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Optimising Nutrient Use Efficiency

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

afbi AGRI-FOOD & BIOSCIENCES INSTITUTE

NIEA

Tonight's Presentations

Ronan Coll (CAFRE):

Innovative Technology to Optimise Nutrient Use Efficiency

Richard Kane (TDF Farmer):

Efficient Nutrient Technology

Ciaran Hamill (CAFRE):

Nutrient Use Efficiency – Beef & Sheep Farm Perspective

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Point View Farms
Richard Kane
Seaforde, Co Down

Efficient Nutrition Technology Demonstration Farm

POINTVIEW FARMS

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

rural Development Programme

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

Business Development Groups are part of the NI Rural Development Programme and are part funded by the European Agricultural Fund for Rural Development

Farm profile

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Farm/Family History

- Purchased 60ac where the farmyard is 1983
- Contracted the same land before hand.
- Acreage jump in 2008 took lease of Seaforde Est

Farm size

- Own 549 ac
- Rent 400ac Seaforde Estates Long Term Lease
- Contract Farm 60ac

Enterprise Details:

Crop	Acres
W. Wheat	278
W .Barley	260
S.Barley	37
OSR	94
W. Oats	94
Potatoes	64
Silage/hay	101
Contract farming	60
Woodland	18
Total	1009

Farm Structure

- Mainly plough based, OSR going in min till this year
- Operate a high input strategy
- Variable costs about 1/3 of the total costs to the business
- Rotation W.Wheat, W.barley, S.barley break crop (inc oats, potatoes, OSR)
- Stubble turnips for grazing
- Organic manures only on spring cropping and W. OSR.
- Minimal staff-seasonal workers
- Well mechanised

Nutrient Planning-why change?

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- Attended Cereal challenge and early BDG meetings talking about soil and in particular pH.
- 500kg of lime (NV50) per acre per year when using arable N levels.
- Treat lime as a yearly input
- Concept started with the thought of applying lime not to soil analysis but to offtake.
- Wanted to identify and correct variation of whole field(s) not only a field average

Nutrient Management Plan

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Started to investigate options for Variable rate technology on farm with the aim to:

- Reduce the blanket spread of chemical fertiliser over the total combined crop area while maintaining or improving yield.
- Reduce the 'localised' (per ha) over application of nutrients in areas where RB209 or NAP do not require any, reducing environmental impact
- Give an overall picture of the pH level of the farm on a per ha basis and target lime applications accordingly

Considered different options and decided SOYL was best fit.

SOYL provided software and an analysis service

Pointview-Soil Analysis Using GPS

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Previously soil sampled in traditional ‘W’ pattern but not giving whole field profile

1. KORA app used to mark out field boundary.
2. Soil sample field(s) using GPS to map precise location of each sample point.
3. Can add in extra samples to grid if needed
4. Approx. 16-24 cores in a 10-12m radius around the sample location

Soil Analysis Results

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Sample Ref FORDES LODGE FIELD
Sample No E256438/06
Crop BARLEY

Date Received 04/09/2018
Area 18.0

Analysis	Result	Guideline	Interpretation	Comments
pH	6.0	6.5	Slightly Low	Slightly low. An acidic environment will reduce soil nutrient availability and the efficiency of any applied fertilisers or organic materials. A sub optimum pH will also impact on soil microbial populations and rates of activity. Refer to lime requirement.
Phosphorus (ppm)	32	16	High	**(Index 3.3)** Adequate. Use soil analysis every 3-5 years to ensure level is maintained.
Potassium (ppm)	191	121	Normal	**(Index 2.5)** Winter Barley - 55 kg/ha K2O (44 units/acre). Spring Barley - 40 kg/ha (32 units/acre). Maintenance.
Magnesium (ppm)	107	50	Normal	**(Index 3.0)** Adequate level.
Lime Req. (t/ha)	5.0			

Nutrient Variation Maps -pH

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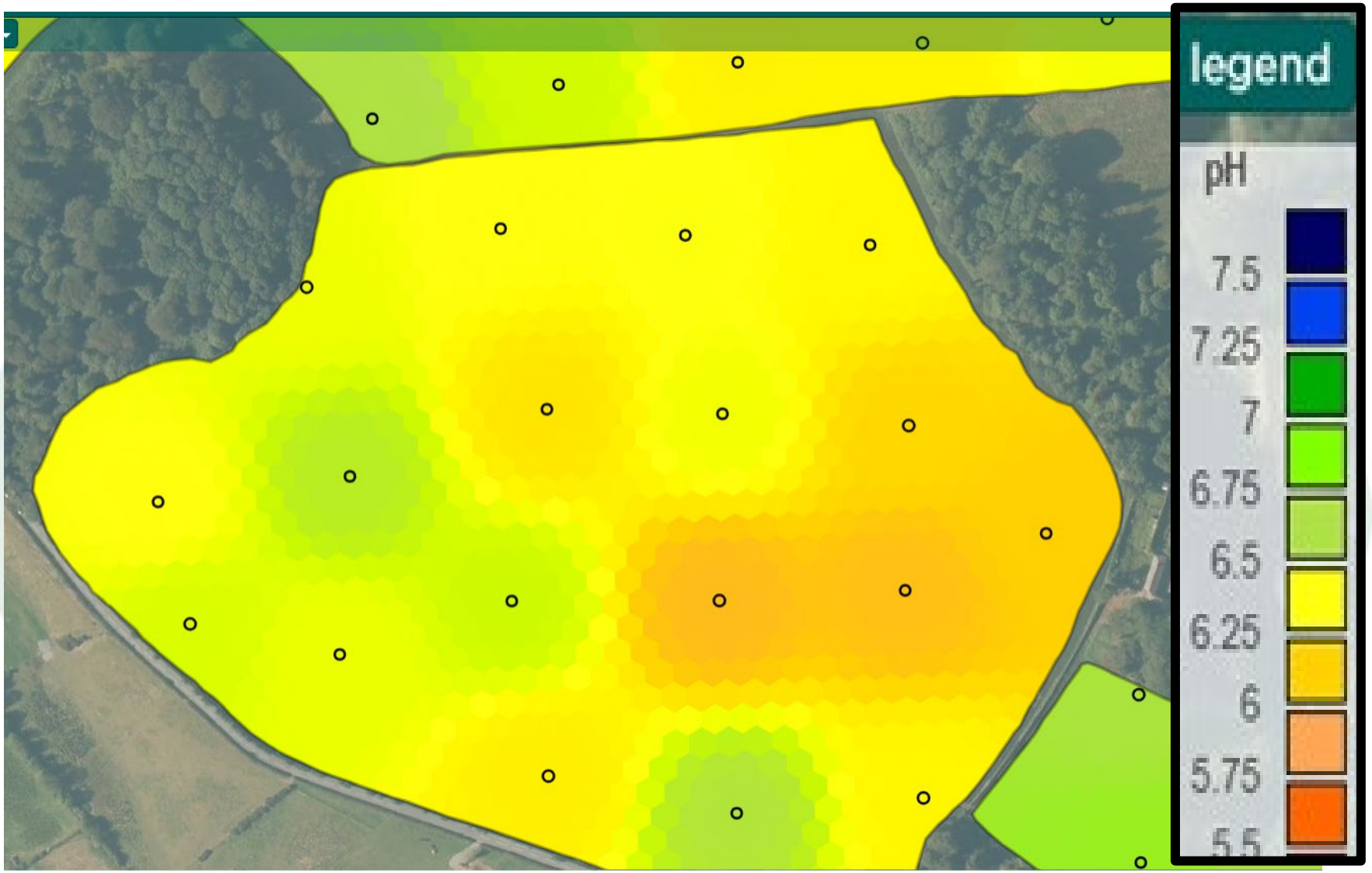
- pH range in field from 6.0 -6.95
- Target pH 6.7
- Variation in pH in field



Nutrient Variation Maps-**Phosphorus**

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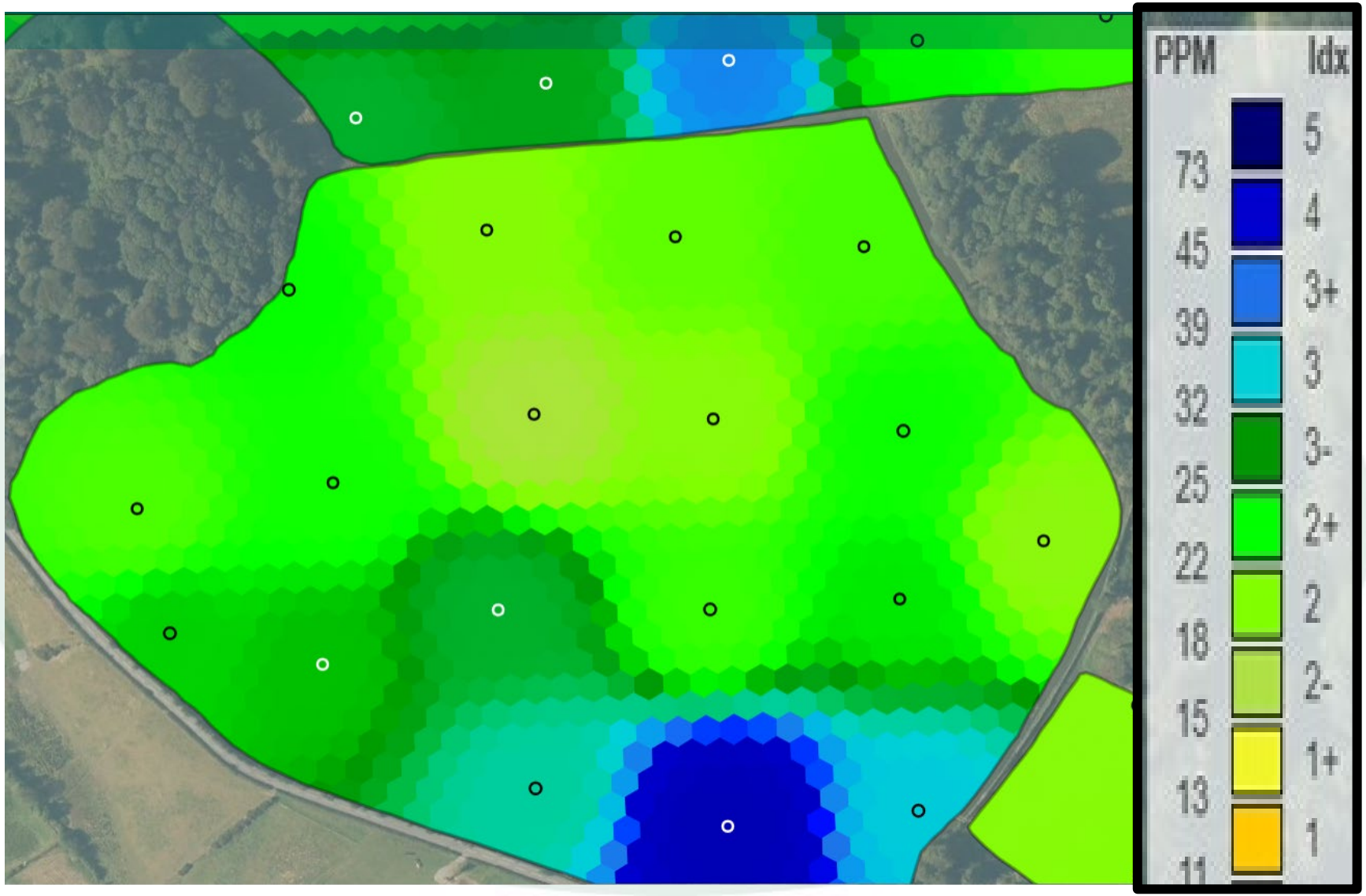
- P range in field from 18-45 PPM
- Index 2- to 4
- Target P level 2
- Variation in P in field



Nutrient Variation Maps-**Potassium**

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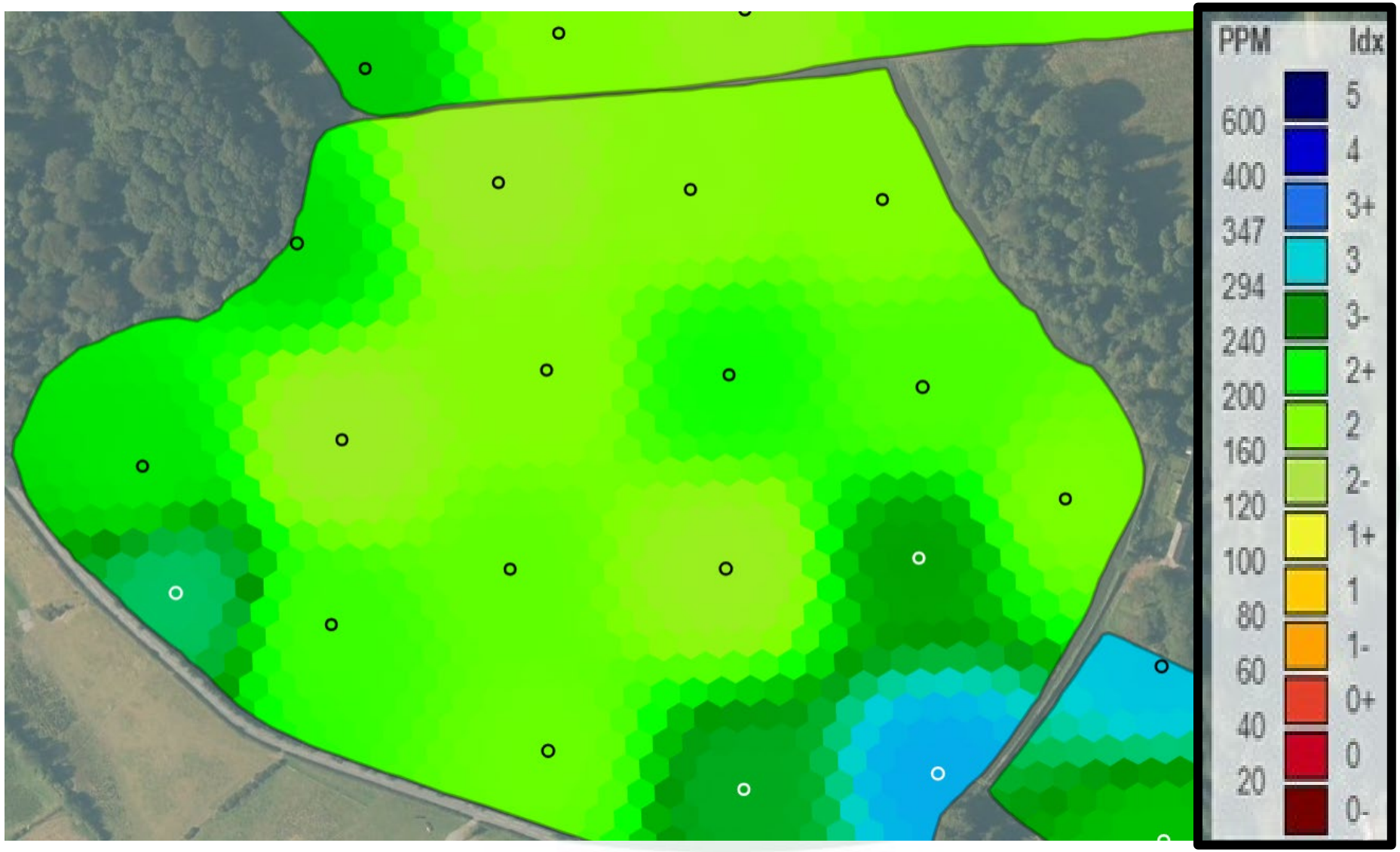
- K range in field from 18-45 PPM
- Index 2- to 4
- Target K level 2+
- Variation in K in field



mySOYL Basic

richard | Help | frontier

Crop Input Form

2018-19 | 2019-20 | 2020-21 | 2021-22 | 2022-23 | Export as a CSV file | Hide view setting

Status : In progress

Phosphorus	Yes	Farm	No	Only fields that require processing by SOYL	No
Potassium	Yes	Area	No	Only recently cropped fields	No
Magnesium	No	Sampled	No		
pH	Yes	Soil type	No	Show previous sampling data	No

Idx	Farm Name	Field Count	Incomplete Count P ...
0	Pointview Farm	40	4

	Field information			Field information	2020-21																	Ap
	-			-	-						Yield	Phosphorus				Potassium				Lime		
	Field name	P...	Recent ...	Notes	Crop	Variety ...	Straw	Plough...	Ded...	Goal	Prev appli...	Fre...	Prod.	Targe...	Prev appli...	Fre...	Prod.	Targe...	Prod.	Targe...	Ap
✓	Yard Field				Winter Barley		Removed (	Plough		10	yes	A	DAP	2	yes	A	MOP	2+	Ca Lime	pH6.7(m	
✓	5 Acre				Winter Wheat		Removed (	Plough		11	yes	A	DAP	2	yes	A	MOP	2+	Ca Lime	pH6.7(m	
✓	Barn Hill				Winter Wheat		Removed (	Plough		11	yes	A	DAP	2	yes	A	MOP	2+	Ca Lime	pH6.7(m	
✓	Church Field				Winter Wheat		Removed (	Plough		11	yes	A	DAP	2	yes	A	MOP	2+	Ca Lime	pH6.7(m	
✓	Corner Field				Winter Wheat		Removed (	Plough		11	yes	A	DAP	2	yes	A	MOP	2+	Ca Lime	pH6.7(m	
✓	Cow Patch				Winter Wheat		Removed (	Plough		11	yes	A	DAP	2	yes	A	MOP	2+	Ca Lime	pH6.7(m	
✓	Cricket Field (Fordes)				Winter Wheat		Removed (	Plough		11	yes	A	DAP	2	yes	A	MOP	2+	Ca Lime	pH6.7(m	
✓	Flat/Big Field				Winter Wheat		Removed (	Plough		11	yes	A	DAP	2	yes	A	MOP	2+	Ca Lime	pH6.7(m	
✓	Grays				Winter Wheat		Removed (	Plough		11	yes	A	DAP	2	yes	A	MOP	2+	Ca Lime	pH6.7(m	
✓	Kiln Field				Winter Wheat		Removed (	Plough		11	yes	A	DAP	2	yes	A	MOP	2+	Ca Lime	pH6.7(m	
✓	Lodge Field				Winter Wheat		Removed (	Plough		11	yes	A	DAP	2	*yes*	A	MOP	2+	Ca Lime	pH6.7(m	
✓	Lurgan				Winter Wheat		Removed (	Plough		11	yes	A	DAP	2	*yes*	A	MOP	2+	Ca Lime	pH6.7(m	

Prescriptions

The prescriptions in type of .RX files were then emailed and imported into the tractor GPS Isobus terminal

Lodge Field				LOFLD			Calc. Area = 17.72			Soil Type = Standard Mineral			
2020	Winter Oats						Straw removed			Yield goal = 8			
Nutrient	PPM			Index			Kg/Ha Product			Target Index	Frequency	Fertiliser Tonnages	
	Max	Avg	Min	Max	Avg	Min	Min	Avg	Max				
Potassium	342	207	154	3	2+	2-	118	207	223	s 2	Annual	**MOP**	**3.67**
Phosphorus	59	26	17	4	3-	2-	0	85	153	s 2	Annual	**DAP**	**1.51**
pH	6.6	6.3	6.0				2000	3027	5360	pH6.7(n	Triennial	**Ca Lime**	**53.65**

Lodge Field				LOFLD			Calc. Area = 17.72			Soil Type = Standard Mineral			
2021	Winter Wheat						Straw removed			Yield goal = 11			
Nutrient	PPM			Index			Kg/Ha Product			Target Index	Frequency	Fertiliser Tonnages	
	Max	Avg	Min	Max	Avg	Min	Min	Avg	Max				
Potassium	342	207	154	3	2+	2-	123	196	218	2+	Annual	**MOP**	**3.47**
Phosphorus	59	26	17	4	3-	2-	0	152	167	2	Annual	**DAP**	**2.69**
pH	6.6	6.3	6.0				0	0	0	pH6.7(n	Triennial	**Ca Lime**	**0.00**

Prescriptions

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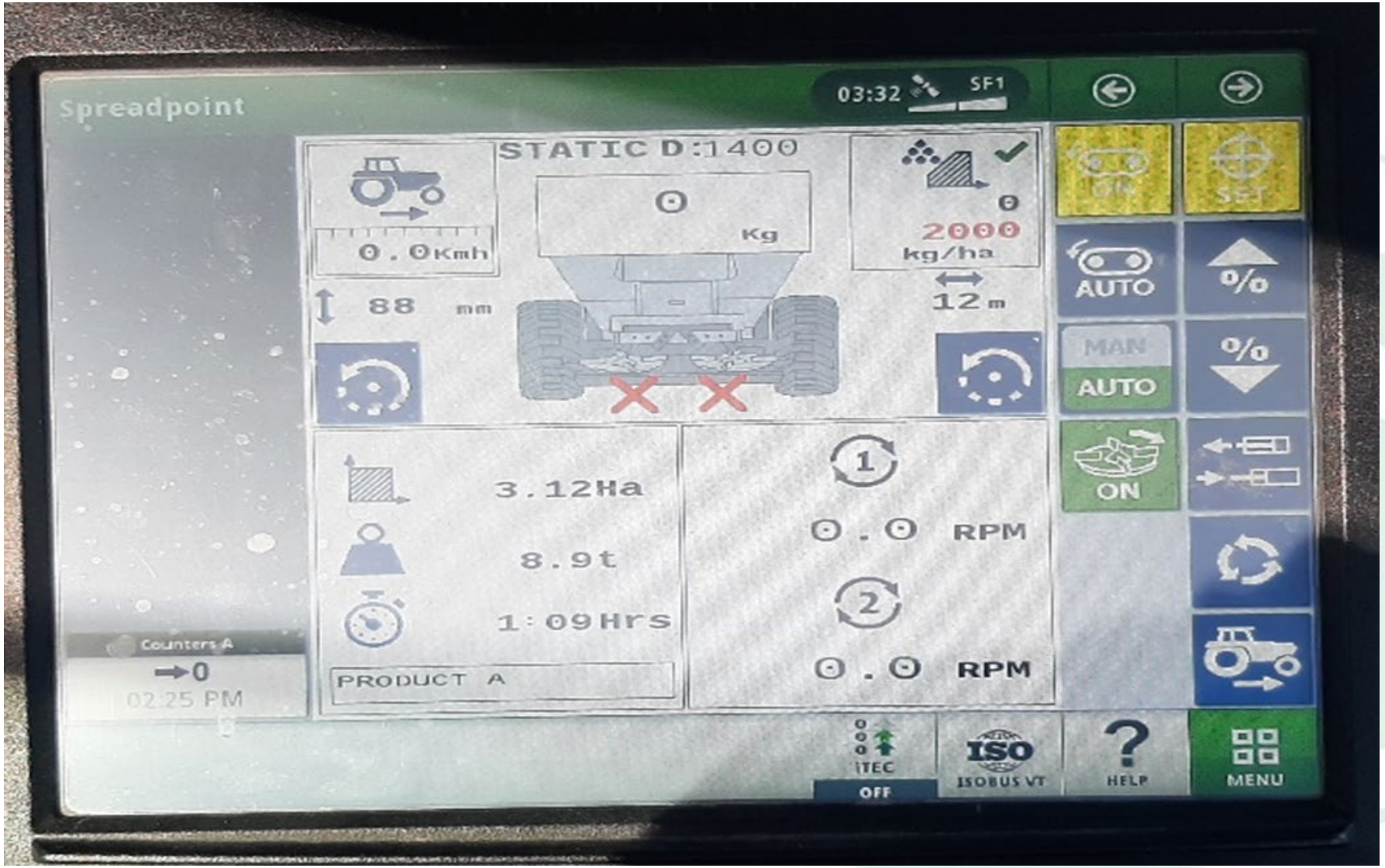
- These prescriptions allow the GPS to determine the exact application of the material being spread at the exact position.
- The GPS will not allow the operator to apply the wrong prescription in the wrong field
- The actual application was then recorded by the machine for future traceability


Spreadpoint
03:32
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1
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2
0.0 RPM
Counters A
0
02:25 PM
iTEC
OFF
ISO
ISOBUS VT
HELP
MENU

Costs

- Cost of SOYL service set up
- Soil sampling
- Annual subscription fees etc
- Capital investments

Savings??

Summary

- The use of VRT to match the variable nutrient availability to crop requirement

- Potential to reduce chemical fertiliser applied??

Targeted applications =
- increase yield on ‘poorer’ parts of each field
- less environmental impact.

- Profitability

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Questions?

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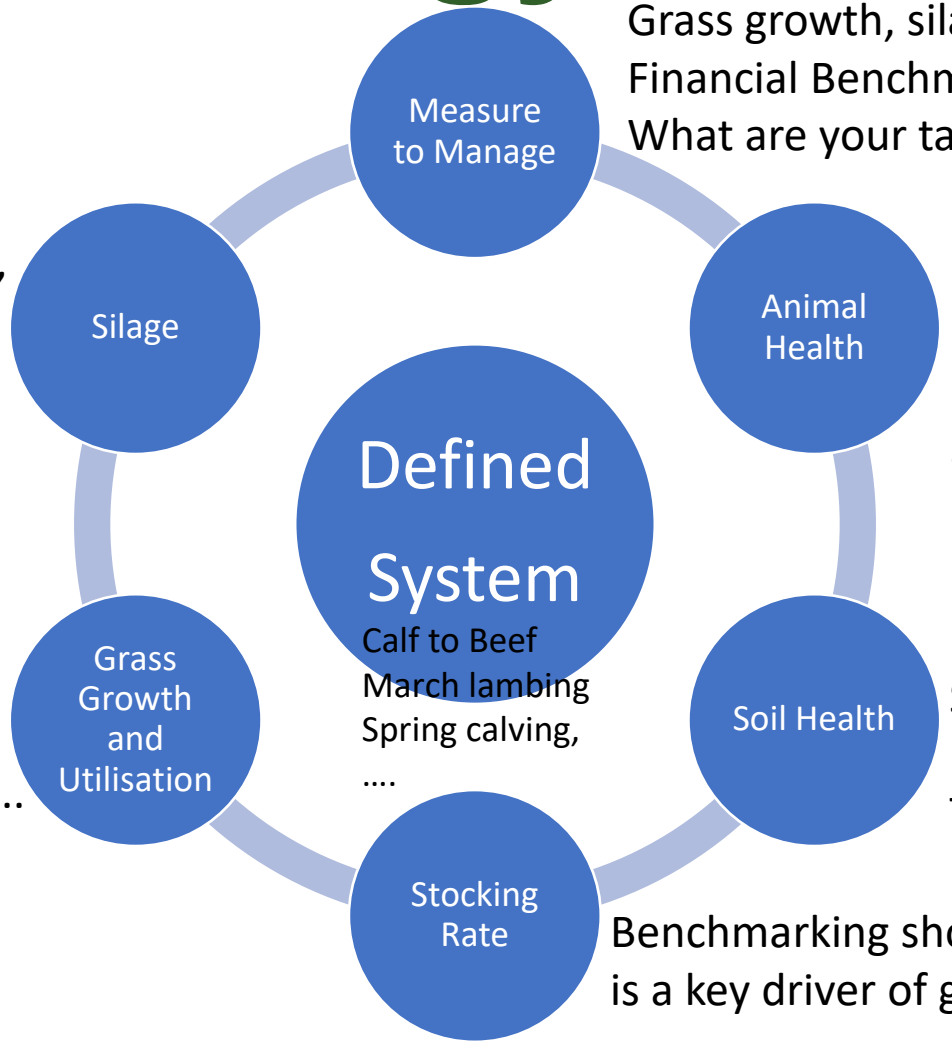
Nutrient Use Efficiency

Beef & Sheep farm perspective

Ciaran Hamill
Senior Beef & Sheep Adviser

Technology Transfer



Grass growth, silage analysis, soil analysis, animal weights, …
Financial Benchmarking
What are your targets?

Health Plan
Housing
Rotate grazing blocks
Nutrition
…

- Have a system
- Understand the building blocks
- Attention to detail
- Measure and manage

Soil Analysis
Nutrient Management Plan
Timing of nutrient application

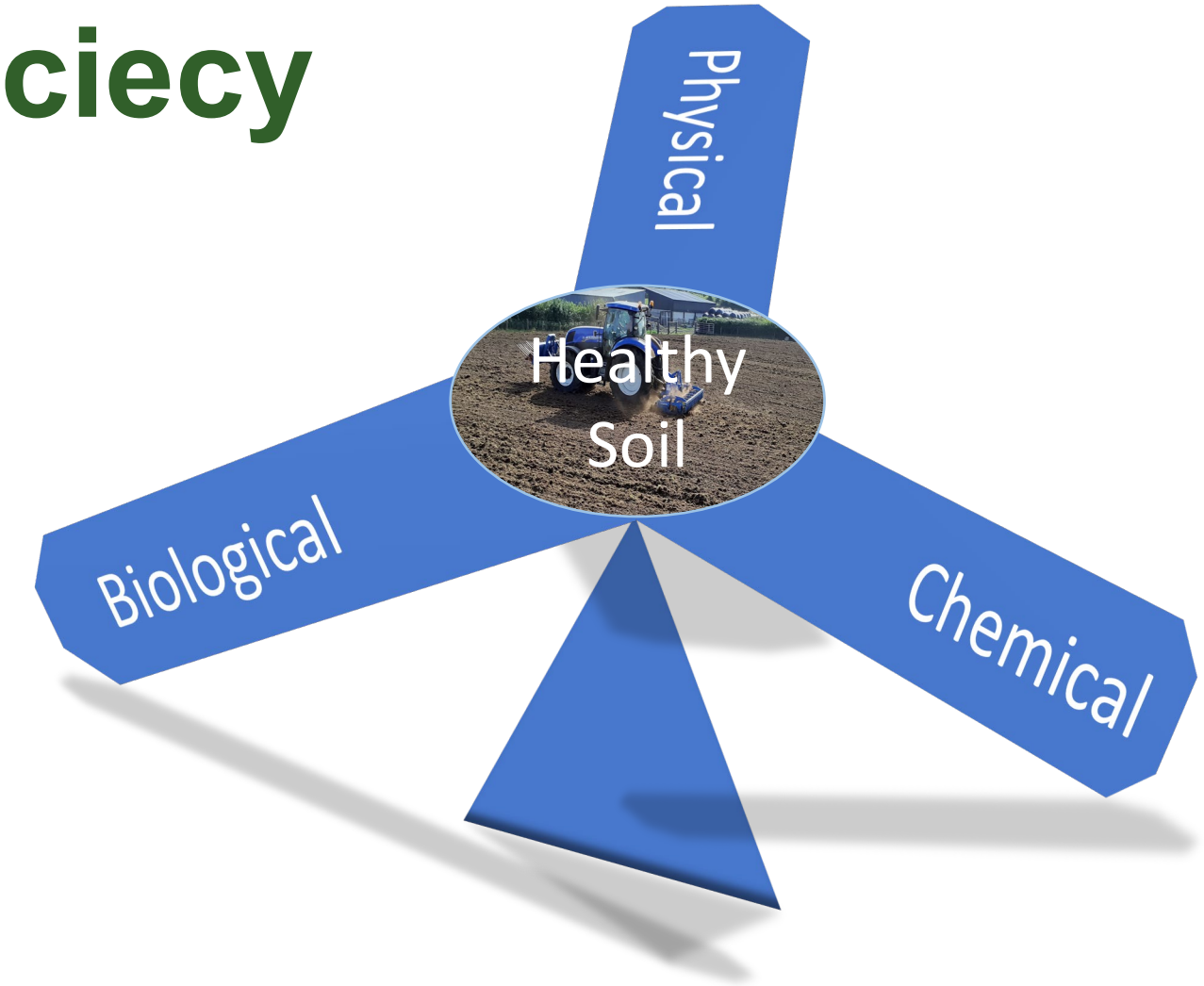
Benchmarking shows stocking rate is a key driver of gross margin

Sward composition and potential
Grazing system
Fencing, water, access, …..
Flexibility

Quality
Timing – Fertiliser, cutting, wilting, ..
Attention to detail

Nutrient Use Efficiecy

- Soil
- Sward
- Nutrients
- Grazing system
- Silage



Technologies used

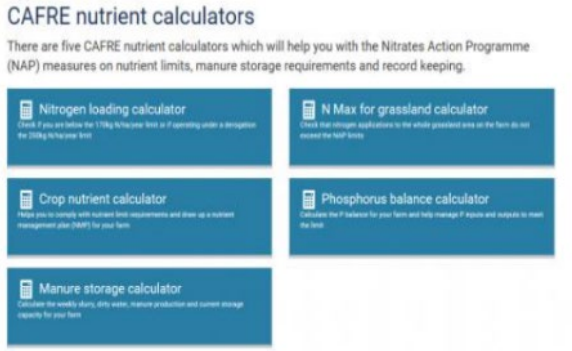
Soil analysis

Grass plate meter

AgriNet software package

Weather station

LESSE Slurry spreading – Dribble bar (Contractor)



CAFRE Nutrient Calculator

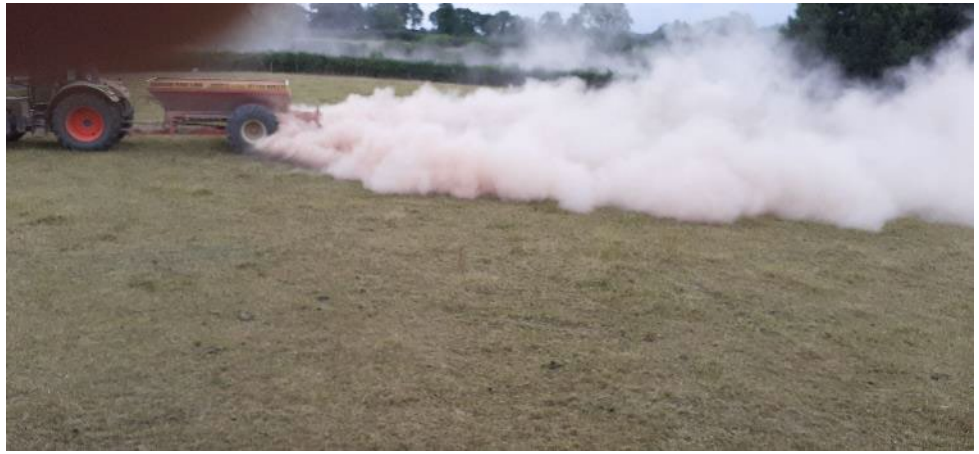
EID weighing scales

SOIL

type
physical state,
nutrient status
Inputs / offtake
Input source
- fertiliser
- slurry
- digestate
- others….

Offtake
- how
- when
- how much

	Soil pH	P	K	P	K	P2O5 Kg/ha	K2O Kg/ha	Lime Te/ha
	6.3	3	2-	36.4	171	0	0	0
	6.6	3	2+	28.0	194	0	0	0



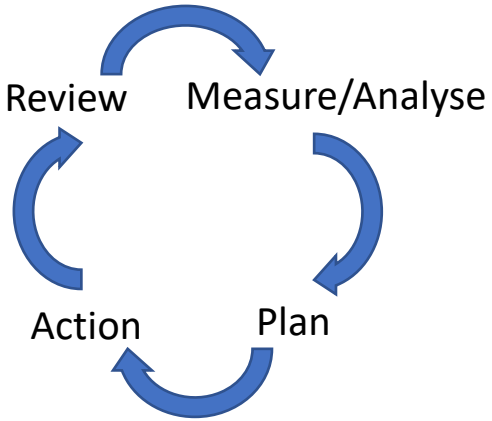
Soil nutrient management

pH	P Index	K Index
6.0	1.0	1-2

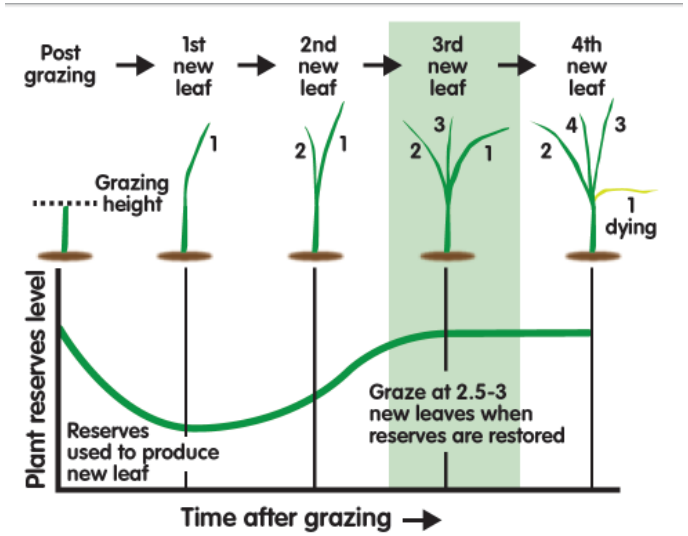
- Soil type: e.g. Light loam on mostly very free draining land / heavy clay / peaty / …..
- Fields sampled every 3 - 4 years
- Liming Plan Developed e.g.
  - 2T/acre at reseeding / 2T/acre after 5 years (half way between reseeds)
- CAFRE Nutrient Calculator - Field specific plan
- N Loading 2021: 142 kgN/ha / 165kgN/Ha / 190 ..
- 6% Dairy Cow Slurry Imported / Digestate import / Pig slurry import /…….

4R's - Right source, Right rate, Right time, Right place

Grass



- Type/variety,
- age,
- consistency,….
- grass, clover, MS, forage

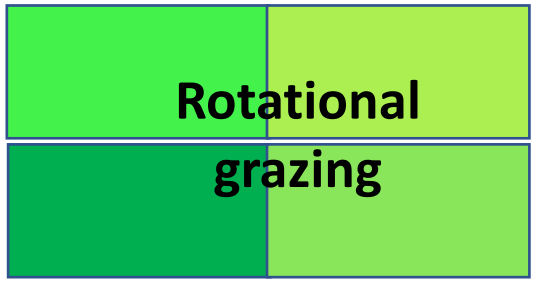


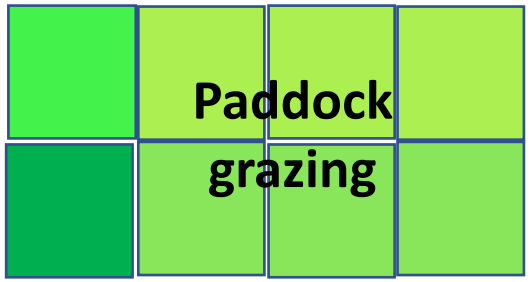
Grass - plus.....

Reseeding

Reseeding

Grazing strategies adopted on beef farms





Strategy	Annual yield (t DM/ha)	Utilization (%)	Useable yield (t DM/ha)	Percentage increase
Set stocking	6.0	50	4.3	
Rotational	10.2	65	6.6	+56%
Paddock	10.2	80	8.2	+92%

Small investment in water troughs, electric wiring & posts and labour gives a high return on investment

Lively et al.,

Is it worth moving to daily paddocks?

Experimental treatments

Paddock system

Intensive grazing - Daily allocation (meeting supply with demand)

Benefits

Grass utilization increased by 19%

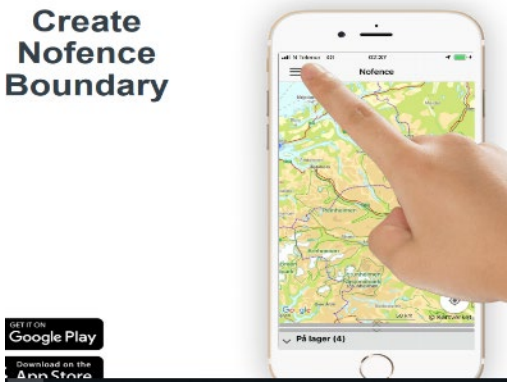
Animal production per hectare increased by 33%

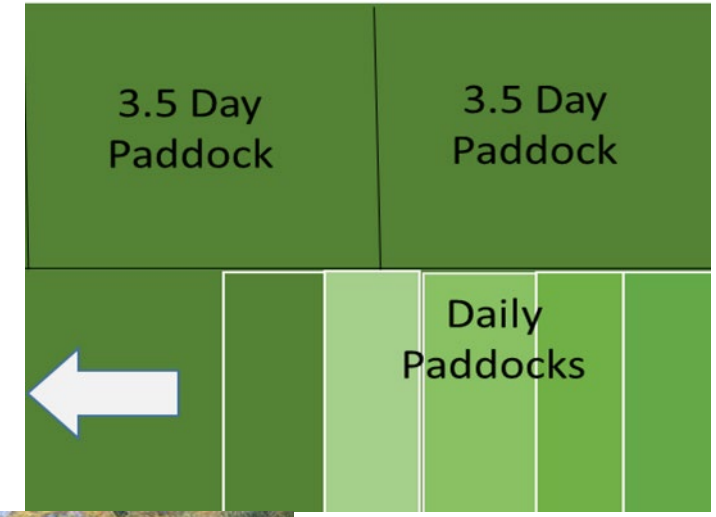
Estimated value £656/hectare

Consideration

However, increased labour demand

Virtual fencing





Paddock grazing

Pros	Cons
Highest grass production and use	Initial cost of fencing and water troughs
High quality grass & higher stocking rates	More intensive management – skill required
More even manure distribution	Requires careful monitoring
Can extend grazing season	
Allows for excess grass to be cut out as silage (bales)	
Quieter/more manageable stock?	

Farm Infrastructure

- Split large areas into smaller paddocks with permanent and temporary fences
- Lane/roadway access to paddocks
- Paddocks are rectangular in shape
- Paddock size: number and type of stock / land area / fencing / water access / …..
- E.g. 0.6 – 1Ha / Average stocking rate: 2.65 LU/ha

Investment in grazing infrastructure essential to improving grassland management

Farm Infrastructure

- Alternate grazing between cattle, sheep and silage
- Reaping the benefits of clean grazing
- Water e.g. water bowsers left in a different location each grazing.
- Fencing – temp vs permanent

Investment in grazing infrastructure essential to improving grassland management

Water

Lively et al., 2007

Maximising duration at grass – spring grass

Spring grass is highly nutritious

A lot of scientific evidence demonstrating improved livestock performance by turning cattle out earlier in the spring

Lowers feed costs & ammonia emissions

	Early turn out	Late turn out	Difference
Date turned out	5 April	22 April	+17 days
Housing live weight (kg)	538	515	+23 kg
Slaughter live weight (kg)	674	666	+8 kg
Carcass value (£)	1306	1288	+£18

Grazing management - Cows and Calves

Example Farm

- Turn out stock Mid-March – House from October (Avg. 200 day grazing season)
- 20-25 cows and calves per group
- Cows on rising plane of nutrition for a 10 Week breeding season (15th May to the 1st August)
- Target mating BCS = 3.0
- Blood sample for mineral deficiency
- Target LWT gain from birth to weaning: 1.2 kg/d (Target 300 kg weaning weight)

2021
First animals Out – 27th February
Last animals in – 23rd November

Grassland Management

Example Farm

- Participant in GrassCheck for the past 5 years
- Farm grew 10.8 tonnes of grass per hectare in 2021 and still grazing
- Measures grass weekly with a rising plate meter
- All data entered on AgriNet and uses a grass wedge to make grazing decisions
- Graze paddocks for 3 days in 21 day rotation
  - Target Pre grazing covers: 2800 - 3000 (8 - 10 cm)
  - Target Post grazing covers: 1600 - 1700 (4 - 5 cm)

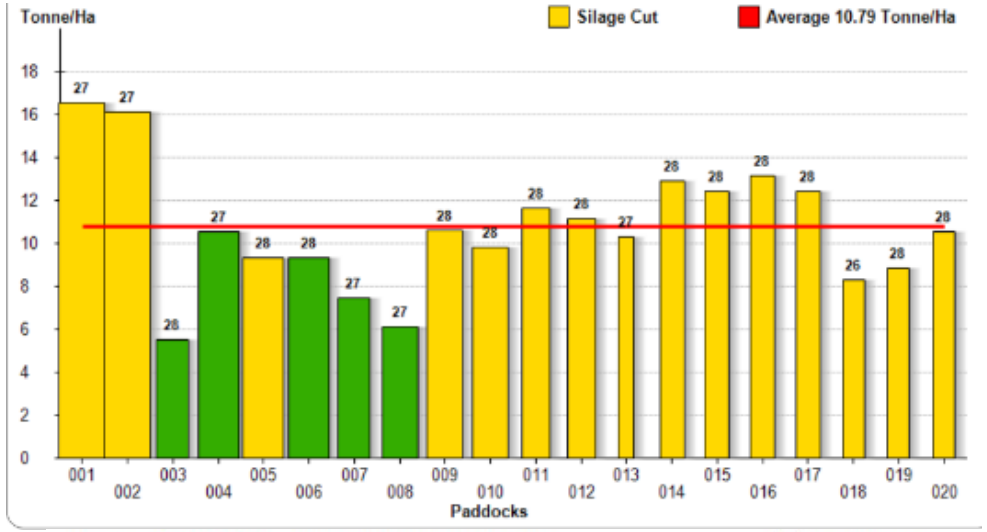
Regular measurement is key to get an accurate estimate of grass growth

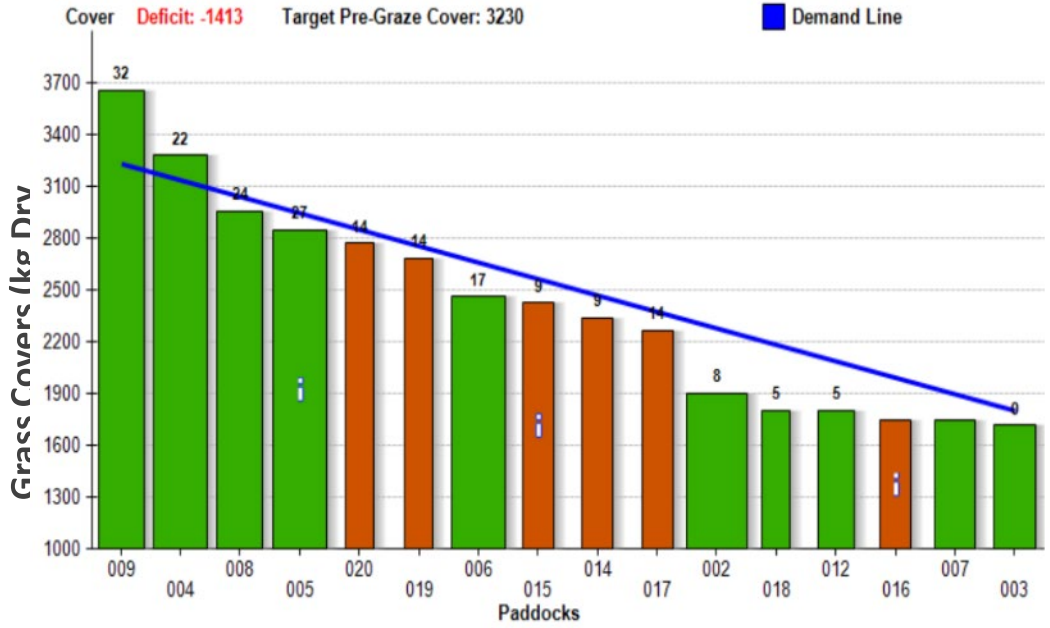
Benefits of grass measuring

- Know how much grass is grown on farm
- Improvement in grass quality

Dry matter	18 - 20 %
Crude protein (%)	18 - 22 %
ME (MJ /kg DM)	11 - 11.5

- Increase cattle performance
- Can identify best and worst performing fields
- Targeted reseeding and soil improvement





Fertiliser

Organic Manures

- Why,
- What,
- Where,
- When, and
- How…..?

Planning for Slurry…

Available Nutrients (Spring applied using LESSE)							
		kg/m^3			units @ 1000gal/ac		
Manure Type	DM %	N CS 40% PS 50% AD 40%	P 100% @ index >2 50% @ index 0-1	K 90%	**N**	**P**	**K**
Cattle slurry	6	1	1.2	2.3	**9**	**11**	**21**
Pig slurry	4	1.8	1.5	2	**16**	**14**	**18**
Digestate whole	5.5	1.44	1.7	3.96	**13**	**15**	**35**
Farm Sourced Digestate	5.5	1.74	1.65	2.52	**16**	**15**	**23**

Silage

Table 13

A general guide to the optimum input of concentrates for various types of finishing cattle (kg per day)

	Silage quality		
	Very good	Average	Poor
First cut taken	Before 25 May	1-10 June	After mid-June
Regrowth taken	6-7 weeks	8-10 weeks	Over 10 weeks
Average D value	Over 70	62-68	Less than 62
Young bulls	3.5	6.5	8.2
Heavy steers of high growth potential	3.0	6.0	7.5
Steers of lower growth potential and heifers of high growth potential	2.2	4.5	6.0
Heifers of low growth potential	1.0	2.5	3.5

(Source: R W J Steen, ARINI, Hillsborough)

Improving silage quality – what does this mean?

3 cut vs 2 cut silage system

- Less bulk but more quality
- First cut taken earlier in the season
- Shorter cutting interval (6-8 weeks)
- Faster regrowth
- Less damage to sward
- Higher silage cost

		Silage system	
		2 cut	3 cut
Date of	1st cut 2nd cut 3rd cut	7 - 12 June 13-18 August	20-25 May 3-8 July 20-25 August
Average yield of grass (t/ha)	1st cut 2nd cut 3rd cut Total	6.9 4.5 11.4	4.7 3.4 2.8 10.9
Silage 'D' value		63	71

Improving silage quality – what does this mean?

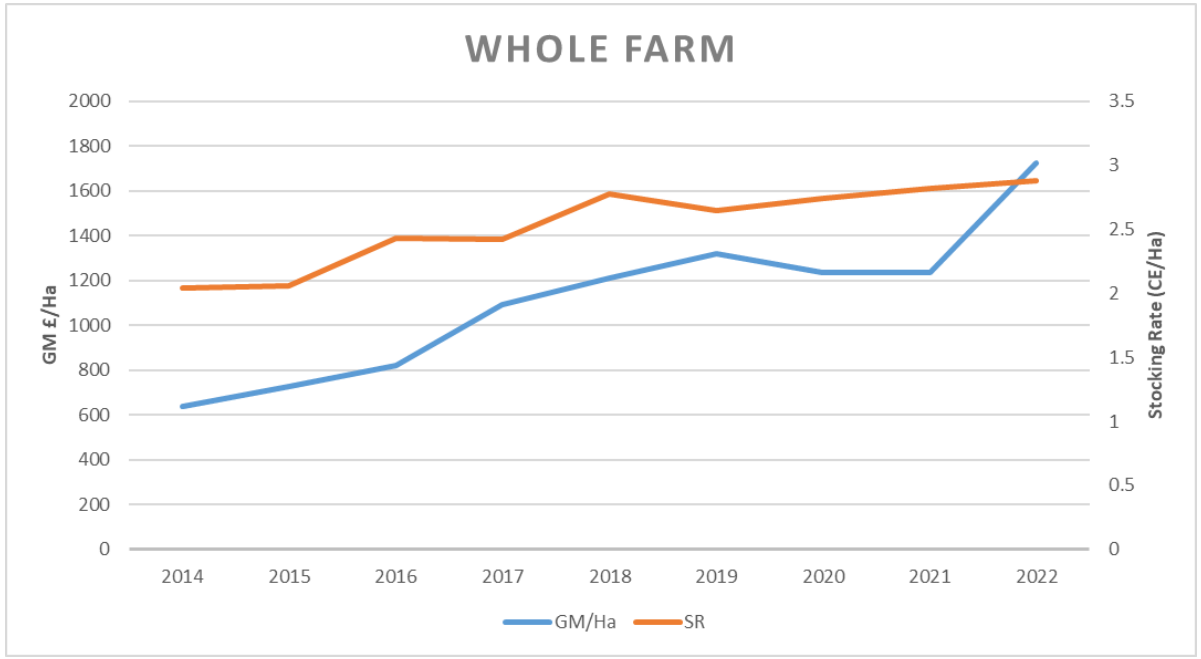
Higher quality silage means:

- Higher animal intakes
- Higher volume of silage required
- Lower concentrate requirements
- More profit for the farmer

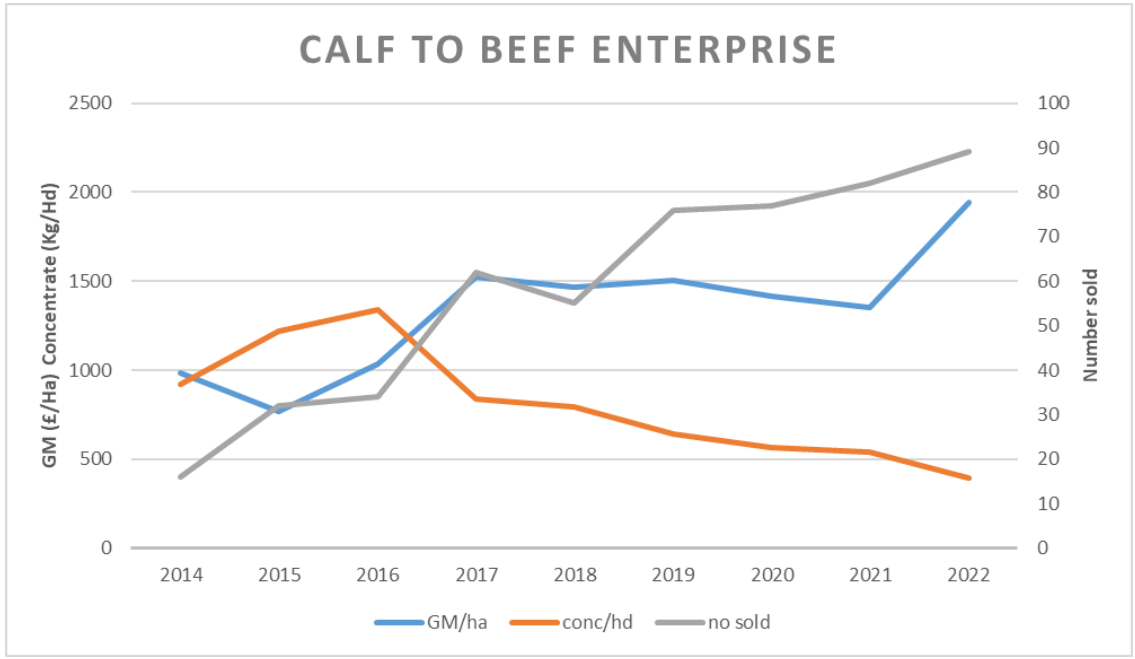
Improved grassland management within grazing systems could free up land for higher quality silage production to reduce concentrate requirement

	Silage system		
	2 cut		3 cut
Concentrate intake (kg/day)	2.5	5.0	2.5
Silage dry matter intake (kg/day)	6.3	5.3	6.9
Carcass gain(kg/day)	0.54	0.76	0.76
Daily feed cost (£/day)	1.46	1.93	1.67
Carcass value (£/kg)	2.00	2.81	2.81
Feed cost – carcass value (£/day)	**0.54**	**0.88**	**1.14**
Feed inputs for 100 cattle			
Silage area required (ha)	10.1	8.5	11.3
Concentrate required (tonnes)	40	80	40

Efficient / Sustainable Production



BENCHMARK –
Increase stocking rate and Gross Margin (£/Hectare) without increasing inputs



BENCHMARK –
Reduce concentrate use while increasing GM/Ha and numbers sold

Grow grass efficiently and use it effectively

Summary

The best place to manage grass is in the field:

- Pay attention to above and below the surface - monitor soil health / grass growth
- Manage Nutrients – input / offtake
- Manage Grazing – Use a rotational paddock grazing system
  - Out earlier, in later
- Measure and manage - animal and paddock performance
- Make better silage…..
- Use appropriate technology – electric fence, soil analysis, Plate meter, AgriNet, CAFRE Nutrient Calculator, GrassCheck, GPS, GIS,…

Department of Agriculture, Environment and Rural Affairs
www.daera-ni.gov.uk
rural Development Programme
cafre College of Agriculture, Food & Rural Enterprise
'The European Agricultural Fund for Rural Development: Europe investing in rural areas'.

Summary

- Use products in the way they are designed to be used, backed by evidence,…
- Trust and focus on the science
- Your farm is not like anyone other farm
- Journey vs destination