Re-mapping the Agricultural Census ~ Cattle and Grassland

Rural Economy and Land Use
Uncertainty Workshop
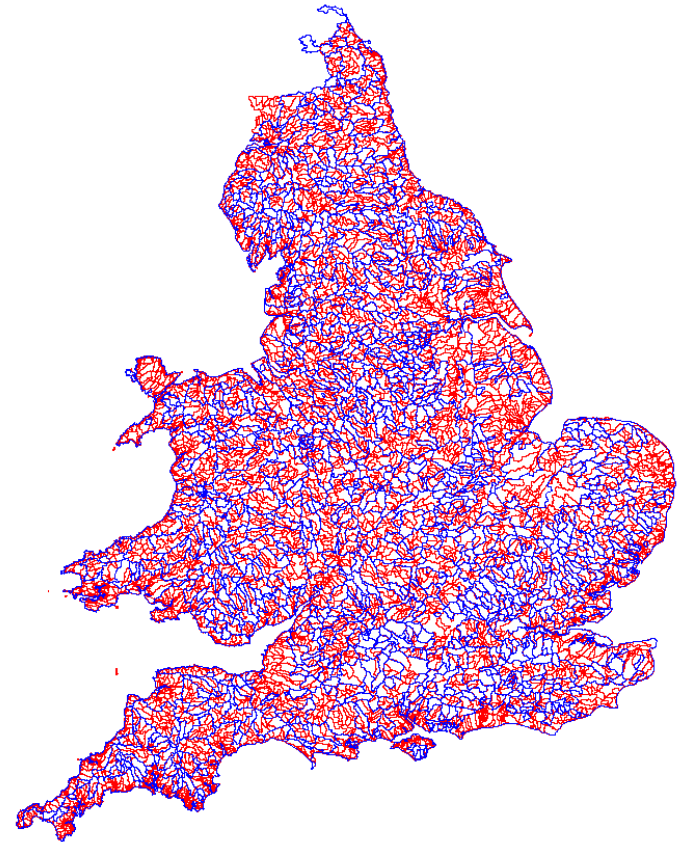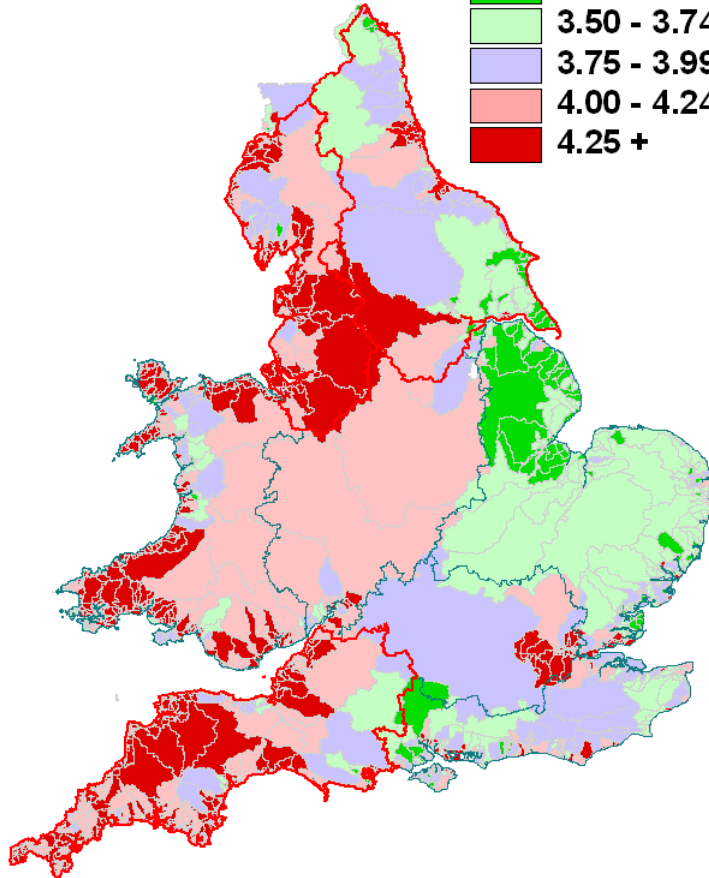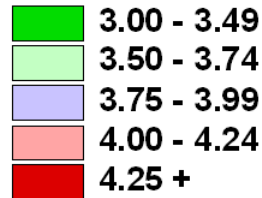
21st March 2007

Dr Steven Anthony
Environment Systems
ADAS UK

Scale of Modelling ~ Catchments and Basins
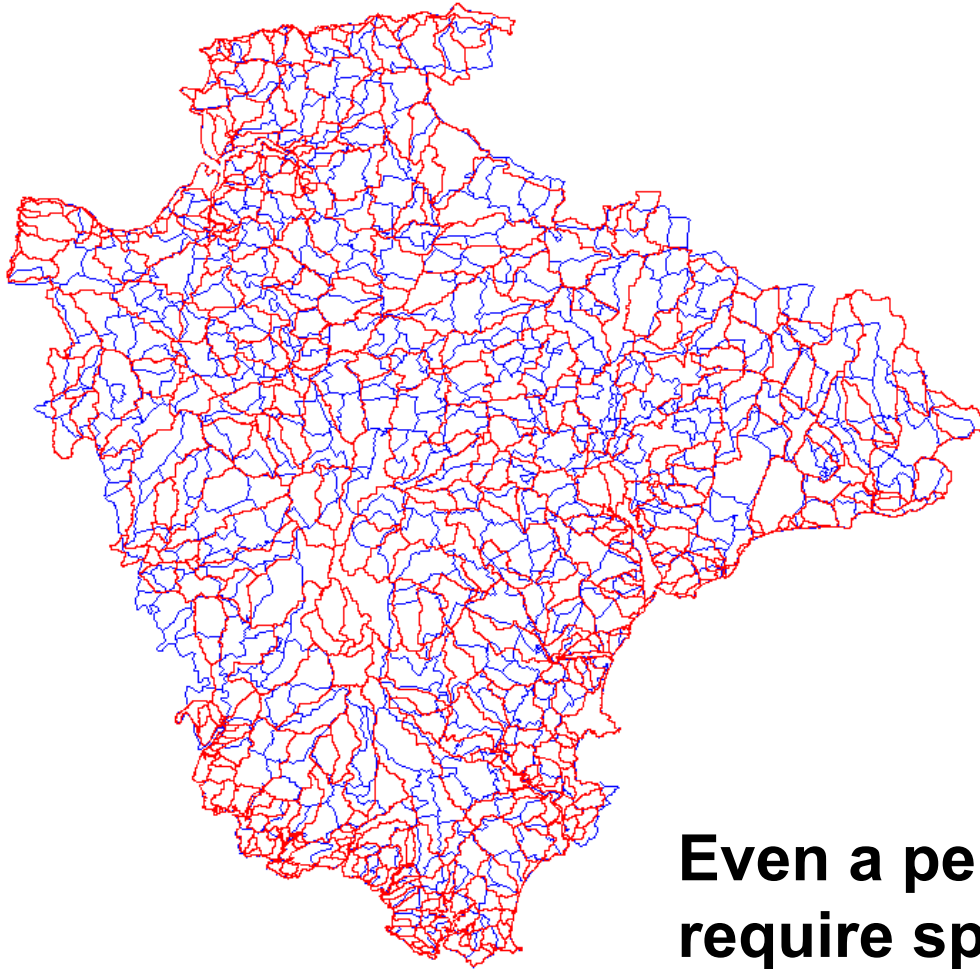
High Flow FIO Concentrations

Log$_{10}$ FIO

🟩	3.00 - 3.49
🟩	3.50 - 3.74
🟦	3.75 - 3.99
🟥	4.00 - 4.24
🟥	4.25 +

— WFD Sub-Catchment (7,816 @ 20km^2)

— Gauged Catchment (1,200 @ 130km^2)

Scale of Agricultural Source Data

0   20   40   Kilometers

Parish (426 @ 16km^2)
Parish Group (154 @ 44km^2)
Super Output Area* (92 @ 73km^2)
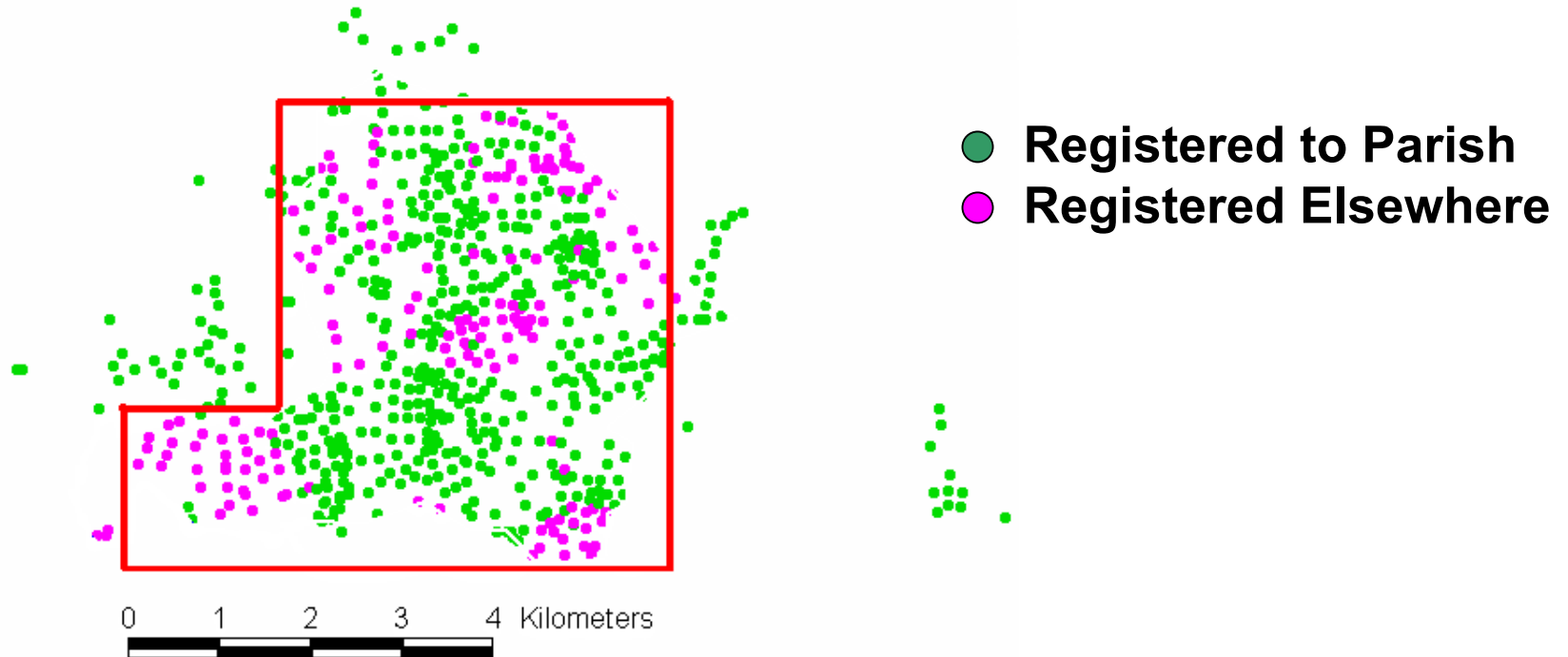
*Farms are Getting Larger
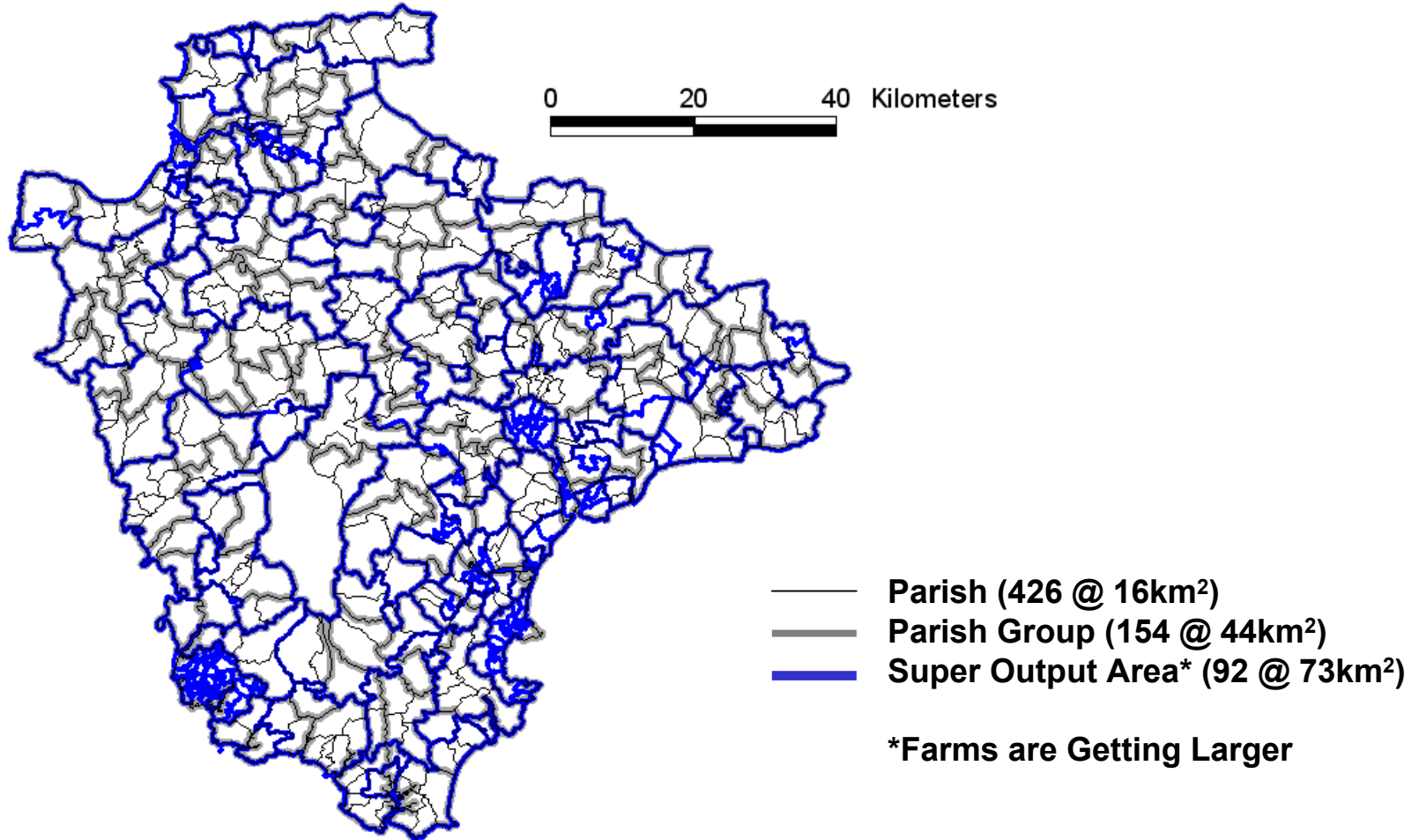
Incompatible Source and Target Units

Parish
WFD Sub-Catchment

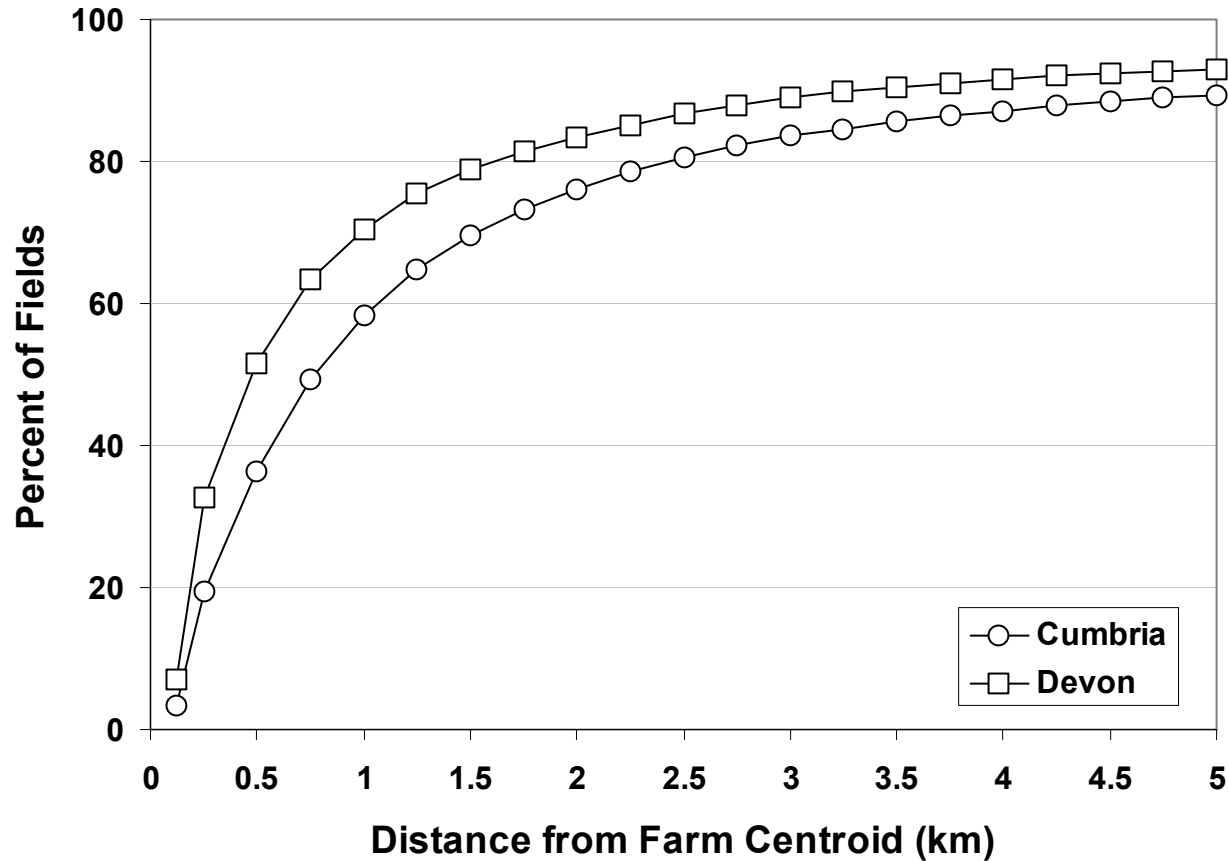**Even a perfect census dataset would require spatial dis-aggregation …**

Parish Registration by Holding and Group

● Registered to Parish
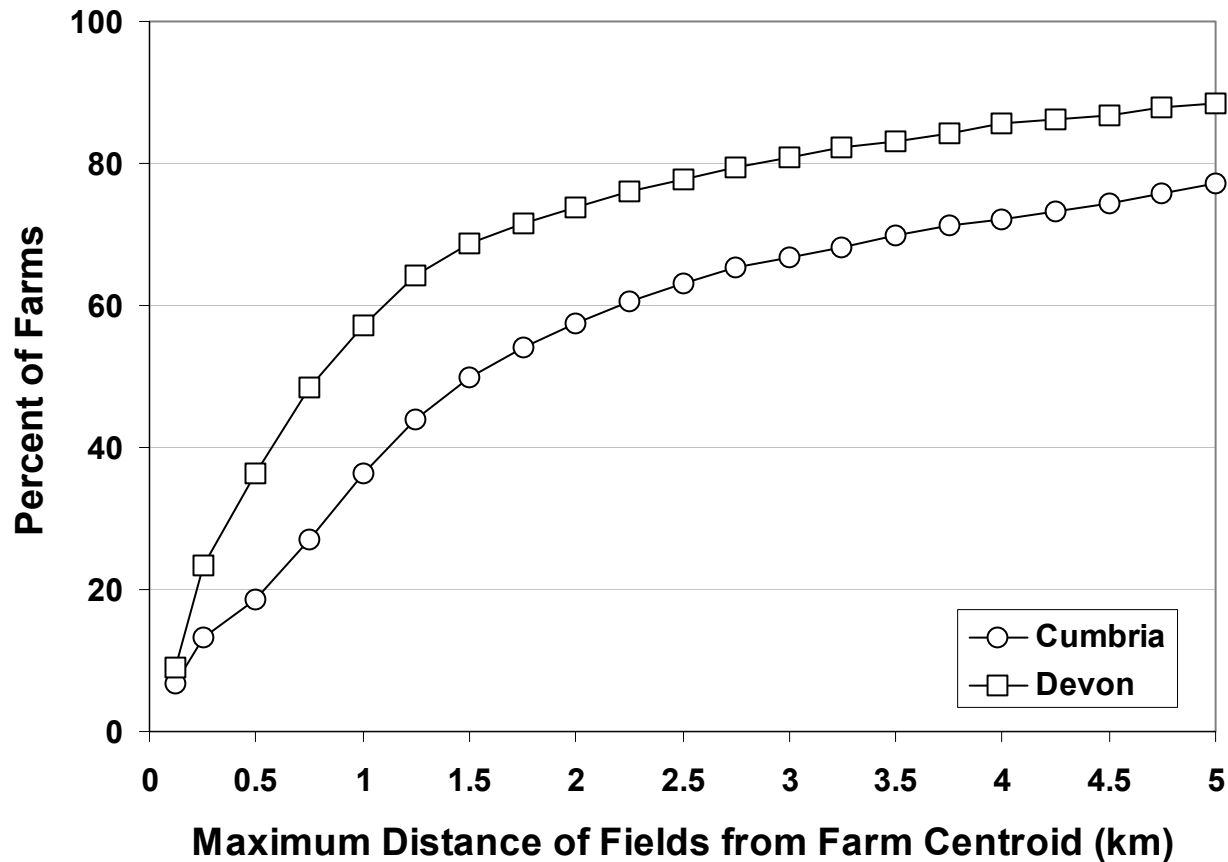● Registered Elsewhere

0   1   2   3   4 Kilometers

Devon : 25% of Fields Outside of Parish to which Holding is Registered, and 18% Outside of Parish Group

Intrinsic Farm Scale ~ Span of Field Distances

Similar Results for Farm Holding Location

# Intrinsic Farm Scale ~ Maximum Distance

SOA Mapping Now Based on Average Field Grid Reference

Re-mapping the Agricultural Census

- **Map potential agricultural land using non-census data sources at high resolution 1km^2, e.g. LCMGB**

- **Use census data at parish and parish group level to provide 'practice information'**

- **Iterative mapping algorithms conserve:**

  Arable : Grass Ratio at Parish Scale

  Relative Areas of Crop Types at Parish Scale

  Stock Density at Group Scale

  Absolute Area / Stock Count at District Scale
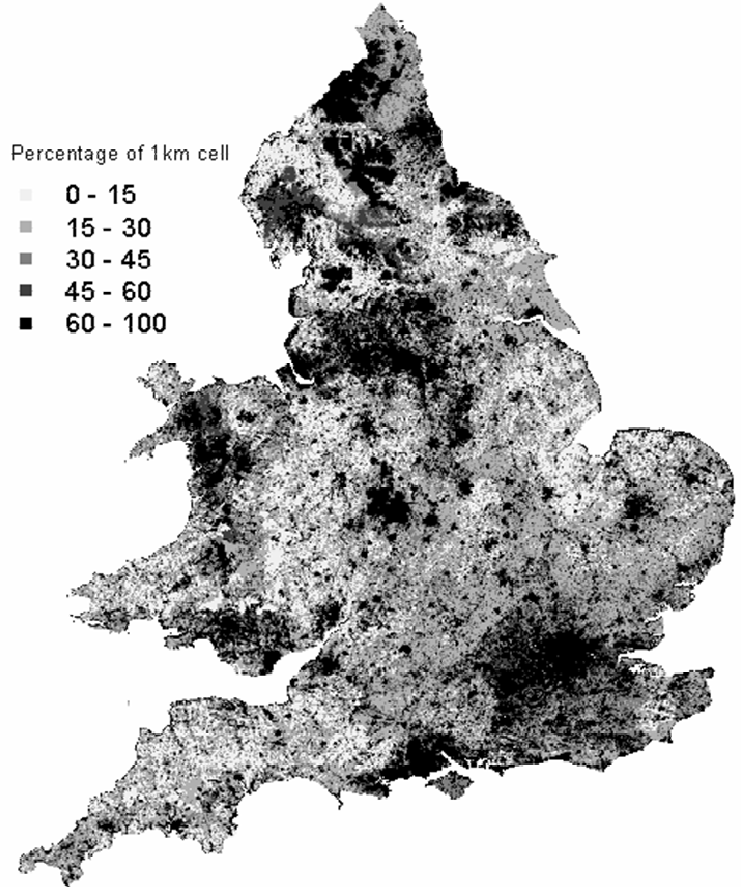
Non-Agricultural Mask – Dasymetric Method

Vector data at a scale of 1 : 250,000 were sourced from government agencies to define areas of non-agricultural land. These included Woodland, Urban Areas, Rivers, Roads, Airfields, and areas of Common Land.
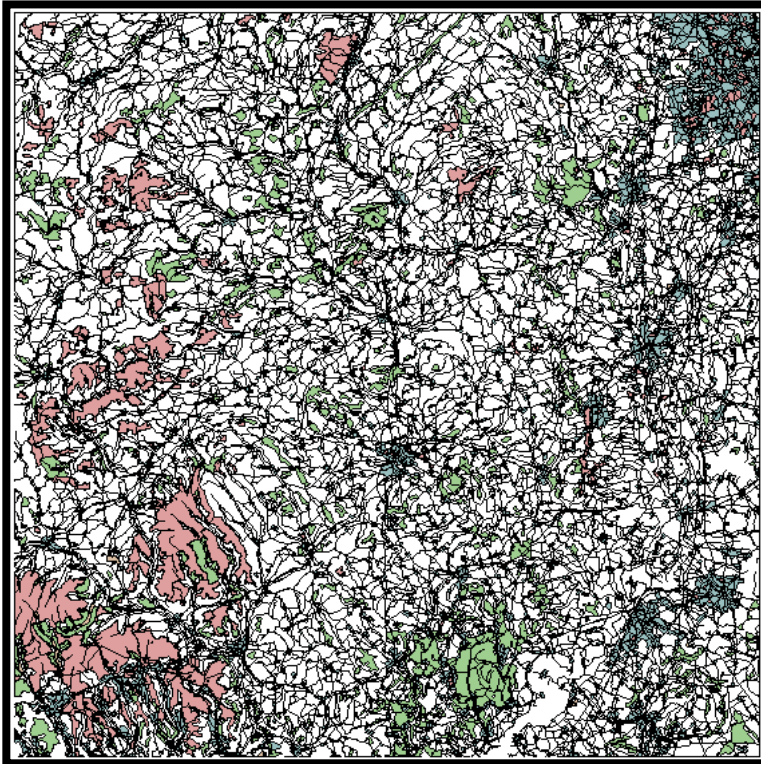
Reproduced with permission of the Controller of Her Majesty's Stationary Office. MAFF Licence no. GD272361

Percentage of 1km cell
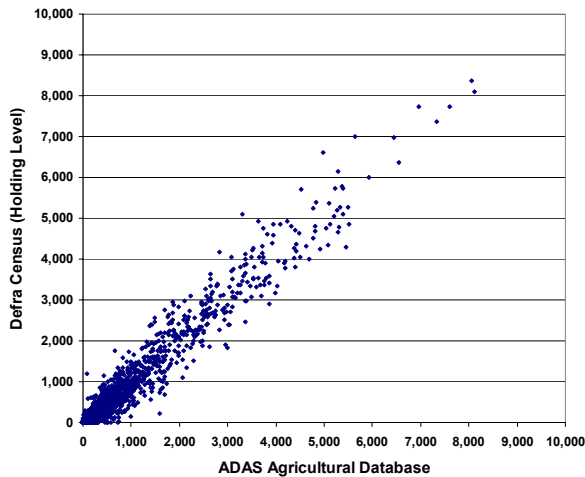
- 0 - 15
- 15 - 30
- 30 - 45
- 45 - 60
- 60 - 100

Non-Agricultural Land

LCMGB Gap Filling – Pycnophylactic Method

Multi-Scale Comparison and Correction

Parish Group Scale

Quantifying the Uncertainty ~ 10by10km Cells

Comparison with Aggregate Holding Level Data

Dairy Cows

Beef Cows

Stock Density

Error σ 310

Error σ 170

Error σ 0.17

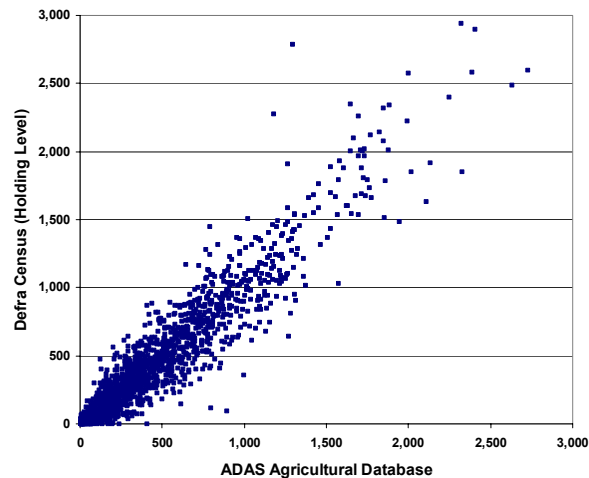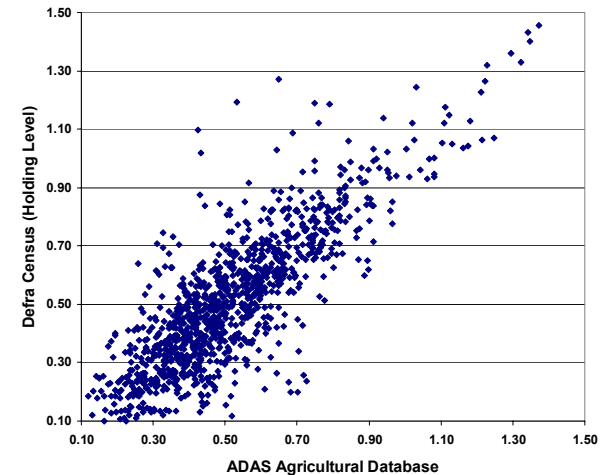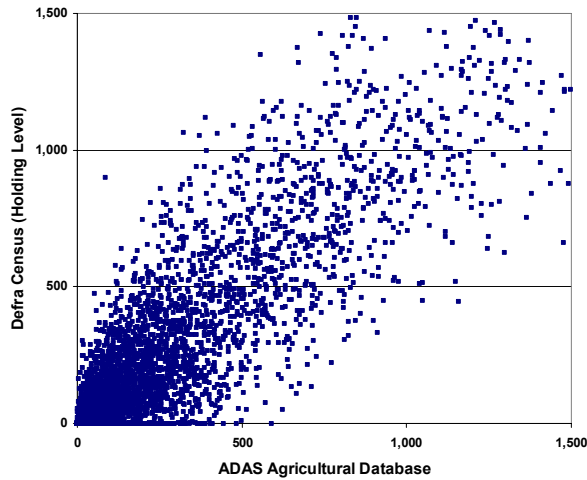# Quantifying the Uncertainty ~ 5by5km Cells

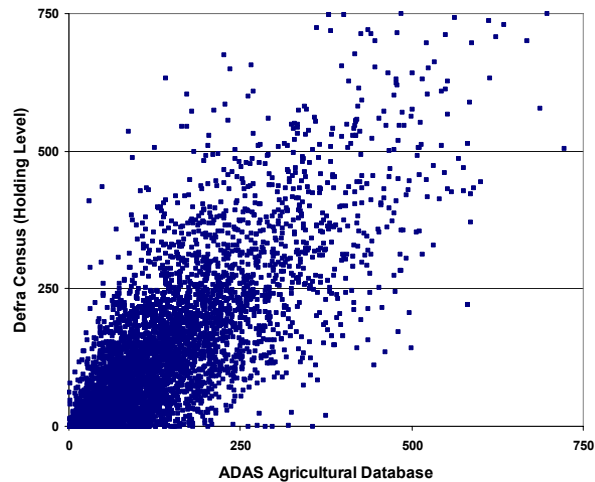## Comparison with Aggregate Holding Level Data

Dairy Cows
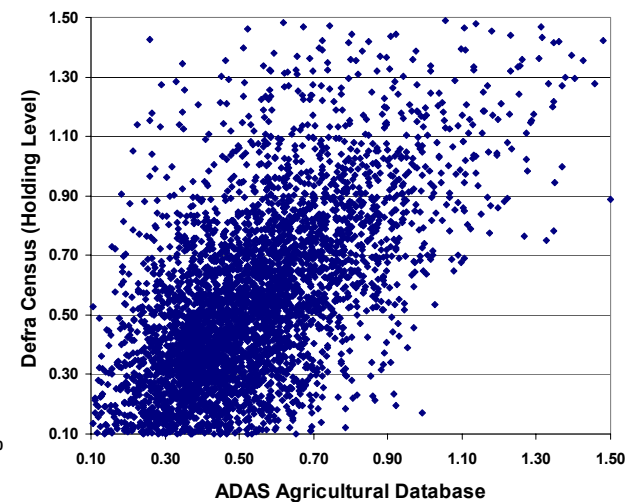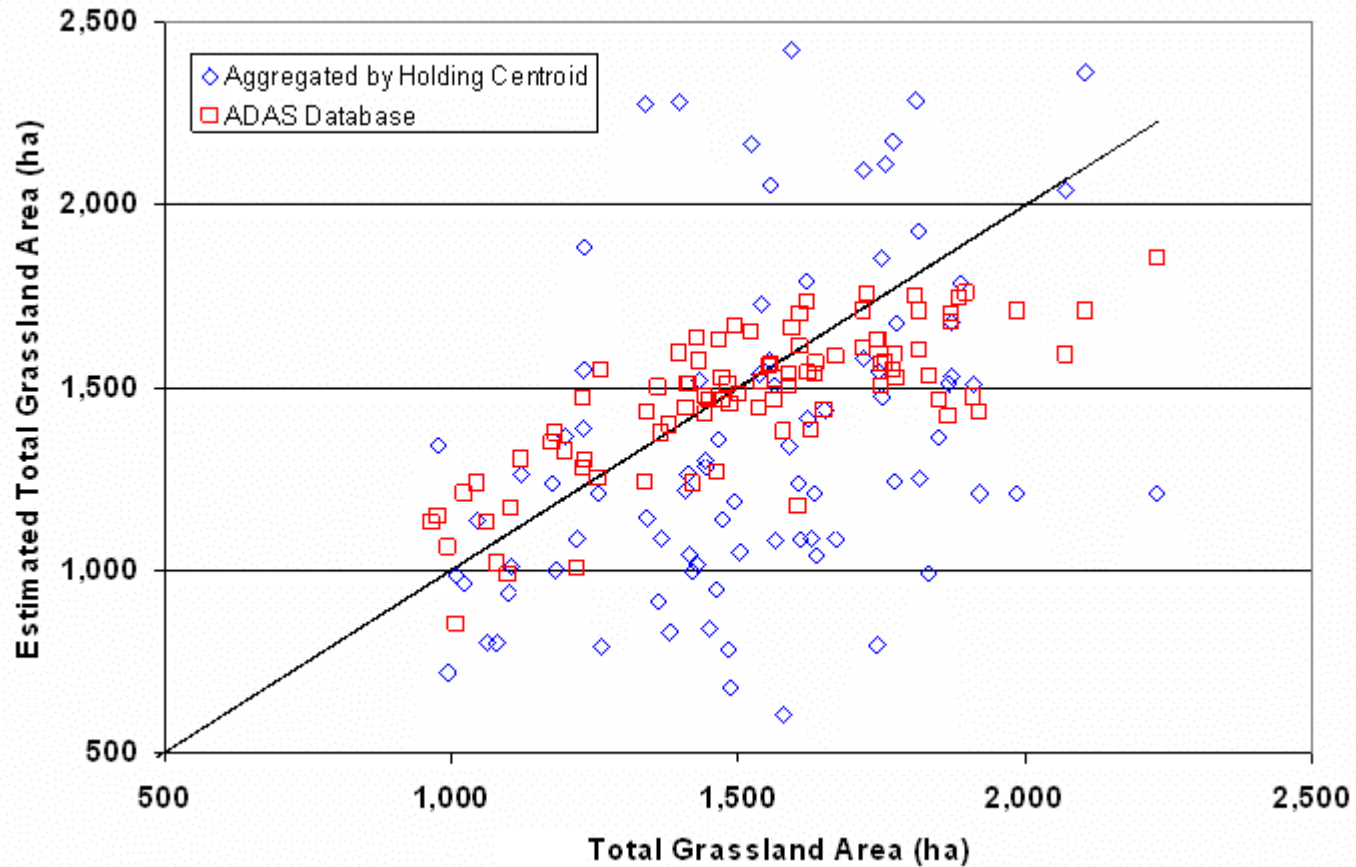
Error σ 174

Beef Cows

Error σ 96

Stock Density

Error σ 0.29

Quantifying the Uncertainty ~ 5by5km Cells

Comparison with Aggregate Field Scale Data (Devon)

Residual Mapping ~ Number of Dairy Cows
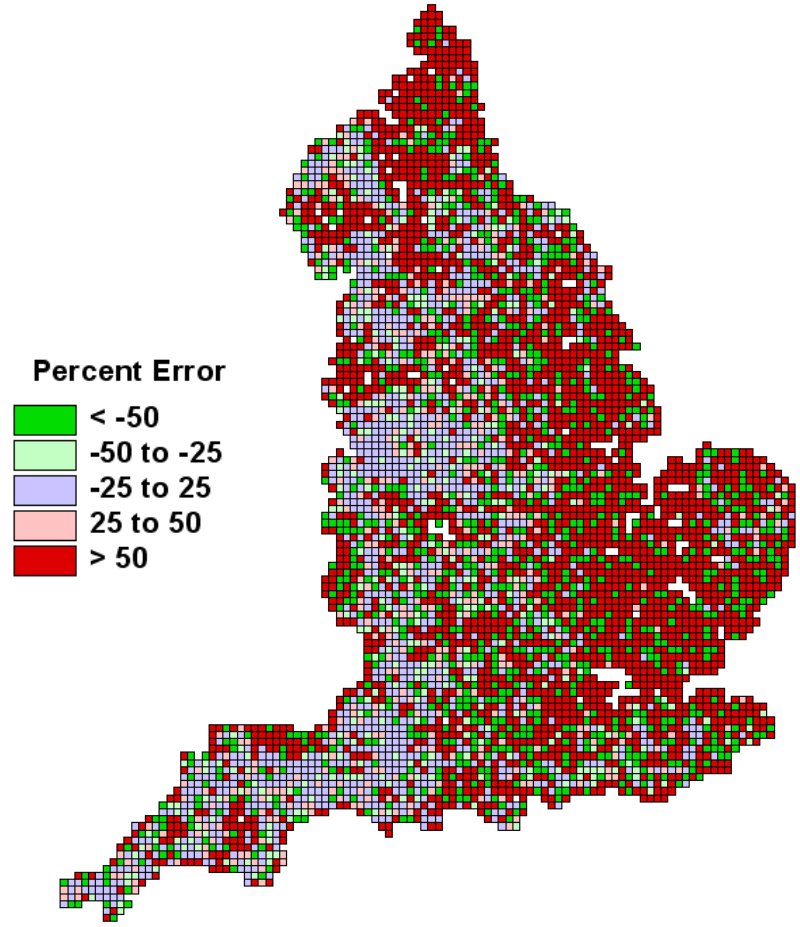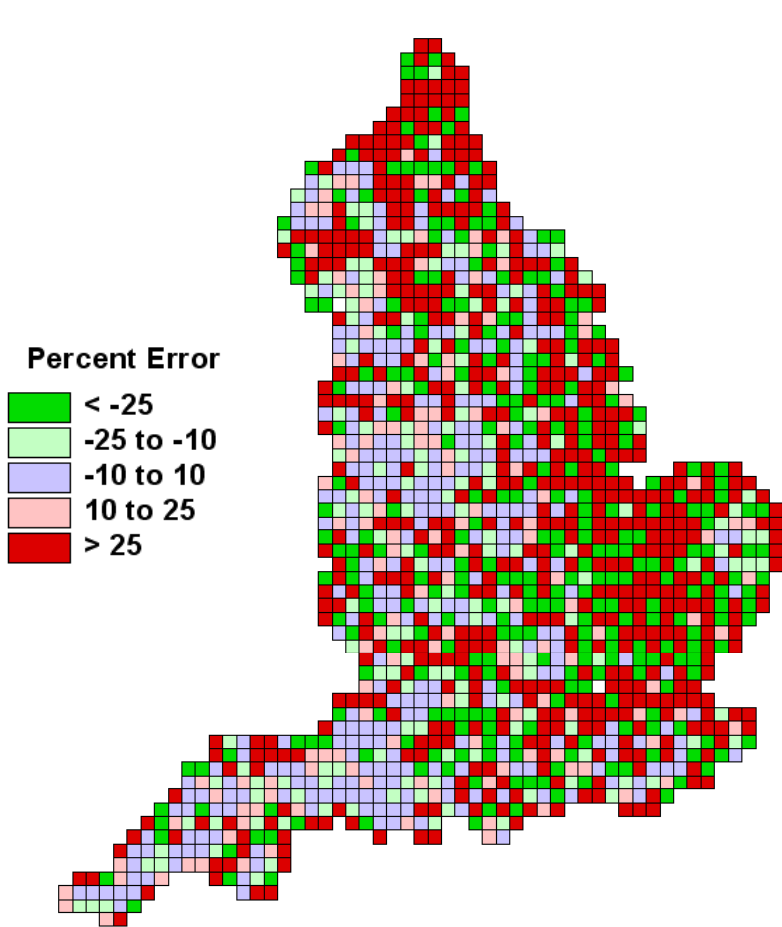
Modelled Dairy Sector Contributions to Total Pollutant Loads

Western : N 36-55% P 44-65%   Eastern : N 3-12% P 5-15%

Spatial Variation on the Farm

Using expert 'activity' weights to improve mapping of stock and emissions, e.g. AENIED model (Dragosits, 1999)

- Hard Standings, Storage ~ On the Holding
- Dairy Stock ~ Close to the Holding (<1,000m)
                      ~ Potentially Zero Grazed
- Beef Stock ~ Unrestricted, Poorer Quality Grass
- Temporal Variation in Grazing and Muck Spreading

But Mapping is Sensitive to MAUP and
is Potentially Disclosive

Farm Risk Survey and Stock Records

Land cover	Stock Access	Drainage	Spreading	Percent:
Grass 86.6	Access 21.7	Drained	Spread	10.8
			Not Spread	6.9
		Undrained	Spread	1.1
			Not Spread	2.9
	Water 21.0	Drained	Spread	11.9
			Not Spread	2.2
		Undrained	Spread	2.7
			Not Spread	4.2
	None 43.8	Drained	Spread	24.1
			Not Spread	5.1
		Undrained	Spread	7.4
			Not Spread	7.3
Arable 13.4	Access 1.6	Drained	Spread	1.3
			Not Spread	0.0
		Undrained	Spread	0.4
			Not Spread	0.0
	Water 2.4	Drained	Spread	1.9
			Not Spread	0.0
		Undrained	Spread	0.5
			Not Spread	0.0
	None 9.4	Drained	Spread	6.8
			Not Spread	0.1
		Undrained	Spread	2.2
			Not Spread	0.2

Attributes of surveyed fields on the 25 survey farms within the Caldew catchment (n = 851)

Fields were surveyed by type (arable or grass); presence of flowing water (49%) and whether there was free access to livestock (25%); installation of drainage (71%); and whether manures were spread in them (54%).

P-Ignorant Risk Model

- **Stochastic model assigning specific risk (inputs) to fields based on a statistical correlation (+/-) with intrinsic risk (environment) index.**

- **Used to establish magnitude of gap between best and worst practice.**

- **Degree of correlation between intrinsic and specific risk factors used to represent effect of uncertainty and education.**

P-Ignorant Risk Model

Field Risk Factors:

Field ID:	Ranked Risk Factors: Intrinsic	Specific	Pollutant Loss
0	1	0	0
1	1	0	0
2	1	0	0
3	1	0	0
4	1	0	0
5	2	5	10
6	2	5	10
7	2	5	10
8	2	5	10
9	10	5	50

Export Coefficient Model Approach, e.g. PIT

Montecarlo Output:

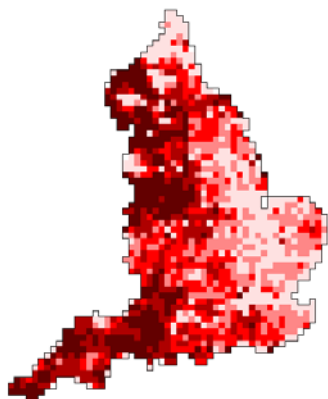| Risk Factor Correlation		Pollutant Loss
P-Expert	-0.8	3,840
P-Ignorant	0	7,710
P-!!! Off	+0.8	10,595

Re-mapping by Farm Type

Farm Business Survey - Farm Types

- **Dairy Farms**
- **Cattle and Sheep – LFA**
- **Cattle and Sheep – Lowland**
- **Cereals**
- **General Cropping**
- **Specialist Pig**
- **Specialist Poultry**
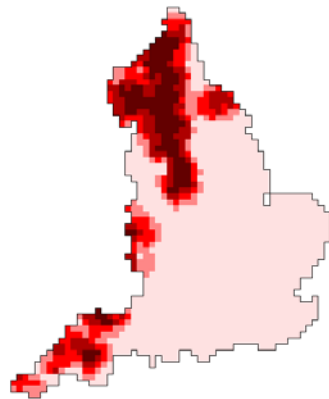- **Mixed**
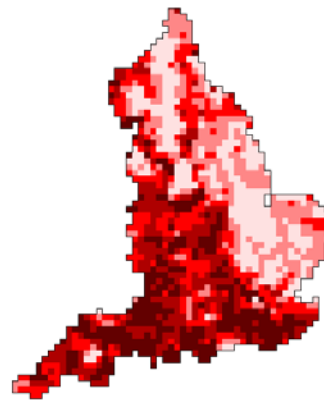- **Horticultural**

50 to 150 Farms per 100km^2 Cell
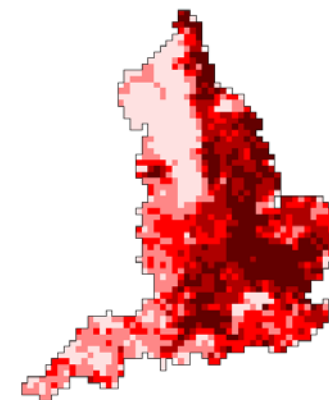
Equal Area Mapping – Farm Type Counts
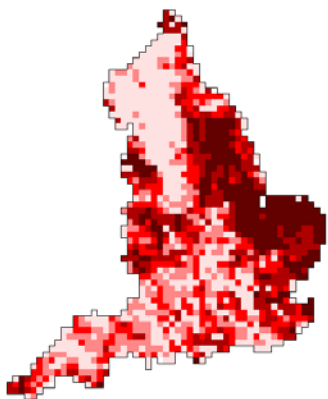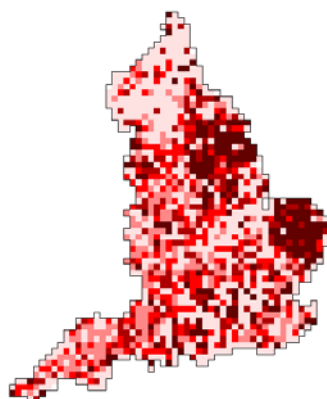

Dairy Farms
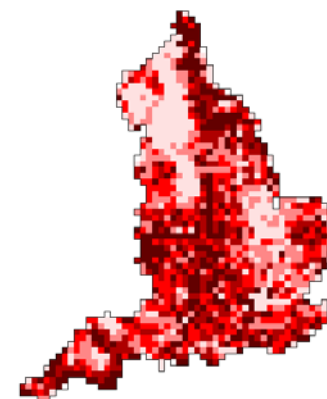
Cattle and Sheep - LFA

Cattle and Sheep - Lowland

Cereals

General Cropping

Specialist Pig

Specialist Poultry

Mixed

Re-mapping by Farm Type

## Use Farm Business Survey Data as Weights to Further Dis-aggregate Non-Disclosive Data

	Dairy	Grazing LFA	Grazing Lowland	Cereal	General	Pig	Poultry	Mixed	Horti-Cultural
Census All Holdings Average Area:	76.0	83.0	27.0	134.0	149.0	15.0	10.0	97.0	11.0
FBS Average Farm Area:	95.0	165.0	82.0	232.0	211.0	29.0	22.0	149.0	22.0

		FBS Average Farm Data							
Land Use Category	FBS Indicator Category	Dairy	Grazing LFA	Grazing Lowland	Cereal	General	Pig	Poultry	Mixed	Horti-Cultural
32 Set-Aside Land	Set-Aside	1.8	0.1	0.2	15.5	13.1	0.7	0.8	6.8	0.2
33 Wheat	Wheat	4.8	0.1	0.4	50.9	46.3	3.5	1.0	19.0	0.5
34 Winter Barley	Barley	2.9	0.4	1.1	14.4	19.3	1.1	0.7	10.5	0.3
35 Spring Barley	Barley	2.9	0.4	1.1	14.4	19.3	1.1	0.7	10.5	0.3
36 Sugar Beet	Sugar Beet	0.0	0.0	0.0	2.1	14.5	0.1	0.3	0.8	0.1
37 Oilseed Rape	Oilseed Rape	0.6	0.0	0.0	16.5	7.6	0.3	0.0	6.1	0.1
38 Potatoes	Potatoes	0.1	0.0	0.0	0.3	7.8	0.0	0.0	0.4	0.1
39 Other Cereals	Other Cereals	0.3	0.1	0.1	3.1	1.7	0.0	0.0	1.8	0.1
40 Other Root Crops	Fallow & Arable Fodder Crops	7.5	0.2	0.7	1.2	2.2	1.2	0.2	3.3	0.6
41 Other Crops	Other Crops	0.2	0.0	0.0	0.8	11.4	0.2	0.0	0.7	5.4
42 Vegetables	Other Crops	0.2	0.0	0.0	0.8	11.4	0.2	0.0	0.7	5.4
43 Soft Fruit	Other Crops	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.4
44 Nursery Stock	Other Crops	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.4
45 Temporary Grassland	Temporary Grass	17.8	2.6	5.4	3.5	3.5	0.8	1.3	12.6	0.2
46 Permanent Grassland	Permanent Grass	33.5	36.3	16.0	10.5	8.0	2.1	2.2	27.0	0.5
47 Common Ownership Rough Grazing	Rough Grazing (Sole Occupation)	3.0	39.9	0.5	0.4	0.4	0.4	0.0	2.0	0.1
48 Sole Ownership Rough Grazing	Rough Grazing (Sole Occupation)	3.0	39.9	0.5	0.4	0.4	0.4	0.0	2.0	0.1
49 Maize	Fallow & Arable Fodder Crops	7.5	0.2	0.7	1.2	2.2	1.2	0.2	3.3	0.6

ADAS

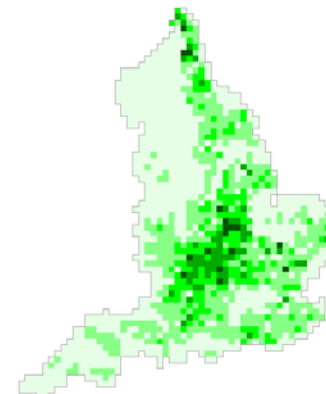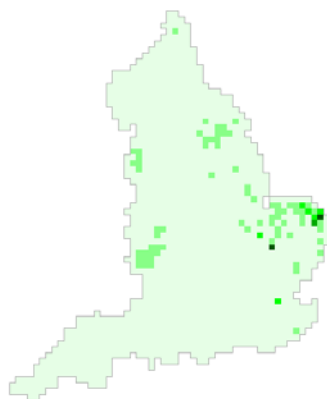# Sample Distribution of Permanent Grass
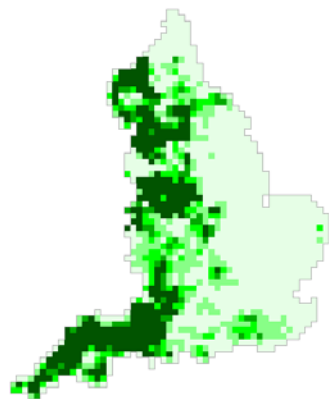
Dairy Farms
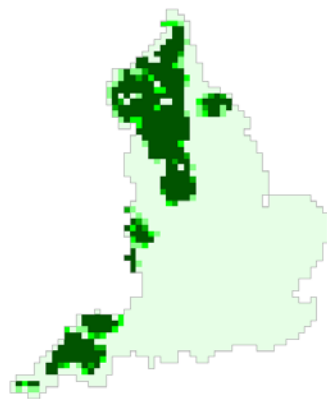
Cattle and Sheep - LFA
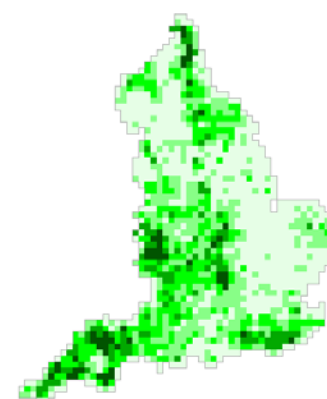
Cattle and Sheep - Lowland

Cereals

General Cropping

Specialist Pig

Specialist Poultry

Mixed

ADAS
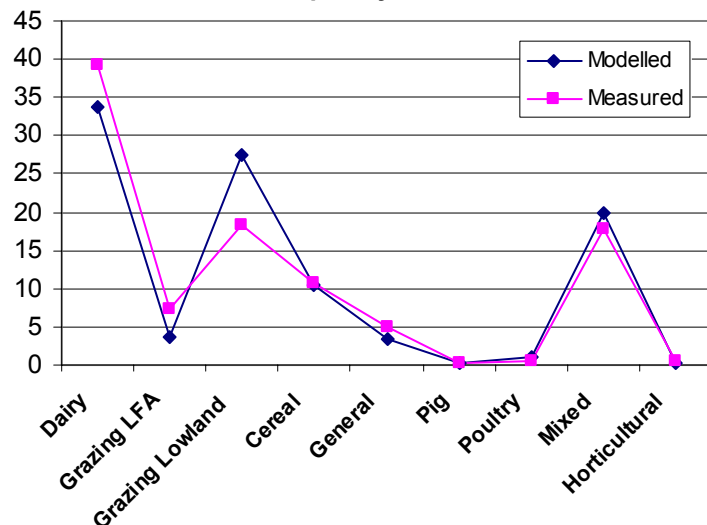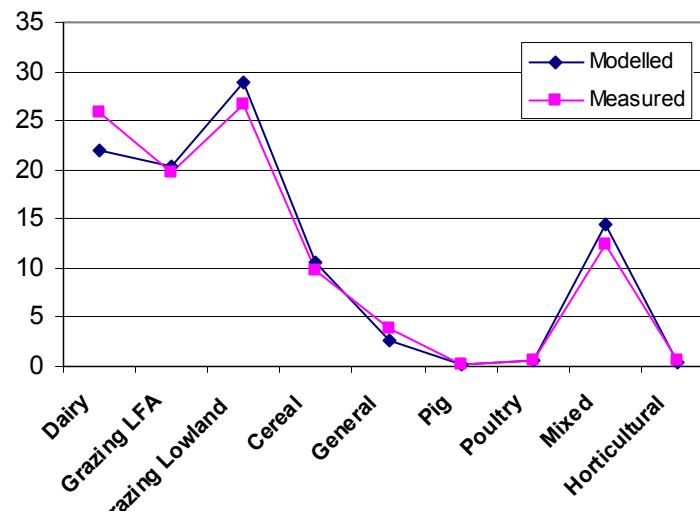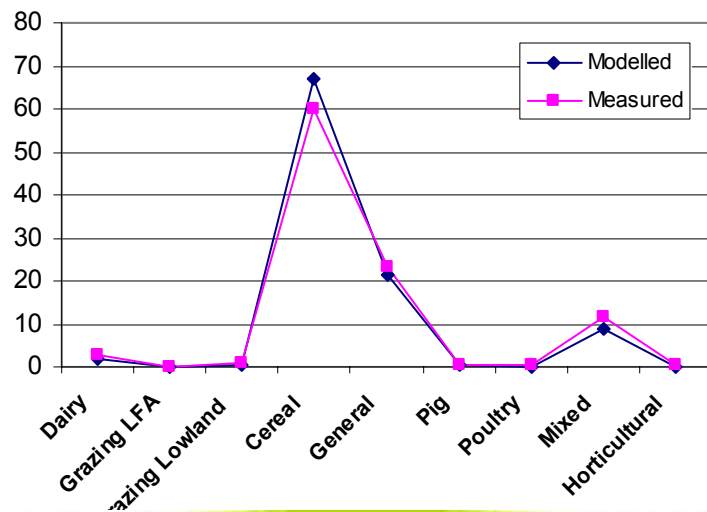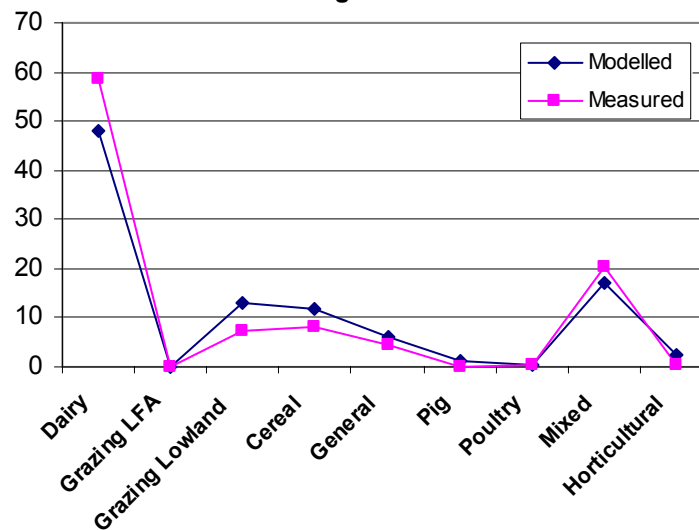
Validation *vs* Holding Level Data

Validation *vs* Holding Level Data
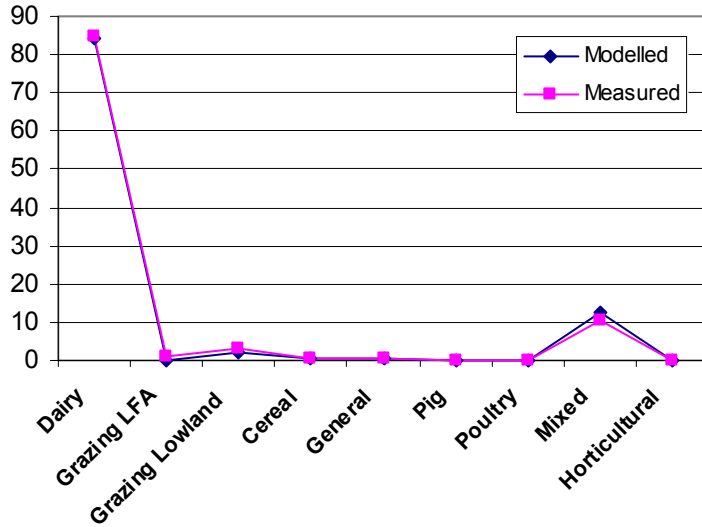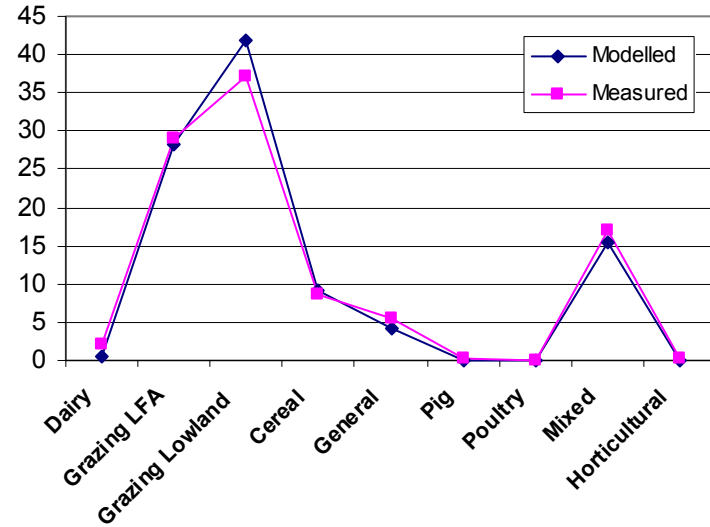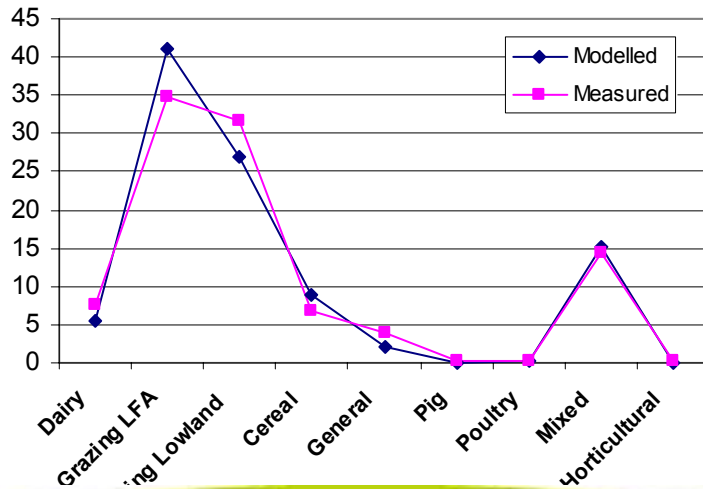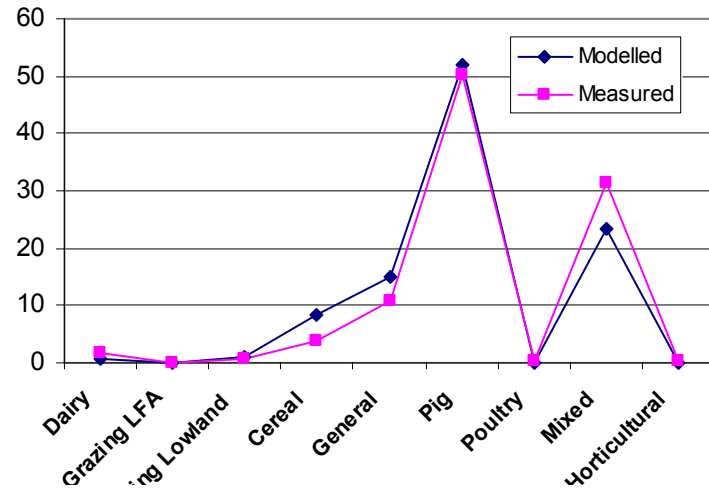
Why do you want to do this ?

- **Links to economic data for cost-effectiveness studies and forecasts of industry structure**

- **Better system characterisation, e.g. stock densities:**

	Dairy	LFA Cattle & Sheep	Lowland Cattle & Sheep	Cereal	General	Pig	Poultry	Mixed
Livestock Units per Hectare	1.98	0.55	0.80	0.54	0.97	0.32	0.49	1.16

- **Farm type specific inputs, e.g. manure management, fertiliser rates:**

Fertiliser Application Rates (BFSP, 2004)

Farm Type	Grassland Nitrogen (kg/ha N)	Grassland Phosphate (kg/ha P_2O_5)	Tillage Nitrogen (kg/ha N)	Tillage Phosphate (kg/ha P_2O_5)
Dairy	129	10	86	38
Cattle and Sheep	50	15	112	40
Mixed	79	13	134	30
Cropping	65	11	163	39

ADAS

Conclusions

- ADAS have a pragmatic approach to mapping the census;

- Uncertainty can be large but significance varies spatially;

- Farm scale mapping possibly compromised by census;

- Interest in smaller WFD sub-catchments is a problem;

- There is value in coarse scale data – ease of linkage to increasingly important economics and mitigation scenario data;

- Potentially more important to a policy relevant model run than high spatial accuracy …

The End