Miljø- og Fødevareministeriet

gudp

STØTTET AF

Promilleafgiftsfonden for landbrug

Variable Rate N in UK

Daniel Kindred

Agronomics

Daniel.Kindred@adas.co.uk M: 07774 701619 @drkindred

ADAS

Whats happening in UK?

- Commercial VRA N services in UK
  - Yara N sensor
  - SOYL – satellites
  - Rhiza – Planet satellites
  - Hummingbird – UAVs
  - Omnia – Plant vision sensor
  - AgLeader – Optrx sensor

ADAS work & interests

- Auto-N

Auto-N Project 2010-2015 *AHDB Project Report 561*

- PNAG – OSR

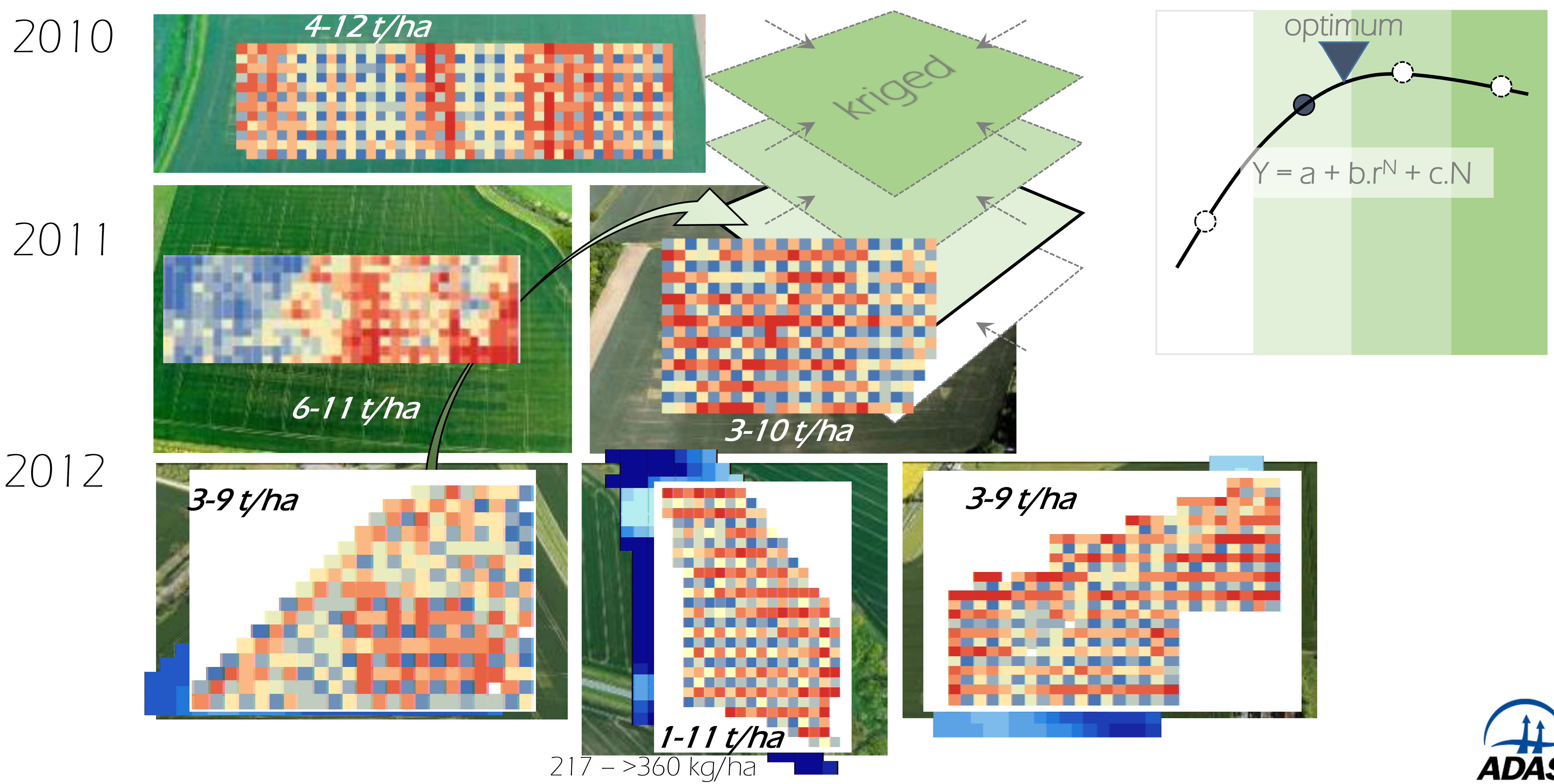
- Commercial work
  - Helping clients develop & test services

ADAS Approach to VRA N

- Using crop to inform SNS estimate
- Previous yield maps /satellite imagery to inform yield potential/N Demand
- Canopy Management approach to adjust spatially & temporally
  - Each unit of GAI = 30kg N for cereals
    50kg for OSR

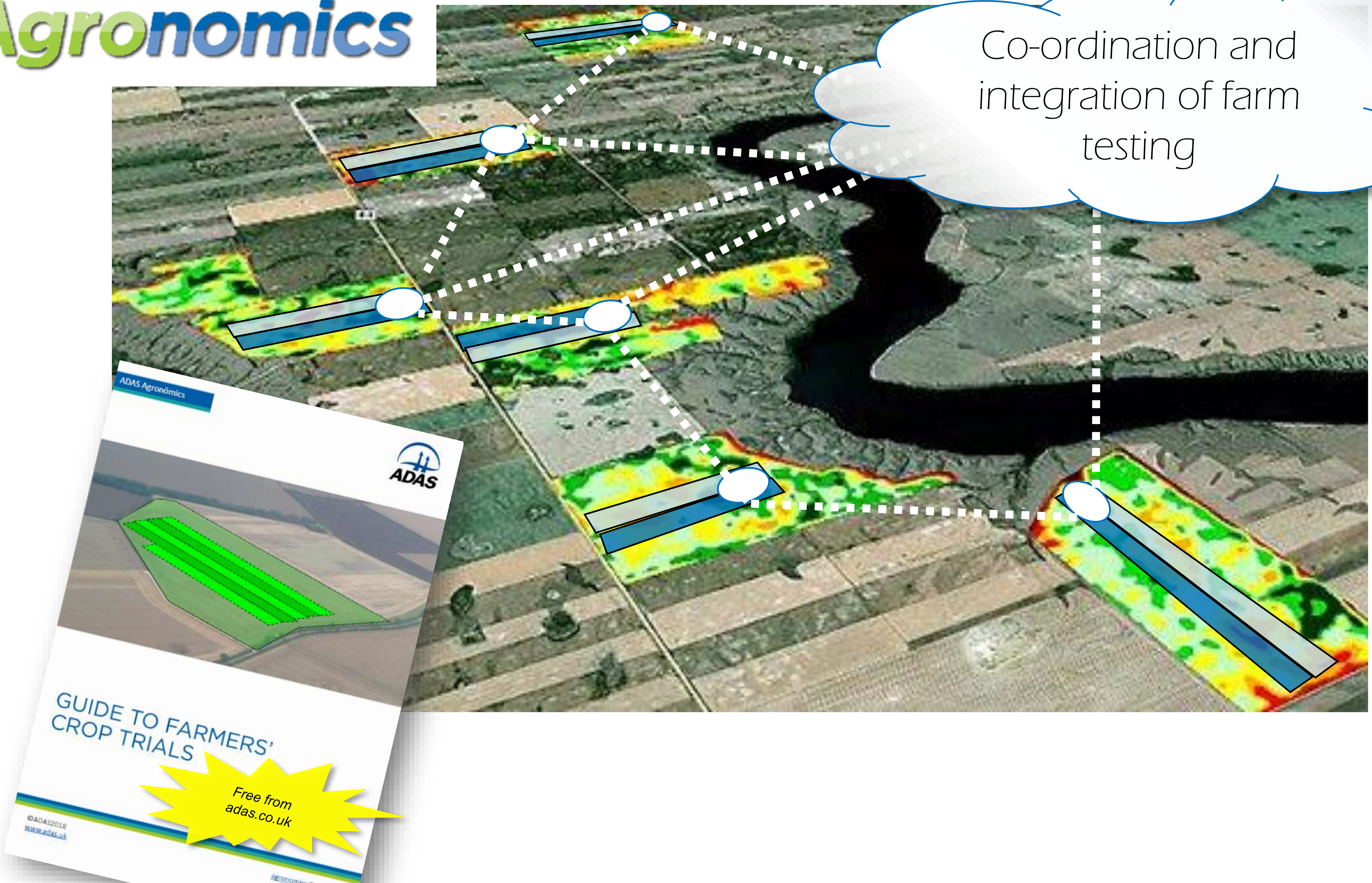

normal trial
0.1-0.2 ha
5 ha 'Chessboard' trial
Auto-N Project 2010-2015
LINK project LK09134, HGCA project RD-2008-3350
Flawborough, Nottinghamshire UK 2010

Analysing Chessboard trials



Agronomics

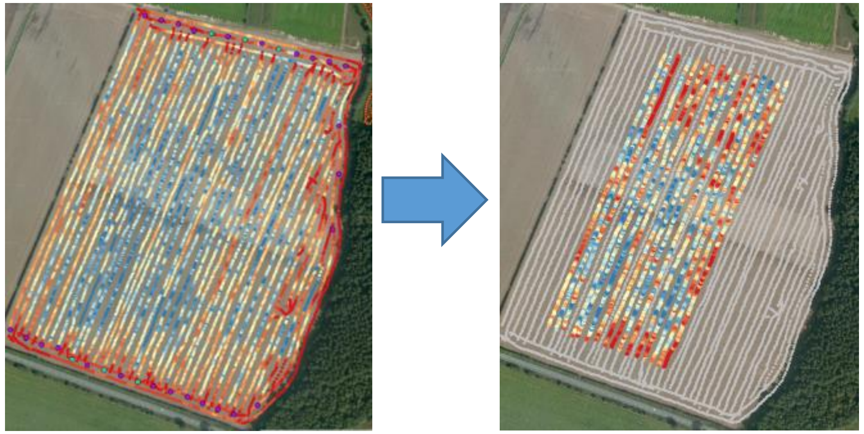
Co-ordination and integration of farm testing

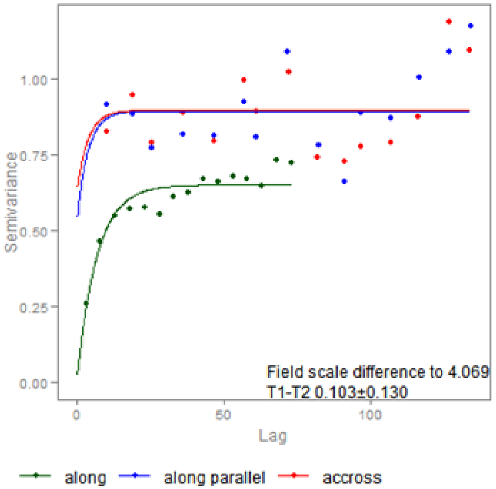


Agronomics

Statistical analysis of yield data using ADAS Agronomics approach

– Cleaned dataset analysed using spatial discontinuity analysis

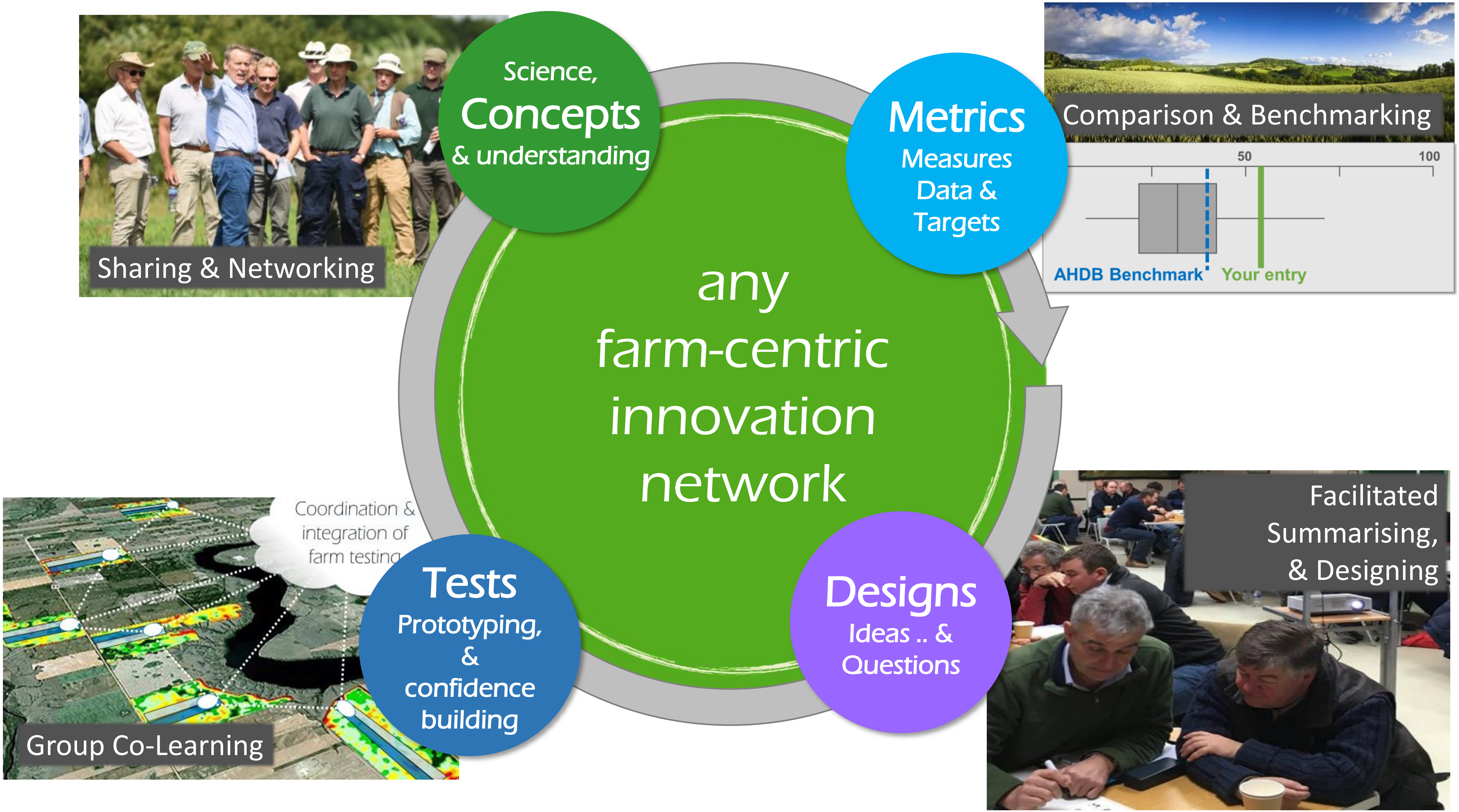




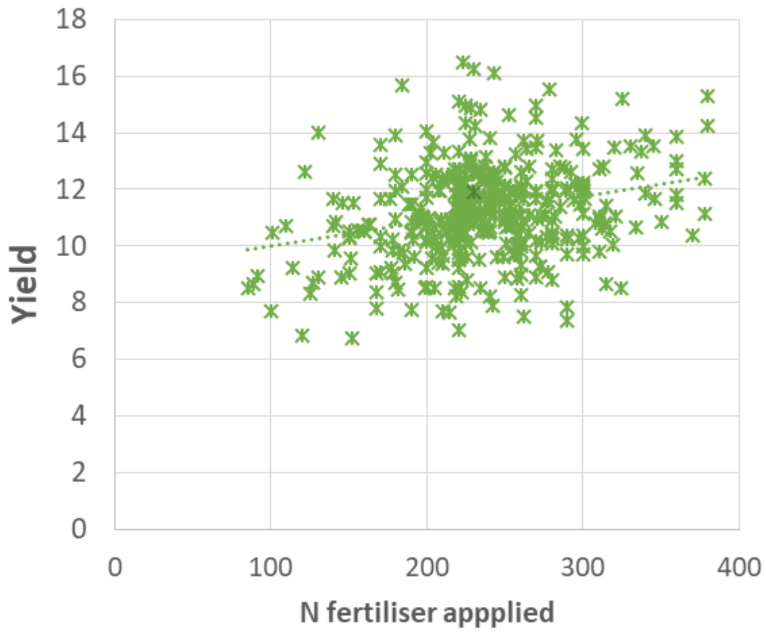
– Takes into account underlying spatial variation in field

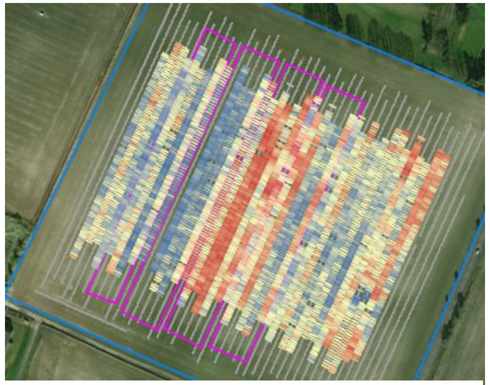
Marchant, Rudolph, Roques, Kindred, Gillingham, Welham, Coleman & Sylvester-Bradley., 2018. Establishing the precision and robustness of farmers crop experiments. *Field Crops Research*. **230**, 31-45

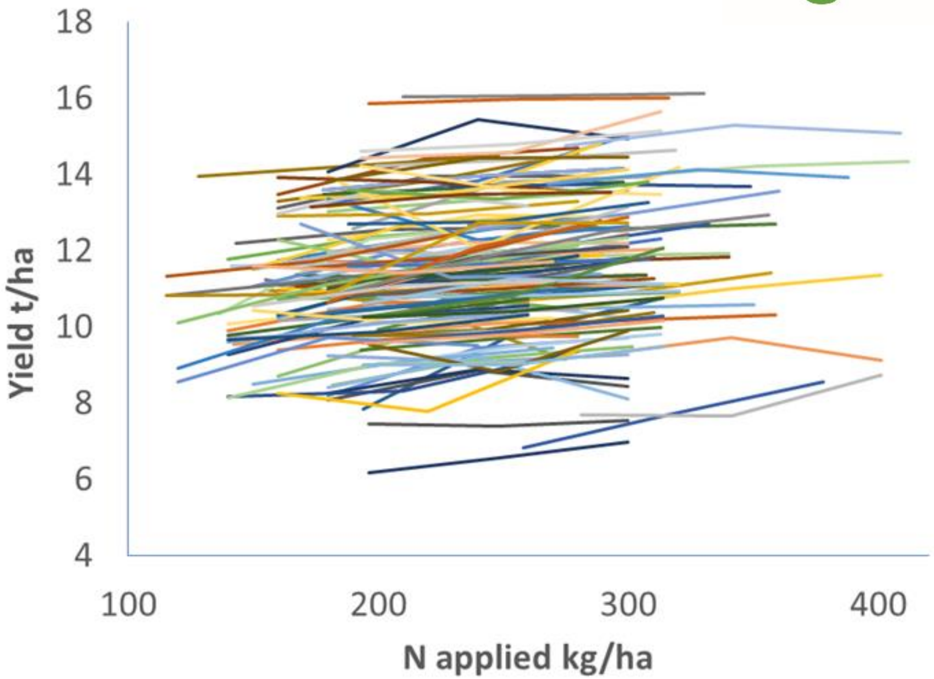
ADAS


Sharing & Networking
Science,
Concepts
& understanding
Metrics
Measures
Data &
Targets
Comparison & Benchmarking
50
100
AHDB Benchmark
Your entry
any
farm-centric
innovation
network
Coordination &
integration of
farm testing
Group Co-Learning
Tests
Prototyping,
&
confidence
building
Designs
Ideas .. &
Questions
Facilitated
Summarising,
& Designing

Variation in yield mostly not due to variability in N applied







ADAS Plans

- Writing paper on Precision Farming and VRA N for Defra
  - Happy to involve co-authors
  - Kate.storer@adas.co.uk
- H2020 Thematic Network on Balanced Nutrition
  - farm-centric involving farm data and farm trials
  - January submission(!)
  - Sarah.Kendall@adas.co.uk
- Intereg North Sea proposal on VR N?
  - Kate.storer@adas.co.uk
- COFE
- ICPA – OFE Community
- EU Plans for H2020 Precision Farming projects – recent JRC report

Agronomics

Daniel.Kindred@adas.co.uk @drkindred

ADAS

Multiple Sensors to obtain spatial information

SOYL SENSE

IPF
....SimplyPrecise

ADAS

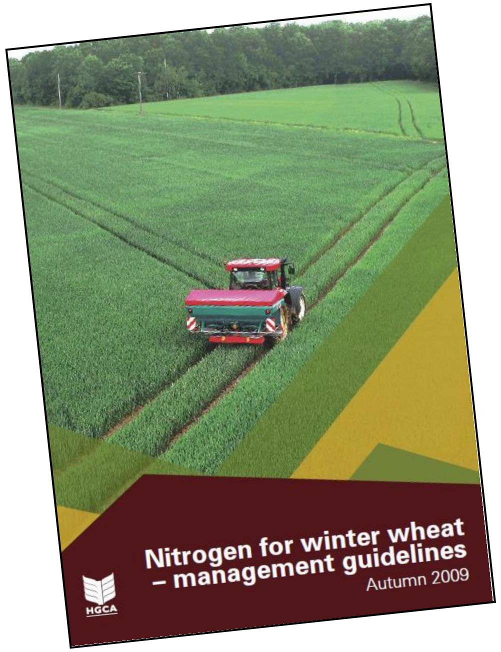
Auto-N Approach

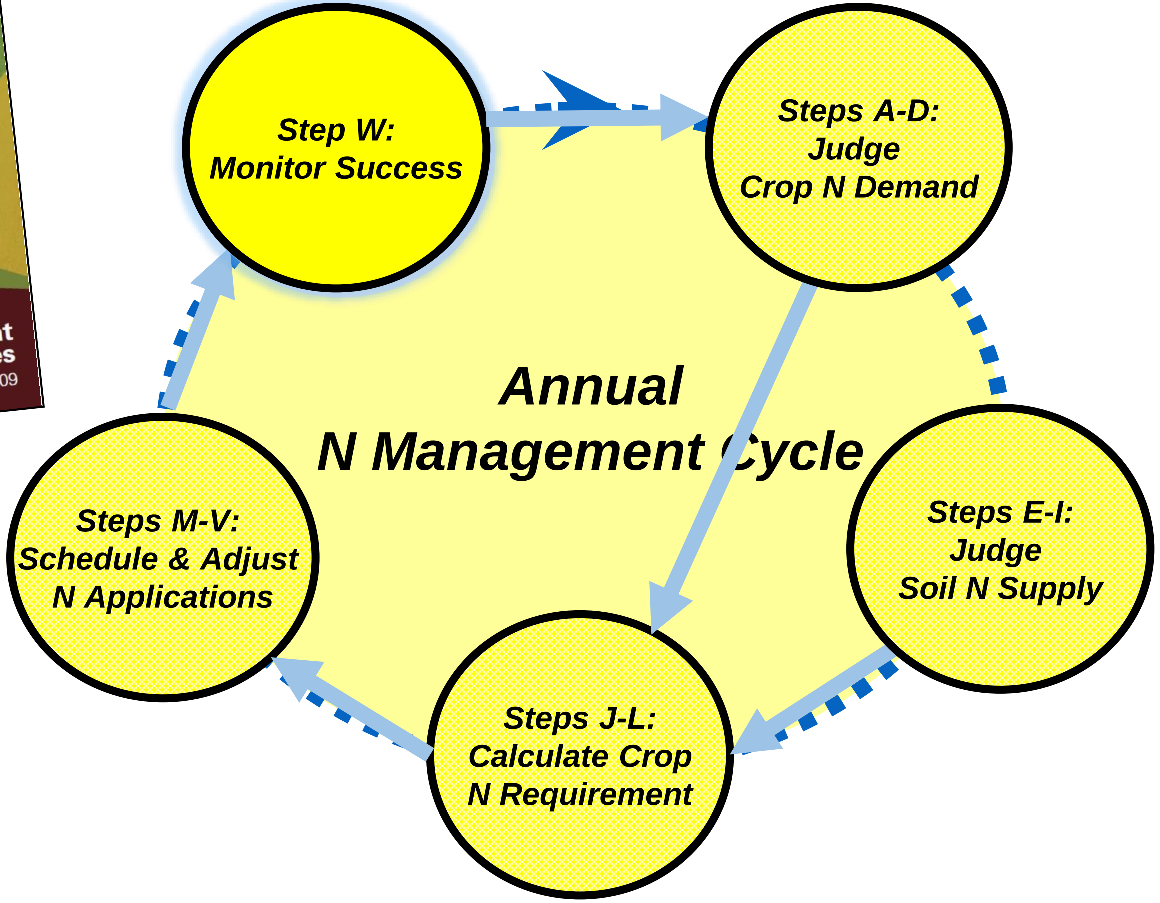
Start with the best *Principles* for N management

Use available technologies to provide relevant information

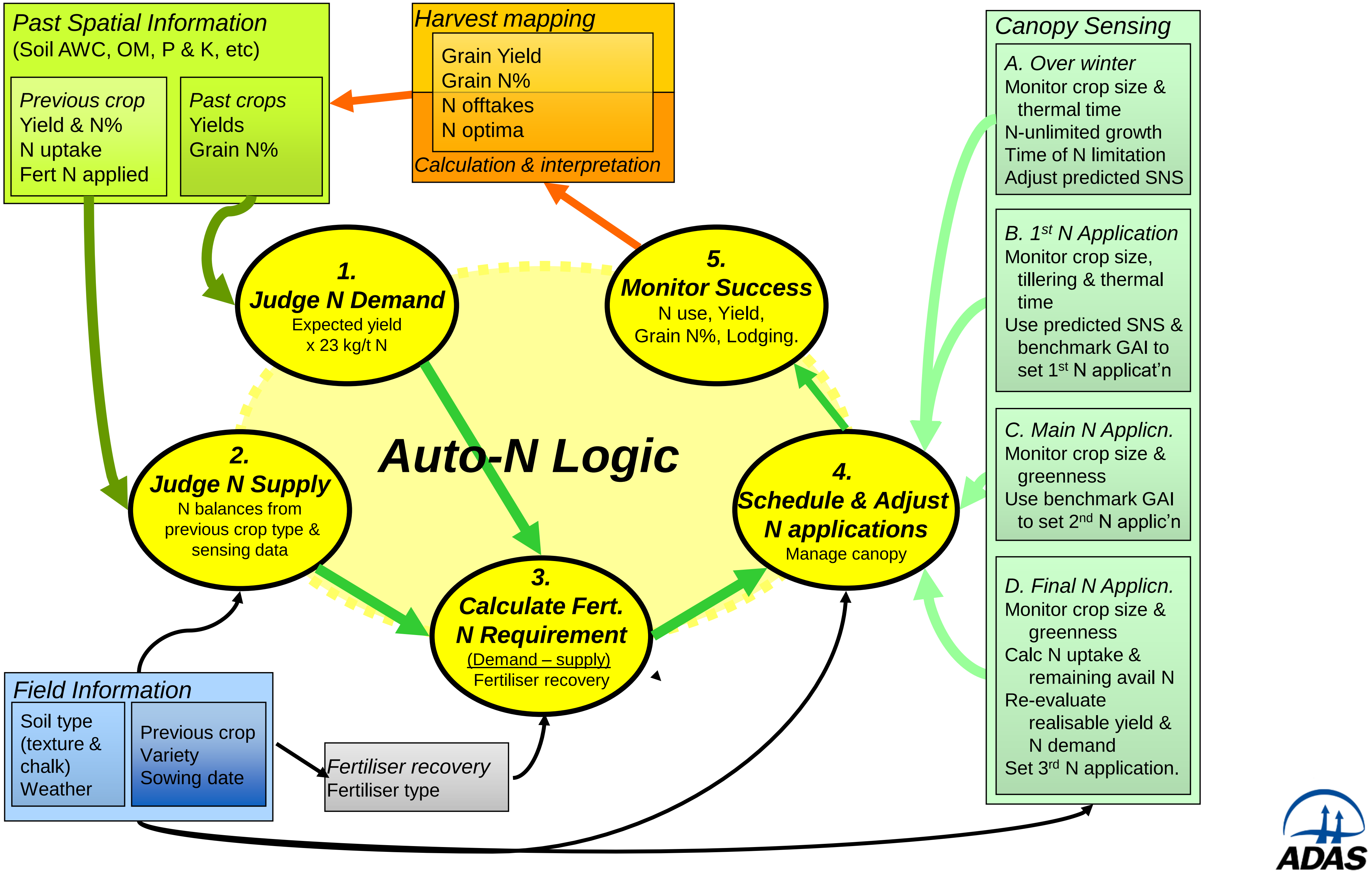
Develop the logic for interpretation

HGCA Guidelines



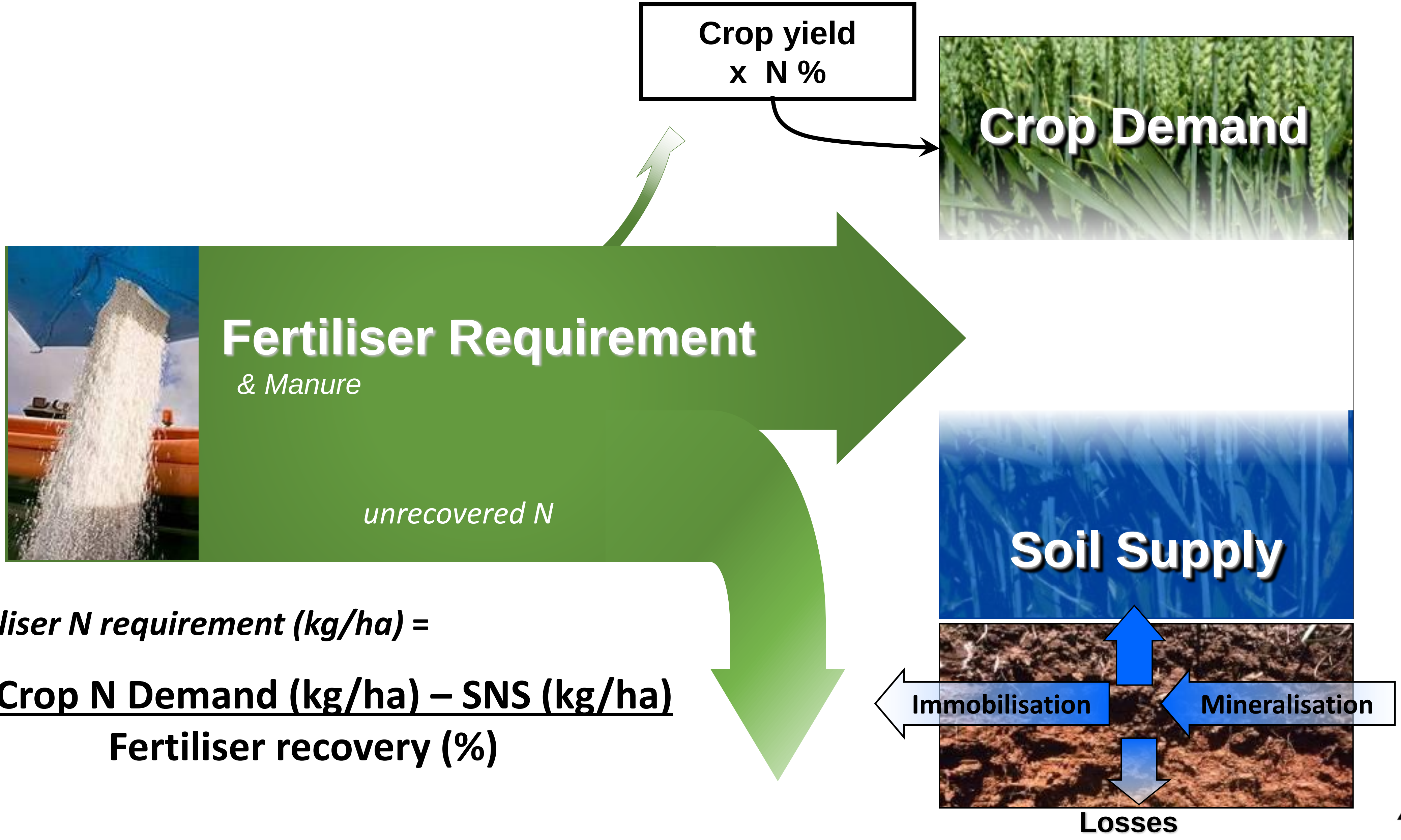


ADAS



Past Spatial Information
(Soil AWC, OM, P & K, etc)
Previous crop
Yield & N%
N uptake
Fert N applied
Past crops
Yields
Grain N%
Harvest mapping
Grain Yield
Grain N%
N offtakes
N optima
Calculation & interpretation
Canopy Sensing
A. Over winter
Monitor crop size & thermal time
N-unlimited growth
Time of N limitation
Adjust predicted SNS
B. 1st N Application
Monitor crop size, tillering & thermal time
Use predicted SNS & benchmark GAI to set 1st N applicat'n
C. Main N Applicn.
Monitor crop size & greenness
Use benchmark GAI to set 2nd N applic'n
D. Final N Applicn.
Monitor crop size & greenness
Calc N uptake & remaining avail N
Re-evaluate realisable yield & N demand
Set 3rd N application.
1. Judge N Demand
Expected yield x 23 kg/t N
5. Monitor Success
N use, Yield, Grain N%, Lodging.
Auto-N Logic
2. Judge N Supply
N balances from previous crop type & sensing data
4. Schedule & Adjust N applications
Manage canopy
3. Calculate Fert. N Requirement
(Demand – supply)
Fertiliser recovery
Field Information
Soil type (texture & chalk)
Weather
Previous crop
Variety
Sowing date
Fertiliser recovery
Fertiliser type
ADAS

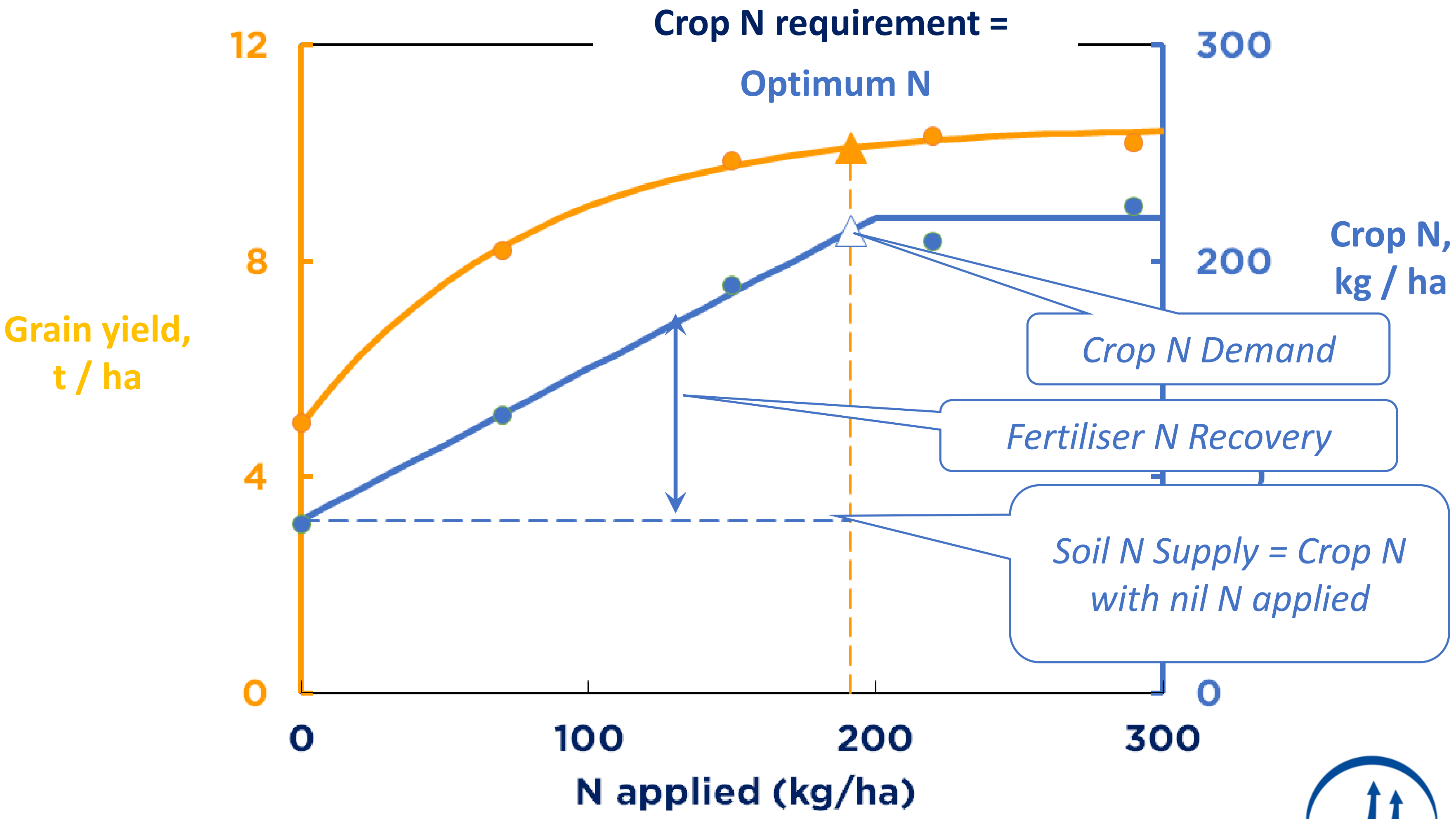
Calculating Nitrogen requirements



Fertiliser N requirement (kg/ha) =

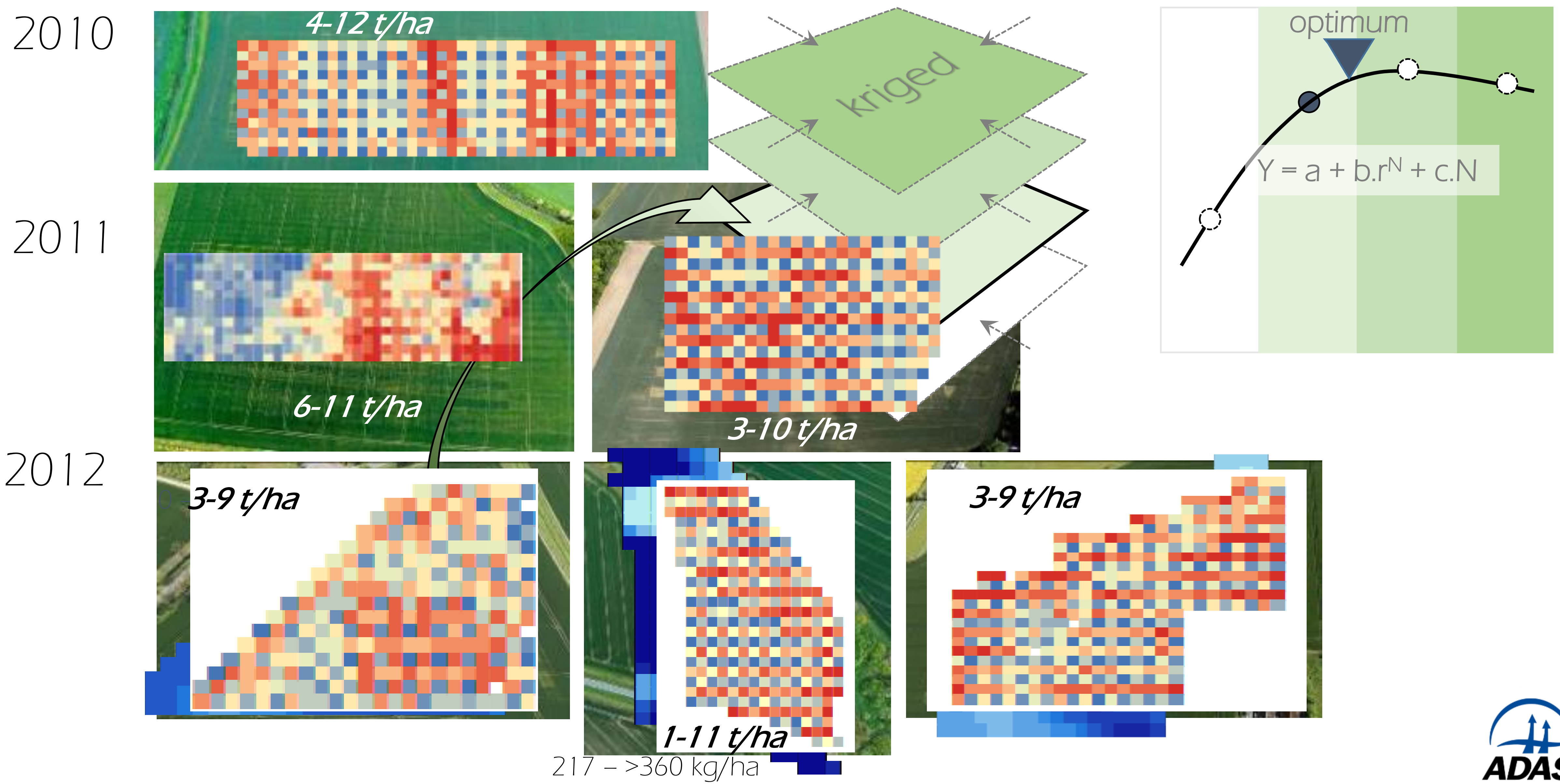
$$\frac{\textbf{Crop N Demand (kg/ha) – SNS (kg/ha)}}{\textbf{Fertiliser recovery (\%)}}$$

Measuring N Requirement – economic N optima



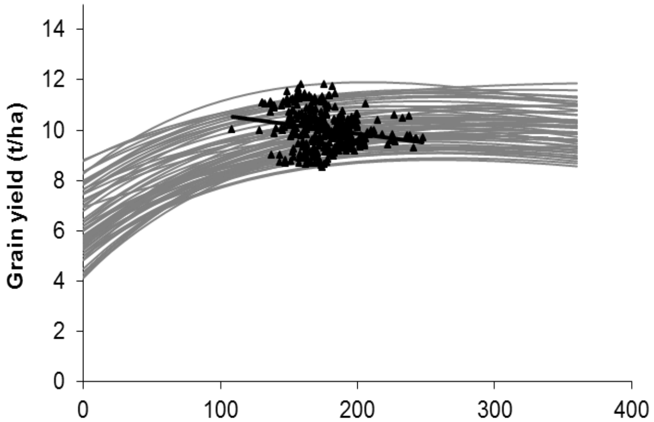

normal trial
0.1-0.2 ha
5 ha 'Chessboard' trial
Auto-N Project 2010-2015
LINK project LK09134, HGCA project RD-2008-3350
LINK collaborative research
soil essentials precision farming solutions
farmade
Agrii
YARA
ADAS
defra
HGCA
BASF The Chemical Company
Ag Leader Technology
FOSS
Hill Court Farm Research
Zeltex Inc.
Precision Decisions Ltd Driving farm efficiency
NIAB TAG
SOYL PRECISION FARMING
ROTHAMSTED RESEARCH
Flawborough, Nottinghamshire UK 2010

Analysing Chessboard trials

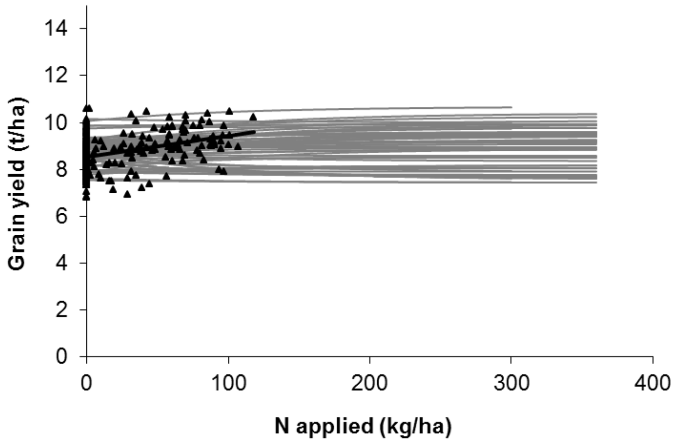


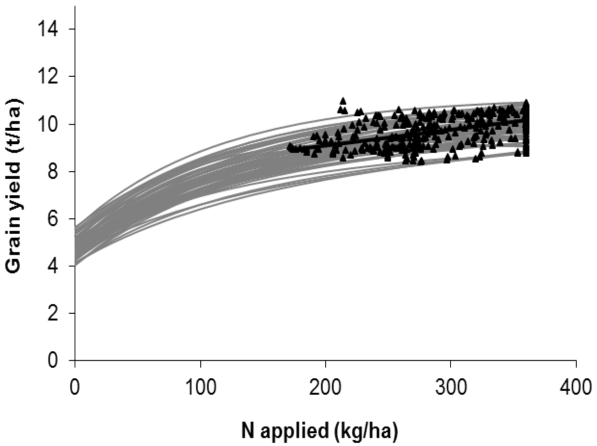
Chessboard N responses

2010

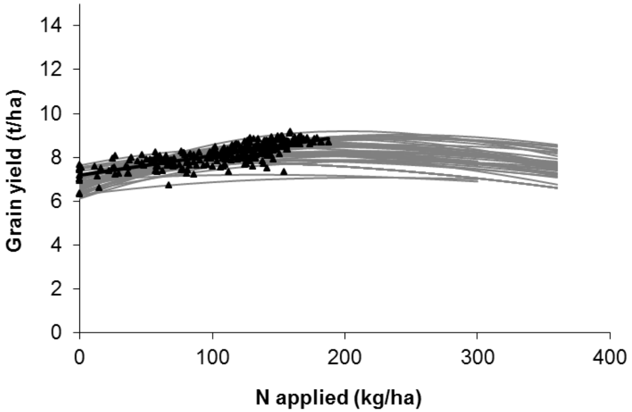


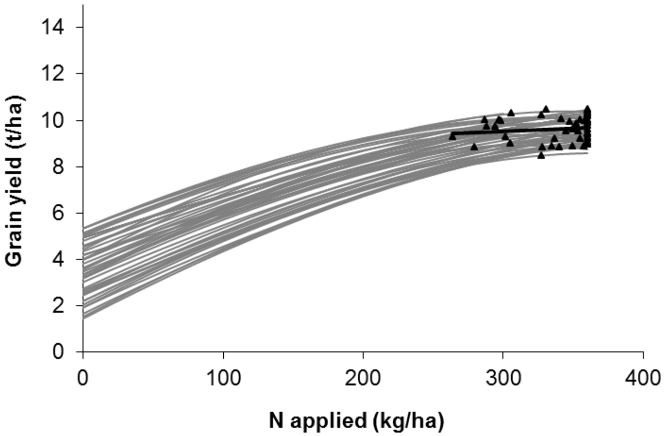
2011

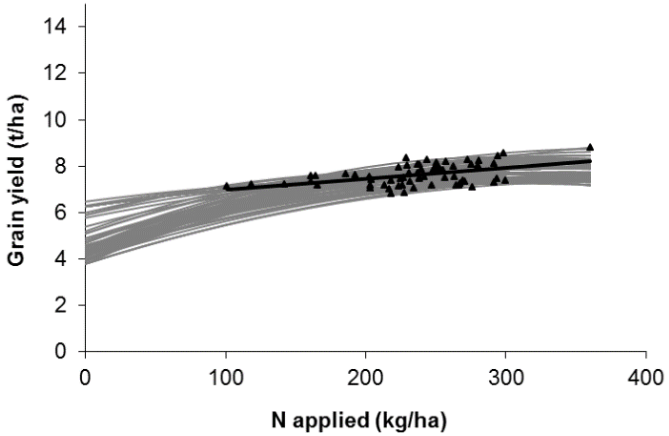




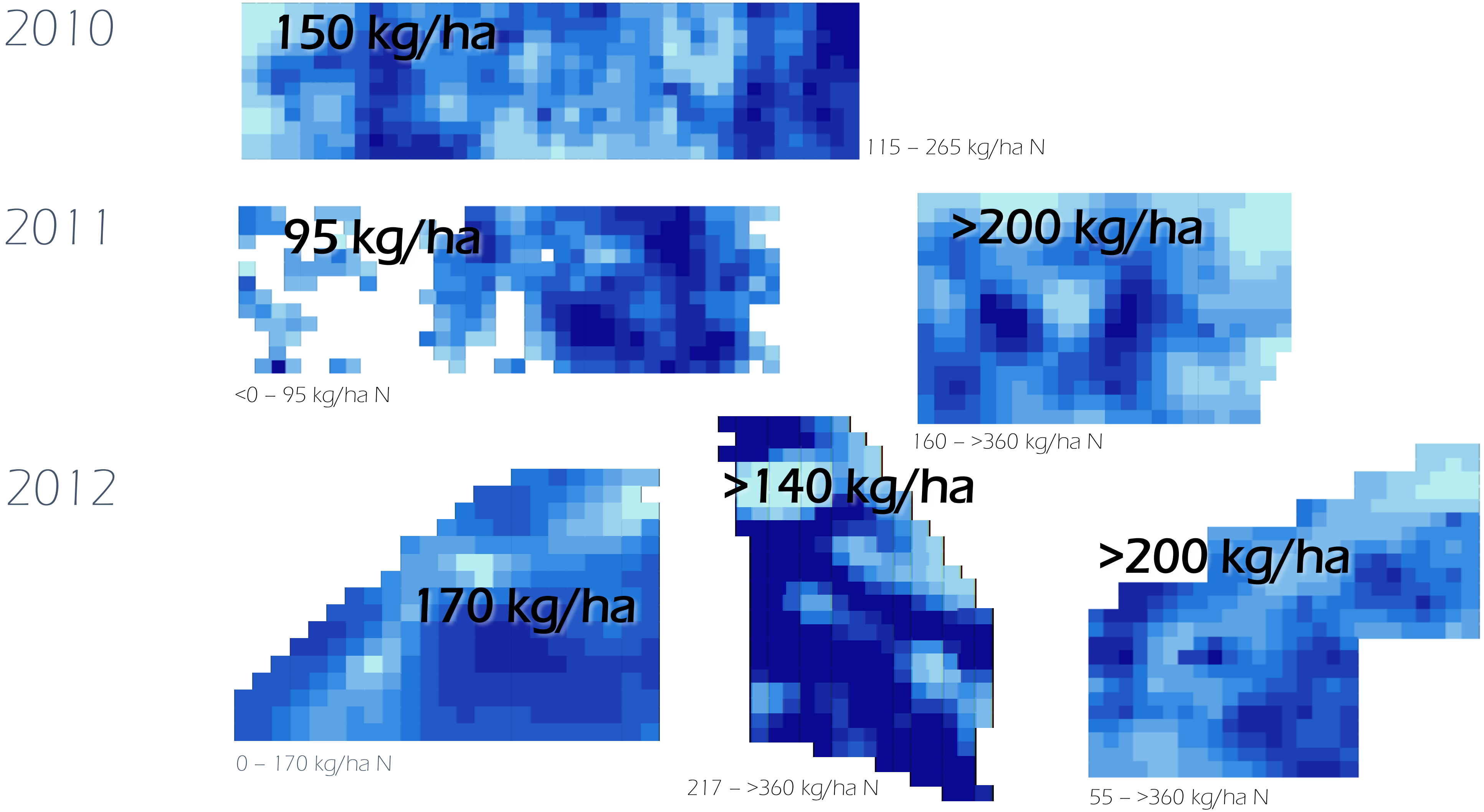
2012







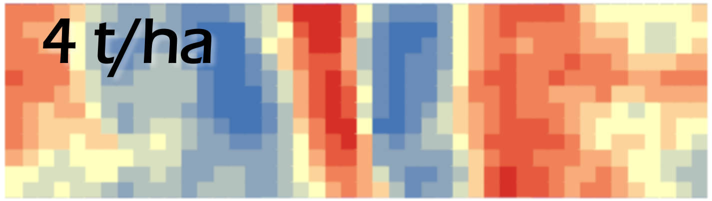
In-field ranges of N requirements i.e. N optima



Kindred et al., 2016. AHDB Project Report 561, Auto-N

Variation in yield at optima

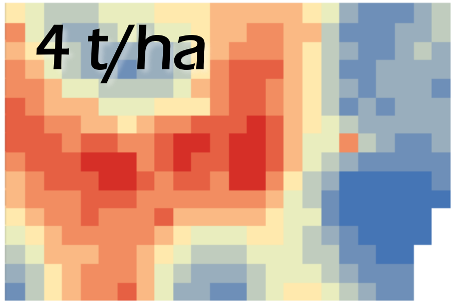
2010



8.2 – 11.5 t/ha

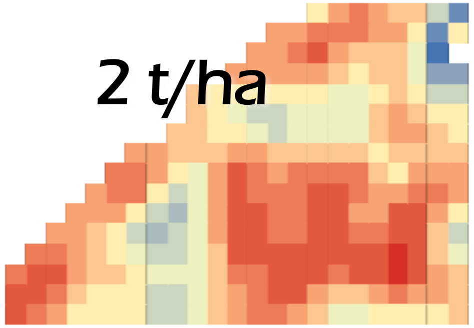
2011

6.5-11 t/ha



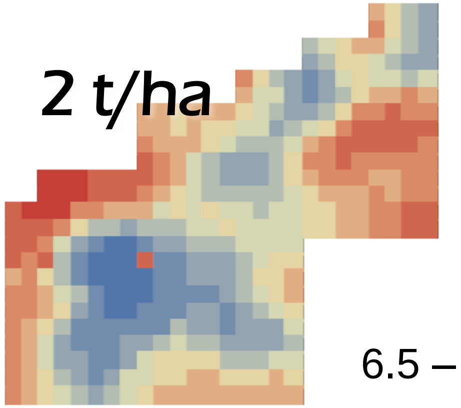
7.7- 10.8 t/ha

2012



6.5 – 9 t/ha

7.5 - 11 t/ha



6.5 – 8.5 t/ha

Kindred et al., 2016. AHDB Project Report 561, Auto-N

ADAS

Variation in SNS

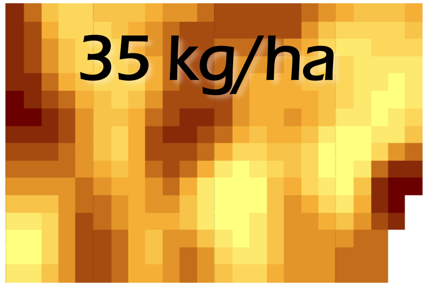
(Total N uptake at zero-N)

2010

60 – 180 kg N/ha

2011

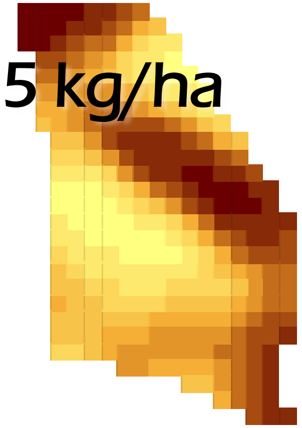
95 – 175 kg N/ha



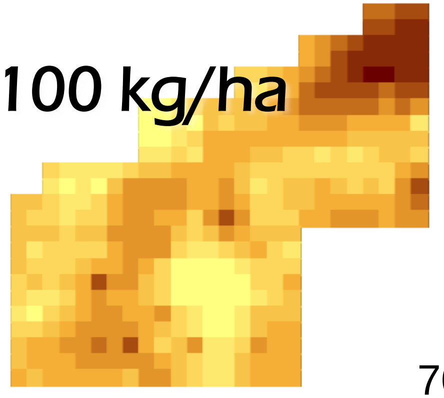
65 – 100 kg N/ha

2012

125 – 200 kg N/ha



25-100 kg N/ha

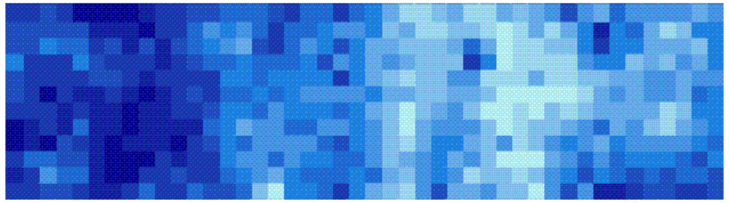


70 – 190 kg N/ha

Kindred et al., 2016. AHDB Project Report 561, Auto-N

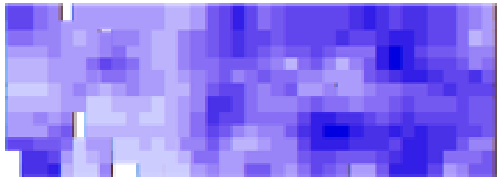
Variation in Fertiliser recovery

2010

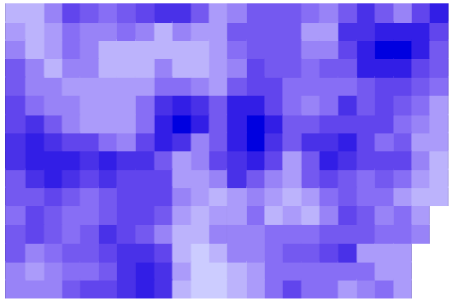


35 – 80%

2011

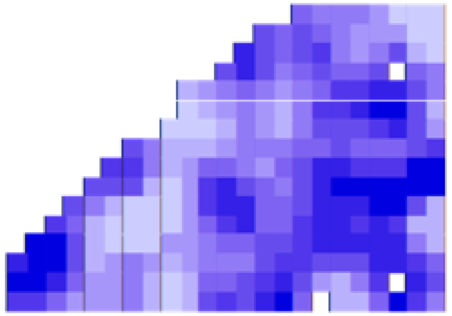


0 – 47%

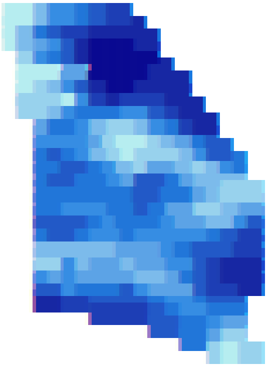


30 – 79%

2012



40 – 95%



37- 60%

35 – 80%

Conclusions from chessboards

- Large spatial variation in yield, N requirement, SNS & fertiliser recovery
  - SNS generally most important driver of N requirement,

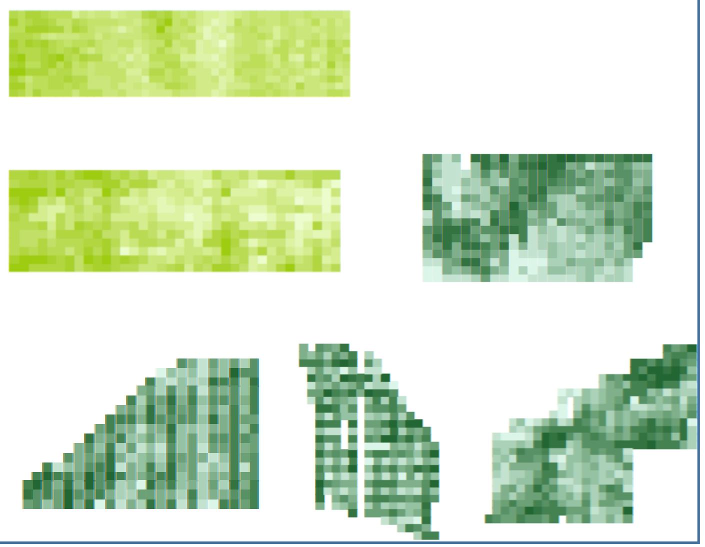
    … but positively related to yield potential (crop demand) and interacts with recovery
    - Makes predicting N optima challenging

- Supports general principles of variable rate system

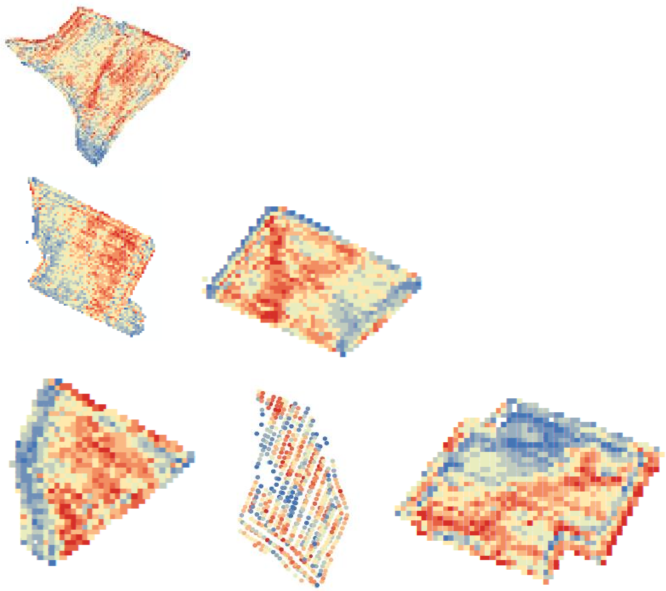
  …Sensing in early spring relates to SNS.

  …Yield mapping and later sensing can inform crop N demand.

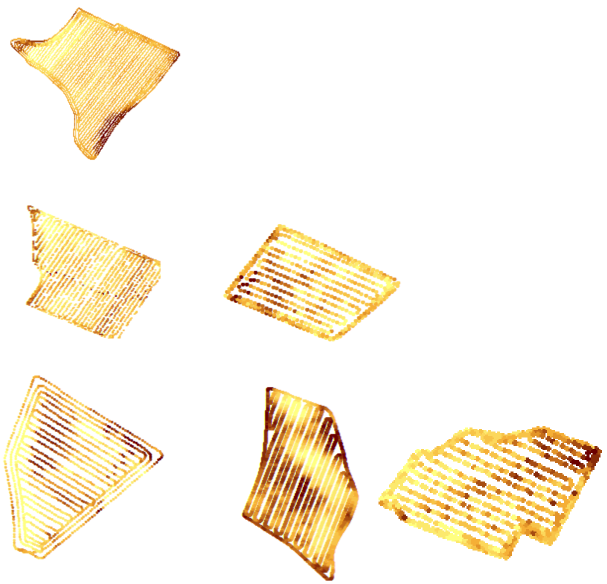
NDVI



Averaged previous yield maps



Soil Sensing



Benefits of variable rate N

Site	N optima kg/ha	Average N optima	Profit foregone vs flat 200 kg N/ha	Profit foregone vs accurate flat rate	Yield gained vs 200 kg/ha flat rate (t/ha)	Yield gained vs accurate flat rate (t/ha)
Flawboro 2010	115-265	185	£7	**£4**	-0.1	**0.03**
Flawboro 2011	0-95	10	£191	**<£1**	0	**0.13**
Burford 2011	162->360	264	£6	**£5**	0.23	**0.04**
Burford 2012	53->360	219	£23	**£8**	0.34	**0.04**
Bedfordia 2012	0-171	93	£51	**£13**	0.06	**0.1**
Shipton 2012	207->360	322	£195	**£23**	1.56	**0.12**

Kindred et al., 2016. AHDB Project Report 561, Auto-N

ADAS

Learnings

- Yield impact of optimal N application surprisingly small
  - So economic benefits of variable rate modest

    … assuming average N application for field is accurate
  - Most important is to get accurate average N rate for farm and field
- N limitation is not the major driver of spatial variation in yield

  … What is???
- Greatest power of Precision Farming is to enable farmers to test decisions
  - Spatial experimentation at field scale is a powerful research tool

Agronomics

Farmer-centric research to develop farm-tailored decision-making

http://www.adas.uk/services/agronomics

LearN

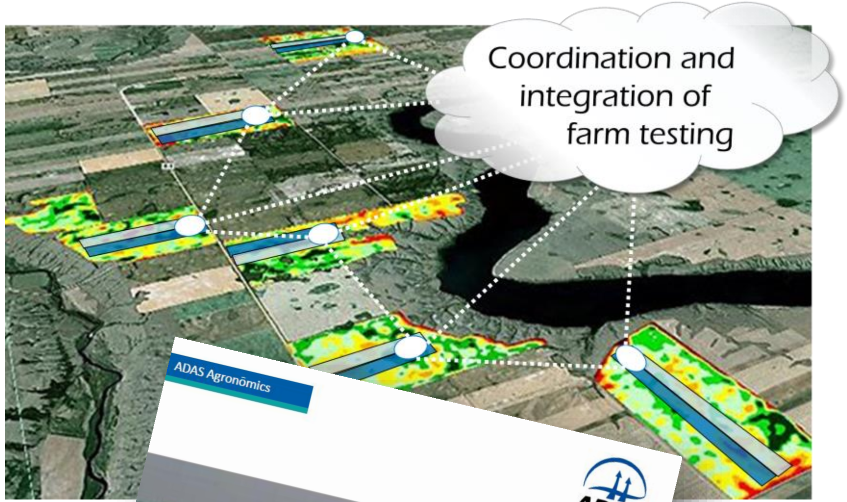
On-Farm Testing of N management, AHDB project 2013 – 2018

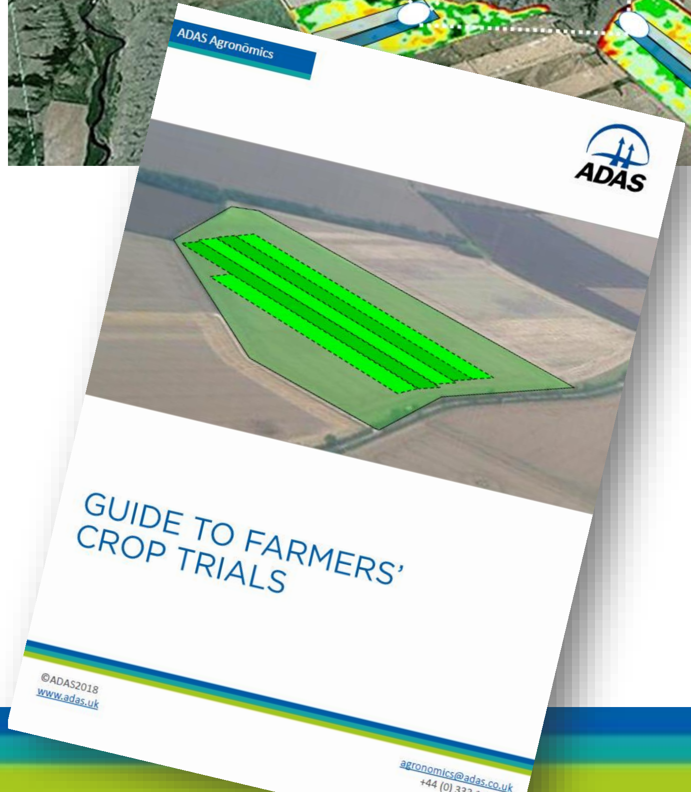
https://cereals.ahdb.org.uk/publications/2018/august/08/using-farm-experience-to-improve-n-management-for-wheat-(learn).aspx

ADAS

Agronōmics: Farmer-centric research to develop farm-tailored decision making

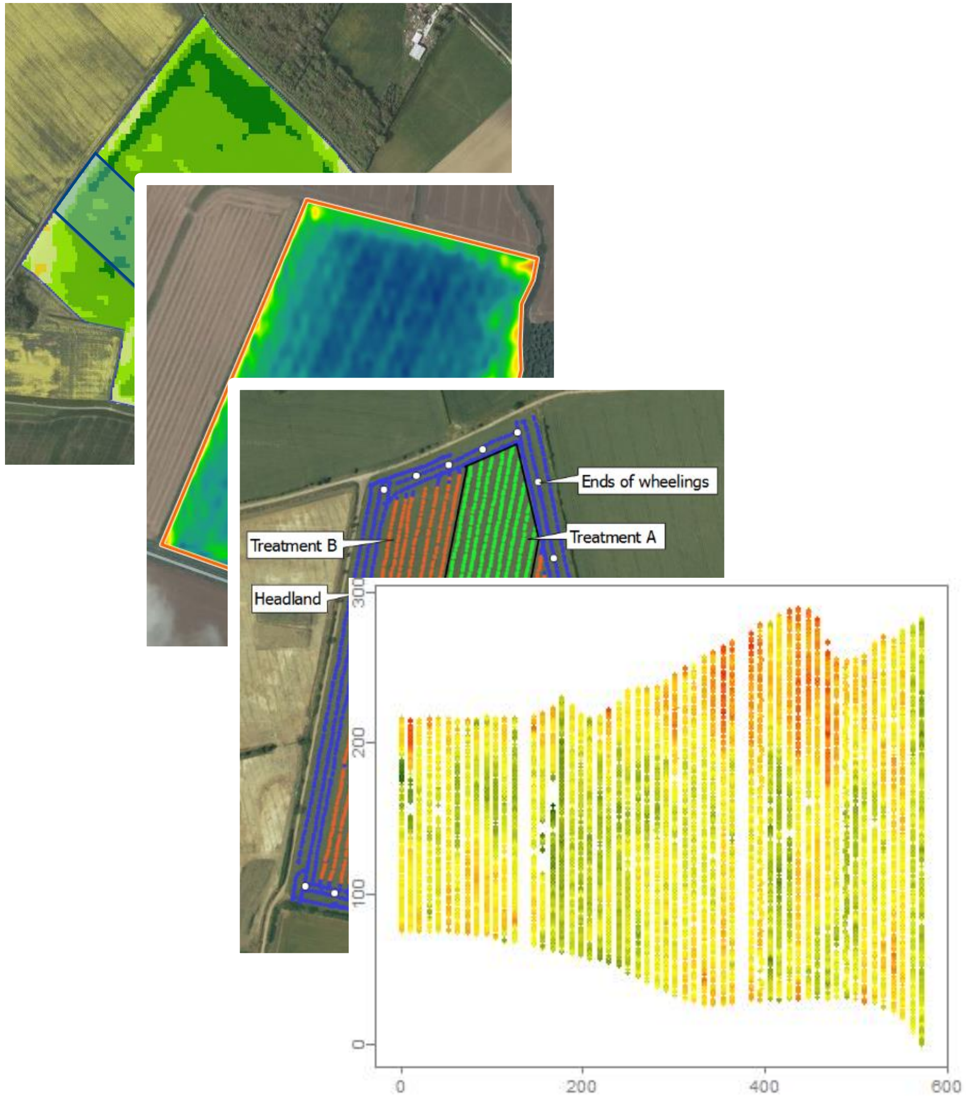
- Farmer networks
- Precision farming
- Remote sensing
- Data sharing





Agronōmics approach

1. Fair trial designs
2. In-season monitoring
3. Assigning data to treatments
4. Data cleaning and correction



Agronōmics approach

4. Statistical analysis
5. Interpretation of spatial and treatment effects
6. Bespoke reporting