CATCHMENT SCIENCE 2019

AGRICULTURAL CATCHMENTS PROGRAMME · WEXFORD, NOVEMBER 5TH – 7TH

ROTHAMSTED RESEARCH

Can the sediment pollution gap from intensive livestock farming be closed? Assessment using the North Wyke Farm Platform, UK

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Long-term focus on soil erosion on arable land

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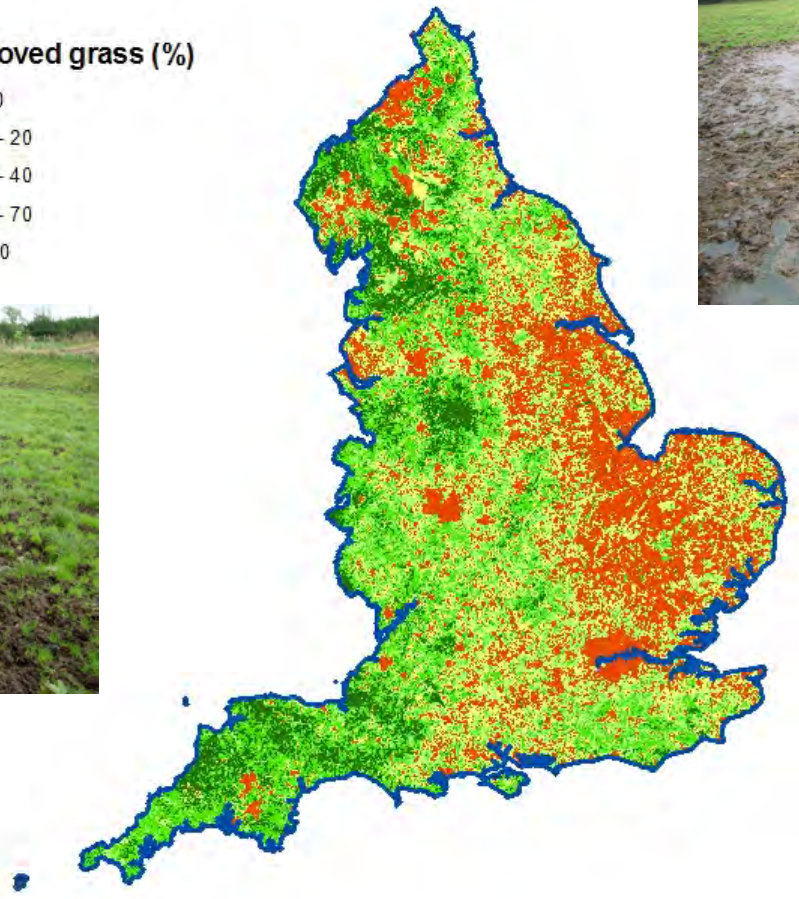
Sediment loss from improved grassland



Sediment loss from improved grassland

Cross compliance soil type	Range in mean erosion rates (t ha^{-1})
Light	0.20 – 0.54
Medium	0.24 – 0.56
Heavy	0.29 – 0.72
Chalk	0.55 – 1.40

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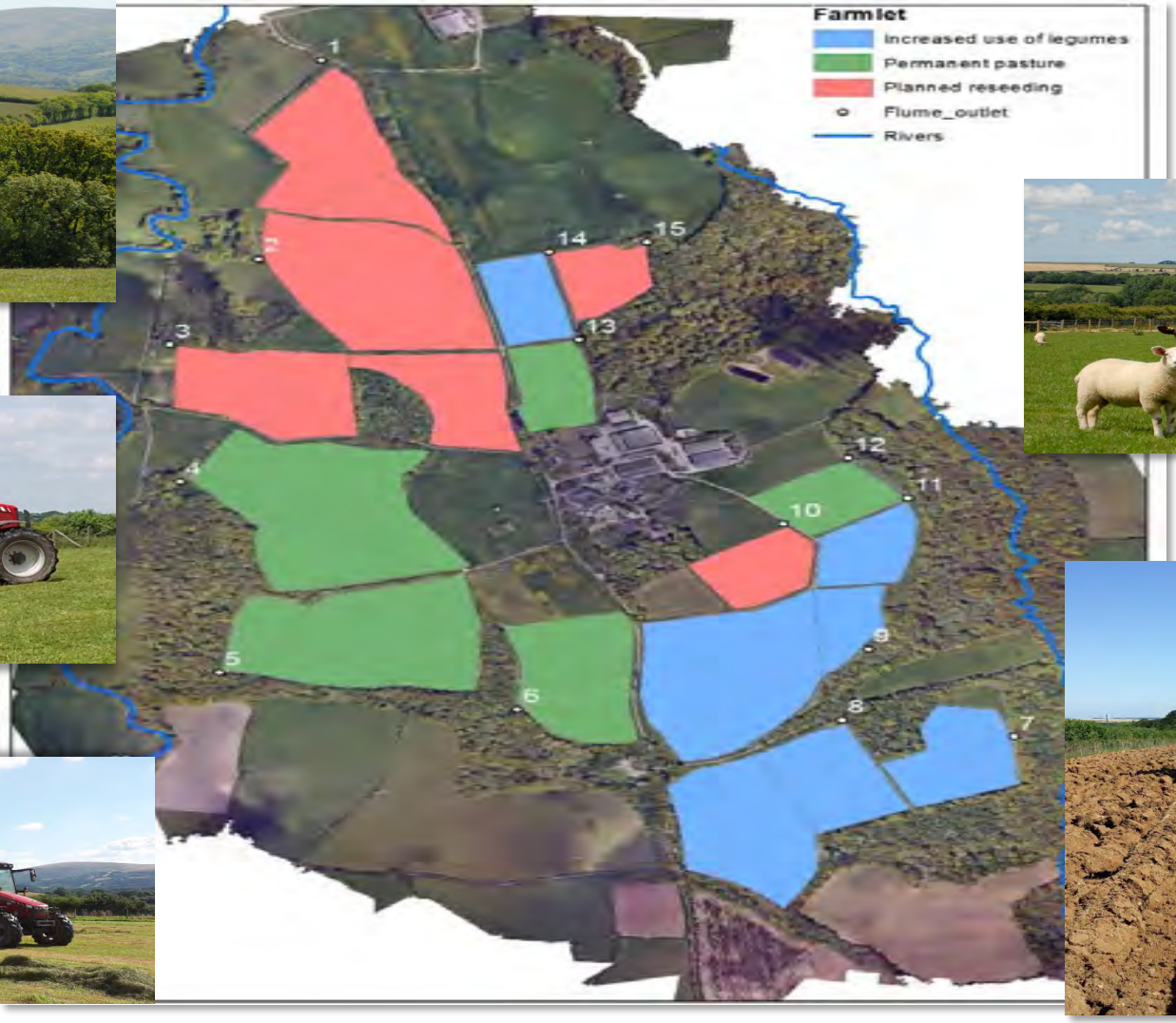
Department for Environment Food & Rural Affairs

The North Wyke Farm Platform



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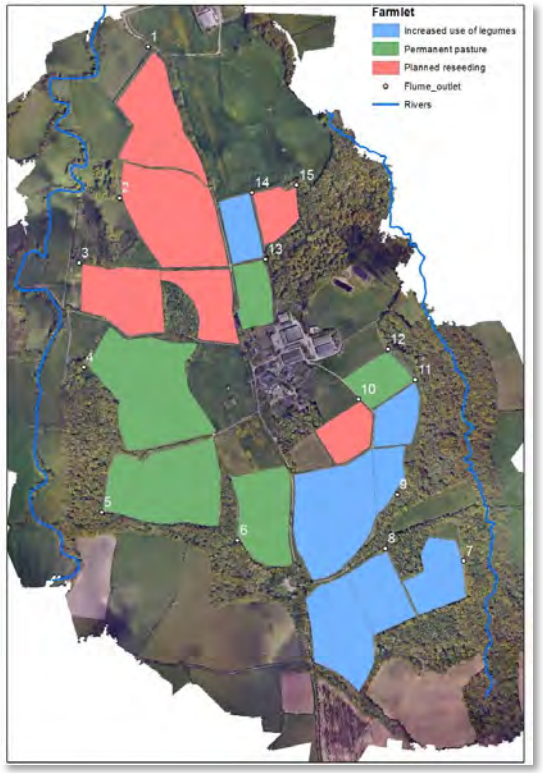
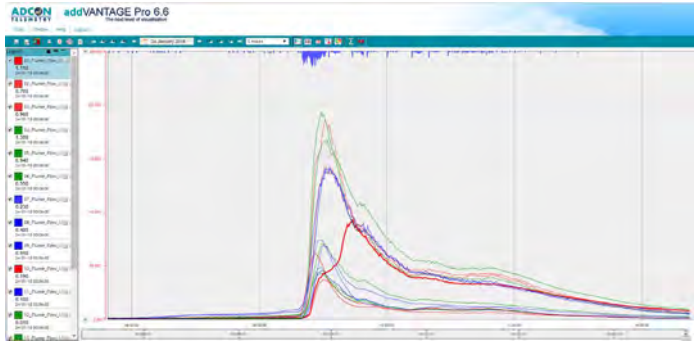
The North Wyke Farm Platform

Soil	Atmosphere	Farm Management
% Moisture	Rainfall	Field inputs/outputs
Temperature	CO_2 and N_2O	Liveweight gain
pH		Farm activities
Bulk density		Labour hours
N, P & C status		Machine hours



15 flume laboratories



Total-P
Ortho-P

Water
Temperature
Conductivity
Turbidity
pH
Dissolved O_2
Ammonium
Nitrate
Dissolved organic C

Sequential/composite sampler

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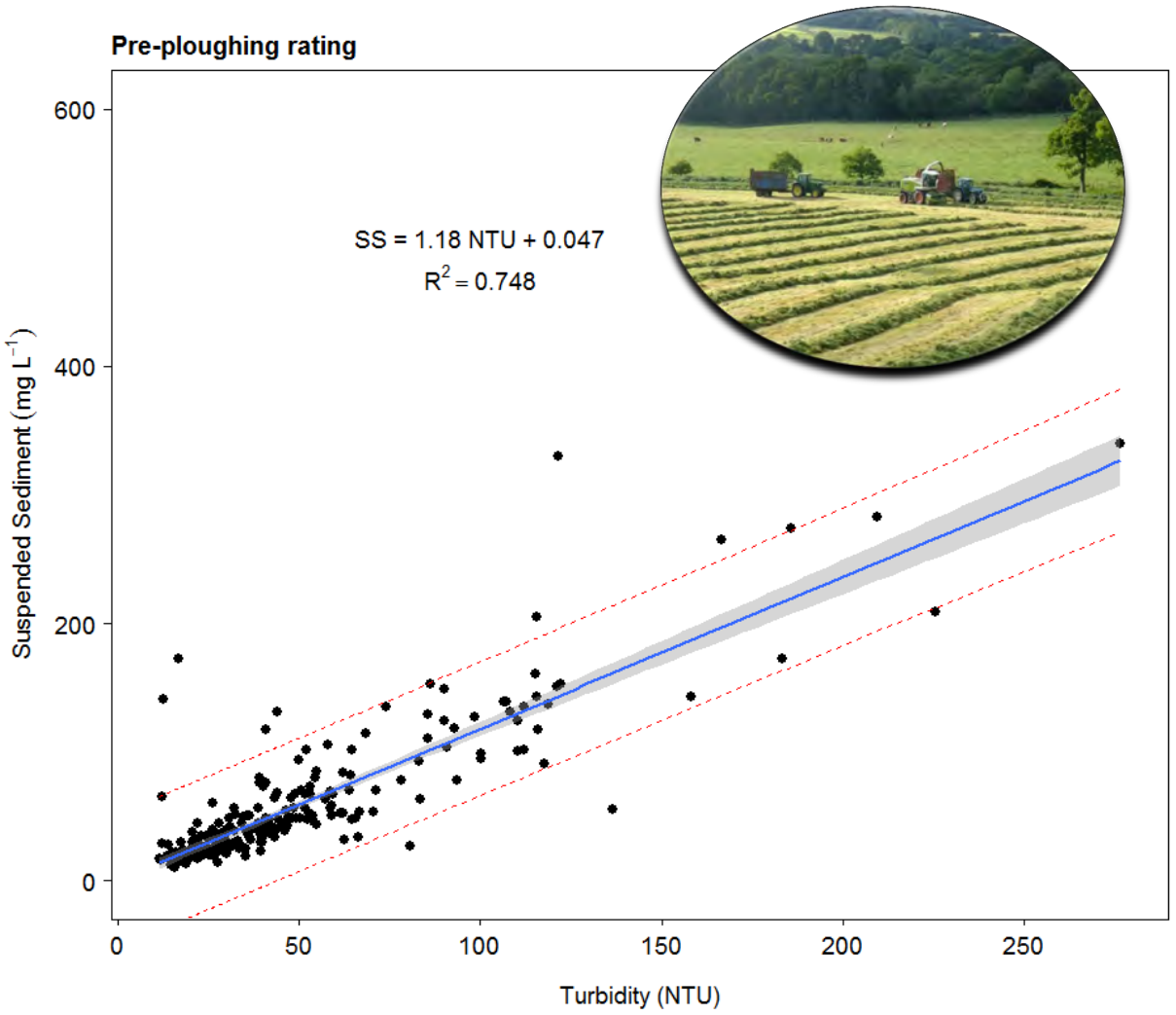
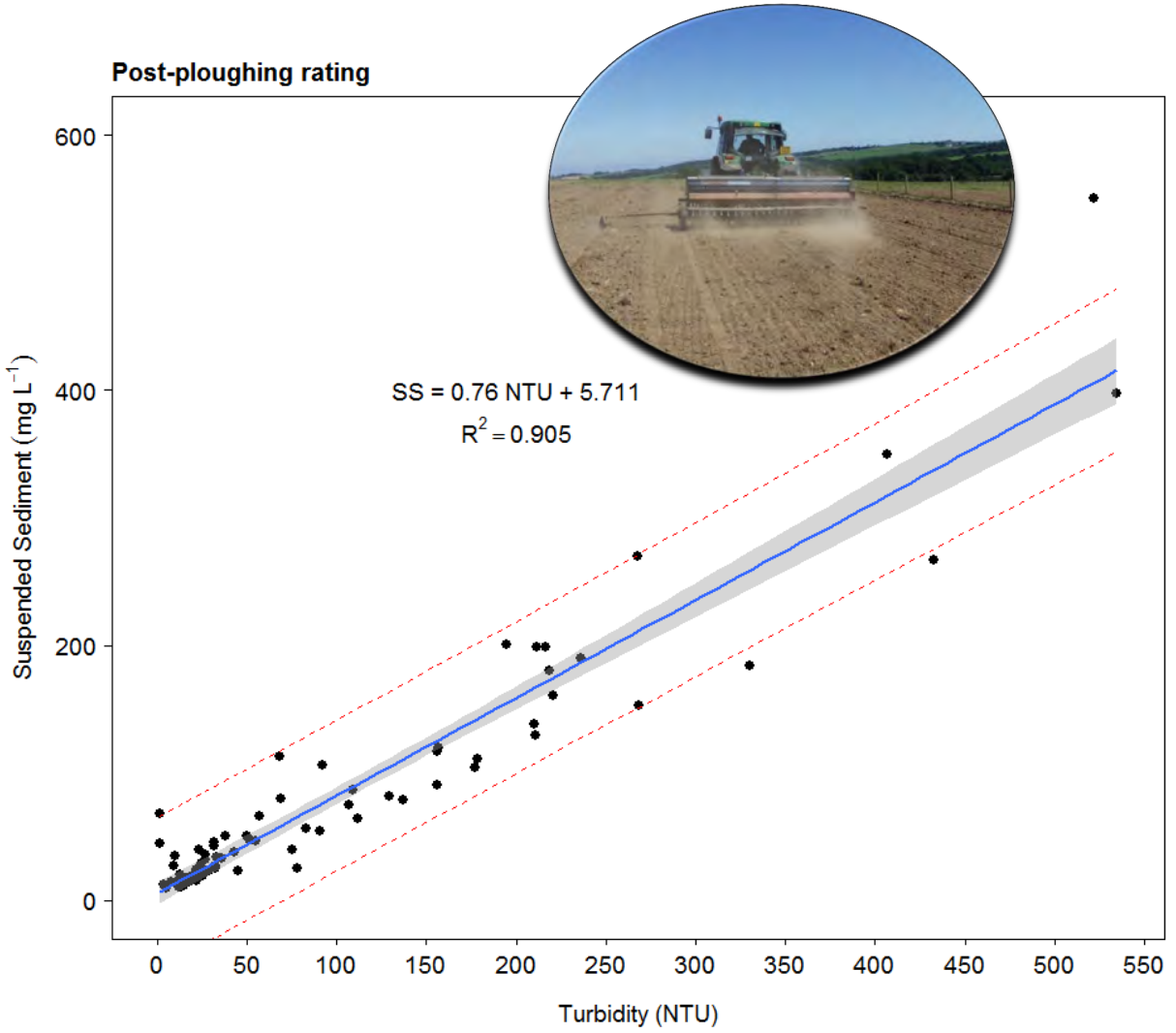
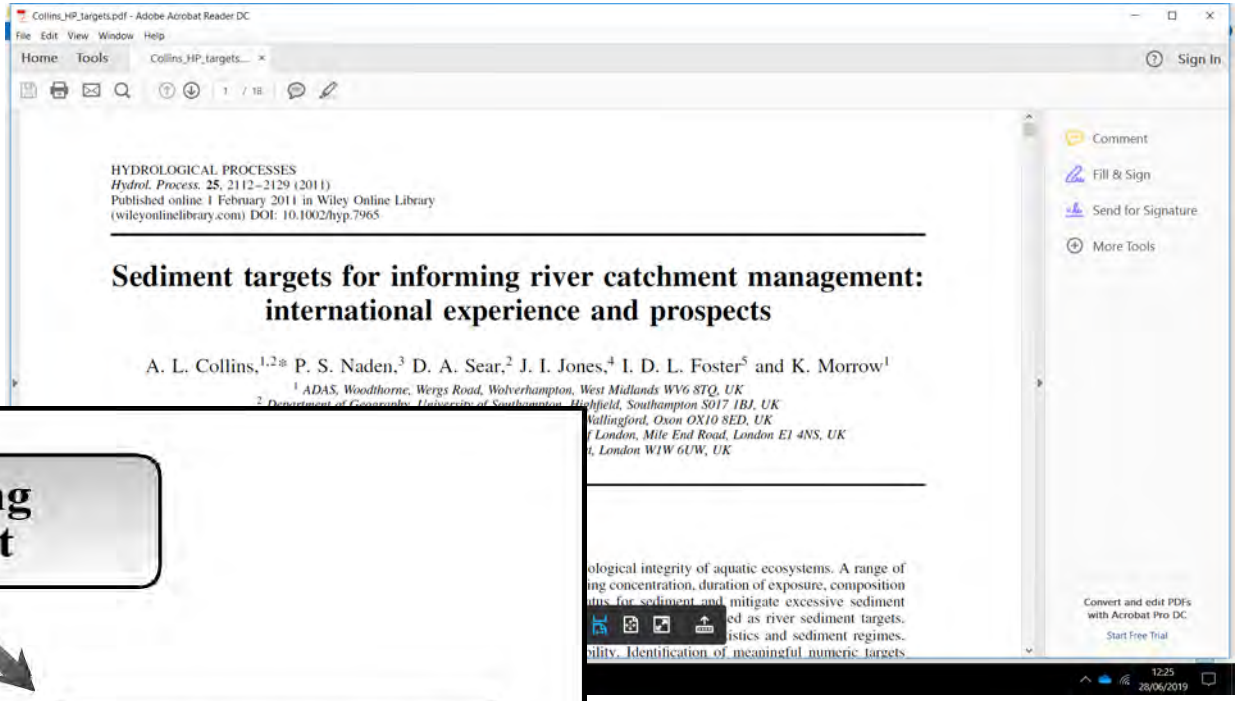
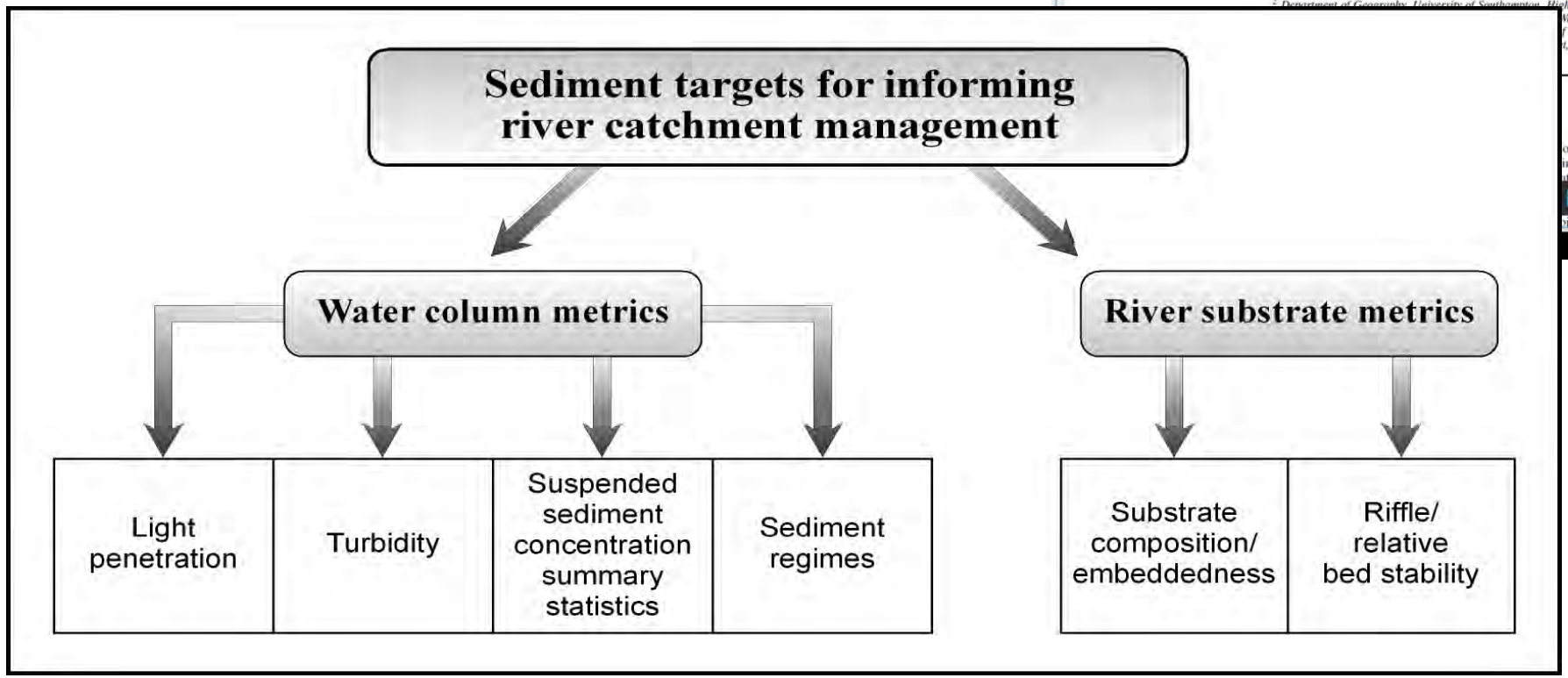
SSC-turbidity conversion ratings



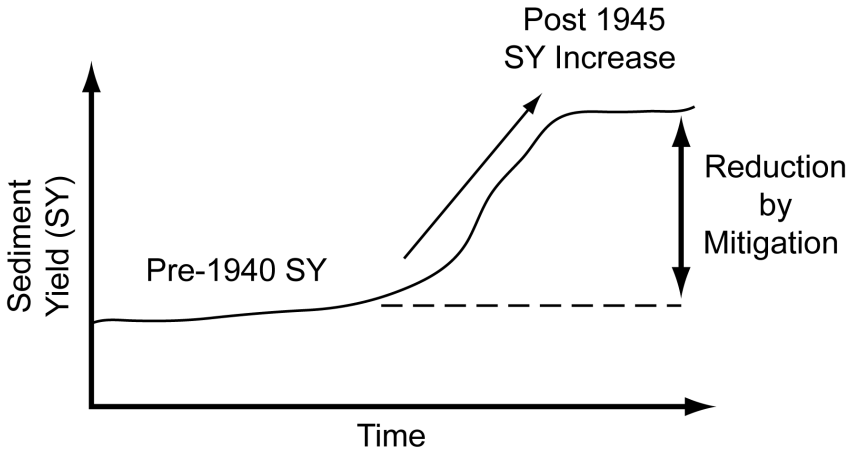


Management targets for sediment

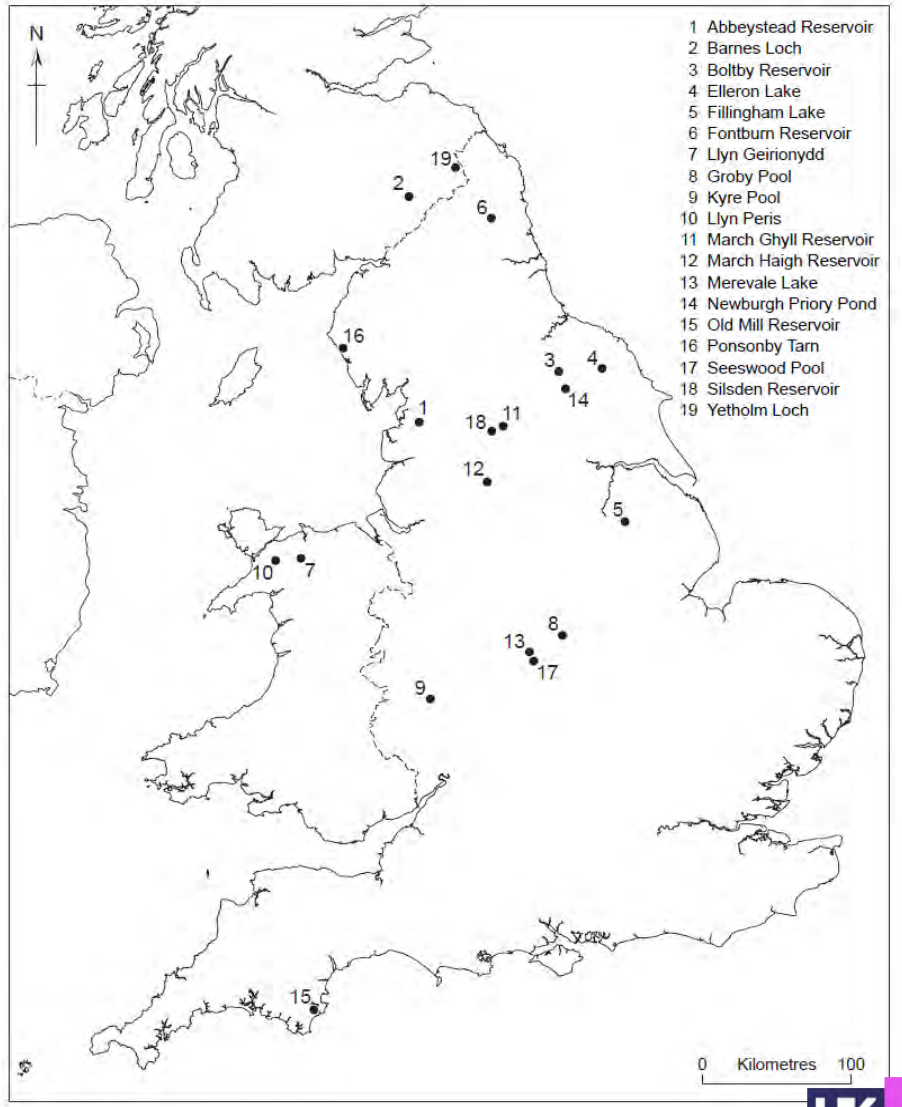




Modern background sediment delivery to rivers



	t/ha/yr	t/ha/yr
Target modern background (TMB)	**0.10**	**0. 20**
Maximum modern background (MMB)	**0.15**	**0.35**



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Sediment loss – permanent pasture

Flume	t		t/ha		t/ha/yr		Exceedance	
	Lower	Upper	Lower	Upper	lower	upper	TMB	MMB
1	6.31	7.82	0.73	0.91	0.23	0.28	Y	N
2	4.44	5.38	0.68	0.82	0.21	0.25	Y	N
3	1.83	2.30	0.47	0.60	0.15	0.18	N	N
10	0.65	0.78	0.37	0.44	0.11	0.14	N	N
15	0.86	1.02	0.49	0.58	0.15	0.18	N	N

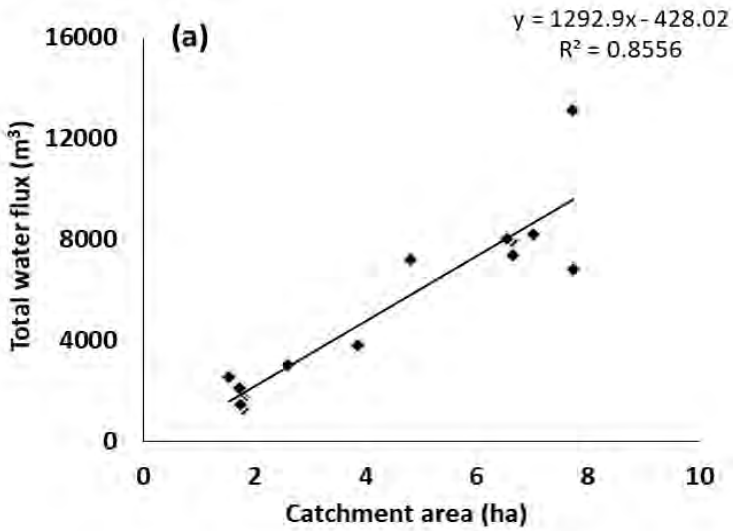
Sediment loss – re-seeded high sugar monoculture

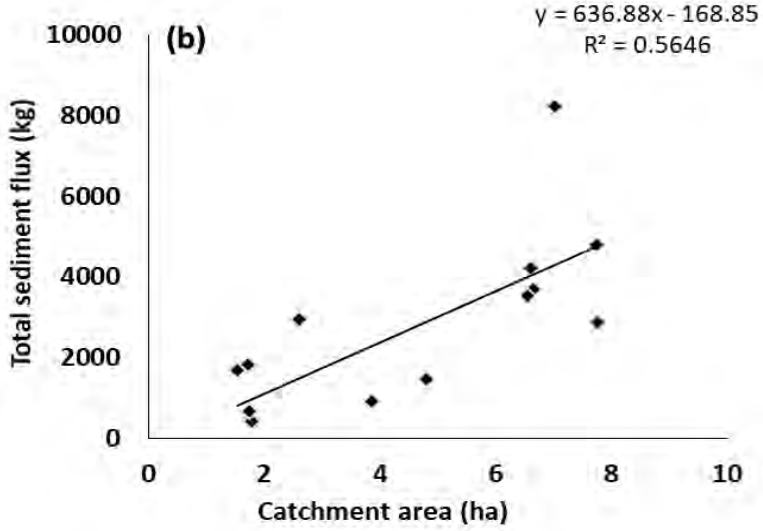
Flume	t		t/ha		t/ha/yr		Exceedance	
	lower	upper	lower	upper	lower	upper	TMB	MMB
1	1.55	2.30	0.32	0.48	0.12	0.17	N	N
2	5.47	6.69	0.82	1.01	0.25	0.31	Y	N
3	5.68	7.01	0.86	1.06	0.26	0.33	Y	N
10	0.50	0.66	0.28	0.36	0.10	0.13	N	N
15	1.88	2.30	1.22	1.49	0.38	0.46	Y	Y

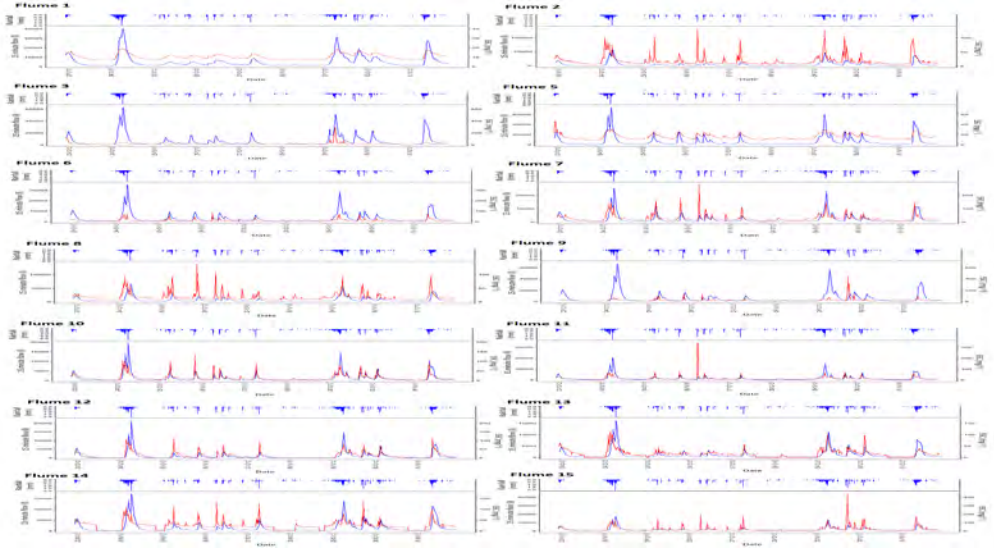
Sediment loss – re-seeded grass-clover mix

Flume	t		t/ha		t/ha/yr		Exceedance	
	lower	upper	lower	upper	lower	upper	TMB	MMB
7	1.50	3.60	0.58	1.39	0.21	0.50	Y	Y
8	9.89	11.64	1.41	1.66	0.43	0.51	Y	Y
9	5.04	6.10	0.65	0.79	0.20	0.24	N	N
11	1.09	1.32	0.62	0.75	0.19	0.23	N	N
14	1.40	1.69	0.81	0.98	0.28	0.34	Y	N

Mechanistic learning







Implications for best management

Farm visit visually-based current interventions
Move feeder rings are regular intervals
Construct troughs with a concrete base
Re-site gateways away from high risk areas
Farm track management
Establish riparian buffer strips

Business-as-usual

Revised management

Mechanistically-based best management interventions
Reduce the length of the grazing season
Reduce field stocking rates when soils are wet
Locate out-wintered stock away from watercourses
Loosen compacted soil layers in grass fields
Use correctly-inflated low ground pressure tyres

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Management scenario impacts – re-seeded grass-clover mix

Visually-based interventions			
t/ha/yr		Exceedance	
lower	upper	TMB	MMB
0.21	0.49	Y	Y
0.42	0.50	Y	Y
0.20	0.23	**N**	N
0.19	0.23	N	N
0.27	0.33	Y	N

Mechanistically-based interventions			
t/ha/yr		Exceedance	
lower	upper	TMB	MMB
0.20	0.48	**N**	Y
0.41	0.48	Y	Y
0.19	0.23	**N**	N
0.18	0.22	N	N
0.27	0.32	Y	N

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Co-benefits and trade-offs

Re-seeded grass-clover mix		
Trade-offs	**Visually-based Interventions**	**Mechanistically-based interventions**
Capital cost (£)	114	70
Operational cost (£)	576	1533
Total cost (£)	690	1603
Nitrate (%)	**1.2**	**2.1**
Phosphorus (%)	**1.0**	**2.6**
Sediment (%)	2.1	5.0
Ammonia (%)	0.0	-21.6
Methane (%)	0.0	**0.1**
Nitrous oxide (%)	**1.9**	**12.4**
Pesticides (%)	0.0	**1.3**
FIOs (%)	**0.4**	**0.6**
Energy use (%)	-0.3	-7.6
Biodiversity (Score)	**0.2**	**1.0**
Soil quality (Score)	**1.0**	**12.5**

Soil to Nutrition institute strategic programme

Mechanistic understanding

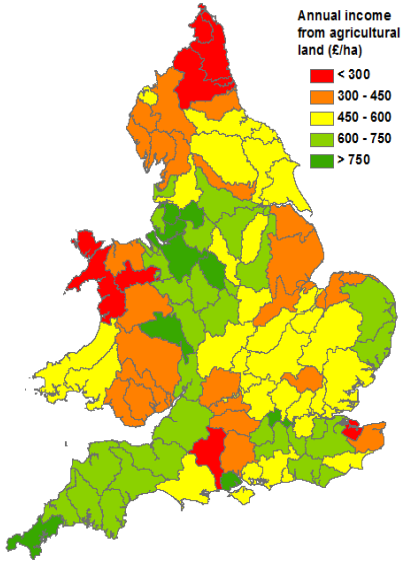
Micro-scale processes which drive nutrient use

On-farm targeted intervention

Management impacts on nutrient use

Upscaling for national impact

Delivering 'fit-for-purpose' metrics to benchmark and improve nutrient use

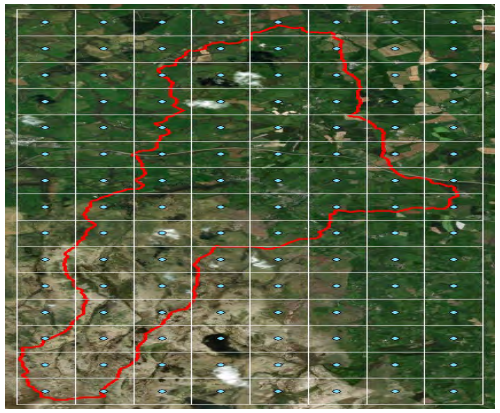


Co-benefits and trade-offs across scales

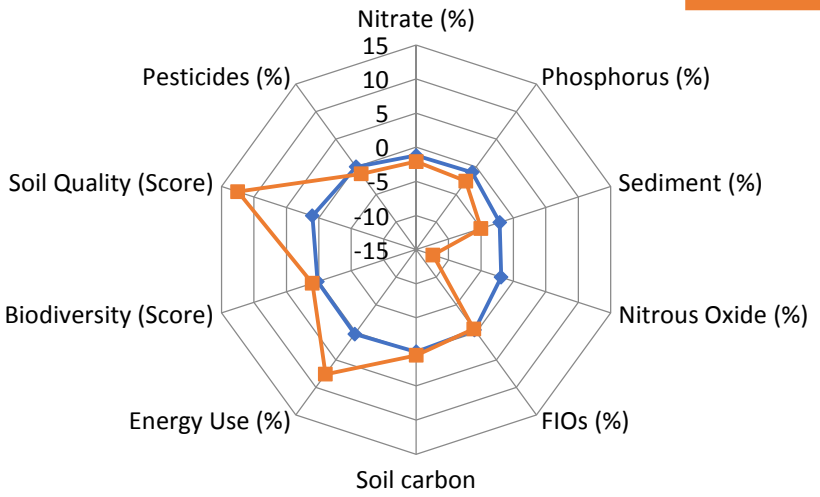
NWFP (Farm scale)

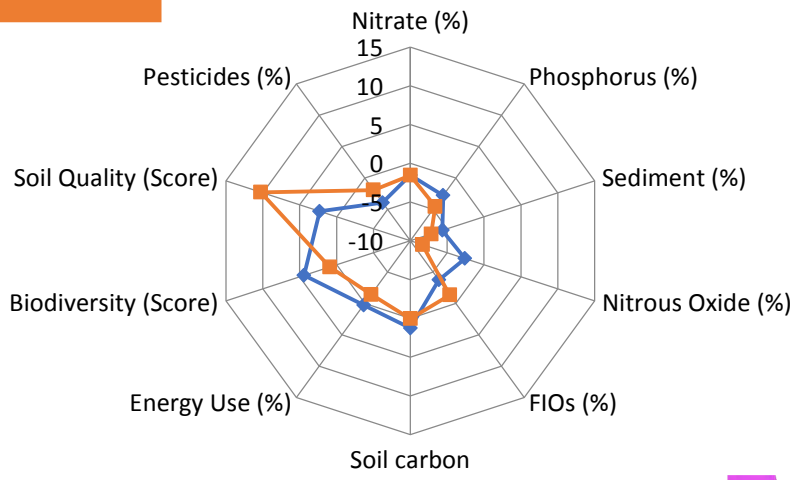
Farm visit visually-based current interventions

Mechanistically-based best management interventions



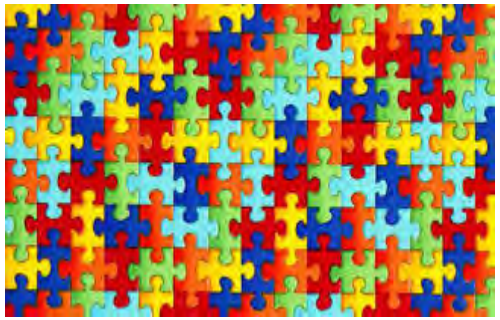
Taw catchment





Re-training farm advisors

Spatial mismatch



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Scheduled ploughing/reseeding and soil moisture

Flume catchment	Plough date	Soil moisture erosion threshold (%)	Soil moisture on plough date (%)	Number of days from ploughing to reaching erosion moisture threshold	Total duration of post-plough phase
1	28/07/2015	39	26.6	124	158
2	06/07/2013	38	14.0	111	269
3	25/07/2014	37	29.9	111	250
7	22/07/2015	38	28.1	54	164
8	06/07/2013	35	25.3	114	269
9	27/07/2014	36	24.3	172	248
10	03/08/2015	38	24.0	42	152
11	03/08/2015	37	16.4	20	152
14 (phase 1)	10/07/2013	37	19.3	85	265
15 (phase 1)	10/07/2013	37	31.0	85	265
14 (phase 4)	07/09/2017	37	37.0	0	214
15 (phase 4)	02/10/2017	37	37.2	0	214

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Thanks!

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