Emerging PA Technologies to reduce nitrogen leaching. The next 8 years

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Presented on behalf of the Precision Ag team at Massey.

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Postgraduate Students: Sue Chok, Pip McVeagh, Tommy Cushnahan, Megan Cushnahan, Istvan Hajdu, Federico Duranovic, Golden Jiang, Theresa Pepperill, Joel Mackereth.

Introduction

Looking at this issue from a point of view of nutrient use efficiency rather than regulatory compliance.

Regulatory compliance takes no real account of efficient effective farming.

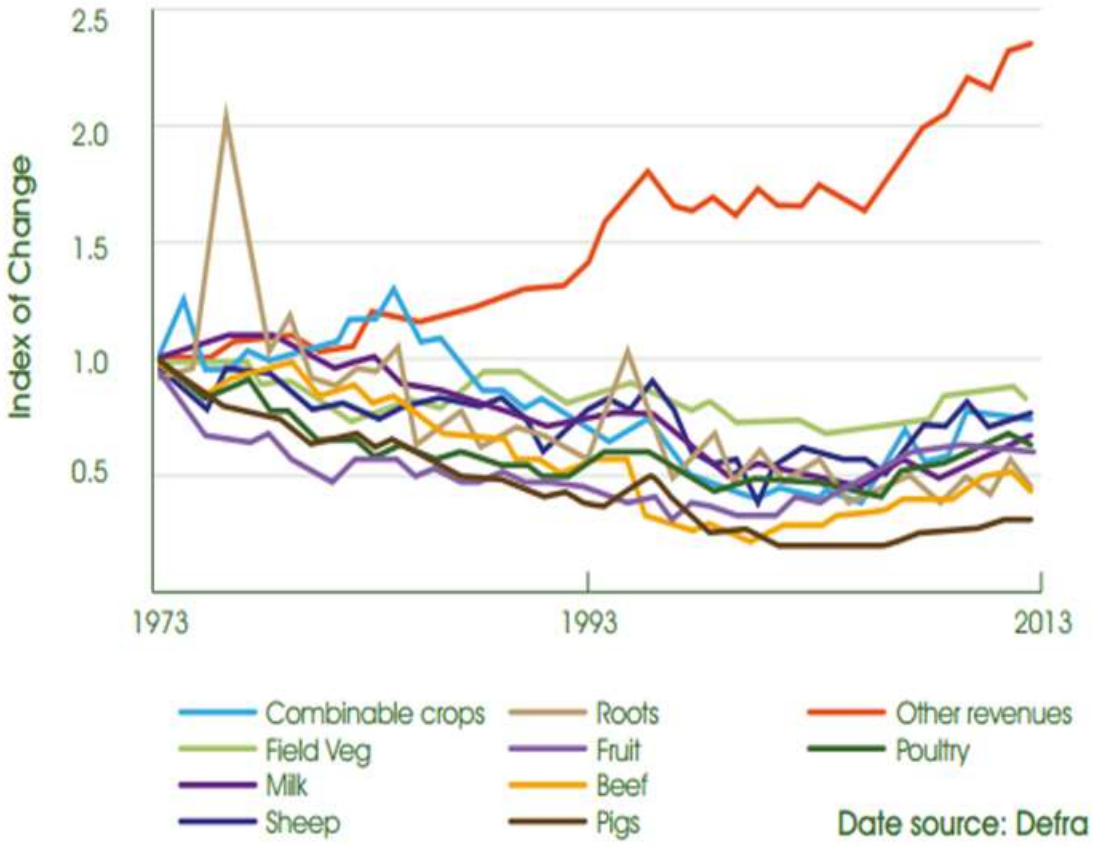
Regardless of what farming system we are using the time is right to take a pretty careful look at our farming operations.

The key messages I want to bring are:

Greater attention to detail to make sure we get things right.

Greater effort in measuring performance.

Indexation of output in real terms

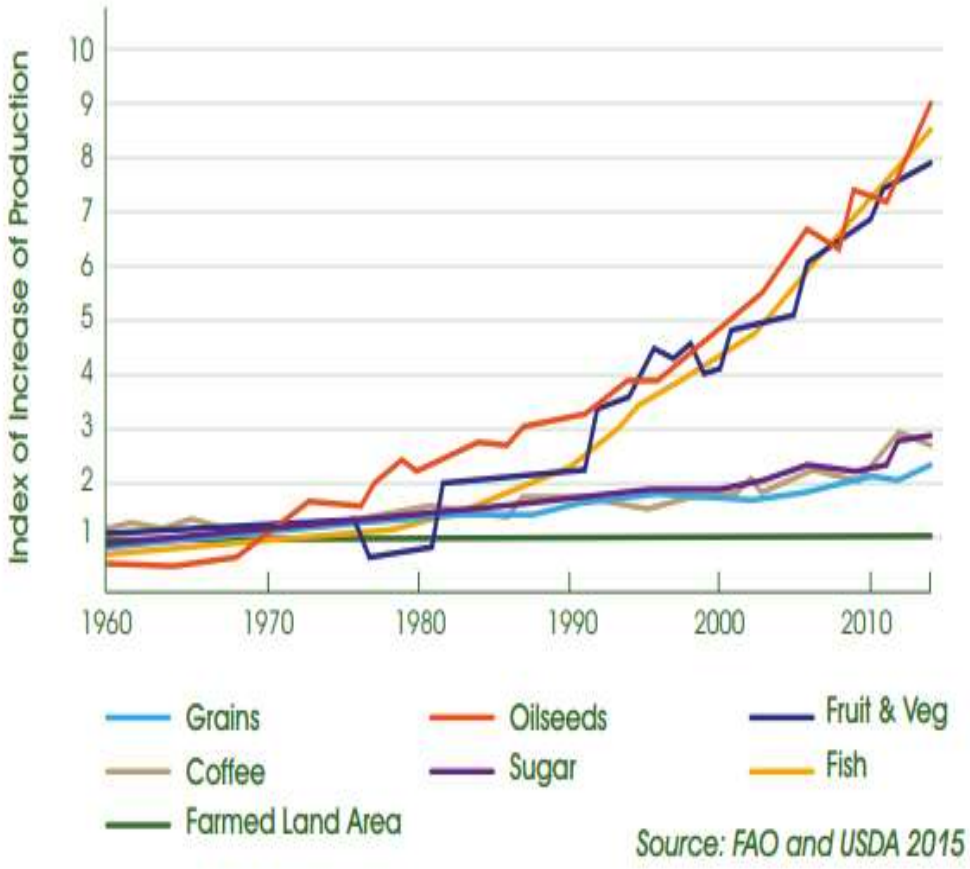


All major agricultural commodities are in oversupply in world market.

Continued downward pressure on prices.

(Source Oxford Farming Conference 6 – 8 January 2015)

Performance and economic background



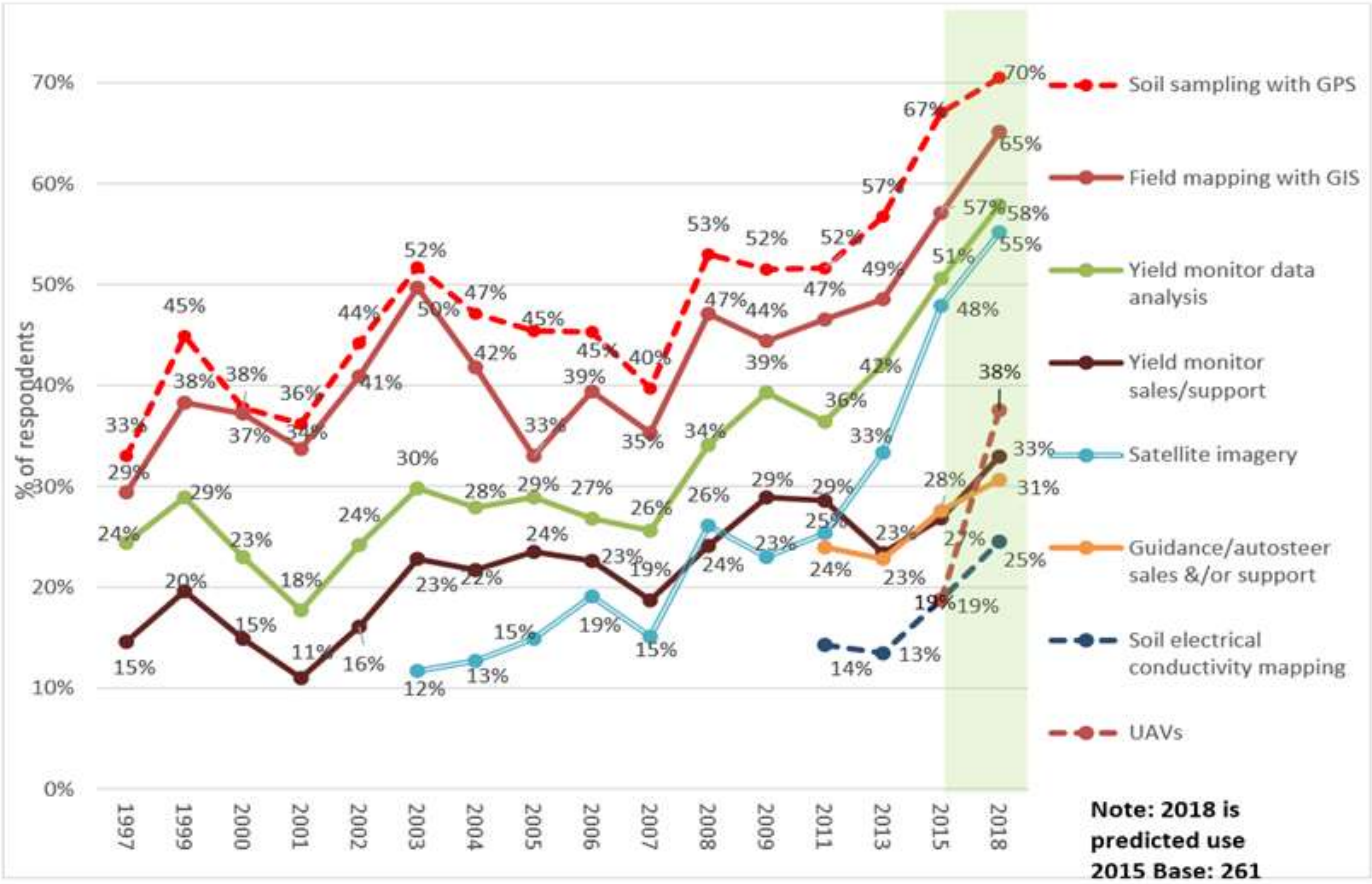
But since the sixties, land area used for agriculture has only increased by about 5% but production has double in the case of grains, tripled in terms of coffee and sugar and increased ten fold in oilseeds, and fruit and vegetable crops.

Interesting how output of fruit and veg and oilseed has increased so much yet they have followed similar pricing trends.

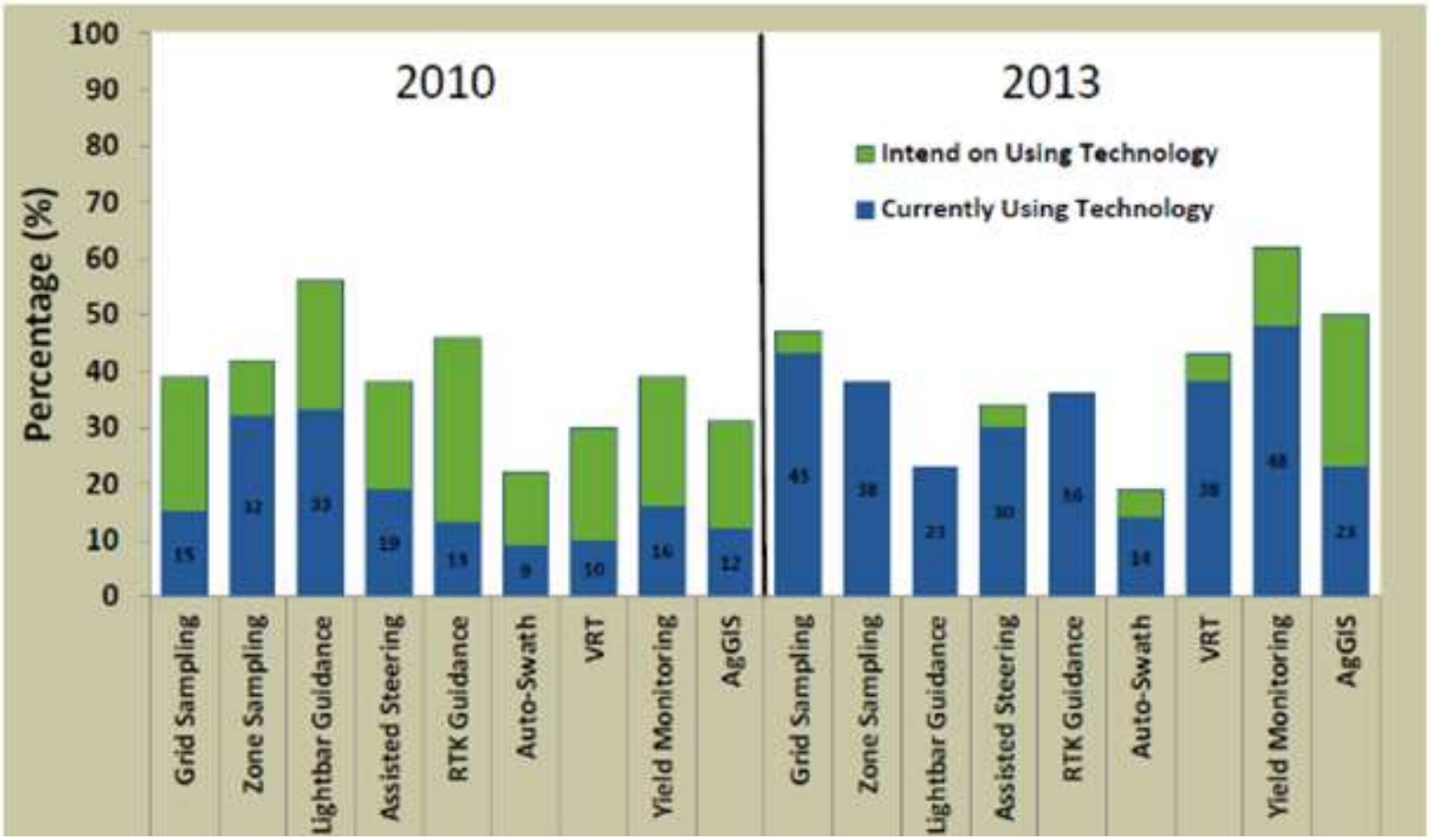
Global Growth of Farming since the 1960's

(Source Oxford Farming Conference 6 – 8 January 2015)

Service Providers. Automated and Sensing Technology



Adoption Trends in the US (Cropping)



Adoption of increased sampling and VRT increasing. (Farmer Survey, Alabama)

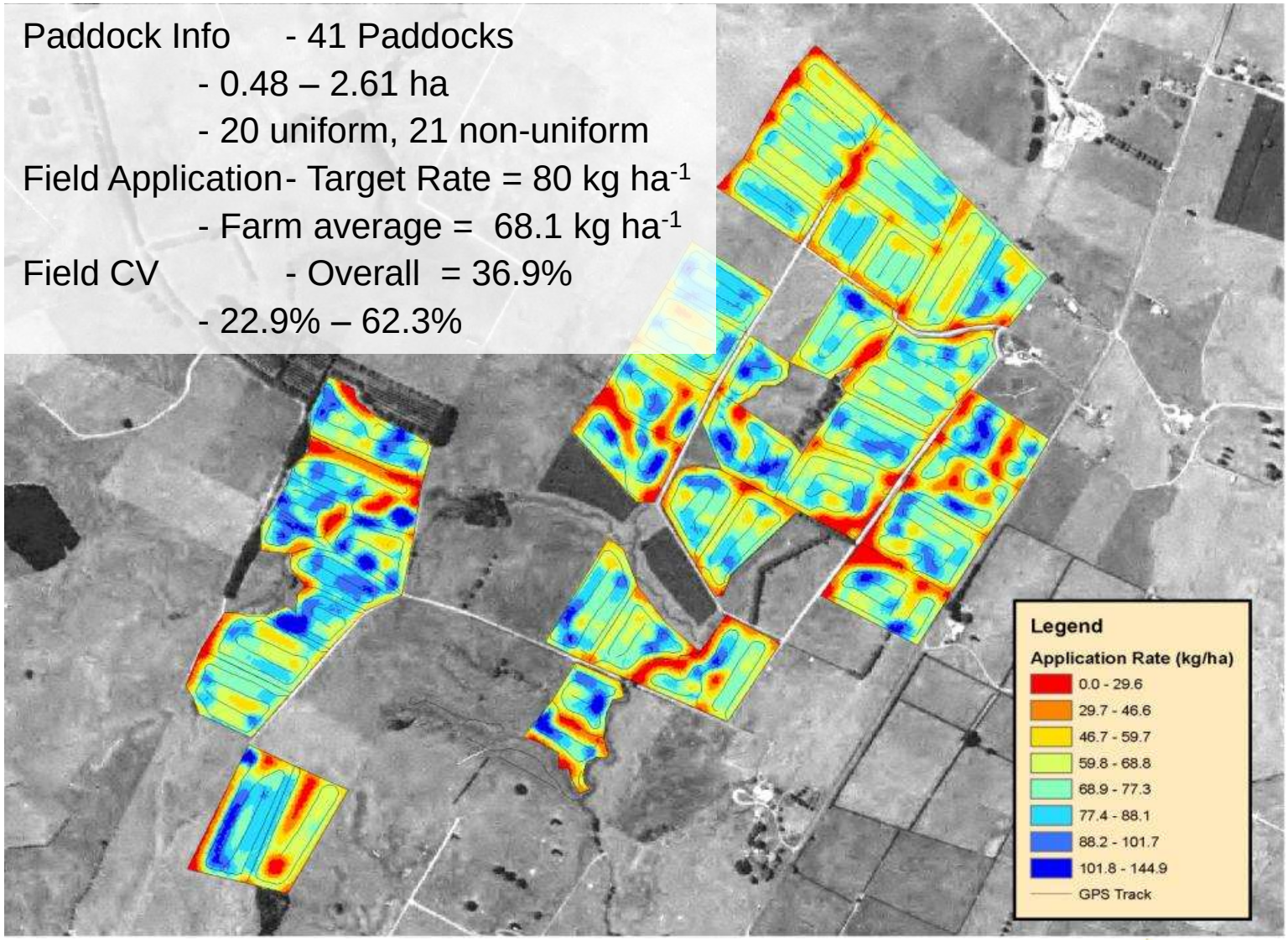
Farmers intented and actual use

Vehicle Based Systems, Field CV's still very high.

Paddock Info - 41 Paddocks
- 0.48 – 2.61 ha
- 20 uniform, 21 non-uniform

Field Application - Target Rate = 80 kg ha^{-1}
- Farm average = 68.1 kg ha^{-1}

Field CV - Overall = 36.9%
- 22.9% – 62.3%



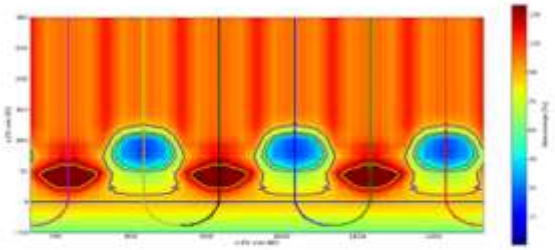
Work of Hayden Lawrence, again 10 years ago.

Accurate even Spreading

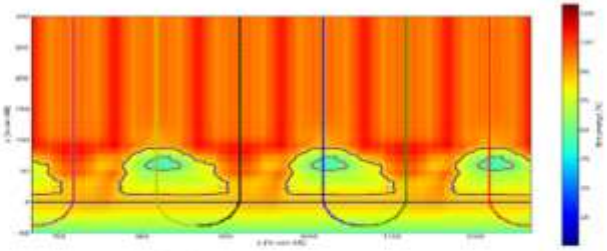
Headland management

AMAZONE 26th FLRC Workshop, Massey University

GPS-Switch - Headland



Normal overlap



Optimized overlap

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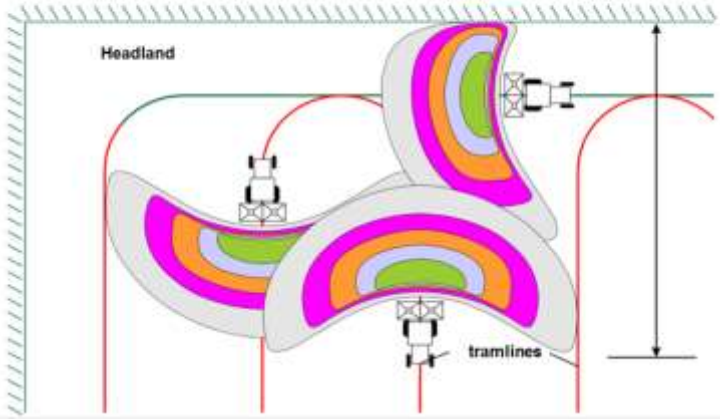
Innovation: GPS-Switch – Headland

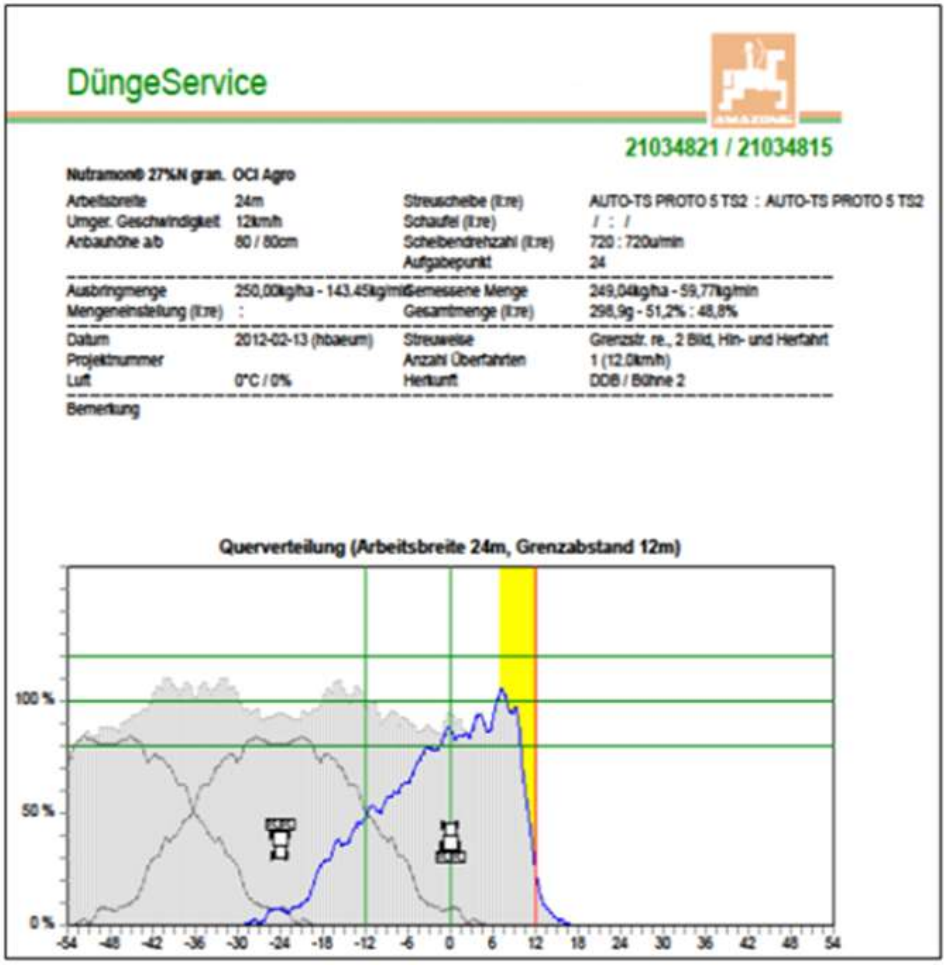
Automtically switchinn on or off ad the Headland



Accurate even spreading

Development of new techniques

- boundary spreading



Amazone AutoTS

Boundary Spreading

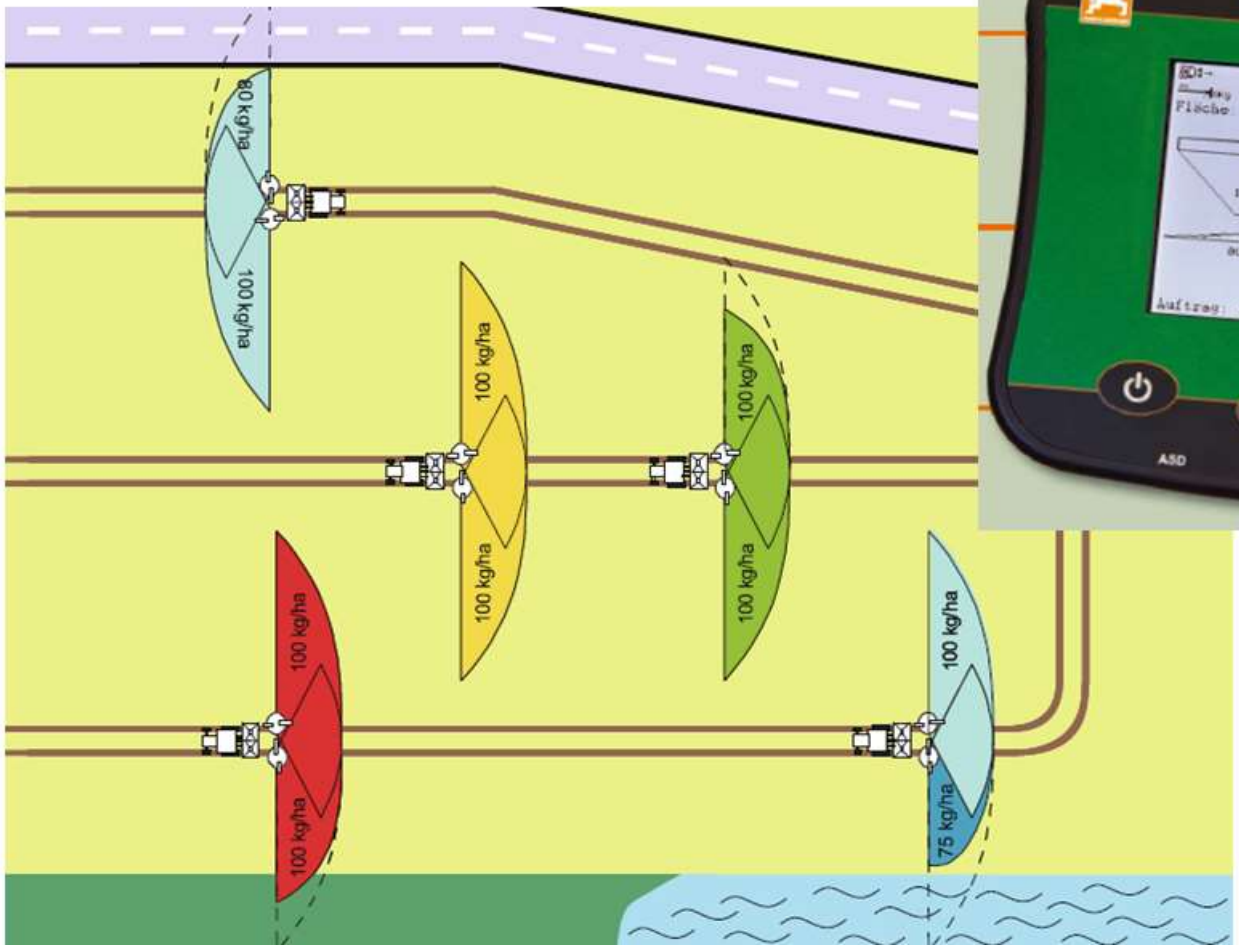
Avoid off target application.

Avoid under application around the boundary.

Other improvements like self calibration through on board weighing.

Developments in Spreader Technology

ZA-M Hydro / GPS-Switch



Additional development since 2013, on board spread pattern measurement. Kuhn and Amazone.

Economic impact of inaccurate spreading.

Surprisingly under researched area given its likely financial impact.

Likely to be significant for New Zealand. $200 - 300M per annum.

Exponential rise in costs as CV increases. Loss of $10 per ha at 15% CV, $45 per ha at 30% CV and $100 per ha at 45% CV.

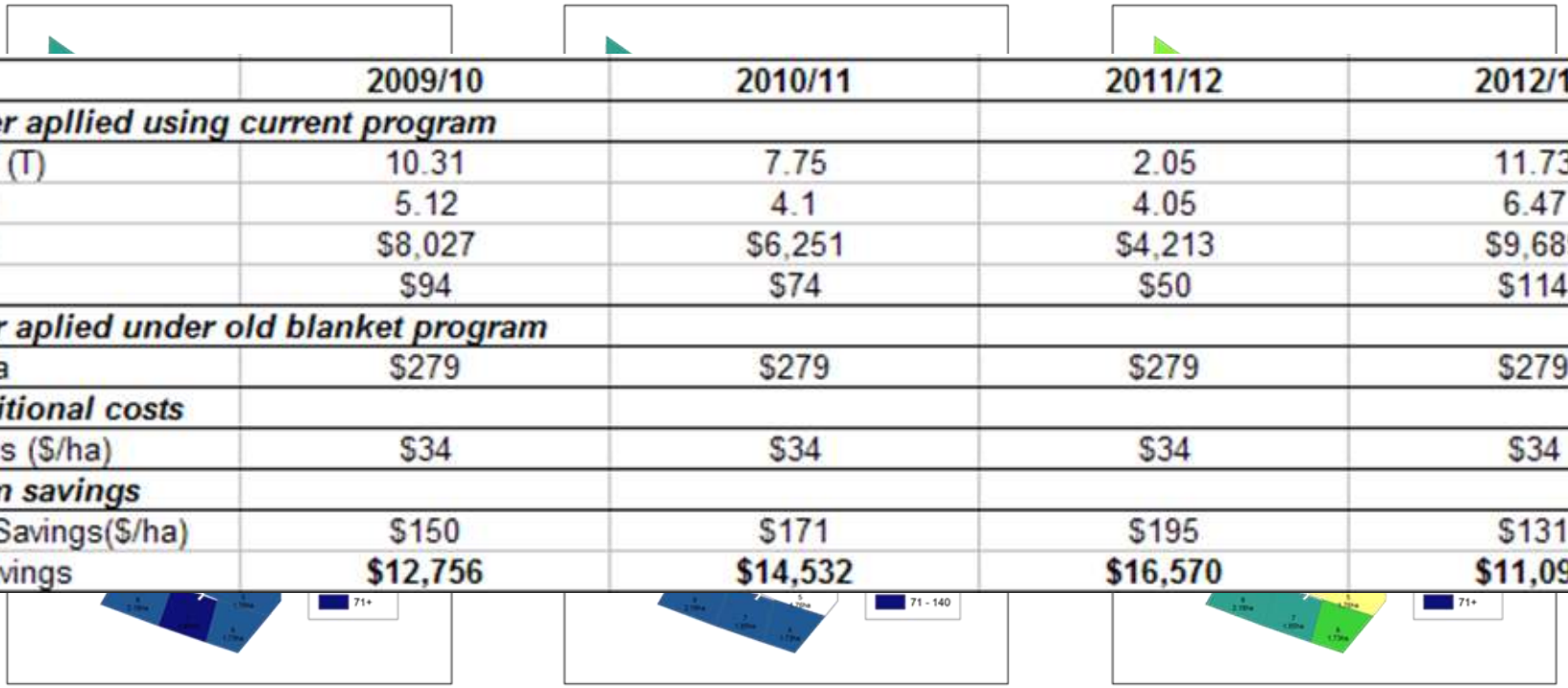
In most cases the financial loss is likely to be greater than the cost of fertiliser application.

Recognition that “Field CV” is likely to be at least 30%, we need to reduce error rather than increasing spreading width.

Need to continue to work on these but also need to move on.

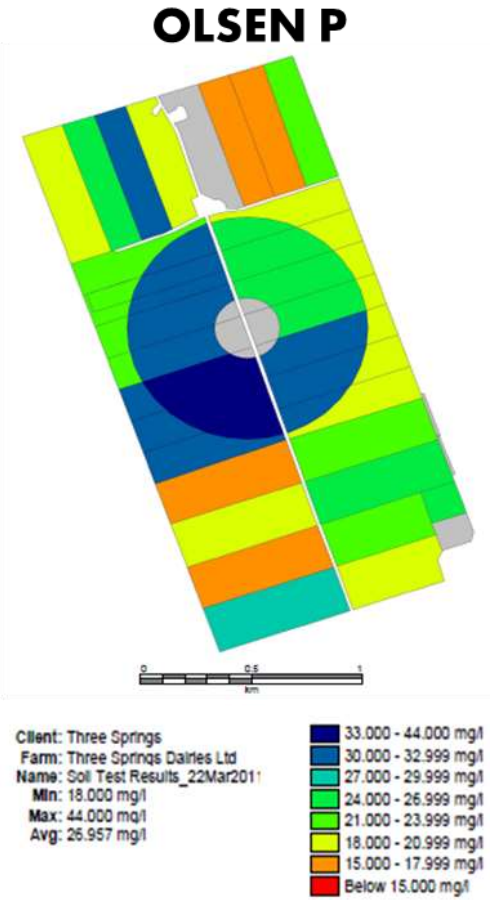
Soil Sampling on dairy farms, base fertiliser needs

	2009/10	2010/11	2011/12	2012/13
Fertiliser apllied using current program				
Super P (T)	10.31	7.75	2.05	11.73
KCL (T)	5.12	4.1	4.05	6.47
$ Value	$8,027	$6,251	$4,213	$9,689
$/ha	$94	$74	$50	$114
Fertiiser aplied under old blanket program				
$ Fert/ha	$279	$279	$279	$279
Less aditional costs				
Soil tests ($/ha)	$34	$34	$34	$34
Program savings				
Annual Savings($/ha)	$150	$171	$195	$131
Total Savings	**$12,756**	**$14,532**	**$16,570**	**$11,094**



Hayden Lawrence, Data presented. Significant increase in revenue through savings in fertiliser and growing more grass. Used Ravensdown's individual paddock testing.

Soil Sampling



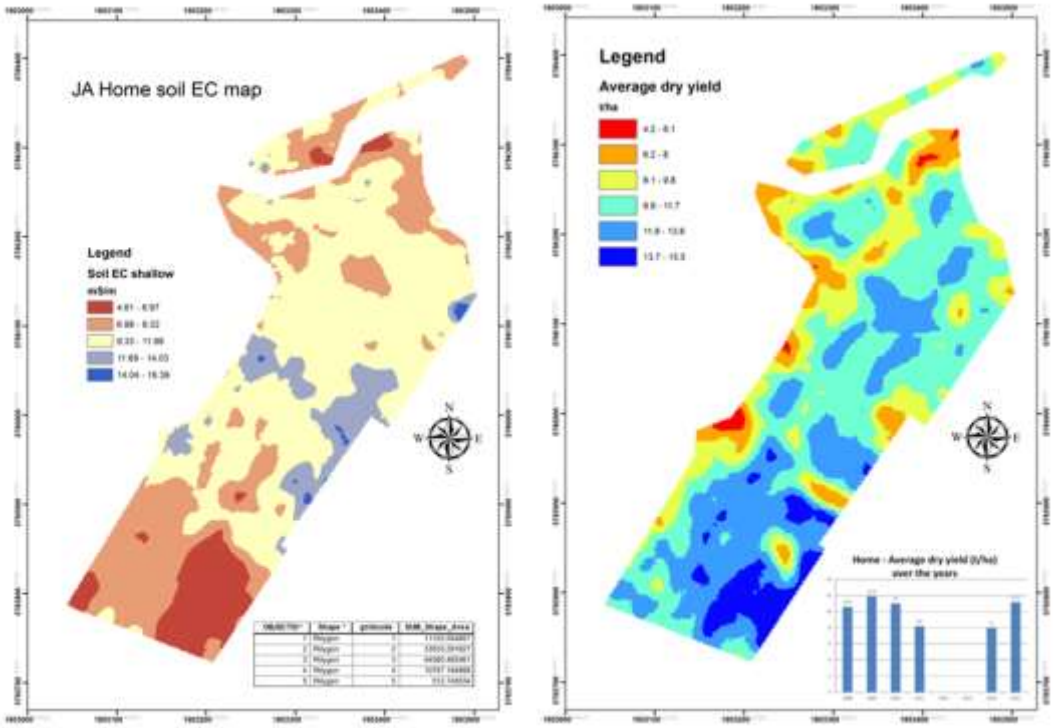
Craige Mackenzie, a similar story, significant savings from increased soil testing and targeted application.
45% saving on base fertiliser and lime costs. ($22,000).

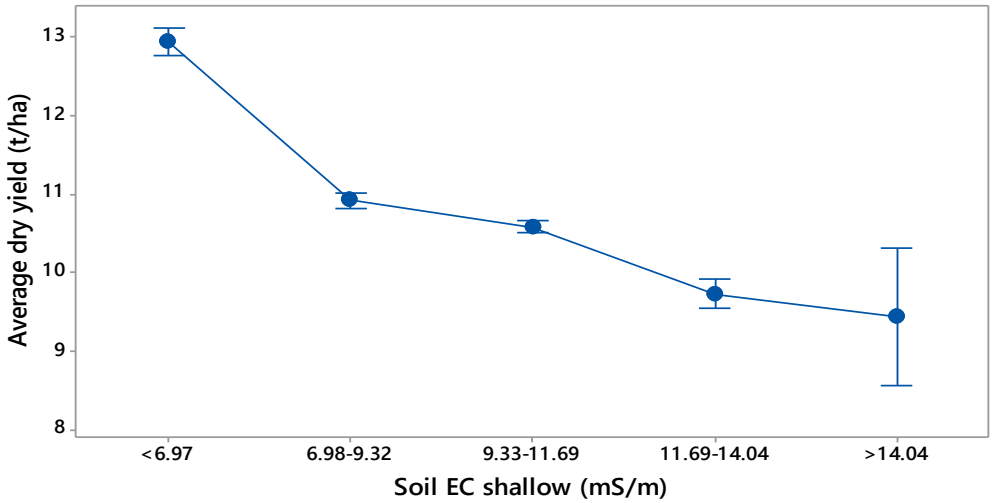
Grid soil sampling or zonal soil sampling.

Management history: Old field boundaries, field amalgamations.

Soil influences: soil changes, soil boundaries.

Relationship between yield and soil EC.





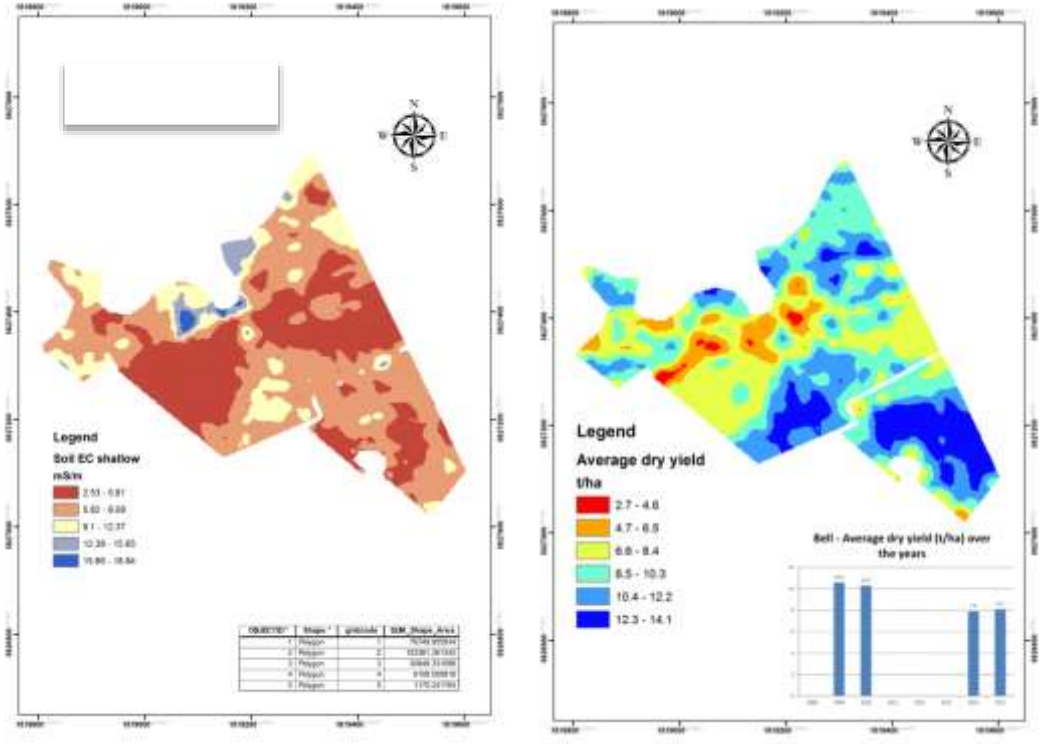
Average dry yield with 95% confidence interval

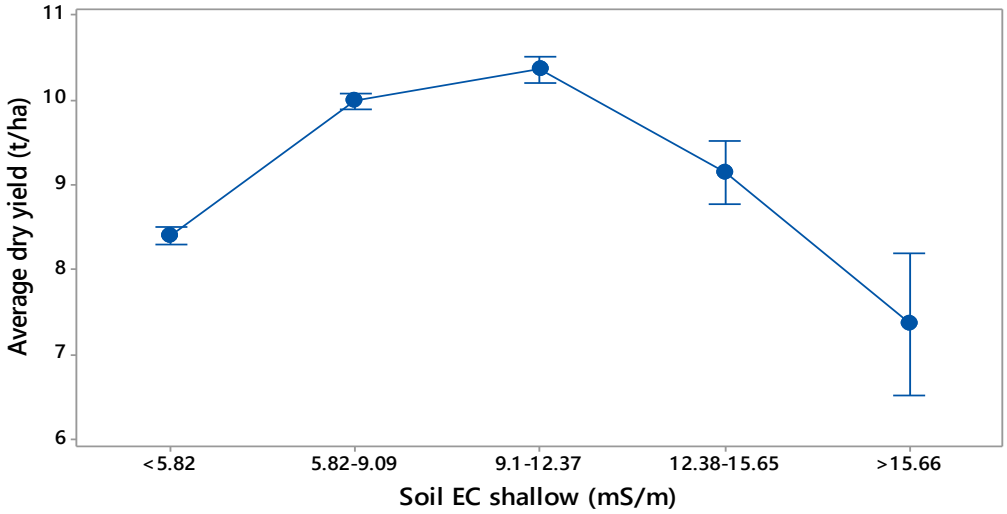
Soil EC and Yield Maps

Information from long term yield mapping

Golden Jiang, Summer Student. Yield data mining, Transforming Variability to Profitability

Relationship between yield and soil EC.





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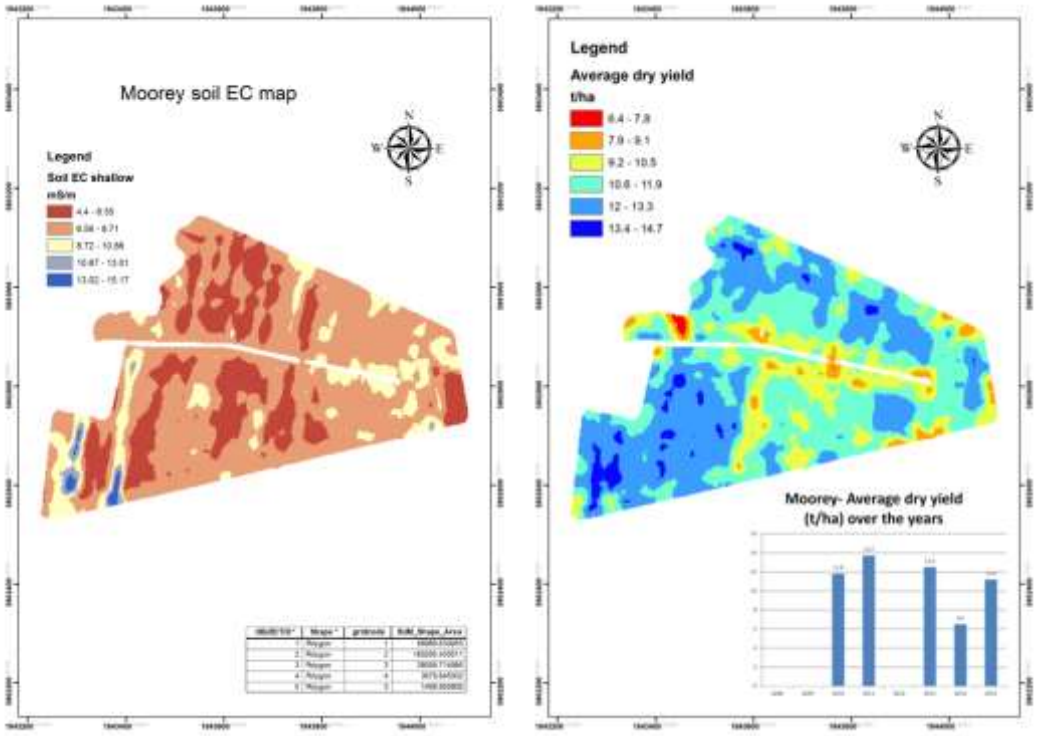

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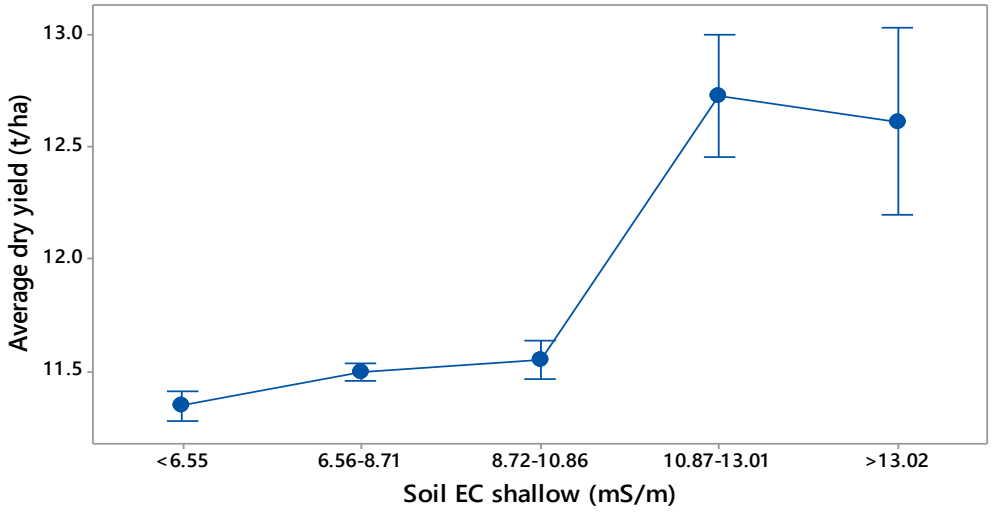

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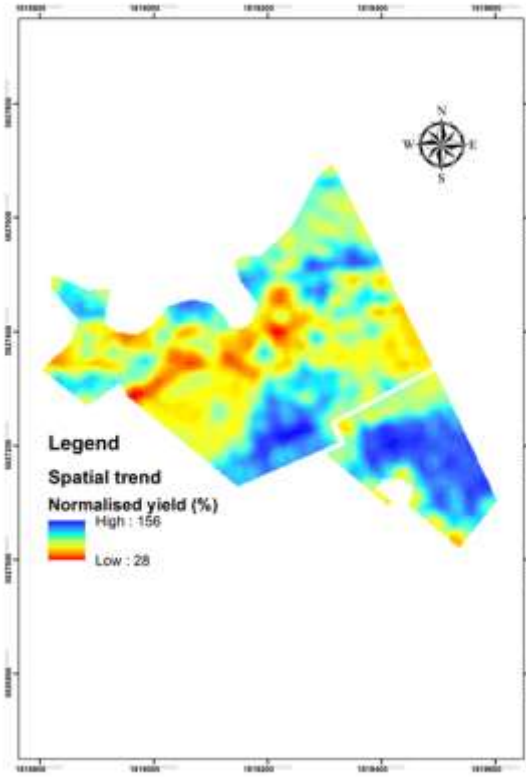
Relationship between yield and soil EC.

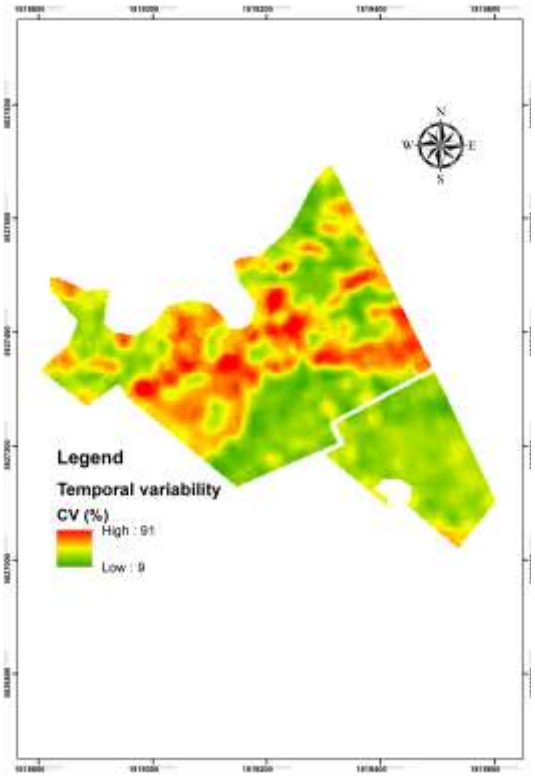
There is no universal solution.

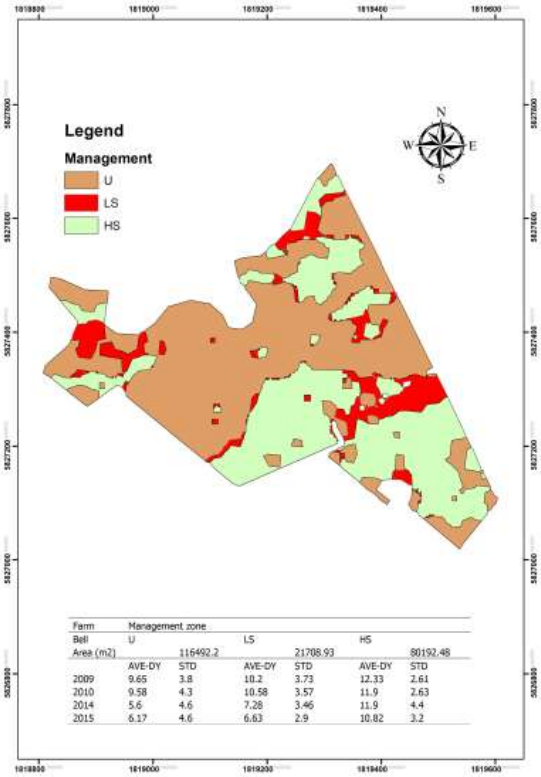
But there is clear variability in every site and a relationship between soil and yield.

Need to explore that further.

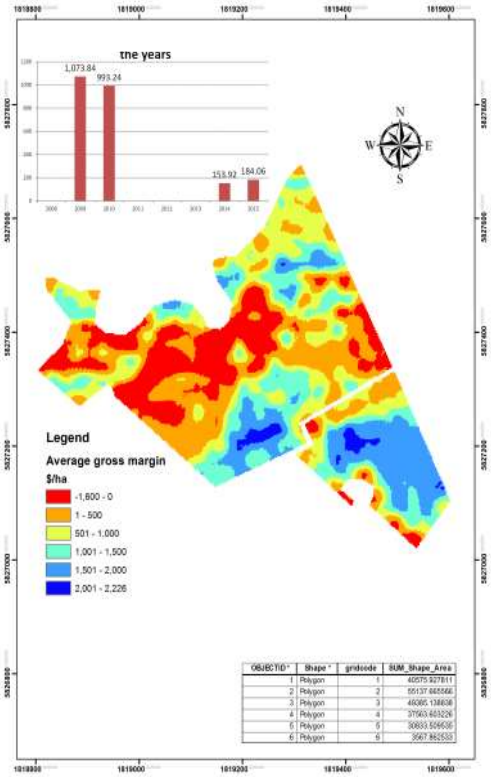
Yield variability, trends, zoning and Gross Margin







Farm	Management zone					
Bell	U		LS		HS	
Area (m2)		116492.2		21708.93		80192.48
	AVE-DY	STD	AVE-DY	STD	AVE-DY	STD
2009	9.65	3.8	10.2	3.73	12.33	2.61
2010	9.58	4.3	10.58	3.57	11.9	2.63
2014	5.6	4.6	7.28	3.46	11.9	4.4
2015	6.17	4.6	6.63	2.9	10.82	3.2

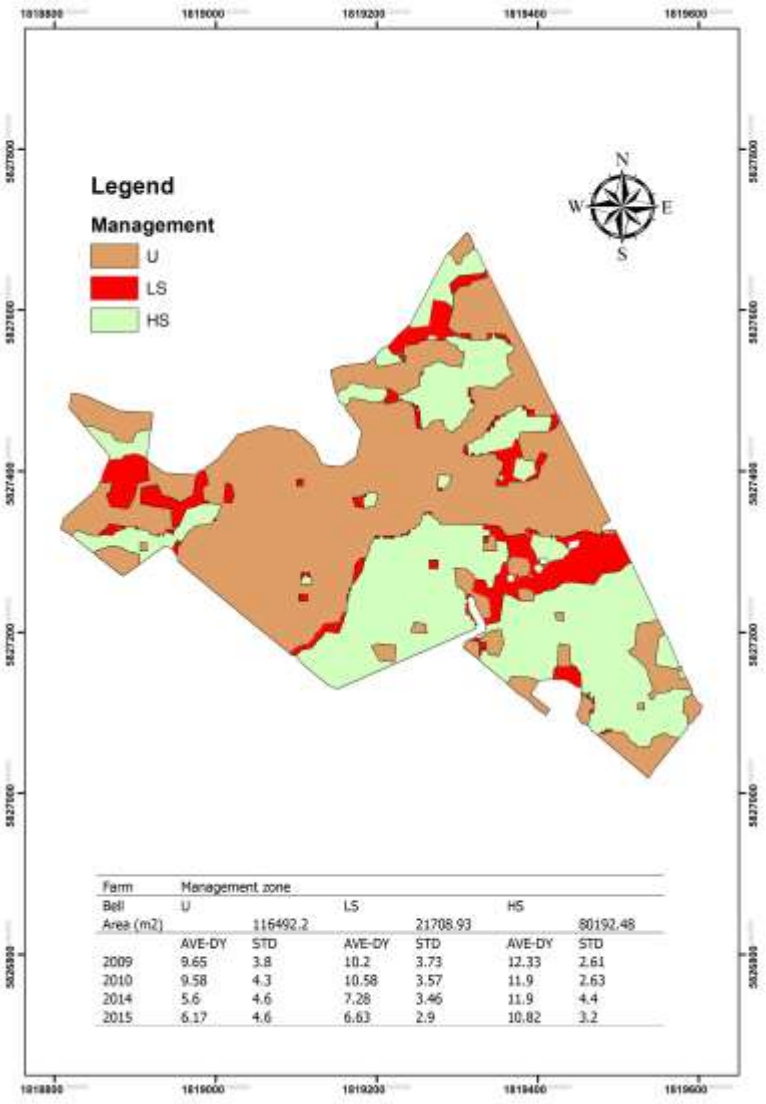


Normalised yield to look at longer term trends.

Expressed the variability, Identified different zones,

Calculated a Gross margin.

Stability and Gross Margin



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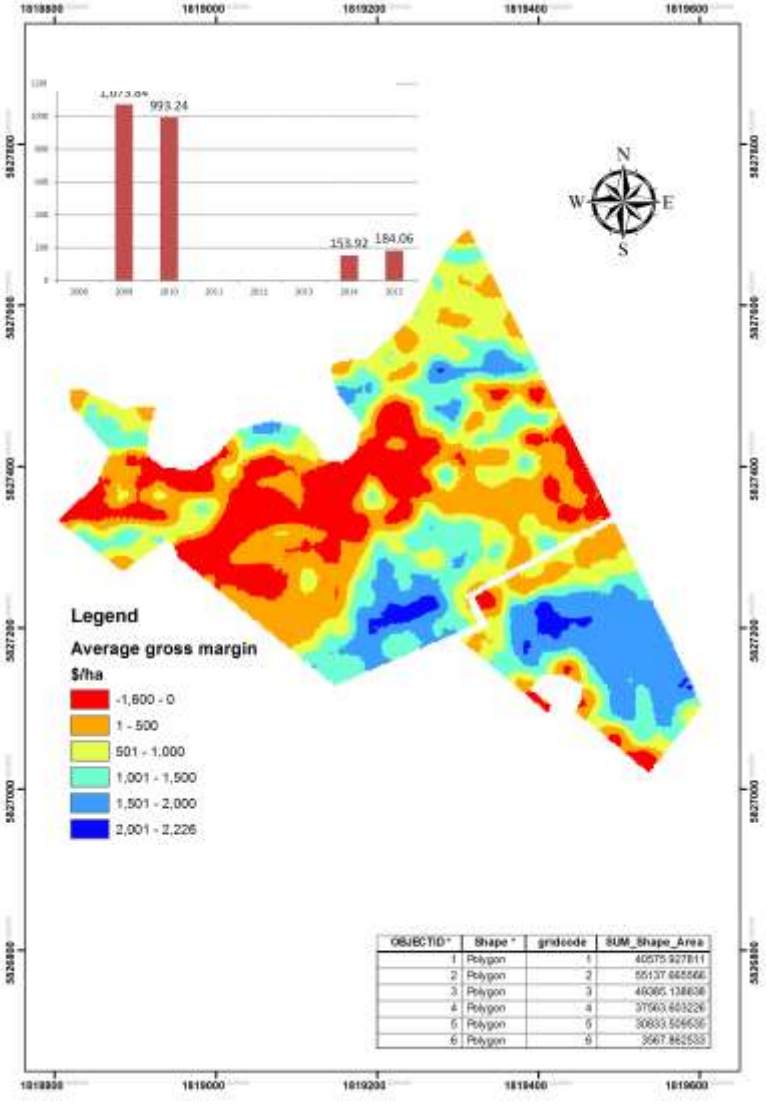

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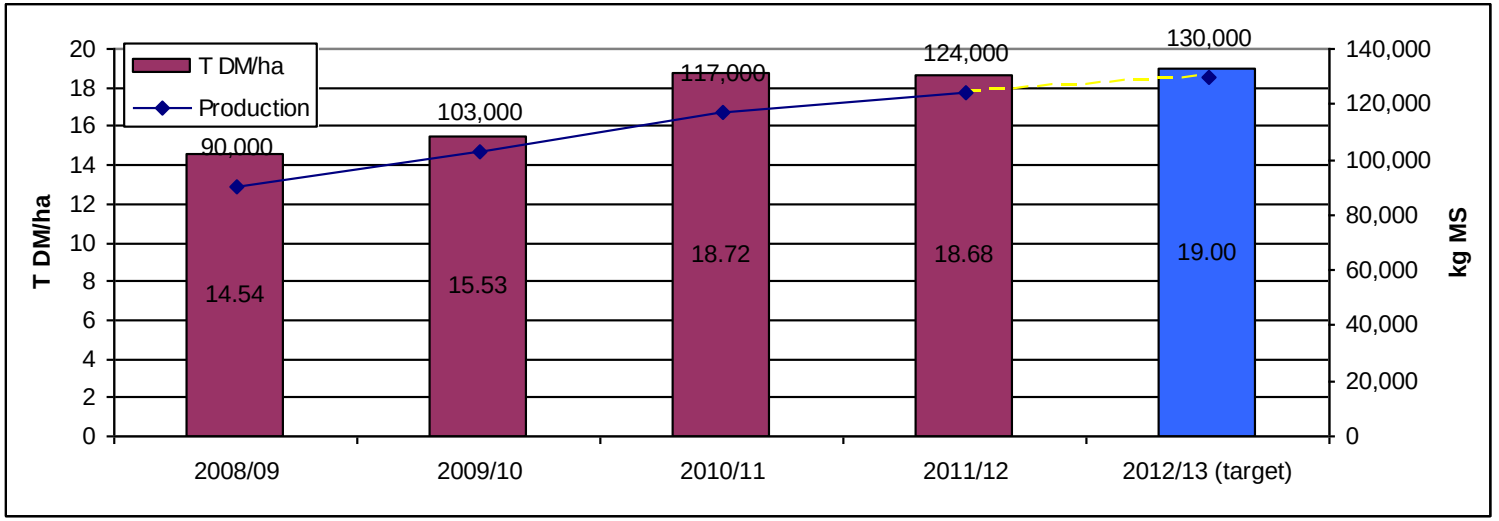
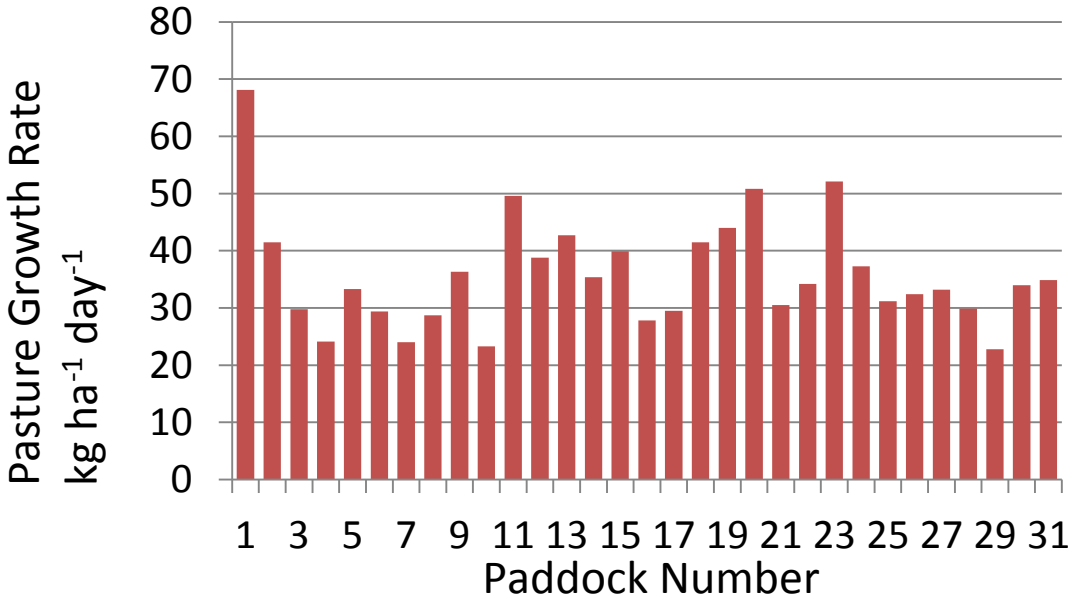
2	Polygon	2	55137.665566
3	Polygon	3	46365.138638
4	Polygon	4	37593.653226
5	Polygon	5	30833.596636
6	Polygon	6	3567.862533

Golden Jiang, Summer Student. Yield data mining, Transforming Variability to Profitability

Pasture Productivity





Individual Paddocks, typical pasture growth rates.

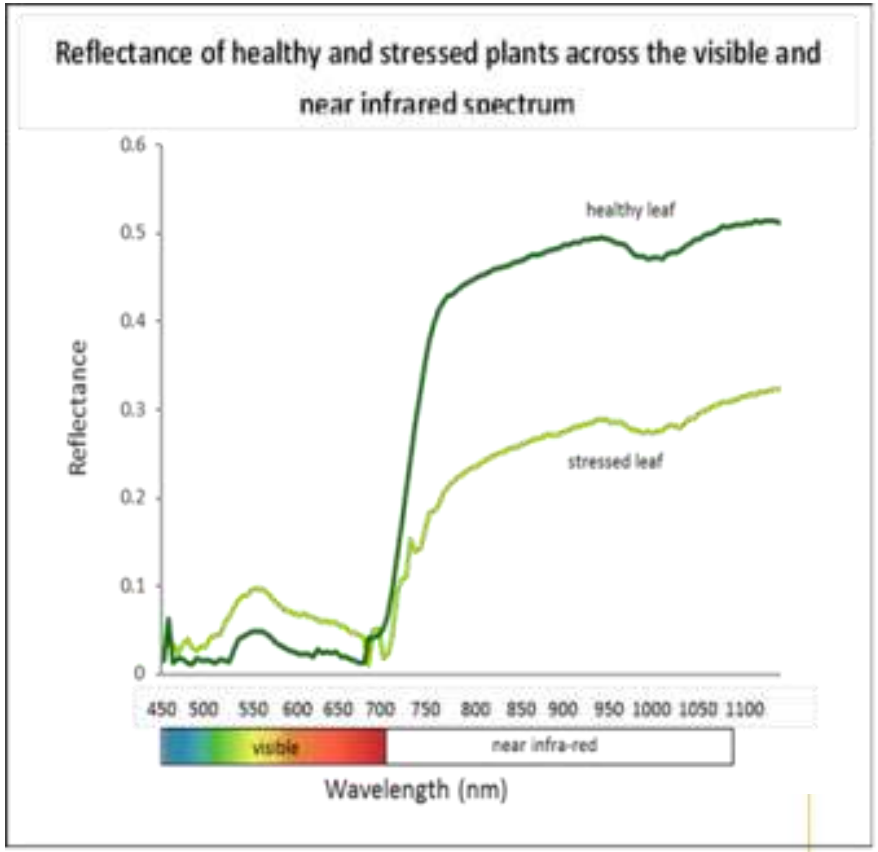
Nitrogen Strategies

Jim Wilson from Scotland, winter crops, clear strategy around when to add more N, when to add less.

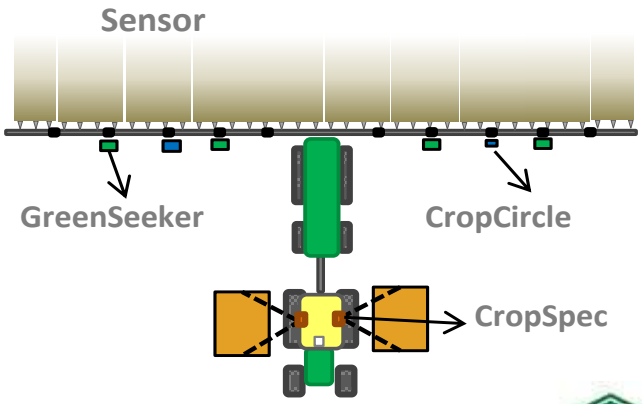
Early season, add more N to where there is less biomass.

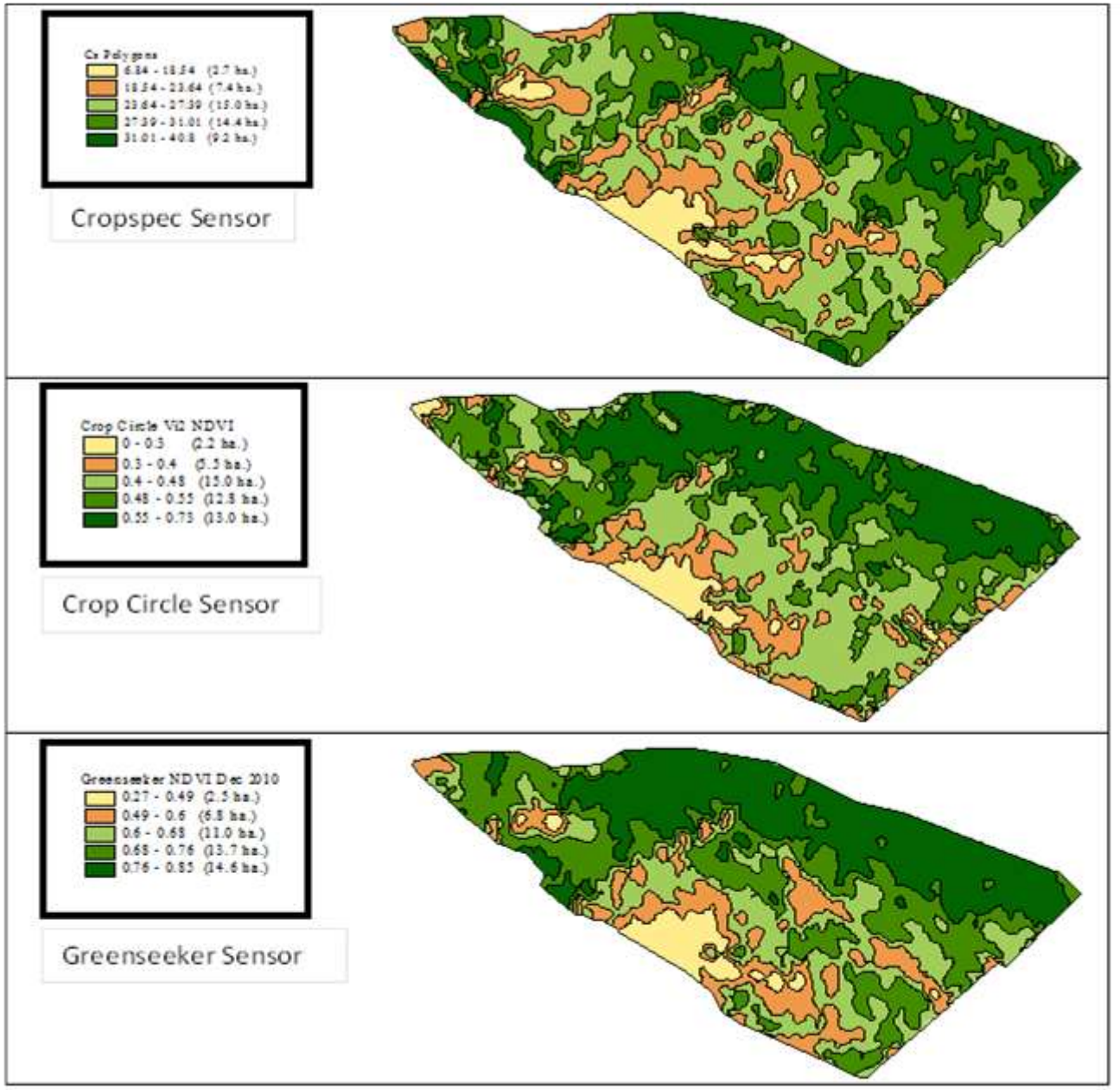
Mid season, similar strategies.

Later season might reduce N on higher biomass areas.



Comparative performance in Maize





FAR

Forever discovering

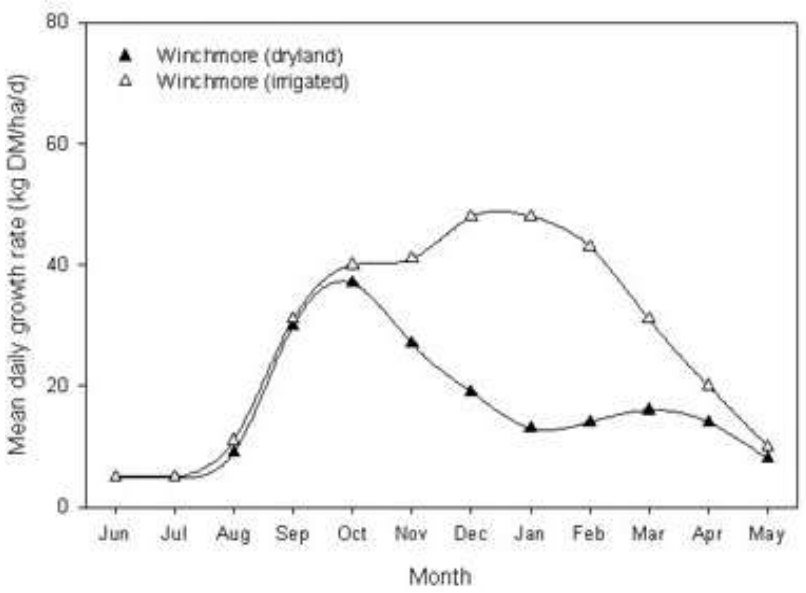
What we have been talking about is the “Right Place”

We need to refine our thinking around the right time and right product.

Possibilities:

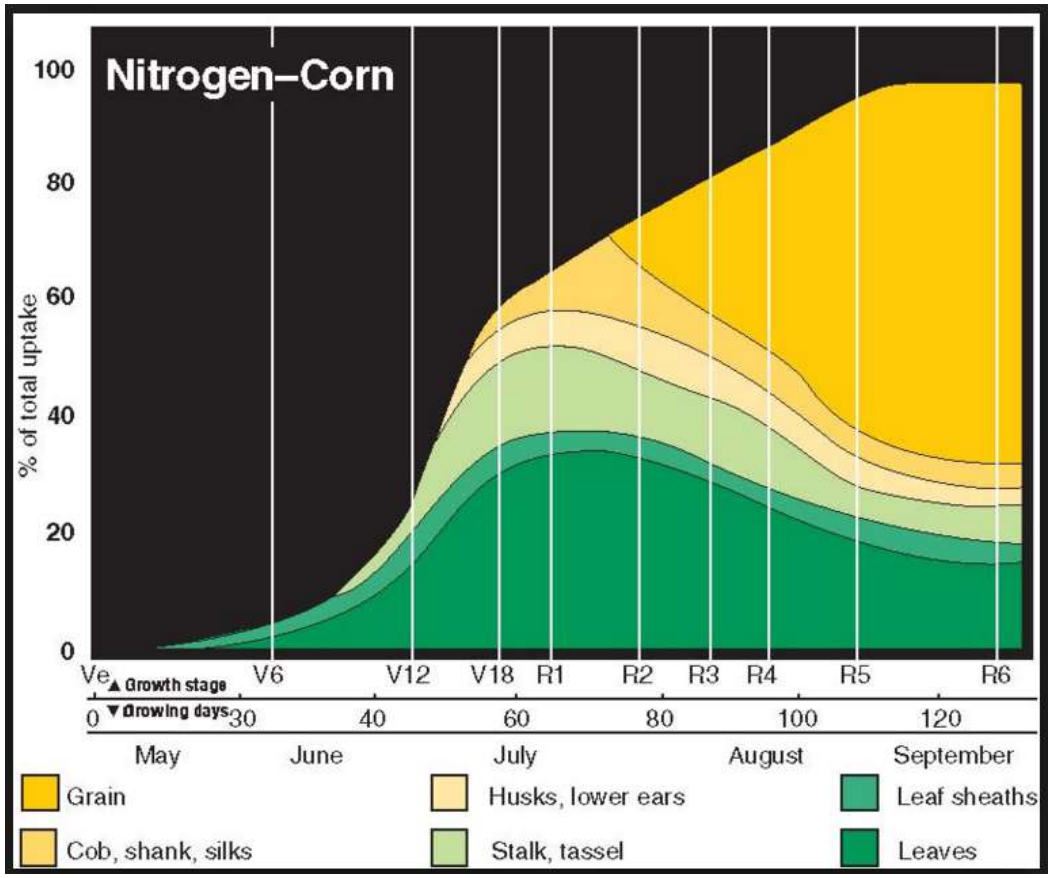
Fertigation. Different products,

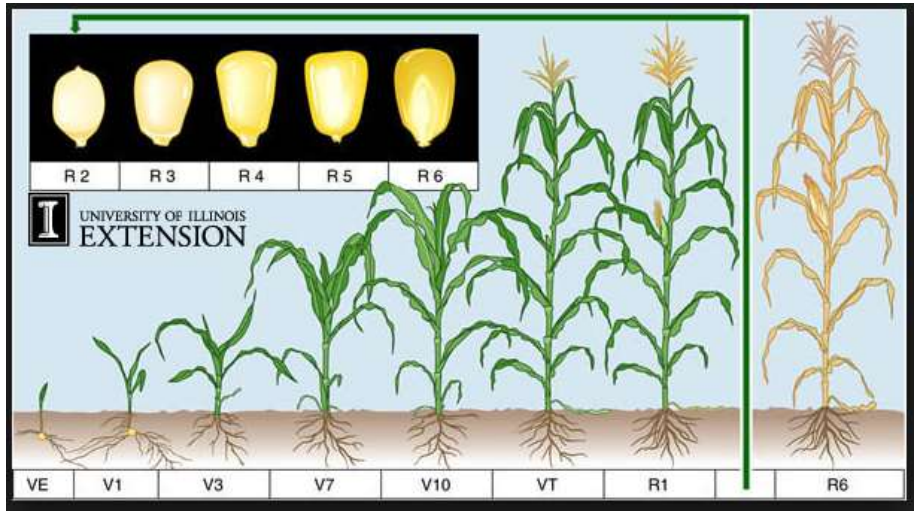
Better match plant demand.



http://www.fao.org/ag/agp/agpc/doc/counprof/newzealand/newzealand3.htm

Nutrient Demand

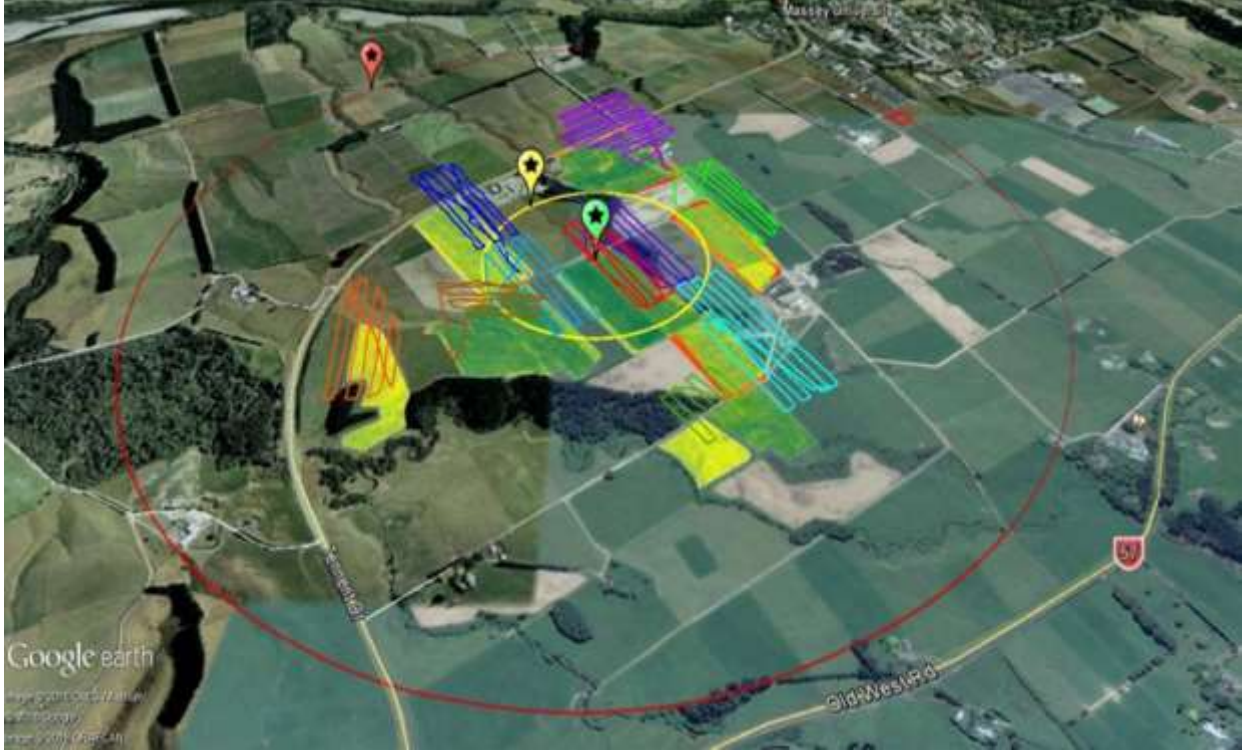




http://plantsci.missouri.edu/nutrientmanagement/nitrogen/practices.htm

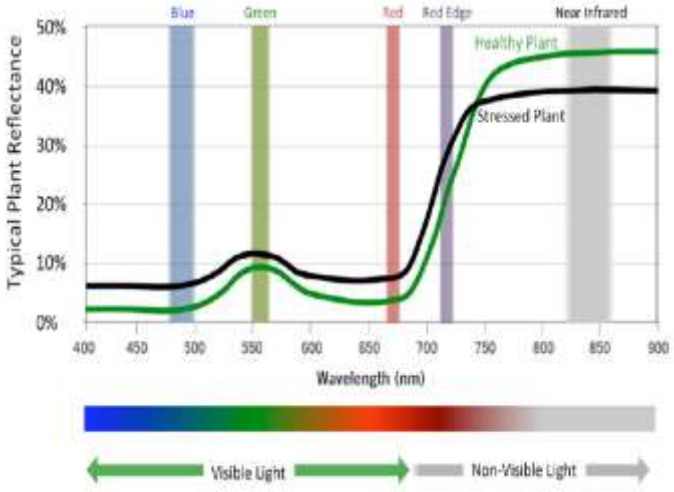
http://www.sidthomas.net/SenEssence/Genes/proteins.htm

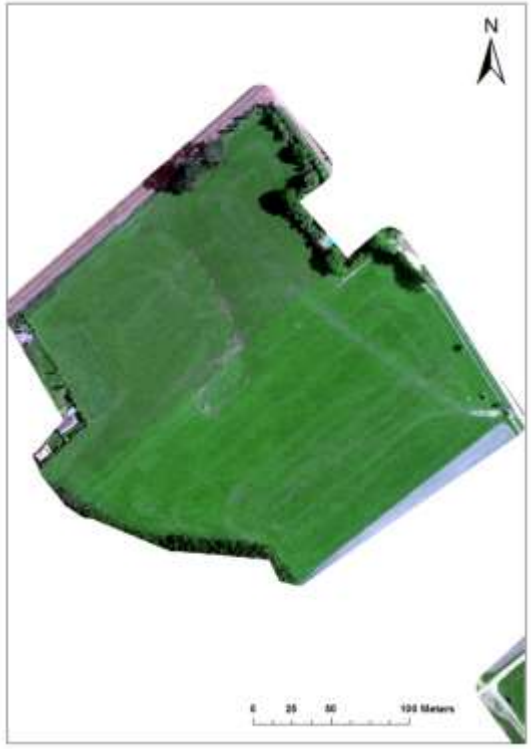
New Generation Sensors

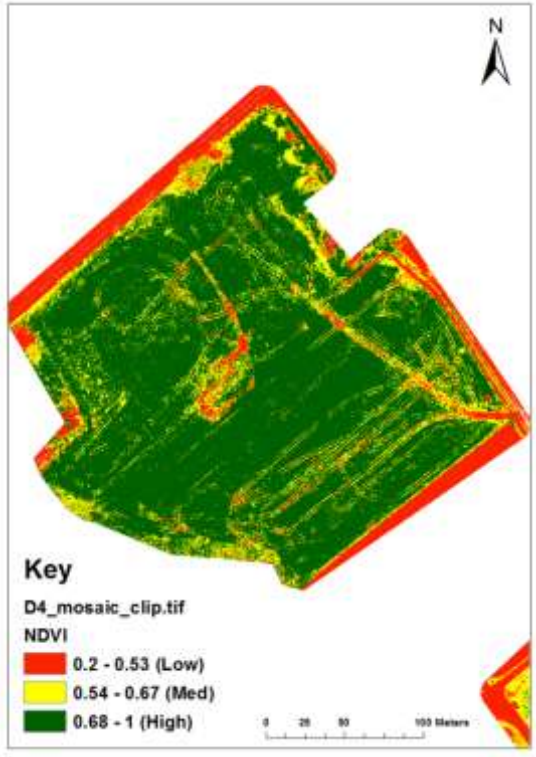


Spectral bands

High-grade optical filters deliver precise information specially targeted to agricultural applications.







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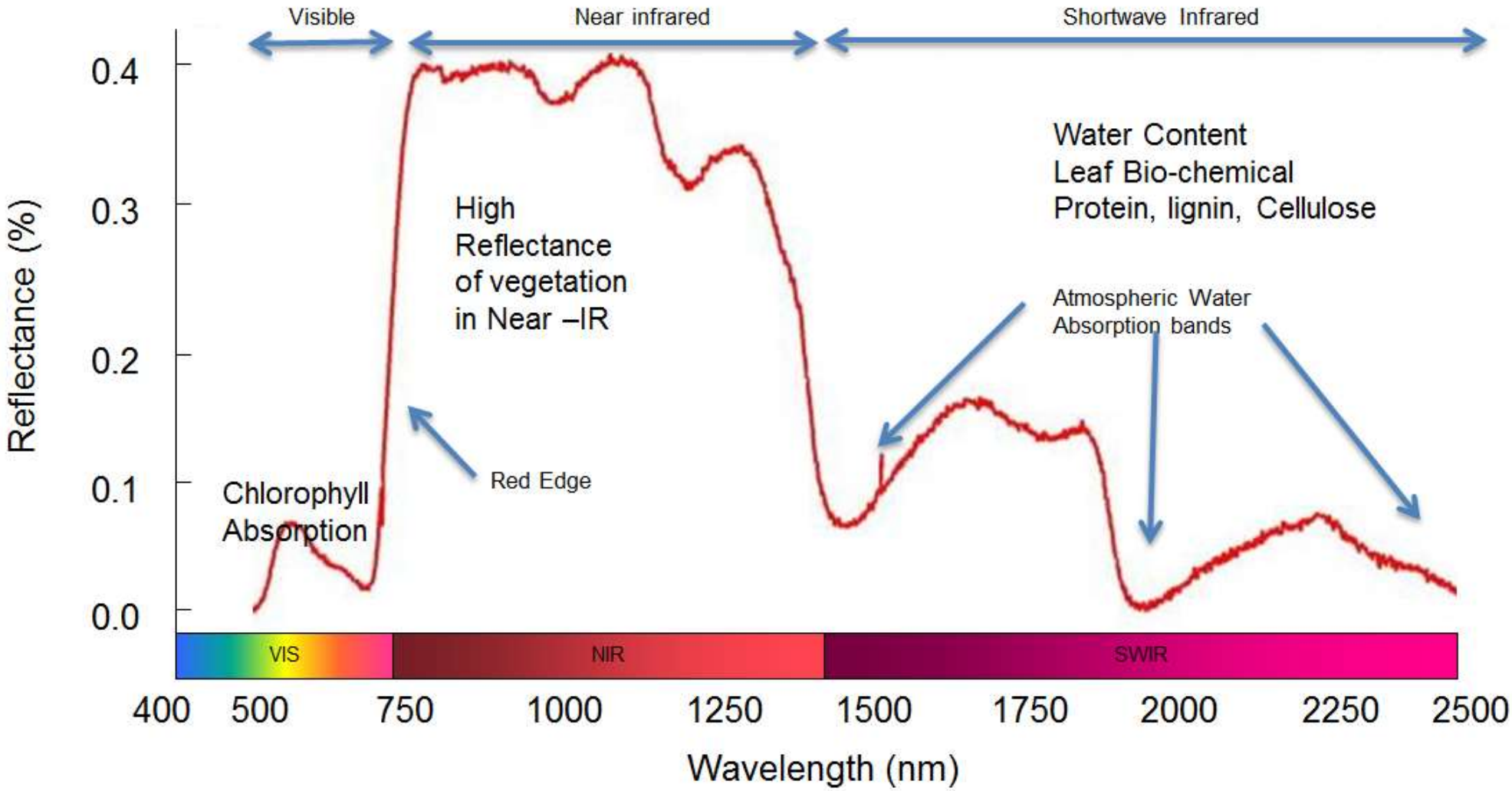
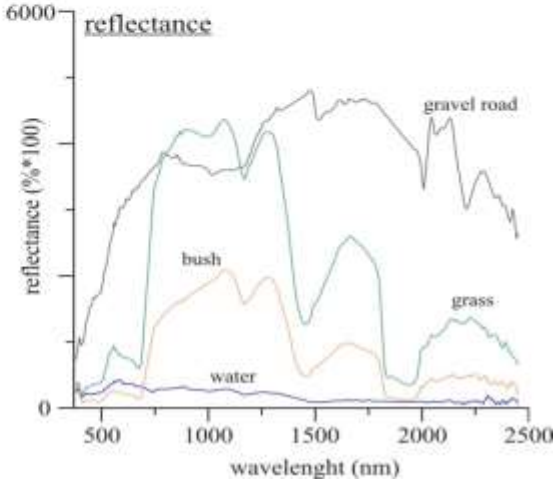
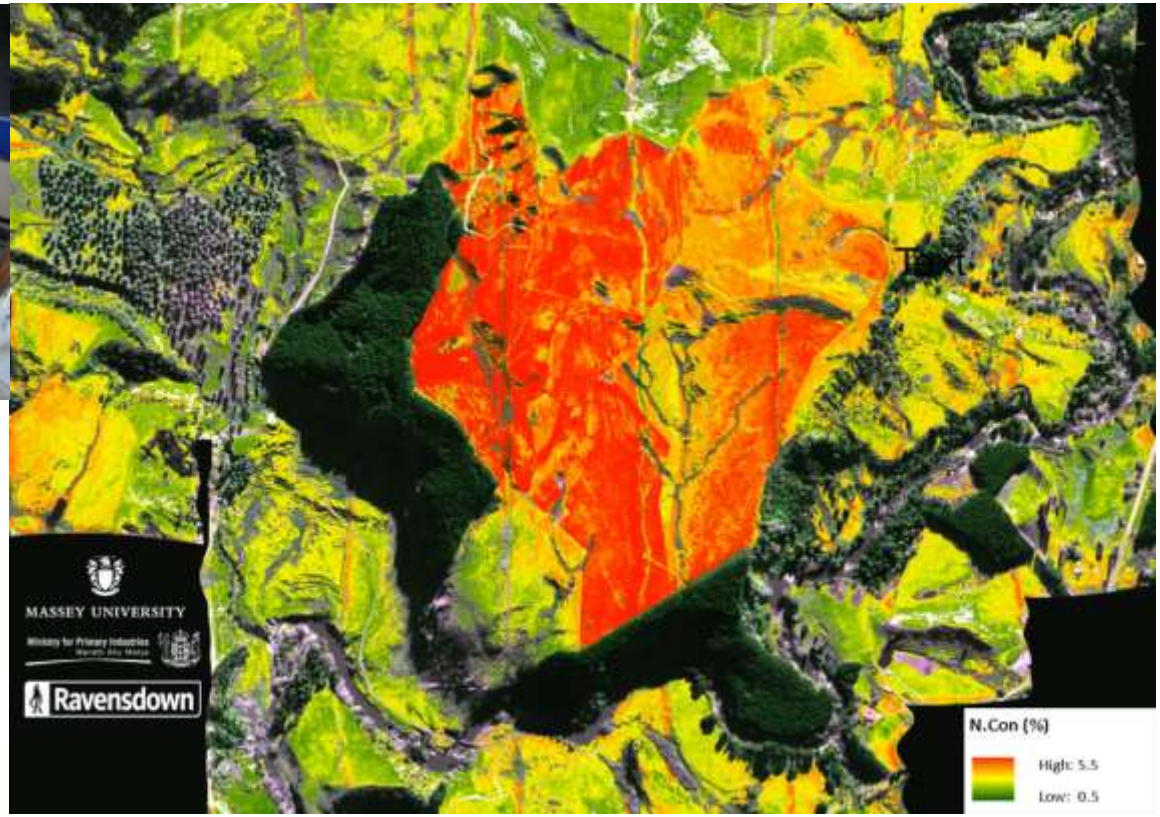
Spectral signature, showing Fenix Range



Adapted from: http://www.markelowitz.com/hyperspectral.html

Hyperspectral Imaging: Fenix Airborne Sensor

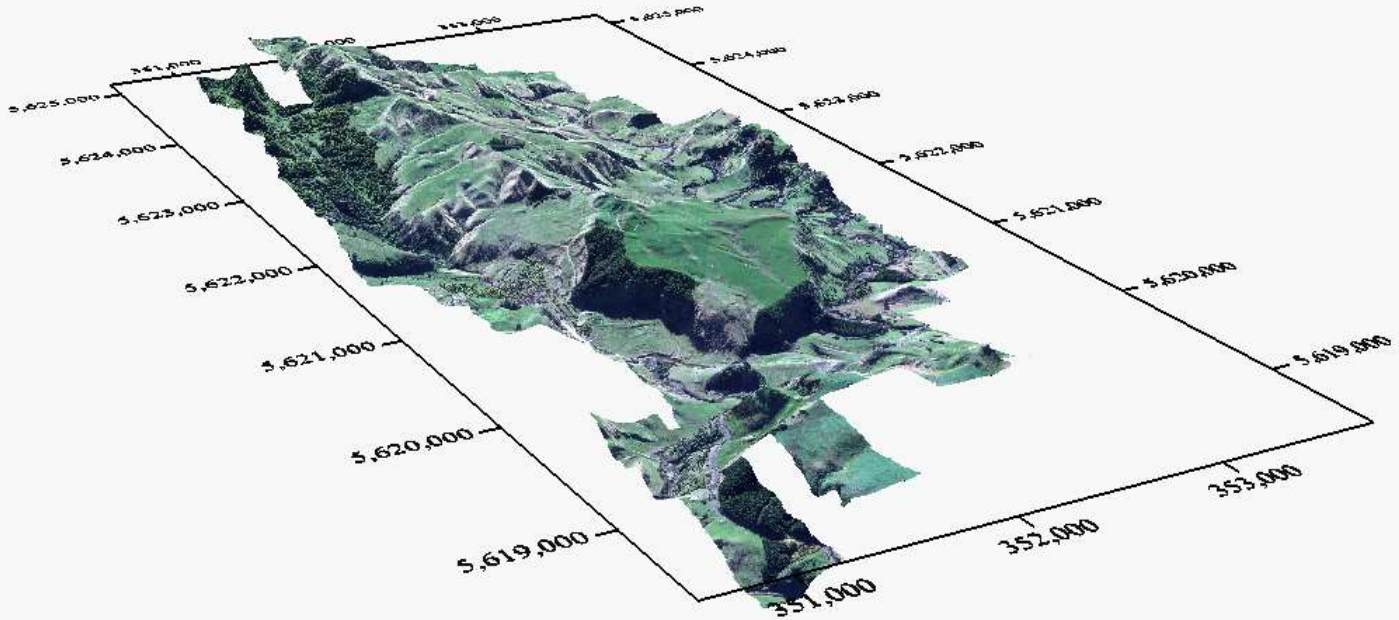


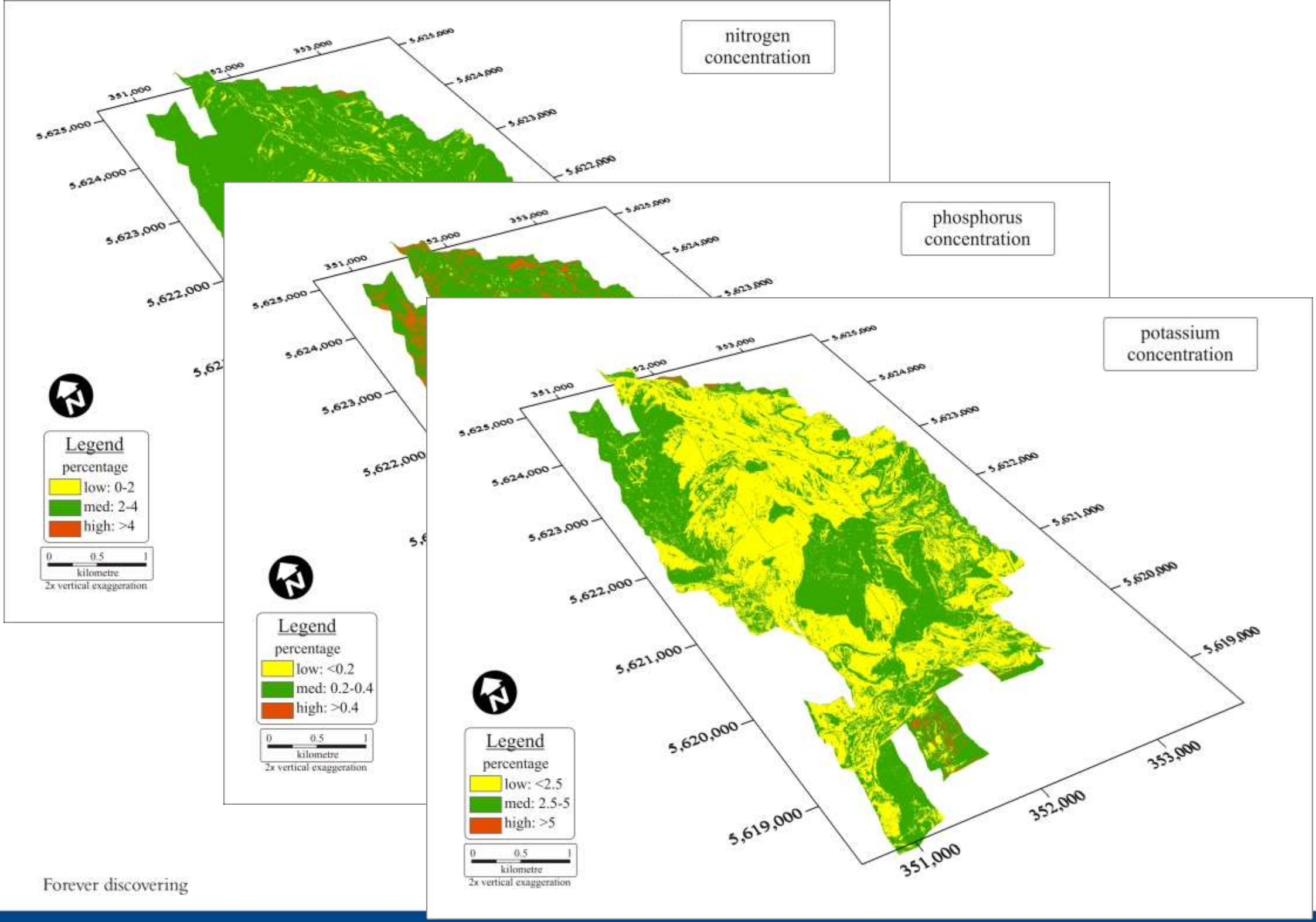


448 wavelengths over the VIS, NIR and SWIR.

Providing biochemical analysis for any target.

Hyperspectral data




nitrogen concentration
Legend
percentage
low: 0-2
med: 2-4
high: >4
0 0.5 1
kilometre
2x vertical exaggeration
phosphorus concentration
Legend
percentage
low: <0.2
med: 0.2-0.4
high: >0.4
0 0.5 1
kilometre
2x vertical exaggeration
potassium concentration
Legend
percentage
low: <2.5
med: 2.5-5
high: >5
0 0.5 1
kilometre
2x vertical exaggeration
351,000
352,000
353,000
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5,624,000
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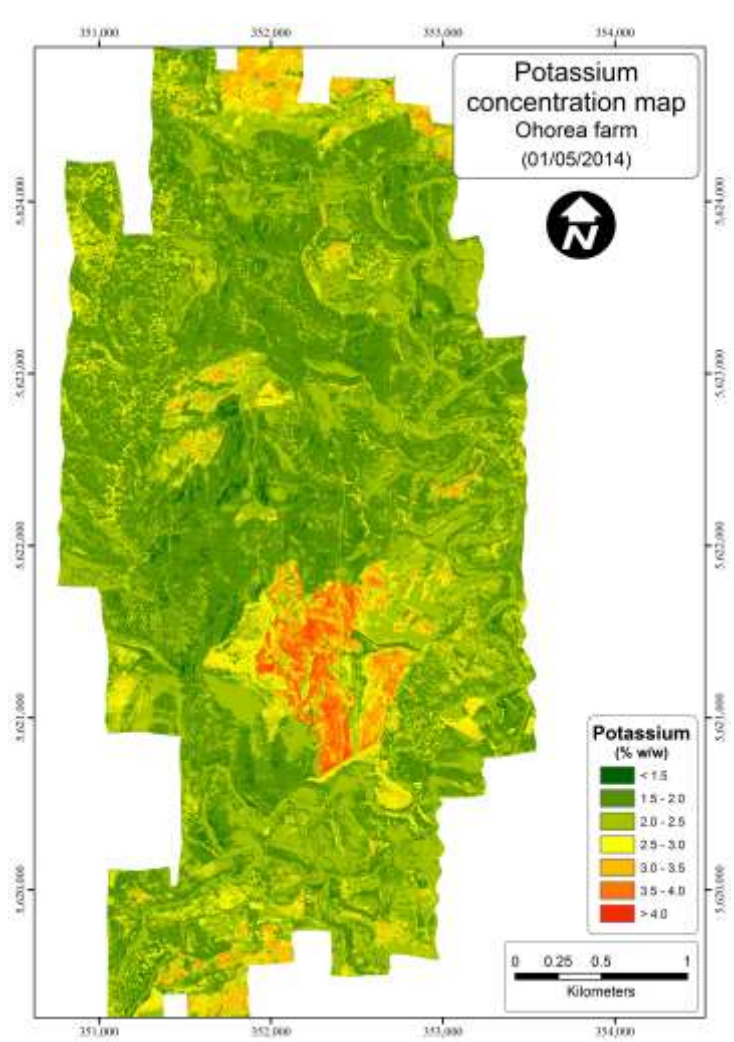
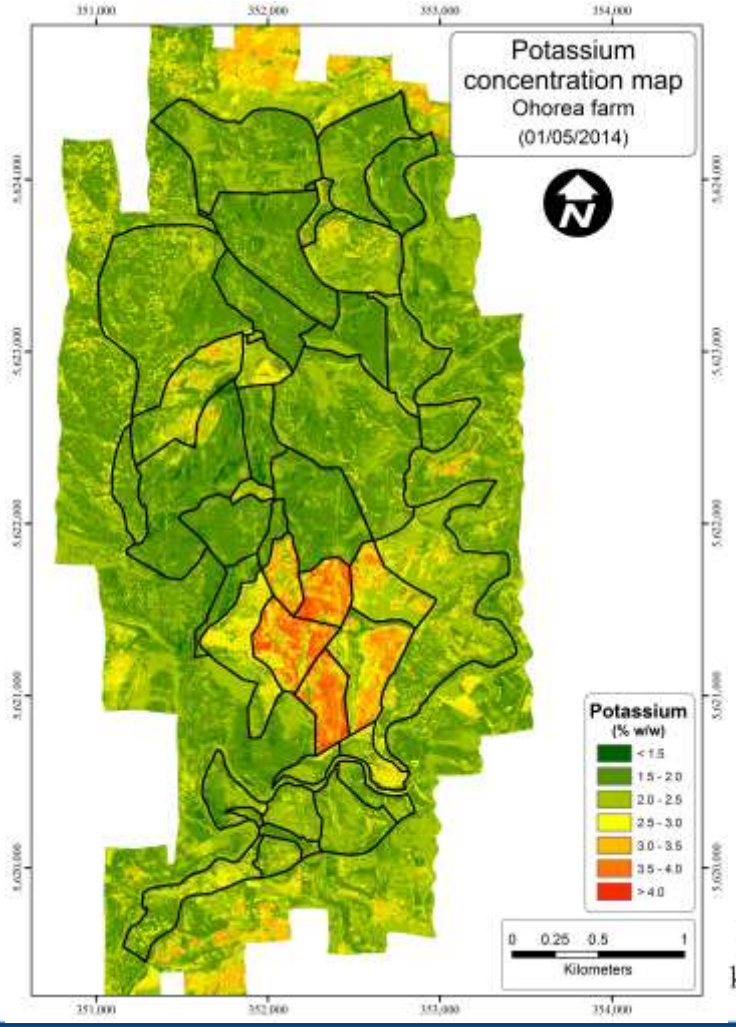
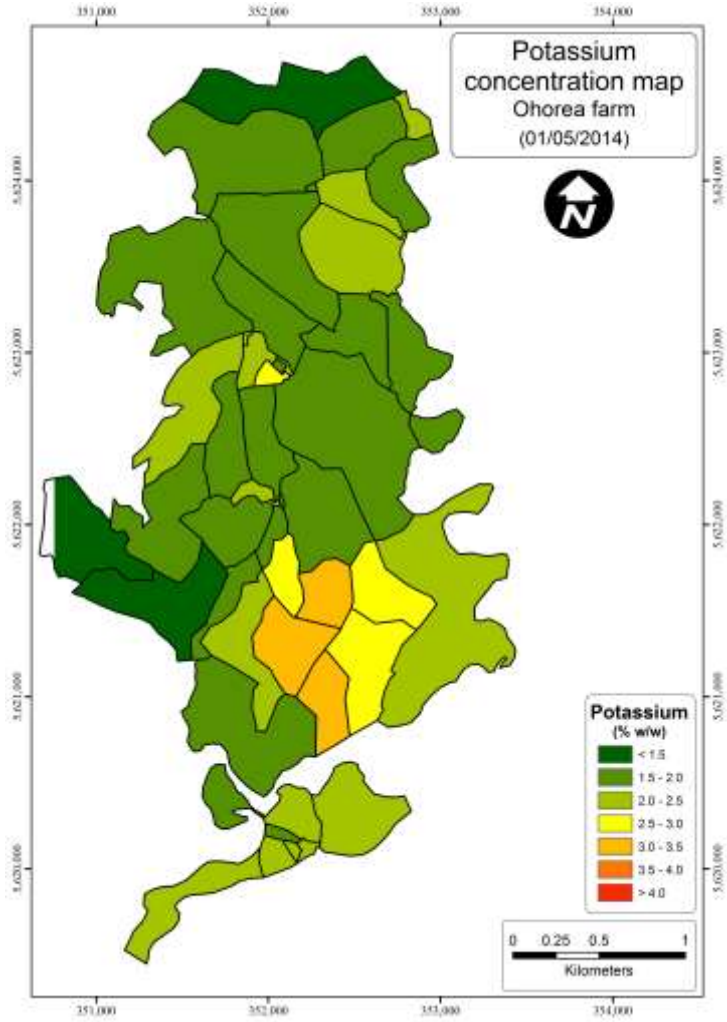
5,621,000
5,620,000
5,619,000



Which format do you prefer?





Conclusions:

There are further opportunities to improve our farming systems.

We need to measure performance.
And we need to reflect more on that performance.

Try to find ways to identify where those opportunities might arise.

Opportunities will be somewhat different on each property, need to equip yourself to look for the opportunities.

There are technologies that are here today that can help you.

There will be new technologies which come along to help you further.

The emphasis is on YOU.