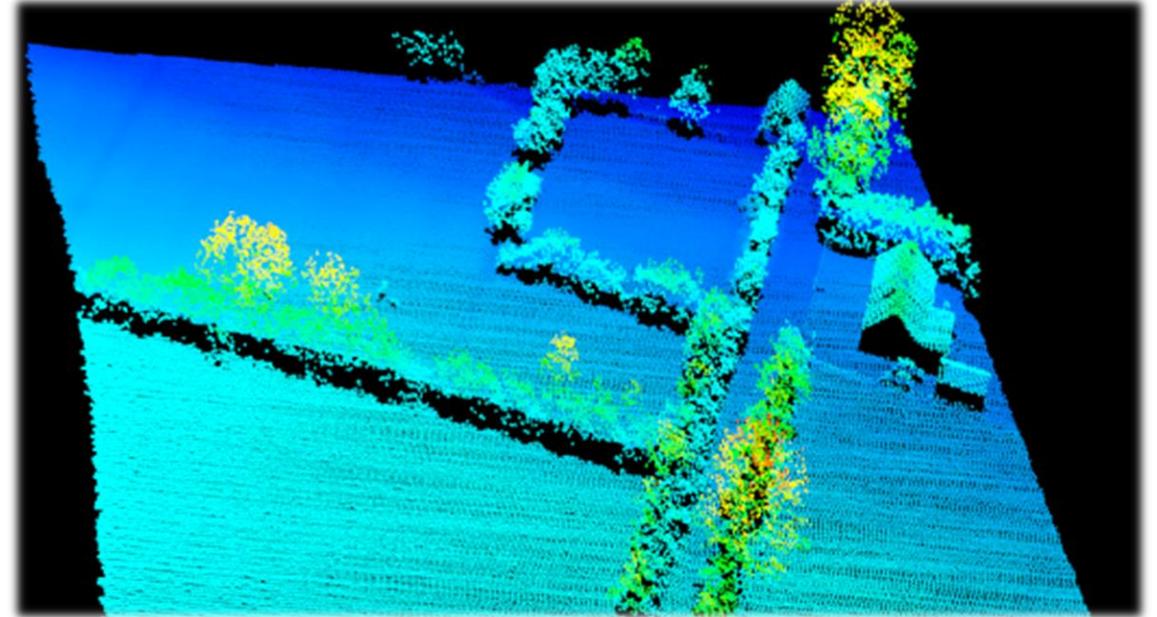# Rebalancing the Conversation
Human & Environmental Credentials of Meat Production

John Gilliland

Director of Global Agriculture & Sustainability

Project Leader, The Devenish Lands at Dowth

BORD BIA
IRISH FOOD BOARD

European Investment Bank

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The Oxford Farming Conference, Science Lecture, 2020

"Food Quality & Human Health – The Evidence"

Alice V. Stanton
Professor of Cardiovascular Pharmacology,
Royal College of Surgeons in Ireland
&
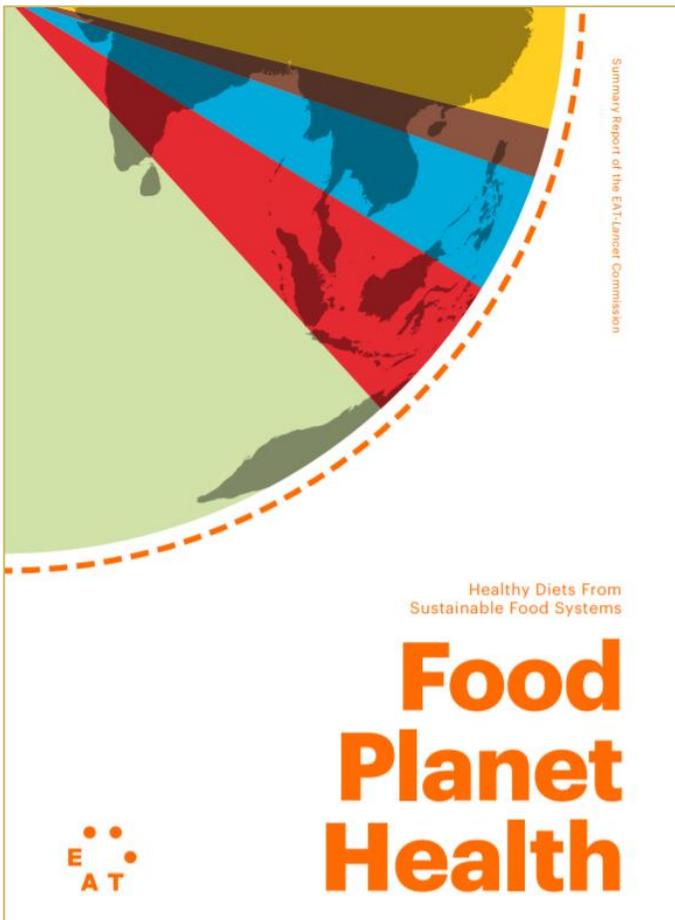Director of Human Health, Devenish Nutrition

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Food, Human & Environmental Health – its Future

The EAT Lancet Commission Report, Feb 2019

Summary Report of the EAT-Lancet Commission

Healthy Diets From Sustainable Food Systems

Food Planet Health

EAT

"Transformation to healthy diets by 2050 will require substantial dietary shifts. Global consumption of fruits, vegetables, nuts and legumes will have to double, and consumption of foods such as red meat and sugar will have to be reduced by more than 50%. A diet rich in plant-based foods and with fewer animal source foods confers both improved health and environmental benefits."

Prof. Walter Willett MD
Harvard T.H. Chan School of Public Health

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The Media Reaction….

"EAT-Lancet recommends slashing red meat consumption by 90%"

Human diet causing 'catastrophic' damage to planet - Lancet report

Eat Plants, Save the Planet

Is this True... 2016 Global Disease Risk Factors, Lancet 2017

Risk	Summary Exposure Values (%)		Deaths (in 1,000's)	DALYs (in 1,000s)
	Male	**Female**		
Nutritional Excesses				
Diet High in Calories / High BMI	10	11	4,525	135,381
Diet High in Sodium	40	36	2,310	47,567
Diet High in Trans Fatty Acids	4	5	224	5,111
Diet High in Processed Meats	6	4	140	3,196
Diet High in Red Meat	25	11	32	1,247
Diet High in Sugar Sweetened Beverages	18	13	23	780
Total for Excesses			7,254	193,282
Nutritional Deficiencies				
Diet Low in Whole Grains	59	61	2,499	62,596
Diet Low in Fruit	62	57	2,361	60,982
Diet Low in Nuts & Seeds	81	82	1,879	49,493
Diet Low in Iron		9	20	35,850
Diet Low in Vegetables	42	43	1,519	35,489
Diet Low in Marine Omega-3 PUFAs	77	79	1,539	33,347
Diet Low in Fibre	53	62	888	20,119
Diet Low in Legumes	45	52	672	14,214
Diet Low in Polyunsaturated Fatty Acids (PUFAs)	40	39	404	8,352
Diet Low in Calcium	57	61	160	3,353
Diet Low in Milk	83	84	123	2,582
Total for Deficiencies			12,064	326,377

DALYs, rather than deaths is the **bigger issue**

Diet, rather than food is the **bigger problem**

Deficiencies, rather than excesses is the **bigger problem**

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Percentage of children under 5 who are stunted (%), by country

- ≥30%
- 20 – <30%
- 10 – <20%
- 2.5 – <10%
- <2.5%
- no current data
- no data

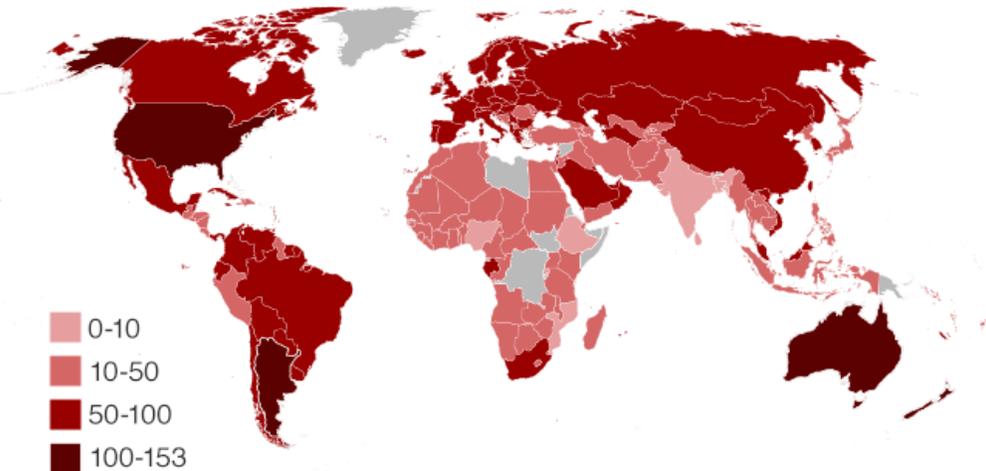*Source: UNICEF, WHO, World Bank Joint Child Malnutrition dataset, March 2019 edition*
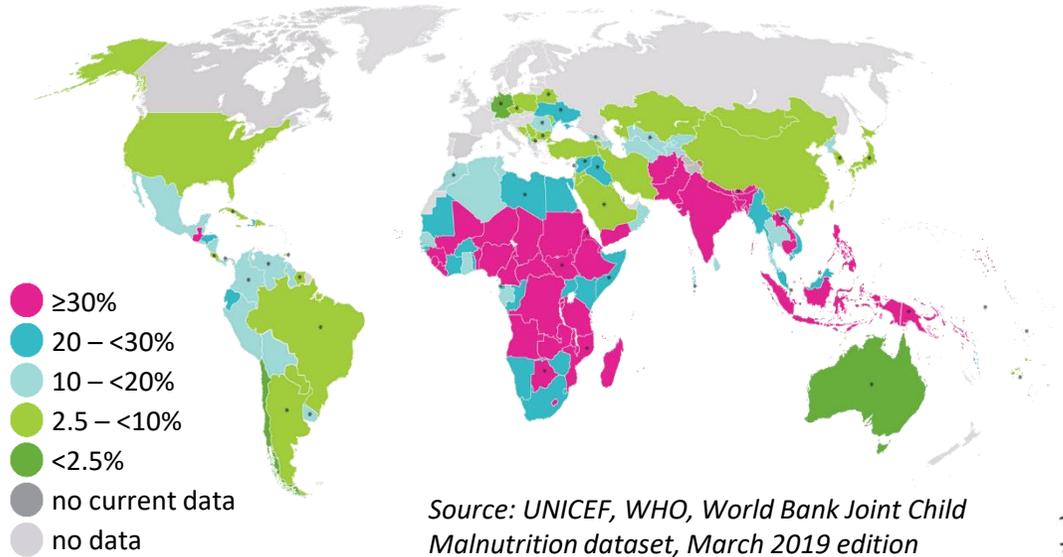
Childhood Stunting Rates
&
Annual Meat Consumption
- an Inverse Relationship
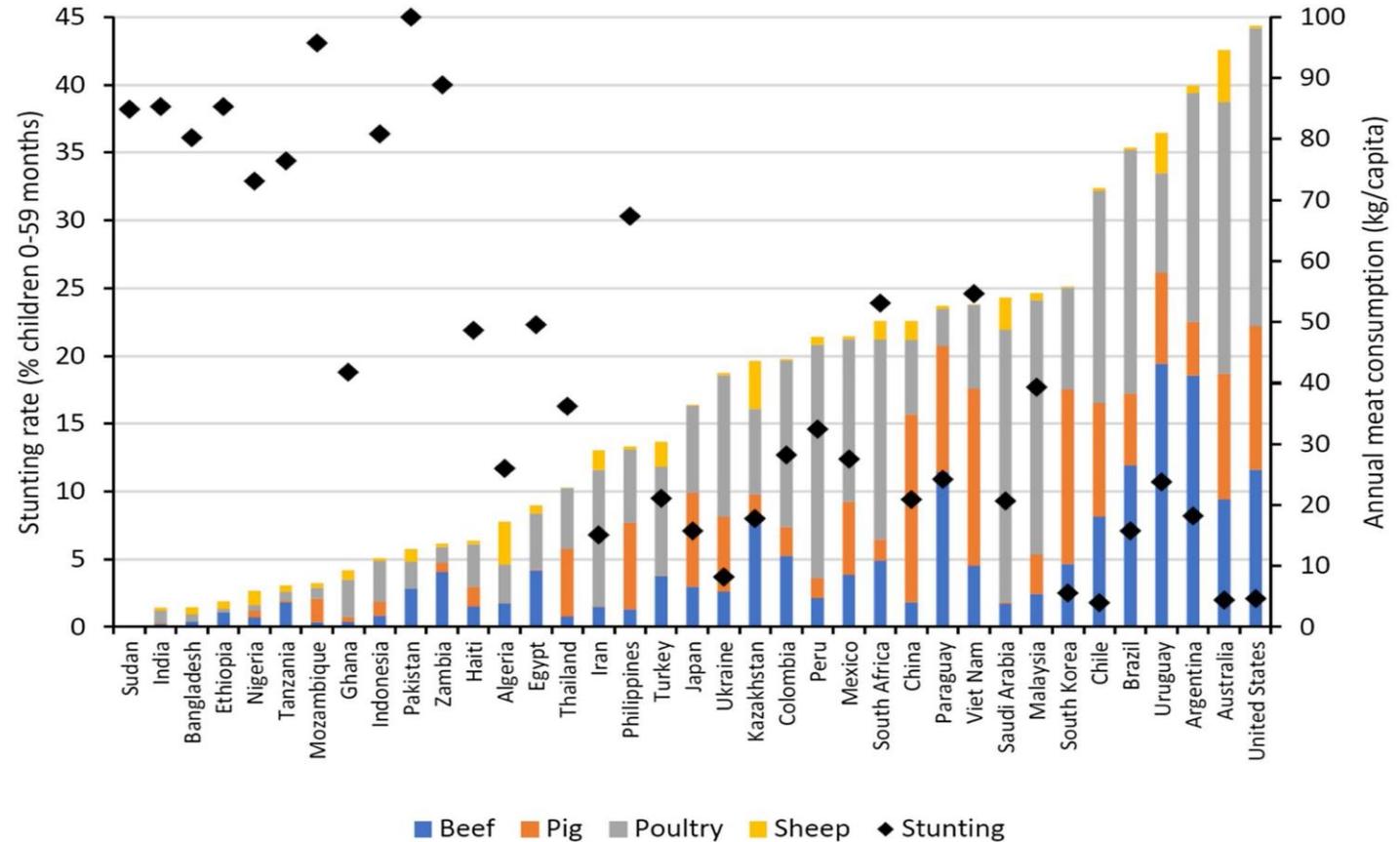
Who eats the most meat?

Meat consumption (kg per person per year)

- 0-10
- 10-50
- 50-100
- 100-153

Source: UN Food and Agriculture Organization / Our World in Data

BBC

Stunting rate (% children 0-59 months)

Annual meat consumption (kg/capita)

Sudan, India, Bangladesh, Ethiopia, Nigeria, Tanzania, Mozambique, Ghana, Indonesia, Pakistan, Zambia, Haiti, Algeria, Egypt, Thailand, Iran, Philippines, Turkey, Japan, Ukraine, Kazakhstan, Colombia, Peru, Mexico, South Africa, China, Paraguay, Viet Nam, Saudi Arabia, Malaysia, South Korea, Chile, Brazil, Uruguay, Argentina, Australia, United States
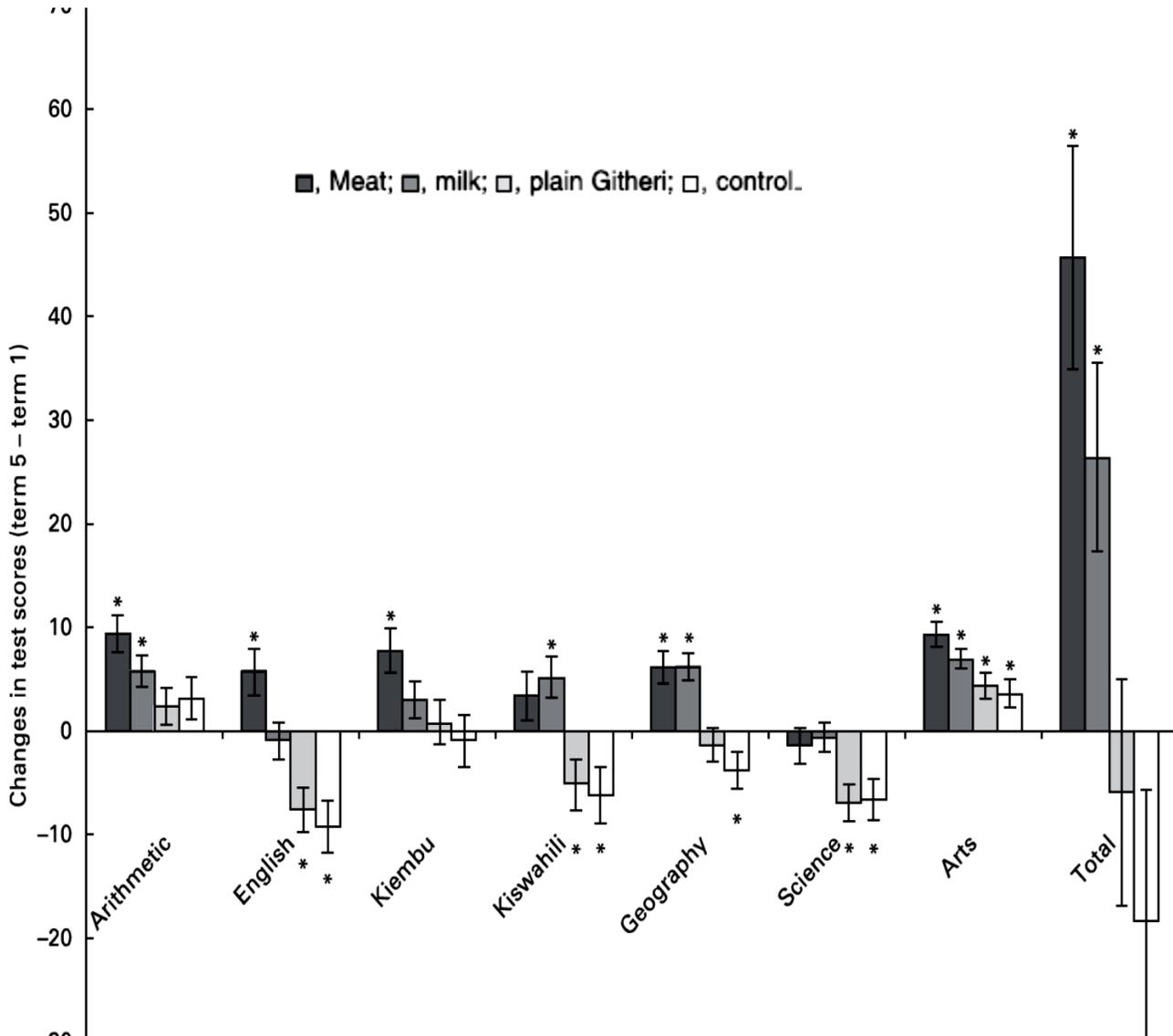
■ Beef ■ Pig ■ Poultry ■ Sheep ◆ Stunting

Animal Source Foods & Impact on Primary School, Test Scores, of Kenyan Schoolchildren
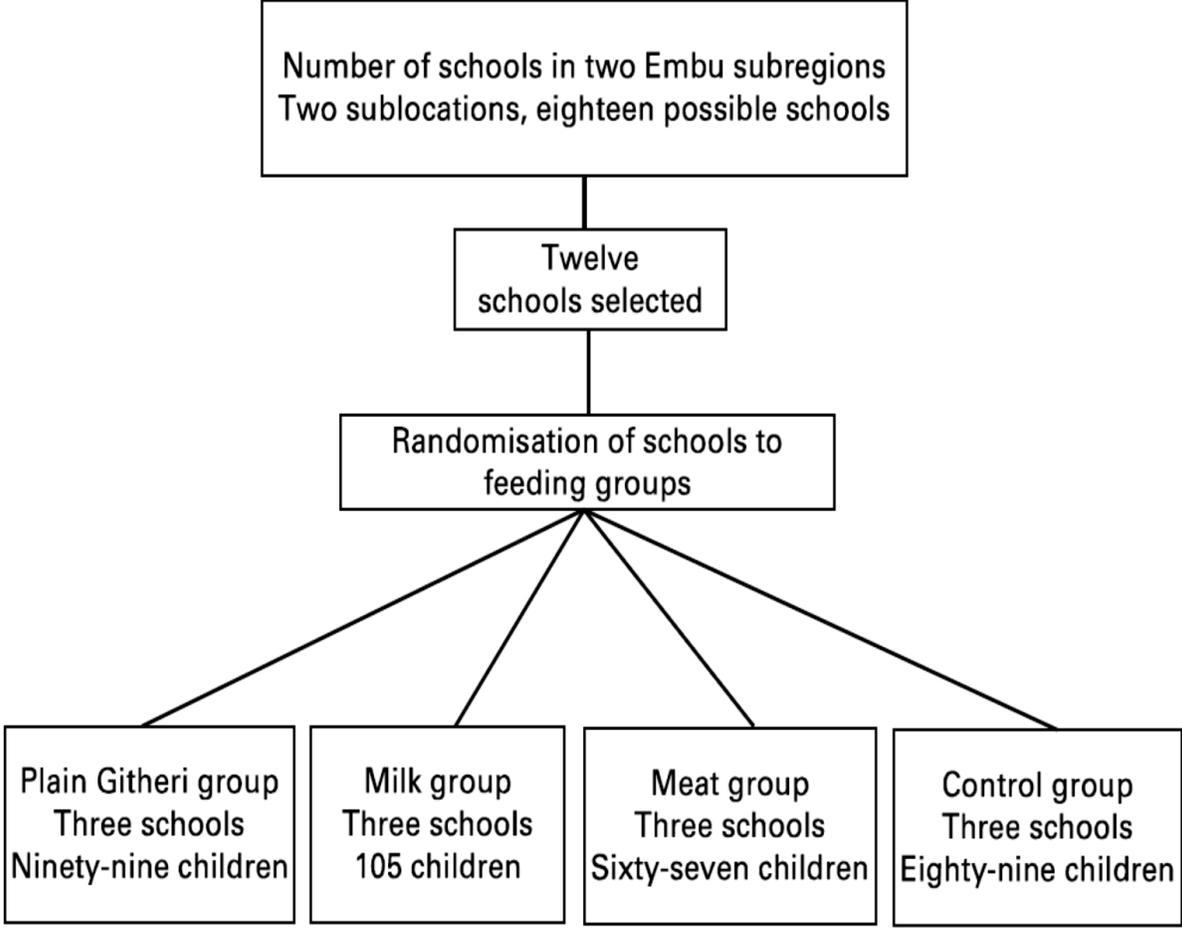
Hulett et al. Brit J Nutrition 2014

Nutritional Quality of Steak *Vis a Vis* Plant-Based Burgers
(4 Ounce = 115g)

	Steak (80% Lean)	Beyond Meat Burger	Impossible Burger
Calories	287	270	220
Fat (g)	23	20	13
Saturated fats (g)	9	6	10
Carbohydrates(g)	0	5	5
Sugars	0	0	<1
Protein (g)	19	20	20
Sodium (mg)	75	380	430
Fibre (g)	0	3	0
Protein source	100% beef	Pea, mung bean, brown rice	Soy protein concentrate (GM), Soy leghemoglobin (GM), Soy protein isolate (GM), Potato protein,
Fat source		Cocoa butter, coconut oil, sunflower oil & canola oil	Coconut oil, Sunflower oil,
Additional Ingredients		Potato starch, Natural flavor, Yeast, Salt & Beet juice extract	8 added vitamins, Natural flavors, salt, Yeast extract, Methylcellulose, Food starch modified, Cultured dextrose & Water

Ultra-Processed Diets Causes Excess Calorie Intake & Weight Gain
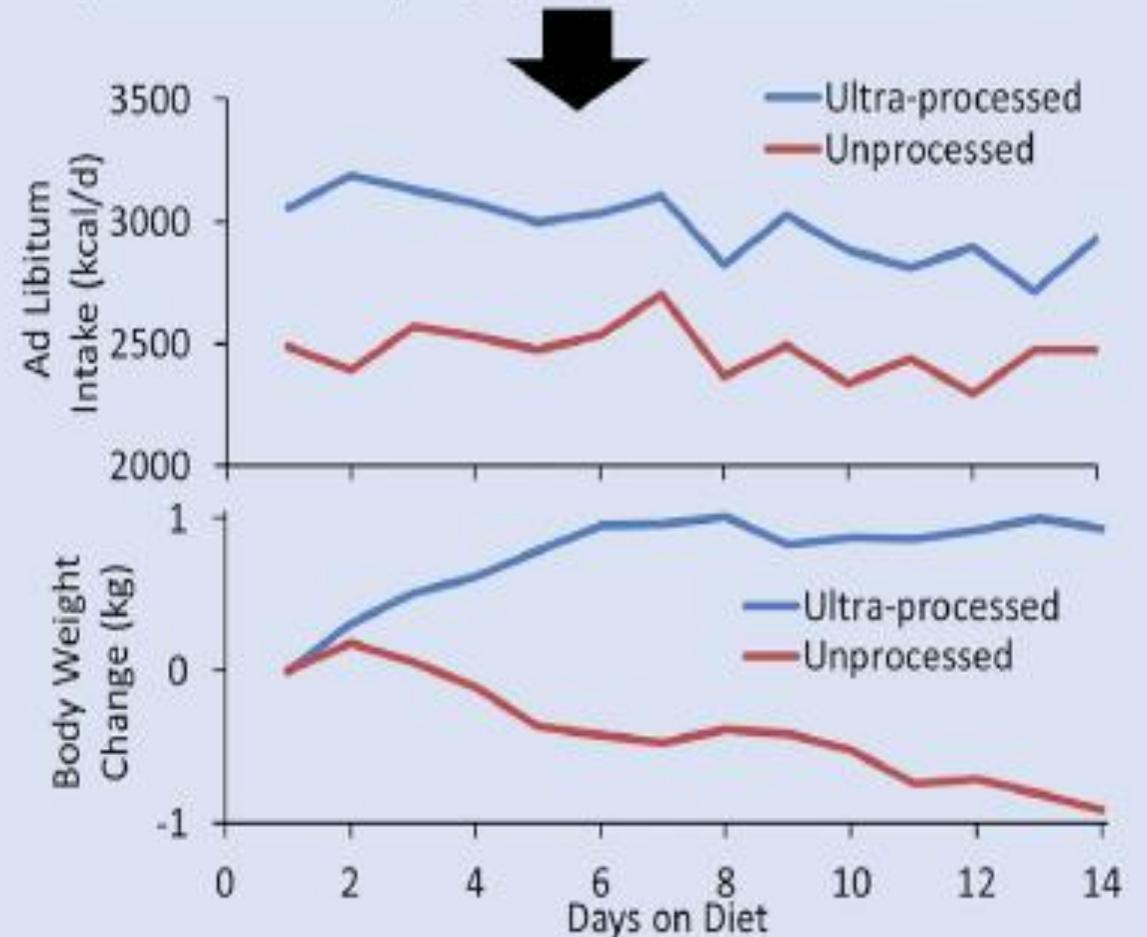
Hall KD et al.
Cell Metabolism 2019; 30: 67–77.

Population Scale Behavioural change….. is not easy!!
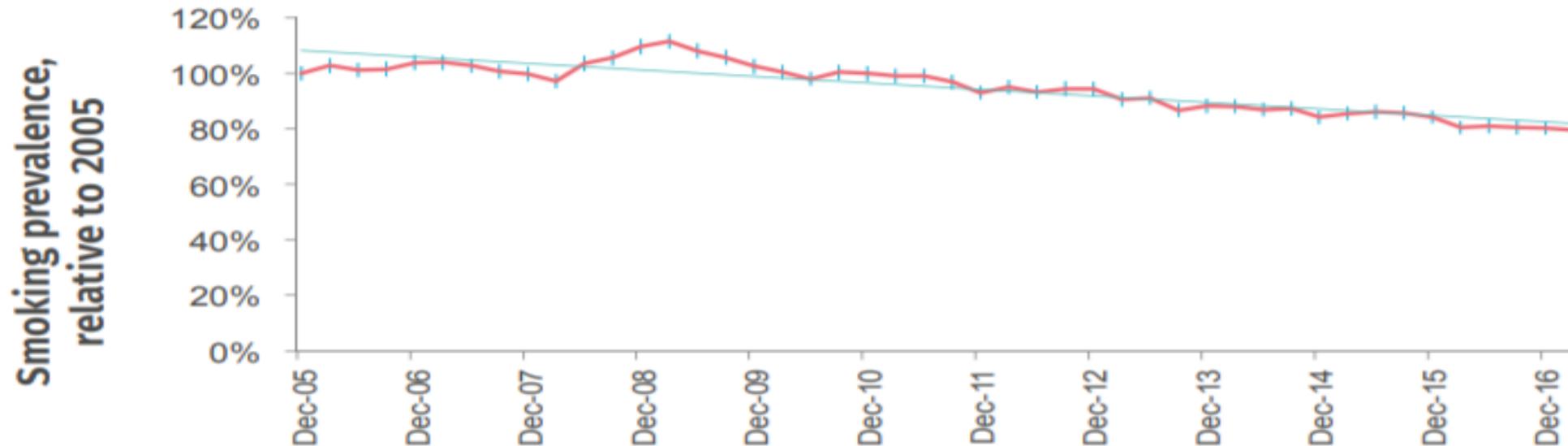## E.g. Smoking in Ireland

Figure 6: Trend in crude smoking prevalence to 2017, relative to 2005

Source: HSE Tracker Survey; 3-month moving average with 95% Confidence Intervals shown as error bars

21% reduction in Irish smokers, over 12 years & cost millions

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EAT–Lancet Commission "Reference Diet"

Impacts on Premature Deaths, Disease Burdens if Adopted……

Risk	Exposure Values (%)		Deaths	DALYs
	Male	Female	(in 1,000's)	(in 1,000s)
Nutritional Excesses				
Calories / High BMI	10	11	4,525	135,381
Sodium	40	36	2,310	47,567
Trans Fatty Acids	4	5	224	5,111
Processed Meats	6	4	140	3,196
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Iron		9	20	35,850
Vegetables	42	43	1,519	35,489
Marine Omega-3 PUFAs	77	79	1,539	33,347
Fibre	53	62	888	20,119
Legumes	45	52	672	14,214
Polyunsaturated Fatty Acids	40	39	404	8,352
Calcium	57	61	160	3,353
Milk	83	84	123	2,582
Total for Deficiencies			12,064	326,377

11 Million premature deaths avoided, mainly due to reduced Sodium, & increased Fruits, Vegetables, Whole Grains & Nuts

A 90% Decrease in Red & Processed Meats intake;

will not save many lives or DALYs.

WILL RESULT in greater deficiencies in Iron, Omega-3-PUFAs, Calcium, Vitamins D & B12 and Protein, with disproportionate effects on women & children

Conclusion – Need Sustainable Farming & Food Solutions to deliver the Rest

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But we must be Honest as ……..

Food today is not always as Nutritious as it could be…

Diet-related Diseases are Increasing

Turn Around Fellas, We Got it All Wrong!!

# Changes in Nutrient Content of Fruit & Veg over fifty years

US study of nutritional data from both 1950 & 1999 for 43 different vegetables & fruits, found statistically significant declines in the amount of:

- Protein   ⬇ 6%
- Calcium   ⬇ 16%
- Phosphorus   ⬇ 16%
- Iron   ⬇ 15%
- Riboflavin   ⬇ 38%
- Vitamin C   ⬇ 20%

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Changes in the Nutrient Content of Oily Fish over Ten Years

Levels of EPA+DHA (g/100g) in farmed Scottish Atlantic salmon between 2006 - 2015

Sprague et al. Nature 2016
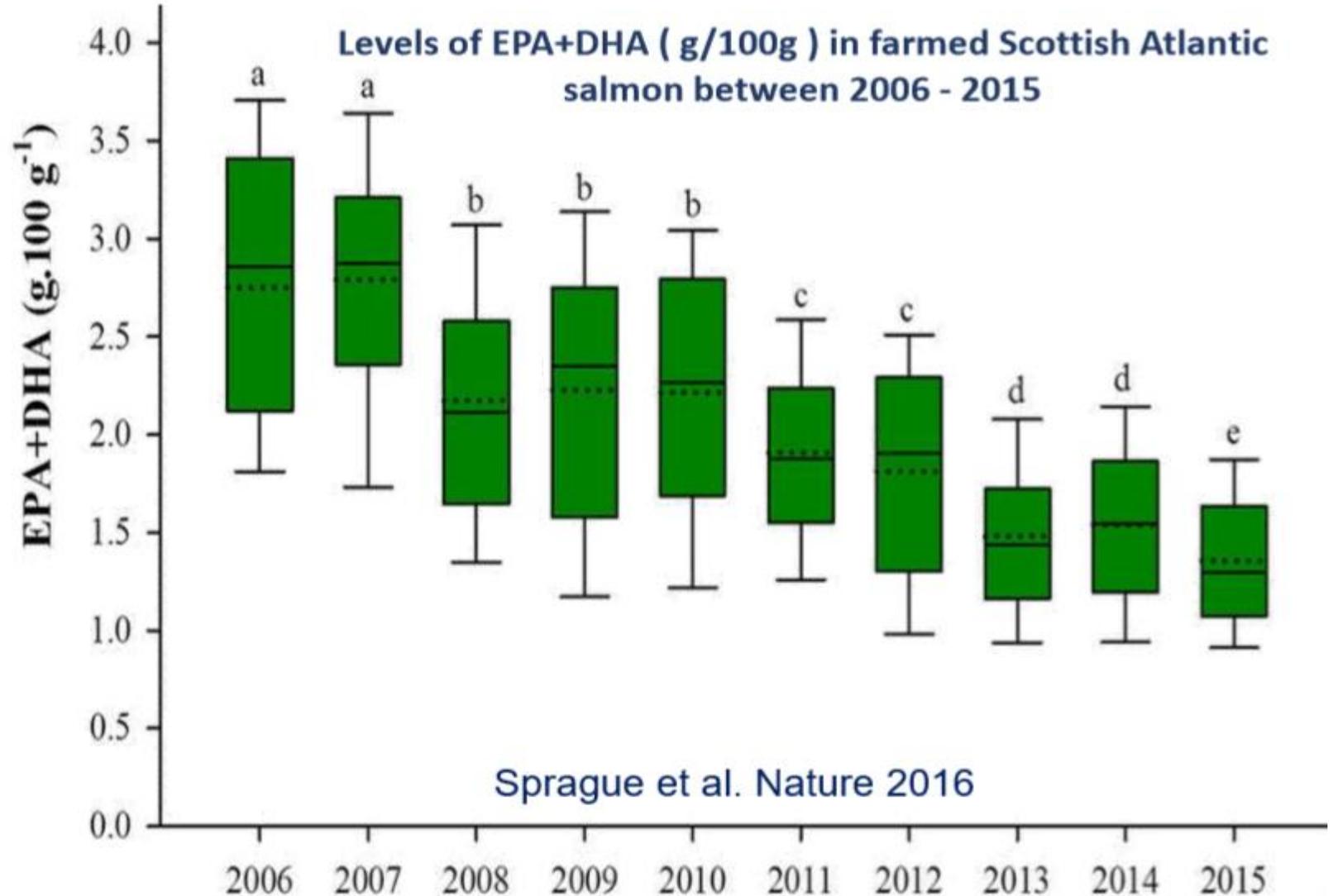
Solutions Already Delivered by Devenish
Naturally enriched Chicken & Eggs, with Algae-Sourced, Omega-3
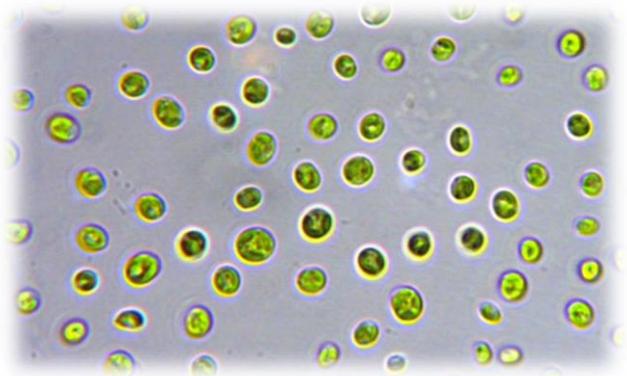
Microalgae
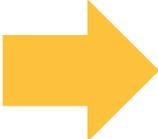
Animal feed

Results of eating Omega-3 PUFA enriched chicken & eggs

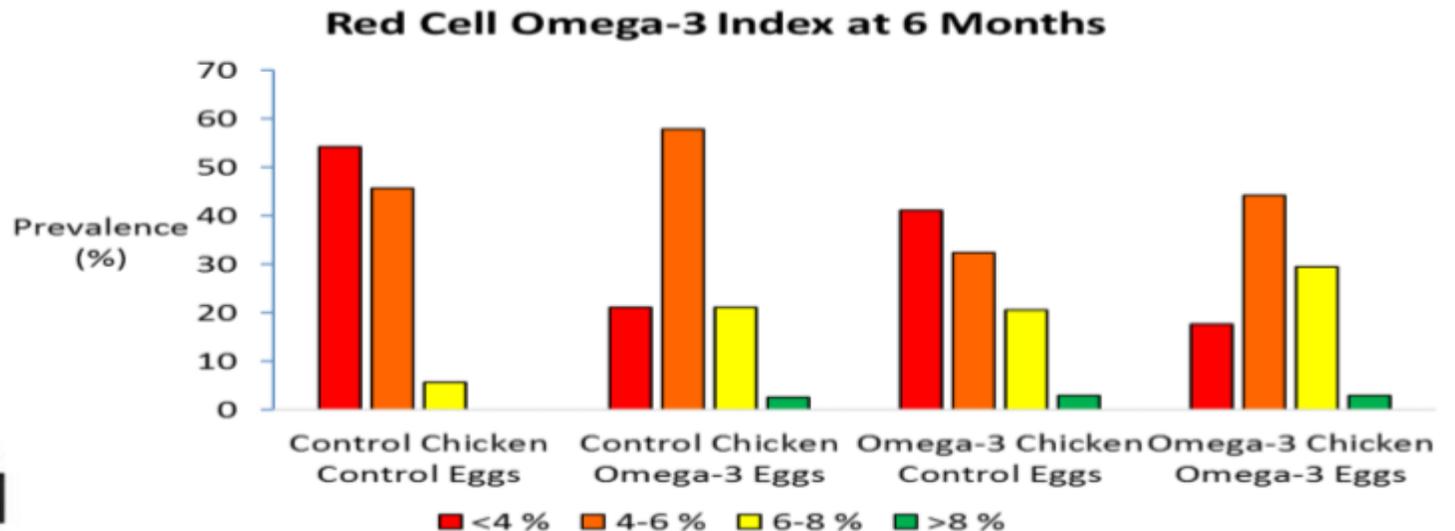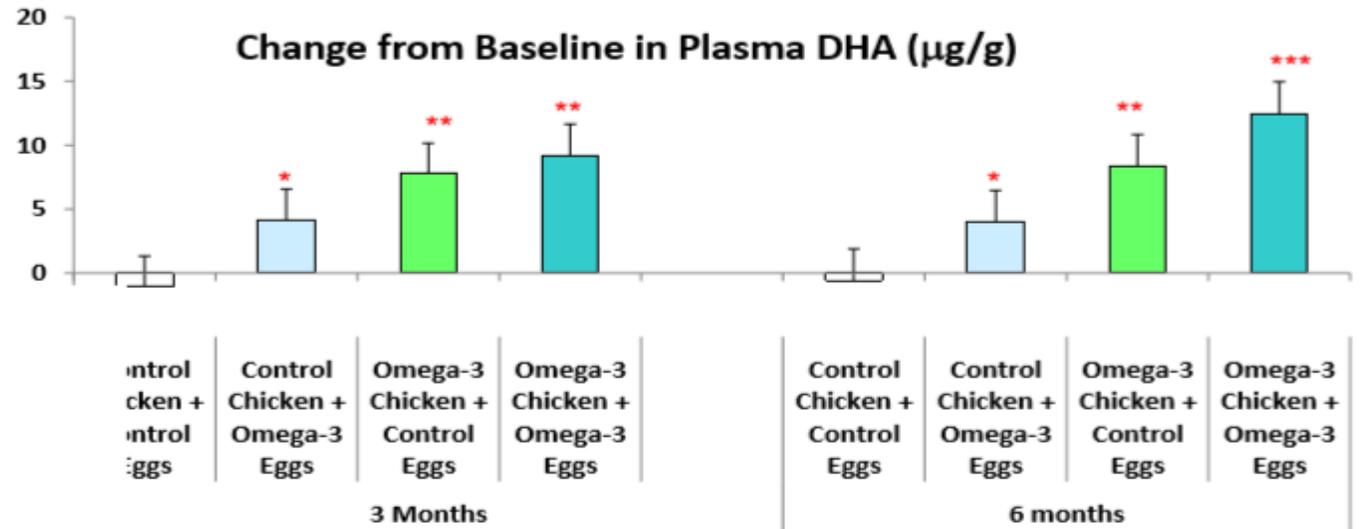1. **Clinically & Statistically Significant Increases in Plasma DHA Levels**
   - * $p < 0.05$
   - ** $p < 0.01$
   - *** $p < 0.0001$

2. **Substantial Shift in the Distribution of the Omega-3-Index in a Healthy Adult Population**

3. **70% reduction in individuals with a high risk Omega-3 Index**

4. **5 fold increase in those with an Omega-3 index > 6%**

Change from Baseline in Plasma DHA (μg/g)

3 Months: Control Chicken + Control Eggs | Control Chicken + Omega-3 Eggs | Omega-3 Chicken + Control Eggs | Omega-3 Chicken + Omega-3 Eggs

6 months: Control Chicken + Control Eggs | Control Chicken + Omega-3 Eggs | Omega-3 Chicken + Control Eggs | Omega-3 Chicken + Omega-3 Eggs

Red Cell Omega-3 Index at 6 Months

Prevalence (%)

Control Chicken Control Eggs | Control Chicken Omega-3 Eggs | Omega-3 Chicken Control Eggs | Omega-3 Chicken Omega-3 Eggs

■ <4 %   ■ 4-6 %   ■ 6-8 %   ■ >8 %

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As a result… A Proactive delivery of an alternative solution
Nov 2017, American Heart Association Awards Research, Best International Paper
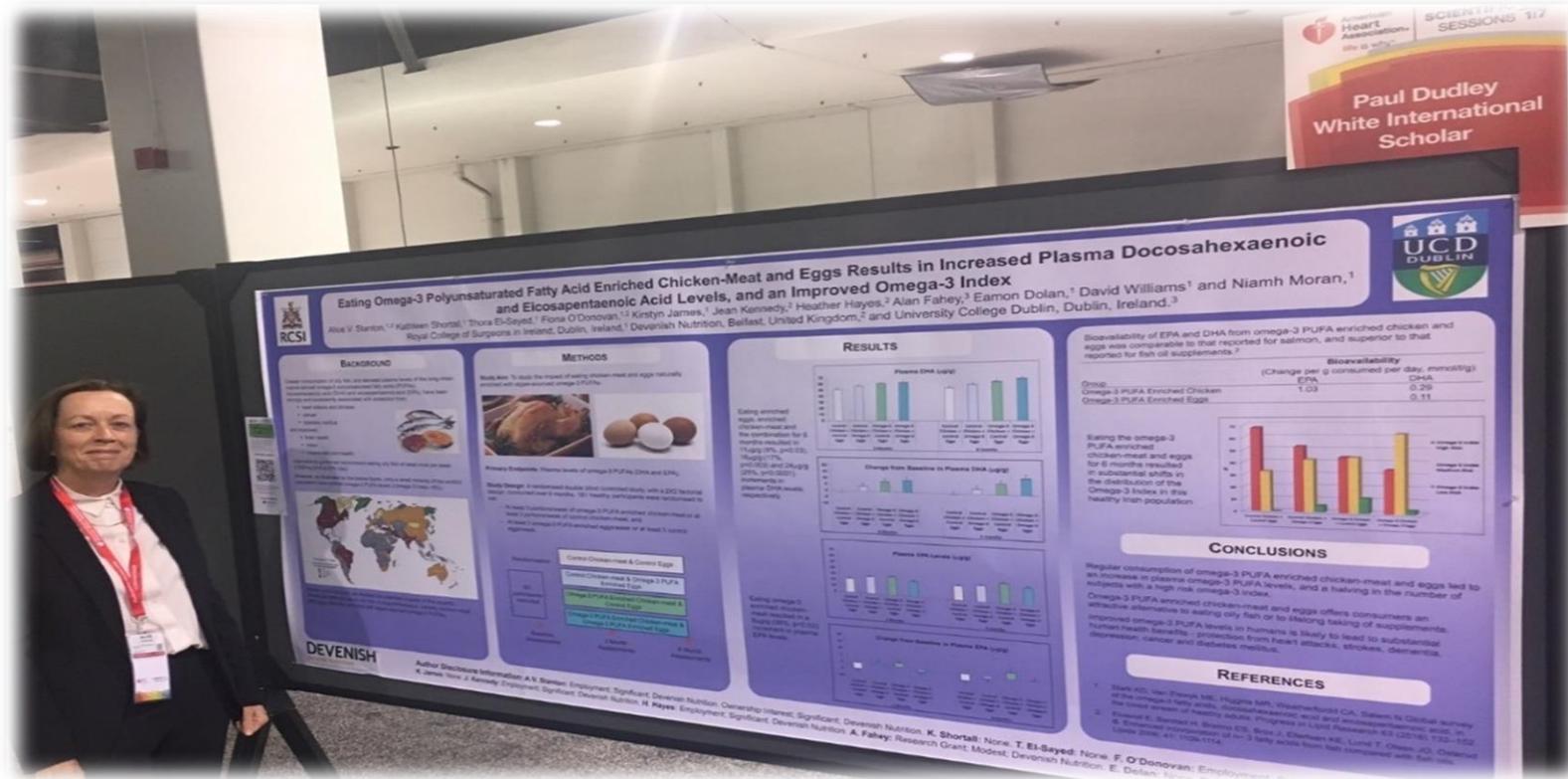
Adding value Pre-farmgate, with Unique Rapid Human Bio-availability

Without the necessity to change Consumer Consumption Behaviour!

One Health…..

Improving Human & Environmental Health

Consumer
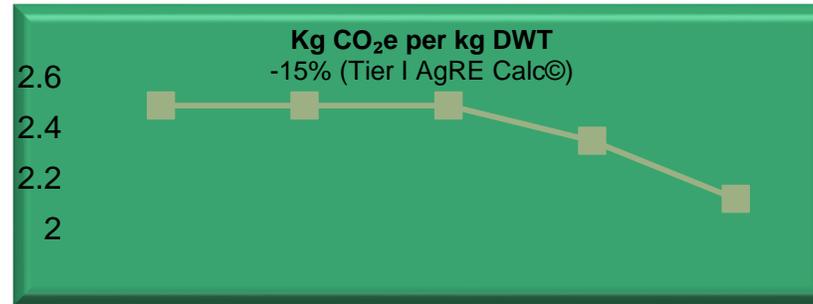
Retailer

Processor

Producer

from "Soil to Society"

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Delivering Smart Sustainable Livestock Solutions
Success with Poultry over the last five years

2kg FCR
1 pt in FCR = £1.50/tonne of feed

1.70
1.65
1.60
1.55
1.50

Kg CO₂e per kg DWT
-15% (Tier I AgRE Calc©)

2.6
2.4
2.2
2

Economic

Environmental

Social

Research conducted by Royal College of Surgeons in Ireland, on behalf of Devenish, presented at American Heart Association Scientific Sessions, in California

The world's first naturally enriched omega-3 chicken and eggs fed with OmegaPro, are liekly to reduce the risk of heart attack, stroke, dementia and depression.

Follow the discussion on Twitter

#Omega3Trial

RCSI

Economic

Environmental

Social

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Designing Precision Nutrition to Mitigate Environmental Impacts

DeviGainPG – Displacing Crude Protein with refined Amino Acids

- **5% improvement** in **growth** rate

- **17kg** per pig **soya reduction**

- **25% reduction in water** intake

- **38% reduction** in **slurry** volume

- **49% reduction** in **ammonia**

- **16% reduction** in **GHGs***

*SRUC, AgRE Calc, Calculator accredited PAS 2050 to BSI

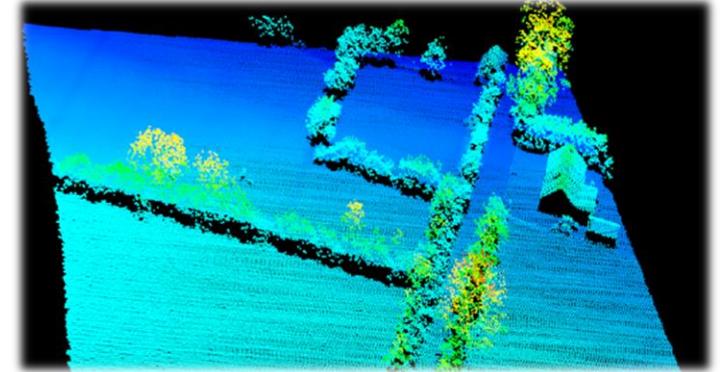# So what about Ruminant Agriculture?
A Pariah… or a Global Asset?

Delivering Soil Improvement

The Devenish Lands at Dowth

Measuring Carbon Sequestration

Optimising Biodiversity

Reducing Over Land Flow

A UNESCO
World Heritage Site
6,000 Years of Farming Evolution
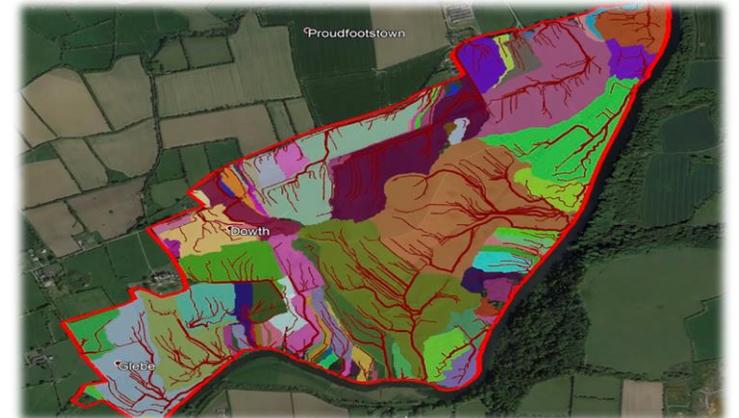
Getting the Basics right, understanding Soils & Nutrient Uptake
Summary of Ireland's grassland sector

Grass Dry Matter Utilisable Yields – Average 5.1t/ha/yr
Top Grassland Yields 16t/ha/yr

Soil Analysis – Only 2% analysed on an annual basis
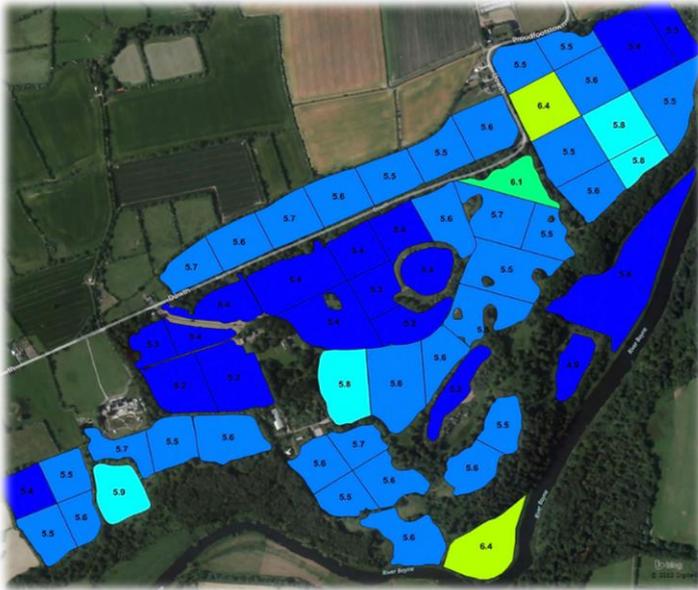**Soil pH –** Optimal 6.0, 64% not achieving optimal
% Soils at optimal fertility – 12%

Teagasc Green Book 2017

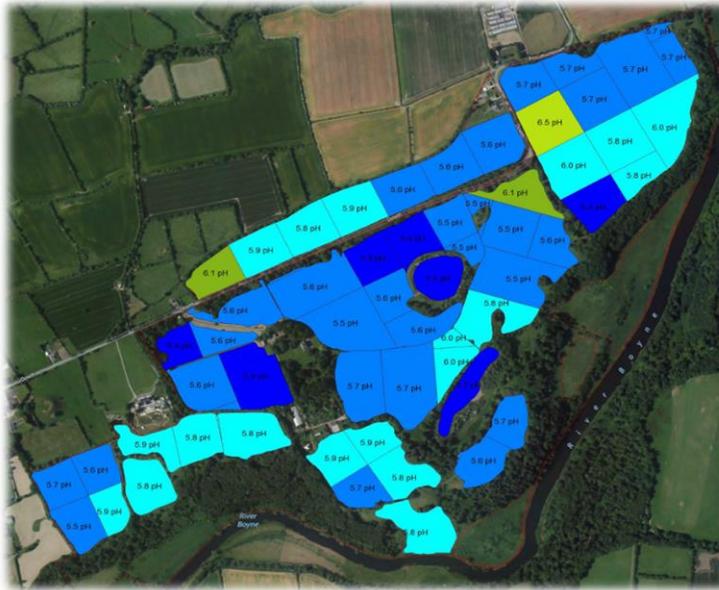| Soil pH	Nitrogen Utilisation	Phosphorus Utilisation	Potassium Utilisation	% of Fertiliser Wasted
5.0-5.5	77%	48%	77%	32%
5.5-6.0	85%	52%	100%	21%
6.0-6.5	100%	100%	100%	0%

Creating a baseline at Dowth to restore our Soil Fertility
- Soil pH

Feb. 2014
Average pH 5.5

Feb. 2016
Average pH 5.7

Feb. 2018
Average pH 6.1
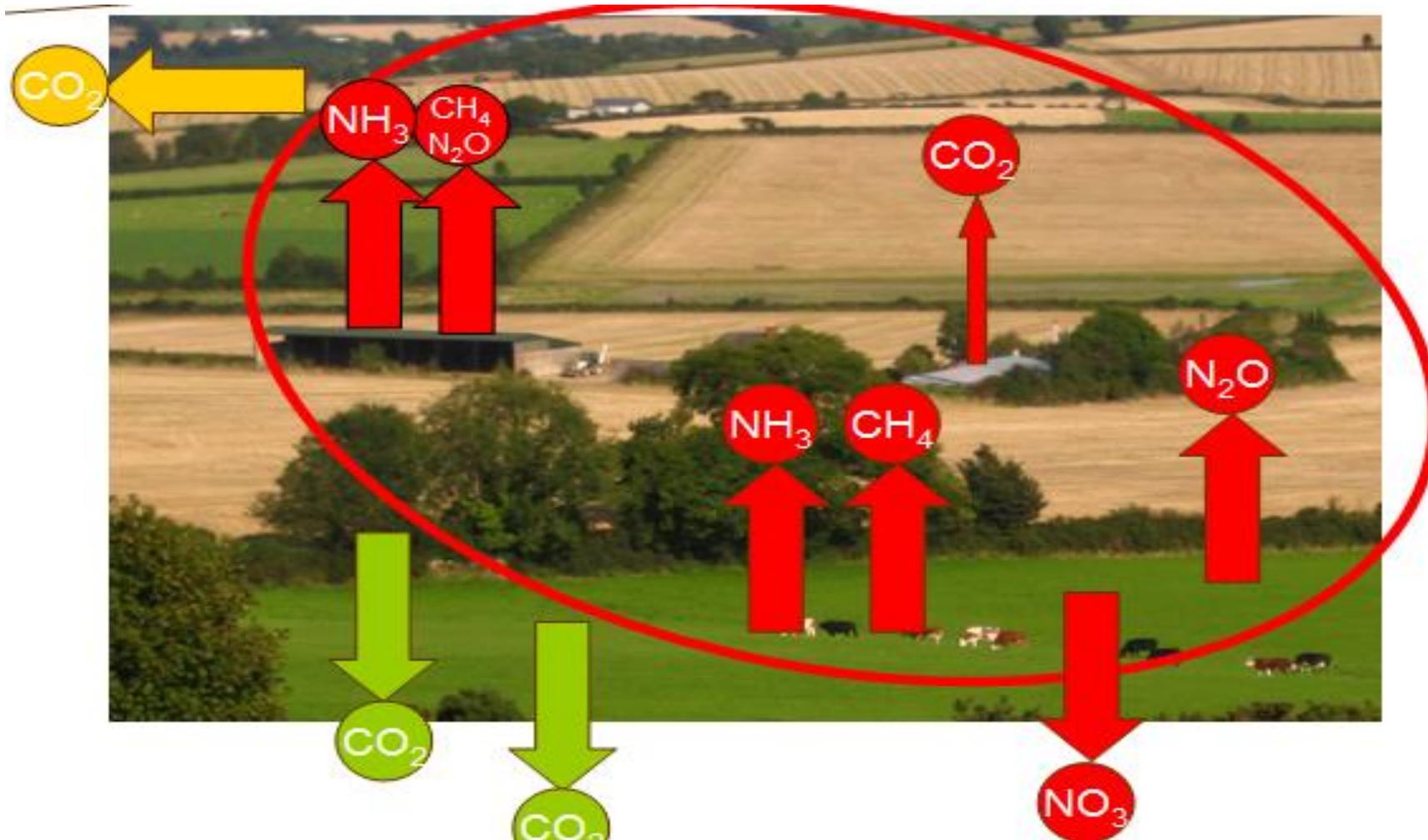
Above 7.0 pH
6.7 - 7.0 pH
6.4 - 6.6 pH
6.1 - 6.3 pH
5.8 - 6.0 pH
5.5 - 5.7 pH
5.0 - 5.4 pH
Below 5.0 pH
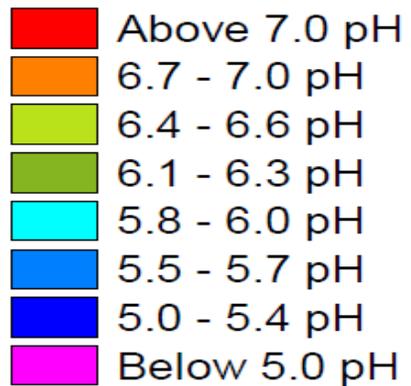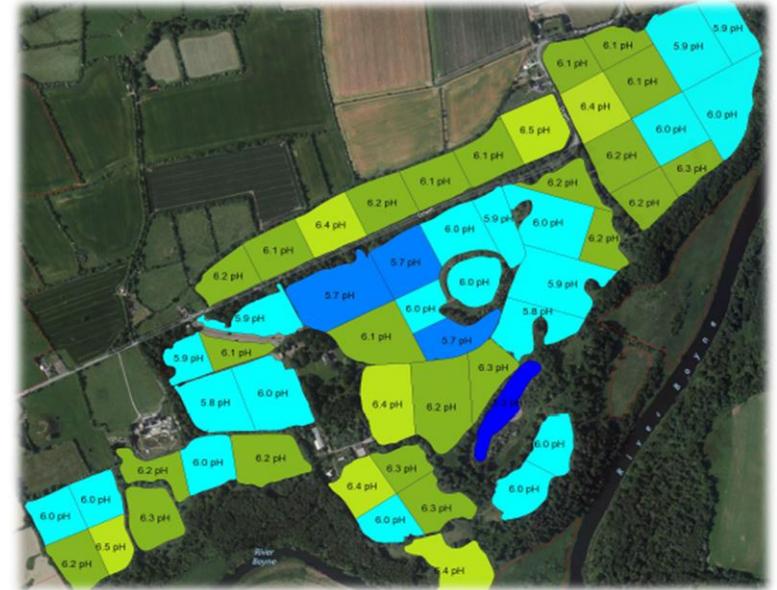
5t/ha Lime (spread Uniformly)
Sept 2014

2-8t/ha Lime (Variable rate)
Sept 2016

FARMTECH SOLUTIONS

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The Ultimate Dilemma… Mitigating Greenhouse Gases
& the Recognition that farms can Sequester GHGs, as well as Emit them

But - how could this be credibly validated, independently?
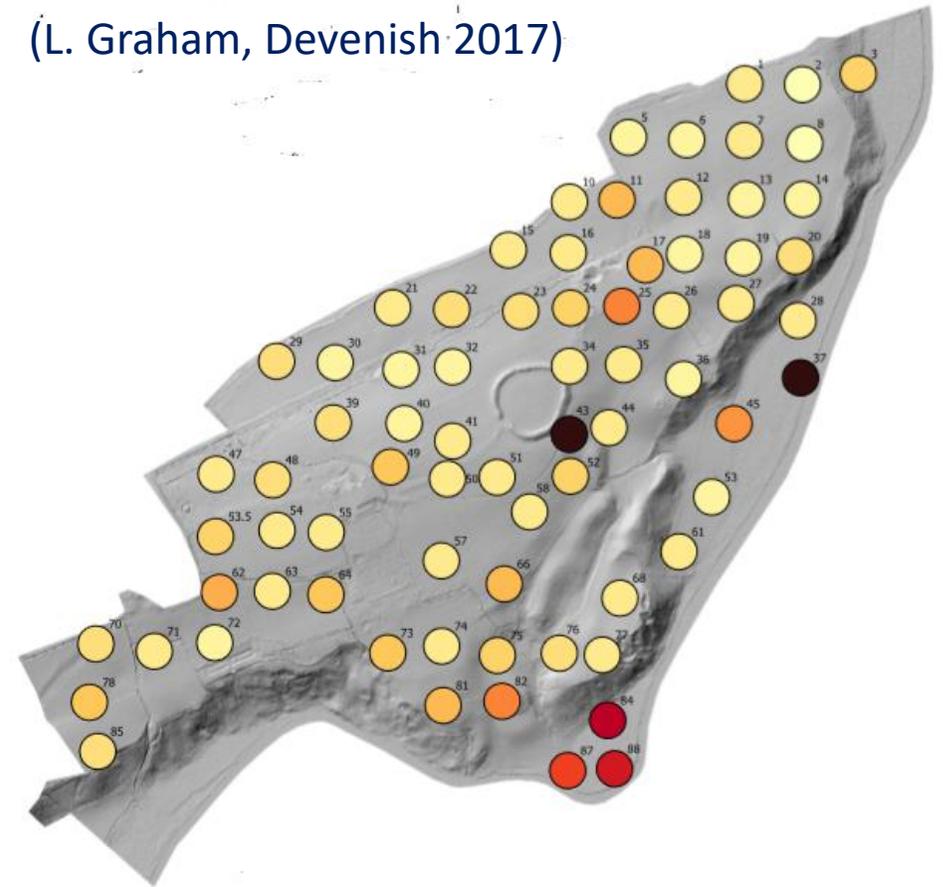
Dowth Grass Swards and its Soils
Soil A Horizon sampled to 30cm in 88 soil pits

No ploughing for 40 Years
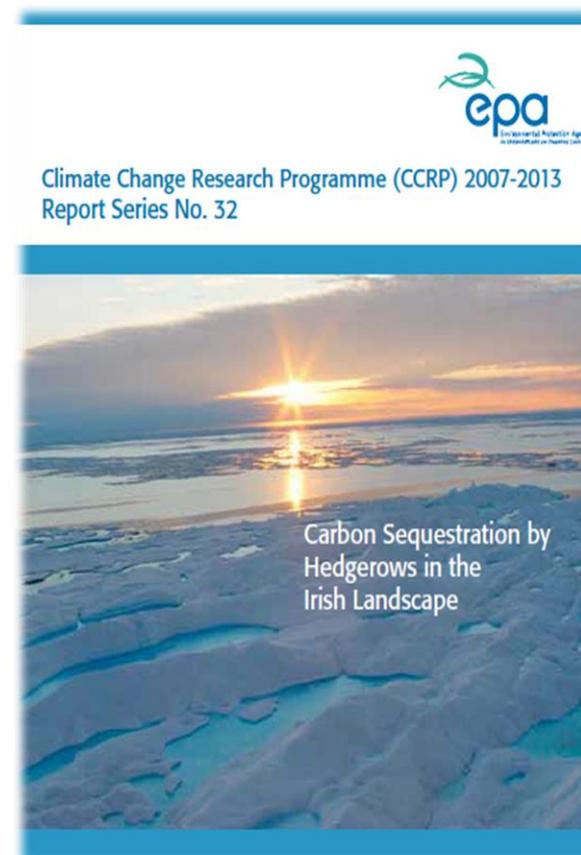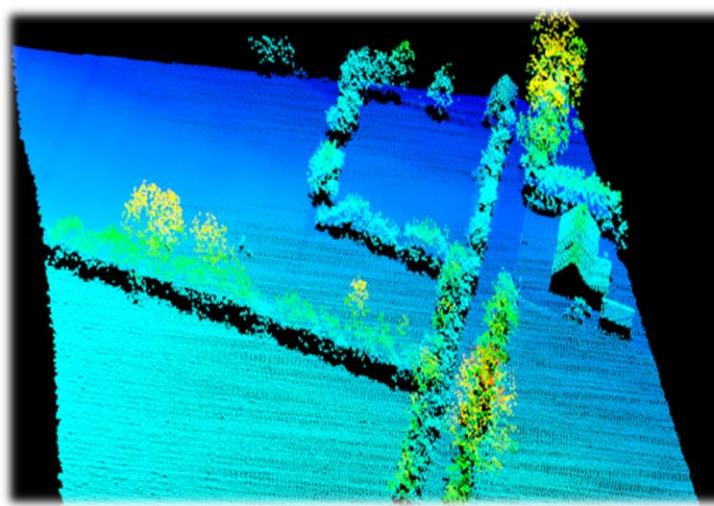Some land never ploughed
Soil Type – Brown Earth

Average Soil Carbon – 2.1%
Expected Soil Carbon – 4 to 5%

Why the disparity in Soil Carbon Levels?

(L. Graham, Devenish 2017)

1.00 - 1.25
1.25 - 1.50
1.50 - 1.75
1.75 - 2.00
2.00 - 2.25
2.25 - 2.50
2.50 - 2.75
2.75 - 3.00
3.00 - 3.25
3.25 - 3.50
3.50 - 3.75
3.75 - 4.00
4.00 - 4.25
4.25 - 4.50
4.50 - 4.75
4.75 - 5.00
5.00 - 5.25
5.25 - 5.50
5.50 - 5.75
5.75 - 6.00
>6

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2. Measured the "Above Ground" Carbon in Trees & Hedges
Using Aerial LiDAR Survey to digitally measure the Trees & Hedges

Climate Change Research Programme (CCRP) 2007-2013
Report Series No. 32

Carbon Sequestration by Hedgerows in the Irish Landscape

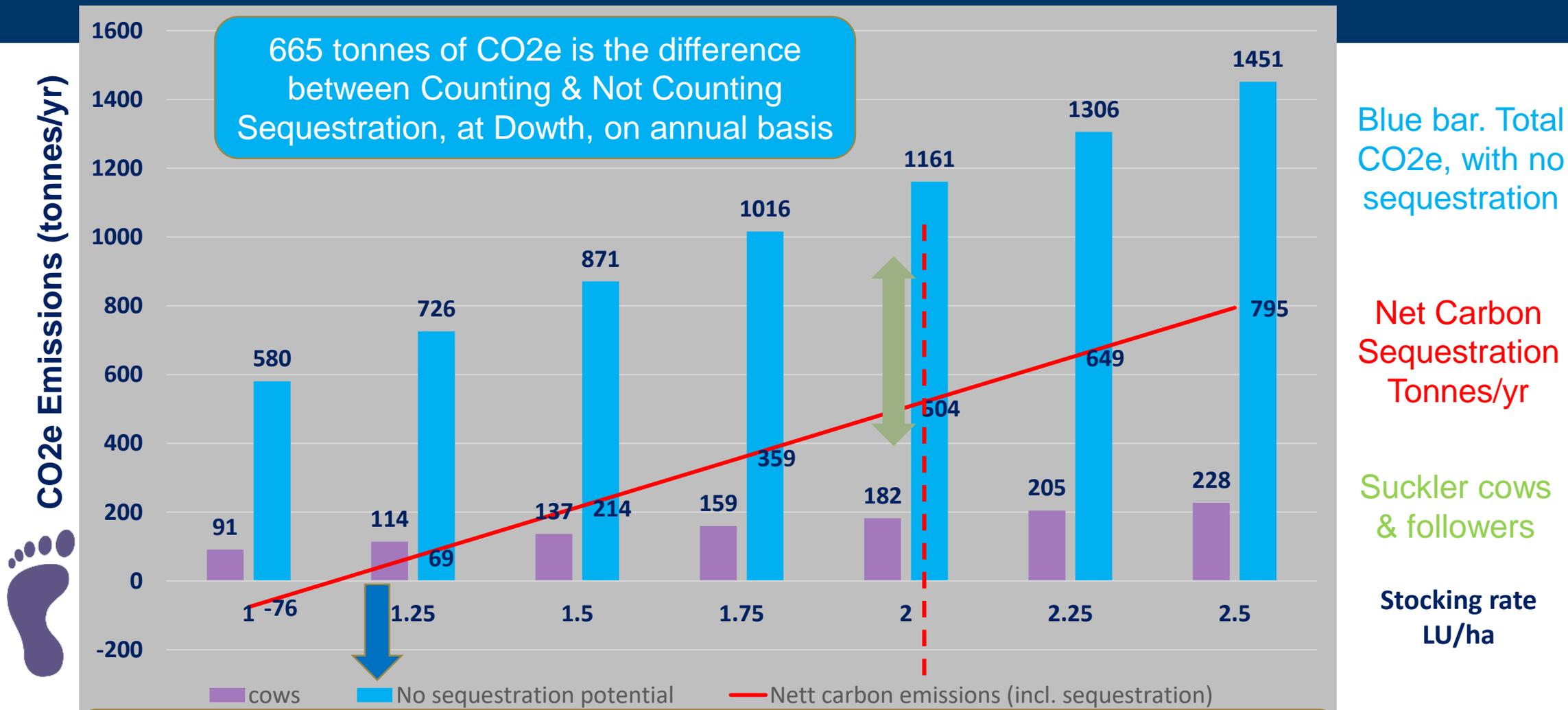|	Woods	Hedges	Total
Biomass Density (t C/ha)	83	127	86
Total Biomass in Dowth (t C)	3495	385	3880
Sequestration Potential for Dowth (t C/Yr)	50	1.2	51

S. Green, Teagasc, 2014

Estimated Annual Carbon Sequestration at the Lands at Dowth

	Area Ha	Carbon Seq. Soils t of C/ha/ yr	Total soil Seq. t/ yr	Carbon Seq. Trees t of C/ha/ yr	Total tree Seq. t/ yr
Grazing ground	91.91	0.5	46		
Woodland	42	1.6	67.2	1.2	50
Floodplains	10.2				
Hedgerows	7.89	1.6	12.62	0.4	3
Total land area	156.48				
		Total soil seq./ yr	128	Total trees seq./ yr	54
		Total Dowth carbon sequestration t of C/ yr.			181.6
		Total carbon dioxide equiveillance, t of CO2 e/ yr			665

Gordon et al 2006, S. Green 2014, L. Graham 2017, D. Hagan 2018

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GHG displacement at different Stocking Rates
Suckler Cows & Calves, Grazing System, on 91 ha of Grass at Dowth

665 tonnes of CO2e is the difference between Counting & Not Counting Sequestration, at Dowth, on annual basis

Blue bar. Total CO2e, with no sequestration

Net Carbon Sequestration Tonnes/yr

Suckler cows & followers

Stocking rate LU/ha

CO2e Emissions (tonnes/yr)

Stocking rate LU/ha	cows	No sequestration potential	Nett carbon emissions
1	91	580	-76
1.25	114	726	69
1.5	137	871	214
1.75	159	1016	359
2	182	1161	504
2.25	205	1306	649
2.5	228	1451	795

cows — No sequestration potential — Nett carbon emissions (incl. sequestration)

D. Hagan Devenish 2018

Red dashed line represents a Stocking Rate of 2 LU/ha, At which point, Dowth's Sequestration displaces 56% of all GHGs emitted by Cows & Calves

Accelerating Carbon Sequestration

- Improving Soil pH
- Sowing multi species, grazing swards, rich with legumes
- Coppicing & Pollarding Trees & Hedges to drive more Vigorous Growth
- Planting Silvopasture in Grazing Platform (J. McAdam AFBINI)

Land Use Practice	Species	tC/ha/yr
Silvopasture	Poplar (200/ha)	2.8
Pasture	Perennial ryegrass	1.0
Forest Plantation	Sitka spruce (yc 18)	3.8

Biodiversity benefits

Spiders

Birds

Beetles

- Planting 400 trees per ha, on mineral soils, growing grass
- Pollarding of trees to optimise grass growth, biodiversity & sequestration
- Extending Soil Trafficability by 17 weeks, improving grass utilisation & reducing nutrient & soil loss, to water courses
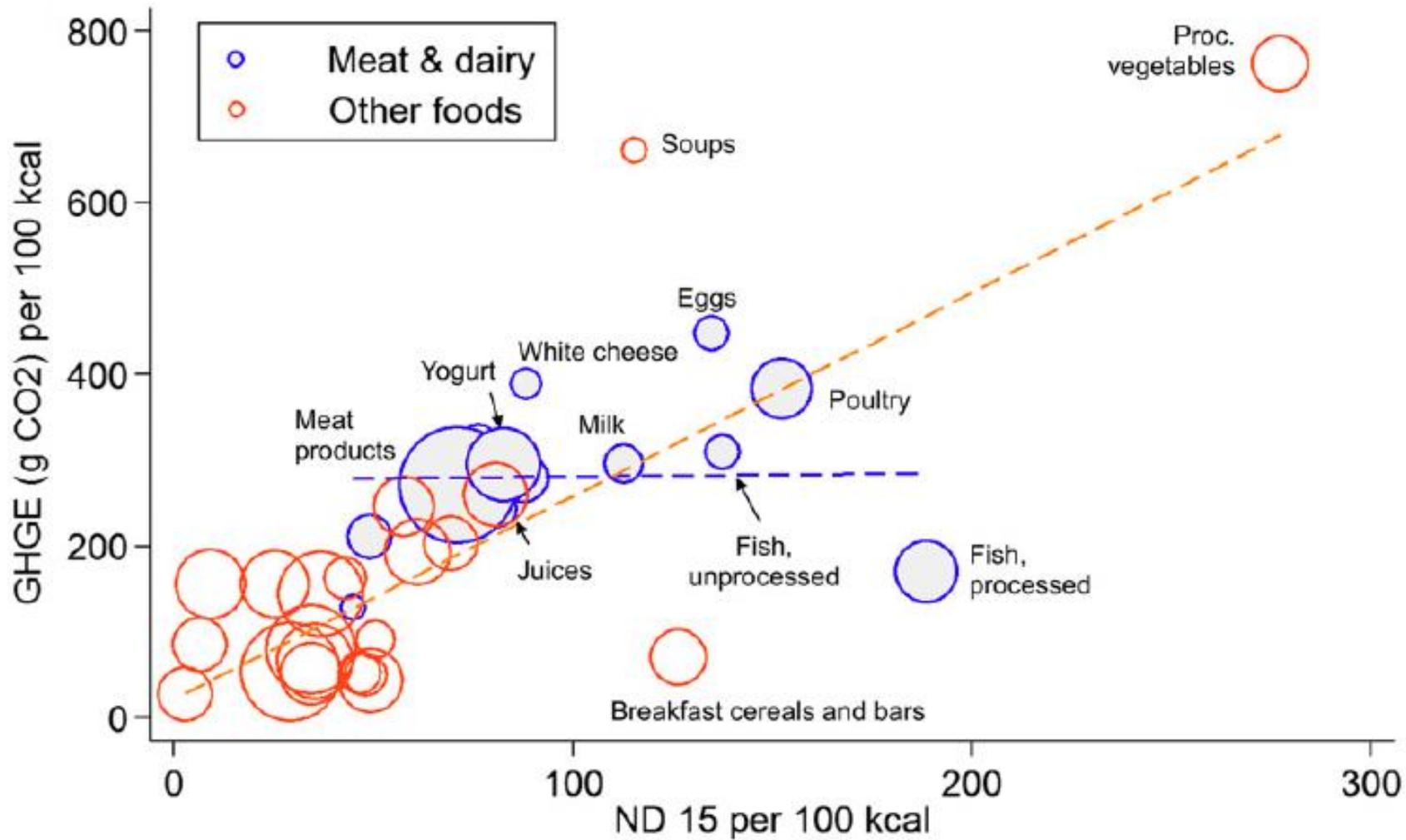
DEVENISH
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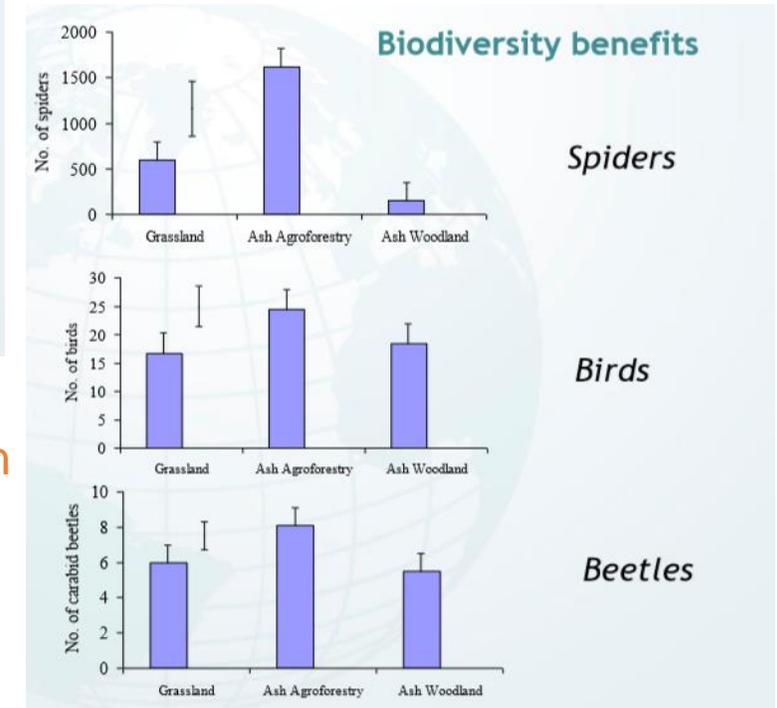
Going beyond Carbon Neutrality with Rumen Methane Reduction?

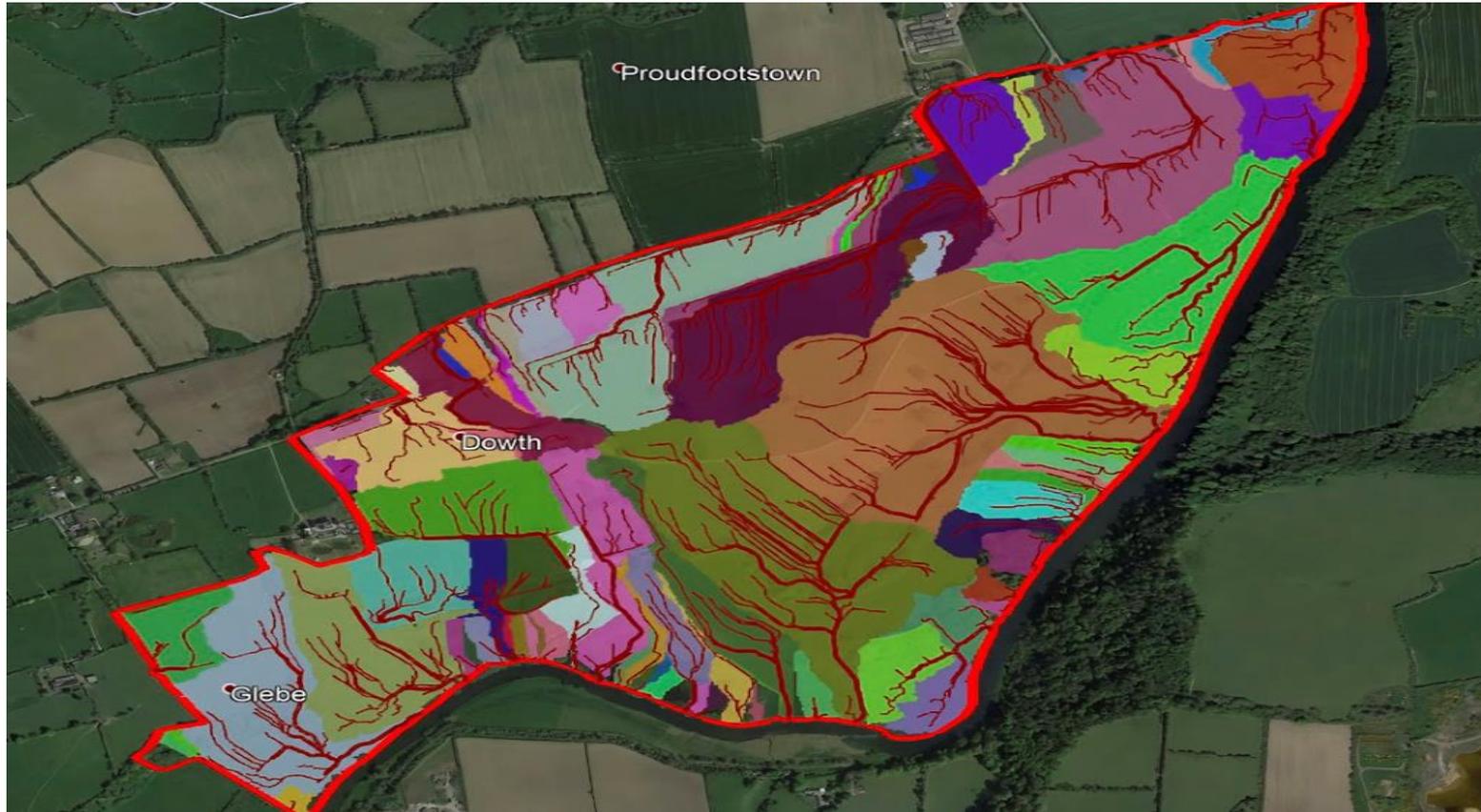Findings of the NLMP Research Program

Methane mitigation research priorities
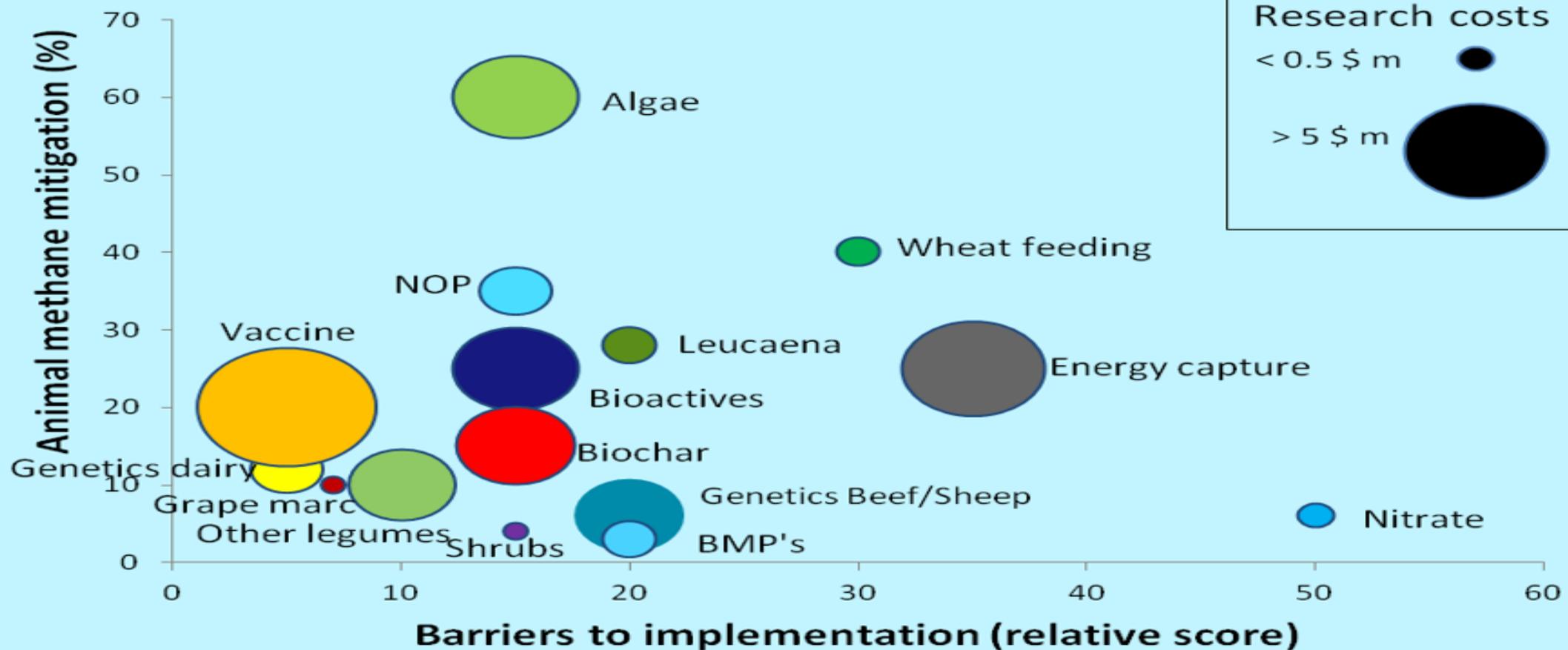
Drewnowski et al. Energy and nutrient density of foods in relation to their carbon footprint. Am J Clin Nutr 2015;101:184–91.

Improving Water Quality.....

80% of Phosphate enters water course through "Over Land Flow!"

2018 – Digital analysis of LiDAR surveys allowed individual Watersheds to be identified

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Landscape Solutions to Capture "Overland Flow" of Dirty Water

Planting "Over Land Flow" Pathways with Woody Riparian Strips to catch Phosphate
Harvesting Wood every three years to mine Phosphate back out of the Riparian Strip
The use of resultant wood as Renewable fuel; while creating a new Habitat

J. Gilliland 2012
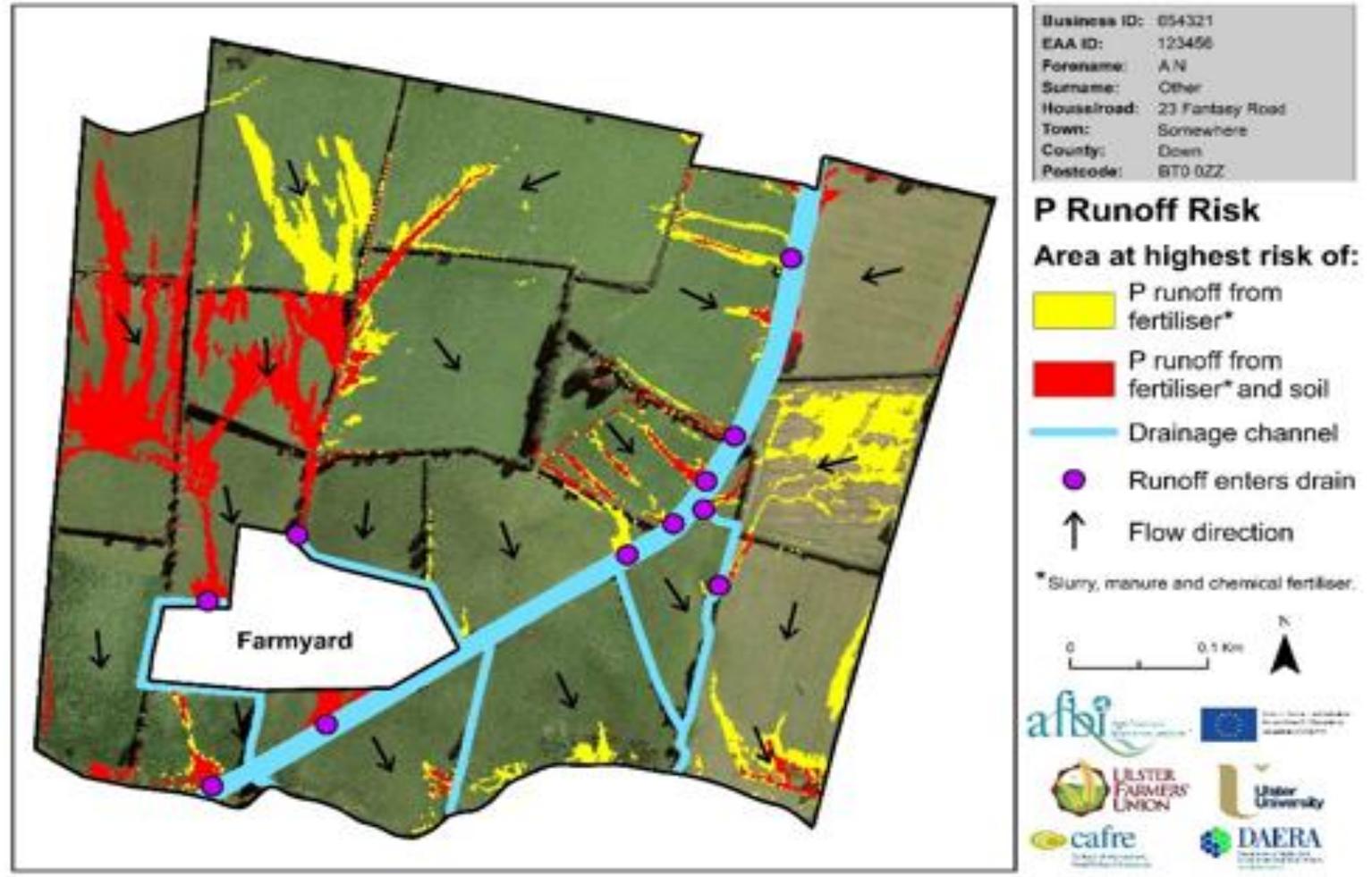
International Credibility Essential
Selected as a Wageningen University Research, International Lighthouse Farm

Access to World Class Researchers, Masters & PhD Students
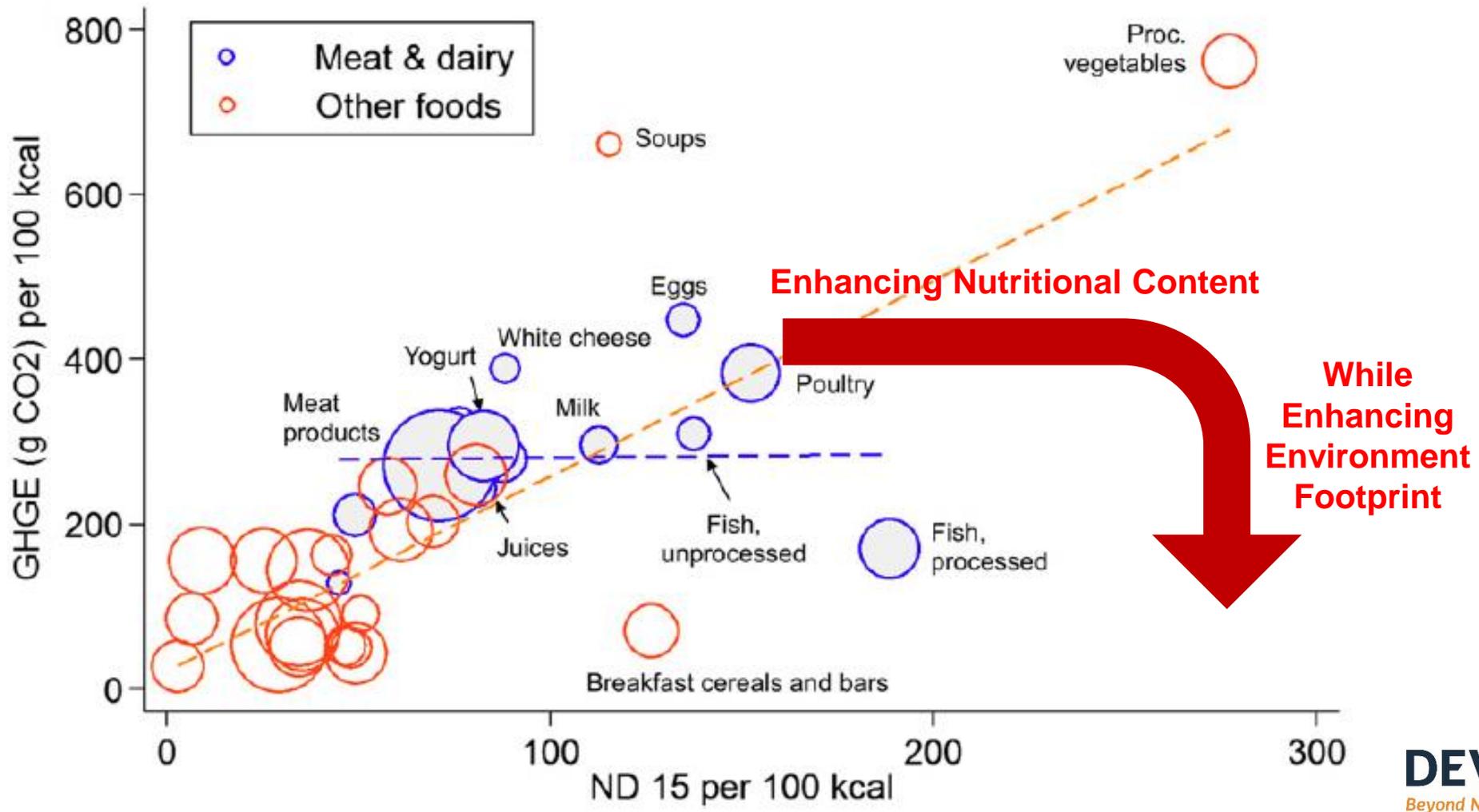
Partnership in Research bids
- **Heartland**
- **SRUC PhD, Verification & Acceptance of Carbon Solutions**
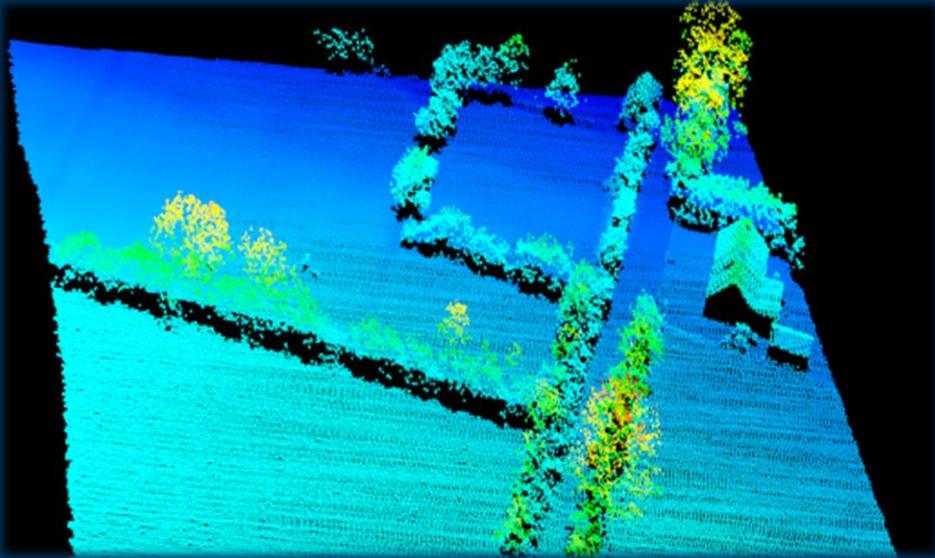
Selected to present to Dutch Royal Couple, jointly

International Credibility Essential

Bringing **exemplar farms** into the classroom

Designing sustainable farms using **Augmented Reality**

WAGENINGEN UNIVERSITY & RESEARCH

in partnership with:

Ministry of Foreign Affairs of the Netherlands

DEVENISH Beyond Nutrition

Website: https://www.wur.nl/en/Research-Results/Chair-groups/Plant-Sciences/Farming-Systems-Ecology-Group.htm

A New Vision for Agrifood.....

Drewnowski et al. Energy and nutrient density of foods in relation to their carbon footprint. Am J Clin Nutr 2015;101:184–91.

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Thank you

Any questions?

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