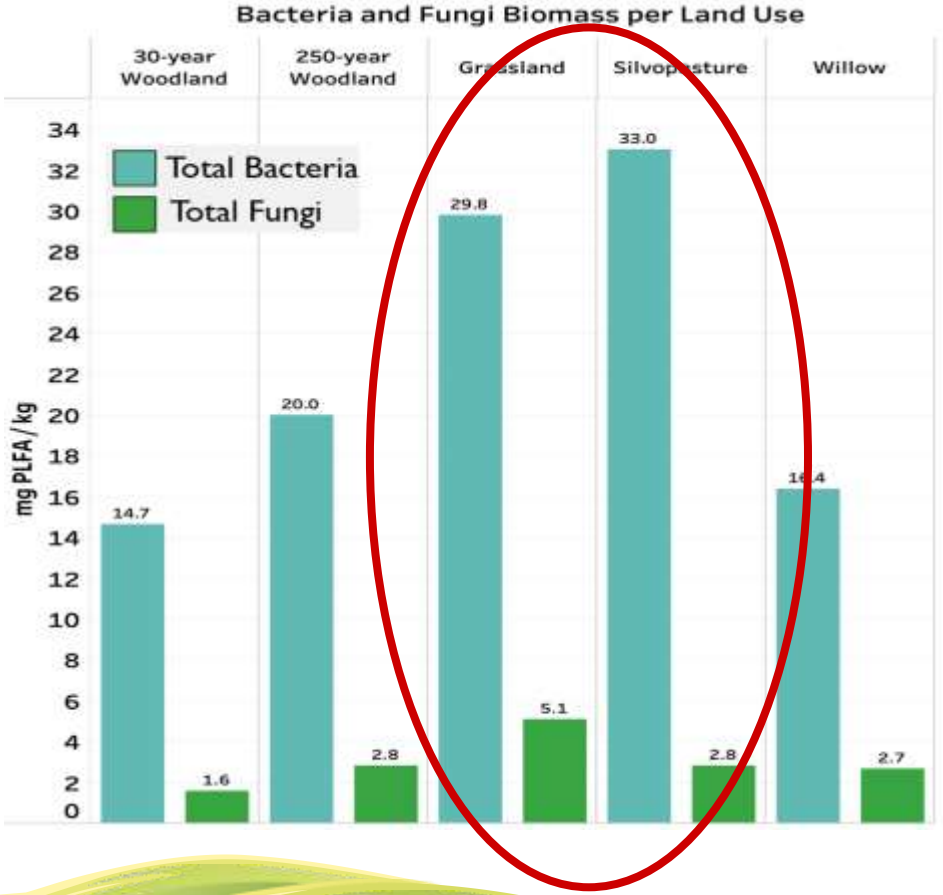
D. Woodland (250 Yrs. Old)

ARCZero
ACCELERATING FARMING TOWARDS CARBON NEUTRALITY

Delivering Multiple Public Goods Simultaneously

Role of Livestock Faeces…. In Increasing Soil Biodiversity……





BROOK HALL
Estate & Gardens

R. Buffara, WUR, 2023

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ACCELERATING FARMING TOWARDS CARBON NEUTRALITY

Delivering Multiple Public Goods Simultaneously

The Importance of Increasing Biodiversity Under the Soil…. 3 New Papers….

The age of extinction

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

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

National Academy of Science, Aug 23

Cessation of grazing causes biodiversity loss and homogenization of soil food webs

Maarten Schrama[1,2], Casper W. Quist[3,4], G. Arjen de Groot[5], Ellen Cieraad[1,6], Deborah Ashworth[2], Ivo Laros[5], Lars Hestbjerg Hansen[7,8], Jonathan Leff[9,10], Noah Fierer[9,10] and Richard D. Bardgett[2]

Oct 2023

agronomy

MDPI

Review

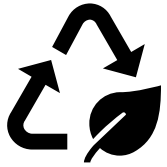
The Effects of Manure Application and Herbivore Excreta on Plant and Soil Properties of Temperate Grasslands—A Review

Arne Brummerloh [1,*] and Katrin Kuka [2]

Dec 2023

Embedding Experience in Pillars of AHDB's Environment Strategy

Collaboration:
Changing the Narrative…..



Multiple public goods

Net carbon

Roadmaps

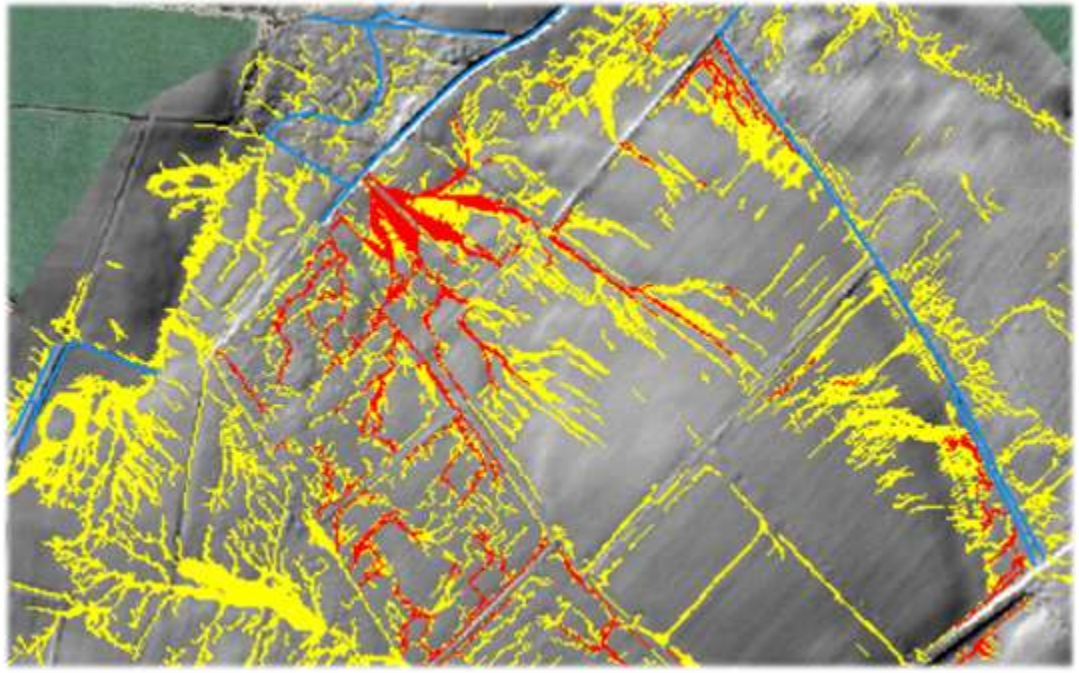
Baselining

Economics & efficiency

Evidence:
Knowing your Numbers…..

Delivering Multiple Public Goods – A Farmer's Perspective

The Experience from N. Ireland, at the Farm & Regional Level



Through Building Consensus, Using Forensic Measurement & Management
to
Empower Farmers, Multiple Public Goods can be Delivered…..

john.gilliland@brookhall.org