Demonstration Test Catchments

Newsletter - Autumn 2014

Welcome to the Autumn 2014 edition of the DTC Newsletter highlighting a few activities and progress over the past 3 months with links for you to follow up on more detailed information about individual items and topics of interest.

"Beware of false knowledge; it is more dangerous than ignorance" – George Bernard Shaw

Extrapolating the benefits of field scale mitigation measures for tackling soil erosion on the Avon DTC Platform

The draft EU Soil Framework Directive requires Member States to improve the protection of soil resources by tackling erosion and degradation. In response, the recent Natural Environment White Paper (The Natural Choice) outlines the government's goal to manage soils sustainably and tackle degradation problems including soil erosion successfully by 2030. Under the auspices of the EU 7th Environment Action programme, Member States are requested to commit to a 'soil degradation neutral world'. Against this background, a new Defra funded project being delivered by a consortium comprising Cranfield University, ADAS, Rothamsted Research North Wyke, Northampton University and Anglia Ruskin University, is developing and demonstrating an extrapolation methodology for quantifying the impact of mitigation measures to address soil erosion by water at field, farm and landscape scale. The overall aim is to determine the level of effort required in a given landscape to achieve a threshold level of reduction in soil erosion at field scale. The consortium is currently building an updated national baseline for soil erosion (arable and grass land) across England and Wales and reviewing the efficacy of appropriate on-farm interventions at field scale. The Avon DTC will be used as the demonstration landscape for the new extrapolation tool, before the framework is rolled out more widely.

The erosion of agricultural soils where roads act as rapid pathways is an important factor in river pollution

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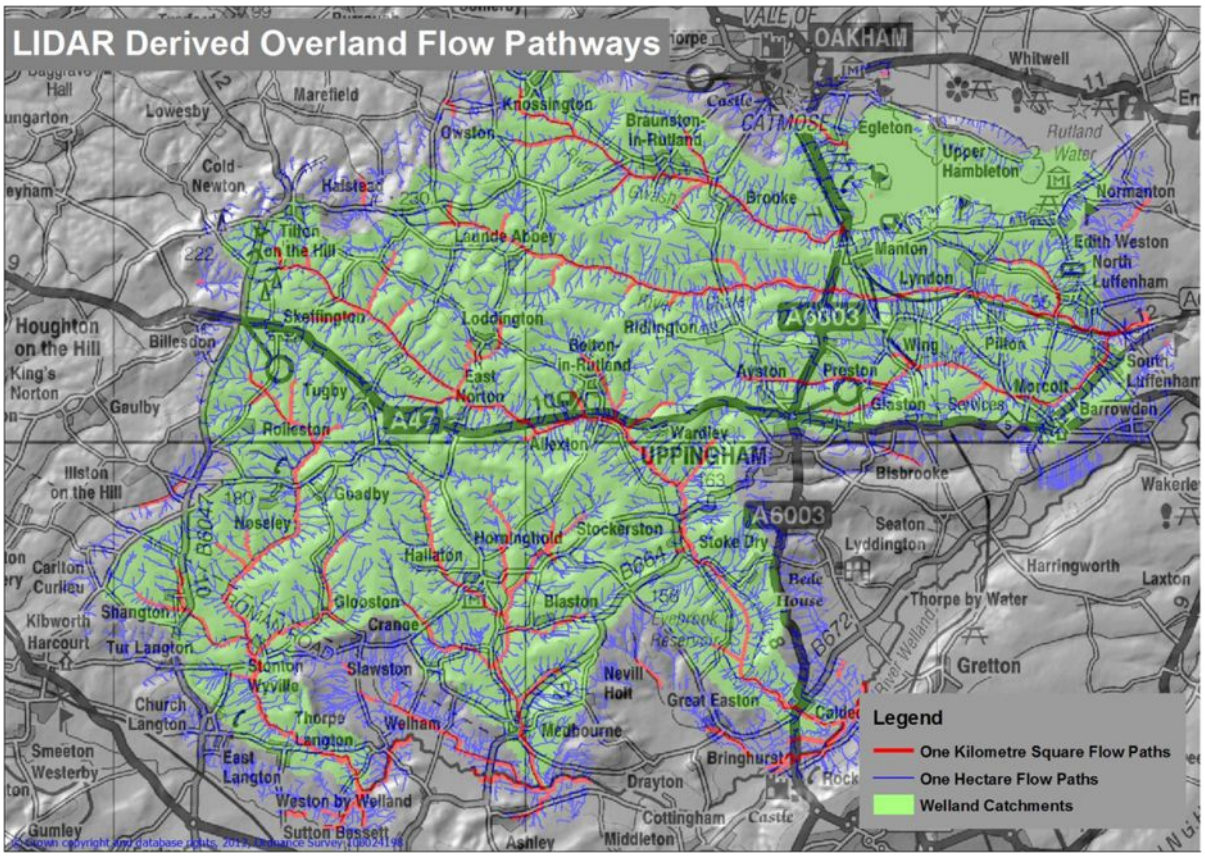
Landscape scale overland flow routing map for England and Wales

Estimating potential flow pathways across the landscape can be an important step to targeting mitigation measures for reducing diffuse pollution from farmland. For example we could install buffer strip features along potential flow routes or put in extra soil management to ensure any compaction is removed to improve infiltration. Predicting flow pathways could be complex, taking into account different soil types, artificial drainage systems and mitigating features such as roads and hedges but indicative pathways on a map will always be a useful first step in deciding where to put in landscape features or change land use to reduce run-off.

The Environment Agency has LIDAR coverage for a high proportion of E&W. It is also possible to fill in gaps for a continuous layer with other available DTM data. The aim of this work is to produce a complete routing map for E&W to be made available to catchment groups and schemes for diffuse pollution work with farmers.



The map shows estimated overland flow pathways derived from high resolution LIDAR Digital Terrain Model (DTM) data. They have been overlaid onto the boundary of the Welland catchments (in green), Ordnance Survey data and a terrain backdrop. The Red lines represent flow accumulation pathways where a minimum of 1 kilometre squared of land flows into them. The blue lines represent flow accumulation pathways where a minimum of 1 hectare of land flows into them. Another level in the flow hierarchy has been generated but not displayed here for the sake of clarity. These are flow accumulation pathways where a minimum of 1000 m^2 of land can flow into them. The red 1 km^2 lines tend towards actual and permanently active water courses.

For a description of how these are derived please follow the following links...
http://webhelp.esri.com/arcgisdesktop/9.2/index.cfm?TopicName=flow_accumulation
http://webhelp.esri.com/arcgisdesktop/9.2/index.cfm?TopicName=An_overview_of_the_Hydrology_tools

This model does not take into account subsurface drainage, soil type or climatic conditions.
The work is expected to be delivered by the EA's Geomatics team before April 2015.

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Avon DTC and CSF partnership project on phosphorus mitigation

The Avon DTC recently started a new Natural England funded partnership project on mitigation measures for tackling phosphorus losses from agriculture in Pewsey Vale (the Upavon East and West CSF target areas in the north of the Avon catchment). Current work is focussing on farm business surveys for ~70 farms in Pewsey Vale to gather detailed local data to be used as input in scenario analyses. A workshop will be used to gather feedback from local farmers on the practicality and acceptability of P mitigation measures. Those measures which score highly will be used in the scenario analyses, before a second workshop is held to discuss the potential benefits of improved P mitigation in the Pewsey Vale landscape. This project involves delivery teams from Rothamsted Research North Wyke, the University of Exeter and ADAS.

Contact: Adie Collins (adrian.collins@rothamsted.ac.uk).

More on-farm measures in the Hampshire Avon DTC

Farmer engagement in the Hampshire Avon DTC has been positive, but occasionally for a wide range of reasons, farmers less willing to engage with such projects are encountered. Through a collaborative and carefully considered approach, staff from Rothamsted Research, ADAS and CSF have managed to gain agreement from another key farmer in the Avon catchment to embrace the DTC Measures project and to work together to make improvements to reduce the farm's impact on water quality. Measures will focus around the separation of clean and dirty water sources via farm infrastructure improvements and managing water more efficiently. Additionally, flow attenuation features will be installed in ditches to reduce sediment and associated contaminant loads to the river. The recent progress demonstrates that collaborative approaches can bring even the most resistant of farmers on-board with projects seeking to implement on-farm interventions for diffuse pollution control.

Separating clean (e.g. roof water) and dirty water (e.g. yard runoff) can have a significant impact on surface water quality

More widely, nutrient management advice is being rolled-out across all nine farms in the Priors DTC experimental sub-catchment, and it is anticipated that the benefits of these new measures, along with those already instigated at other farms in the sub-catchment, should soon be seen in improvements to water quality detected at the DTC core monitoring sites.

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High-temporal Resolution Fluvial Sediment Source Fingerprinting with Bayesian Uncertainty Analysis

Richard Cooper in the Wensum DTC team at UEA has been working to address two developing areas of sediment fingerprinting research. Specifically, how to improve the temporal resolution of source apportionment estimates whilst minimising analytical costs and, secondly, how to consistently quantify all perceived uncertainties associated with the sediment mixing model procedure. This first matter has been tackled by using direct X-ray fluorescence (XRF) and diffuse reflectance infrared Fourier transform (DRIFT) spectroscopic analyses of suspended particulate matter (SPM) covered filter papers in conjunction with automatic water samplers. This method enables SPM geochemistry to be quickly, accurately, inexpensively and non-destructively monitored at high-temporal resolution throughout the progression of numerous precipitation events. We then employed a Bayesian mixing model procedure to provide full characterisation of spatial geochemical variability, instrument precision and residual error to yield a realistic and coherent assessment of the uncertainties associated with source apportionment estimates. Applying these methods to SPM data from the River Wensum catchment, UK, we have been able to apportion, with uncertainty, sediment contributions from eroding arable topsoils, damaged road verges and combined subsurface channel bank and agricultural field drain sources at 60- and 120-minute resolution for the duration of numerous precipitation events.

Metalled roads within the River Wensum catchment act to enhance land-to-river sediment transfers by channelling sediment laden runoff into roadside ditches which discharge directly into the river.

An example application of this geochemical fingerprinting procedure is presented in Figure 1 below for a succession of precipitation events in November 2012. This reveals that as successive rainfall events passed across the catchment, concentrations of organic carbon and major clay mineral-associated elements within SPM increased, whilst concentrations of calcium declined. Modelling these geochemical trends with a Bayesian sediment mixing model revealed that each passing precipitation front is associated with a peak in topsoil and road verge sediment contributions and a decline in the importance of subsurface sediment contributions. This indicates that the antecedent wetness of the catchment, combined with these rainfall volumes, led to an increase in saturation excess surface runoff and hence greater land-to-river transfer of topsoil and road verge sediments. These results correspond well with visual observations of sediment-laden road runoff, emanating from a few critical source areas, discharging into the stream channel during these precipitation events (Figure 2). The methodology we have developed demonstrates how combining Bayesian mixing models with the direct spectroscopic analysis of SPM-covered filter papers can produce high-temporal resolution source apportionment estimates that can assist with the appropriate targeting of sediment pollution mitigation measures at a catchment level. Importantly, the rapid and inexpensive nature of the analysis, combined with a model code that can be simplified to allow end users to simply input a spreadsheet of their geochemical data to obtain results, means that this procedure is ideally suited for upscaling to regional and national scales, whilst also making it accessible to stakeholders working at a local sub-catchment level.

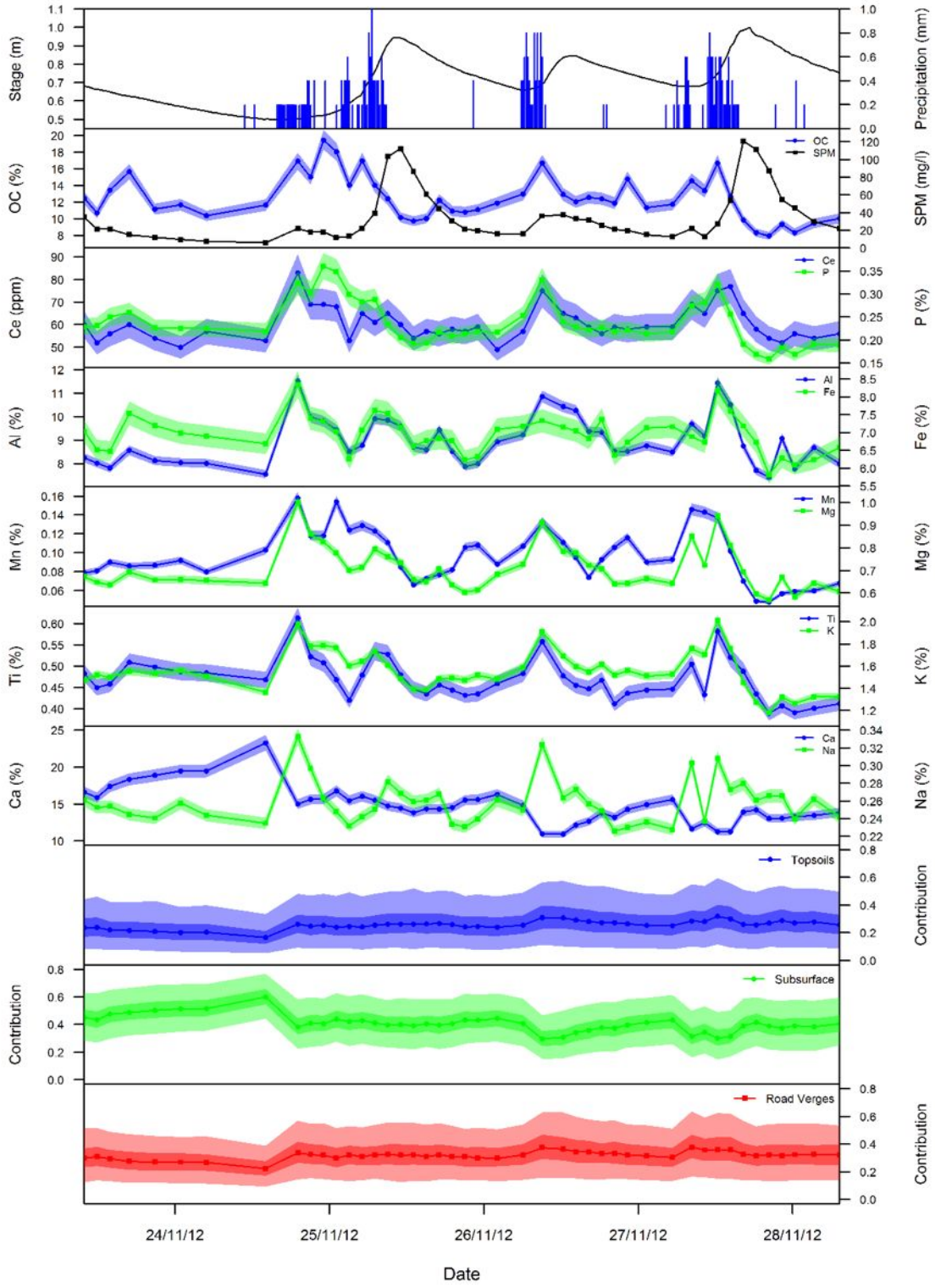

Figure 1: Time-series plots for three consecutive precipitation events in November 2012, showing changing SPM geochemistry (% by weight) and sediment source contributions at 120-minute intervals over a 118-hour period. Shading around geochemical parameters represents instrumental precision (2 standard deviations) based on 46 repeat analyses of a control sample. Light and dark shading around median source apportionment estimates represent the 95% and 50% Bayesian credible intervals respectively.

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Our partner in the Wensum DTC scoops both the 2014 *'Farmers Weekly' Farmer of the Year* and *Arable Farmer of the Year* awards

Wensum DTC is working closely with the Sawle Estate in testing on-farm measures to cut pollution while maintaining food production. Our measures work is taking place across 143ha of the estate, with water from the field drains and channels that form part of the Blackwater tributary system of the River Wensum being monitored closely. So, it is very pleasing to learn that the Estate Manager, Poul Hovesen has won two prestigious national awards: both the 'Farmer's Weekly' Farmer of the Year and their Arable Farmer of the Year, placing science and the environment alongside crop yields.

Defra secretary, Liz Truss, presented the top trophy to Mr Hovesen at the Farmers Weekly Awards Night, where more than 1,200 guests gathered to celebrate the achievements of 45 finalists and winners. The judges' citation read: "Poul Hovesen is an inspiring leader for farming in so many ways. He's developing his own young team to run every farming operation so that he can deliver the highest standards. His business insight, environment awareness and uptake of science are delivering a genuinely sustainable operation on a vast scale. His modest, but authoritative, character is influencing farming, and the wider industry, for the good of everyone"

Poul Hovesen discussing the DTC oilseed radish trials at a recent Defra visit to Sawle (see March newsletter for further

Poul managed farms in his home country of Denmark before moving to the UK in 1987 to take over the role of farms and estate manager at Salle Farms Company. From here he manages more than 5,000ha of high-yielding crops in Norfolk and Poland for Salle Farms Company and Holkham Estate, with the guiding principals of building a sustainable farming strategy and using leading modern farming technology.

Poul is a highly respected farming champion for the environment, innovation and making farming a desirable career. Field margins have always played a part on the Salle Estate, whether in set-aside or not. More than 10% (240ha) of the estate is managed for wildlife, including 183ha of arable and permanent grassland in entry and higher level schemes.

He is attempting to develop a career structure in the businesses he manages as well as within the industry by working with his own team, other estate managers and colleges. He works closely with nearby Easton and Otley Agricultural College to recruit and train young graduates with five out of the eight farming staff at Salle Farms being under the age of 30.

The results speak for themselves. Profits are almost 40% of turnover and output has doubled at Salle Farms in seven years. Average wheat yields have risen from a little over 9t/ha to nearly 11t/ha over the past 10 years. He has been in touching distance of achieving 13t wheat crops. Sugar beet yields have also risen, from 55t/ha to almost 80t/ha. Oilseed rape is averaging 5t/ha and spring barley 7.5t/ha. Good establishment for oilseed rape and spring barley, which now follows sugar beet, have been critical in delivering these results.

Rotation is considered to be the key. At Salle Farms, winter wheat is followed by winter barley, oilseed rape, winter wheat, sugar beet, wheat or spring barley and finally spring beans to make up the seven-year cropping cycle. It has been tailor-made to improve soil structure, spread harvest workload (early-cut barley to late-lifted beet) and increase yields on this easily damaged light land. Blackgrass has been virtually vanquished from the estate. Poul puts this down to using the plough, spring cropping (enabling better timing of cultivations) and drilling, as well as uniform seed-beds and judicial use of herbicides.

The DTC funded work under way at Sawle includes: the establishment of cover crops over the winter, such as oilseed radish, to see how these can hold nutrients and potentially cut fertiliser requirements for subsequent crops; a new spray store and spray filling gap, washing and storage area with outflow to a biobed, being evaluated for its potential to minimise pollution and; an area of wet woodland planned alongside one of the tributaries streams to 'slow the flow' and trap both sediments and nutrients, while creating a much needed habitat for this part of the world.
(Text adapted from Farmers Weekly article)

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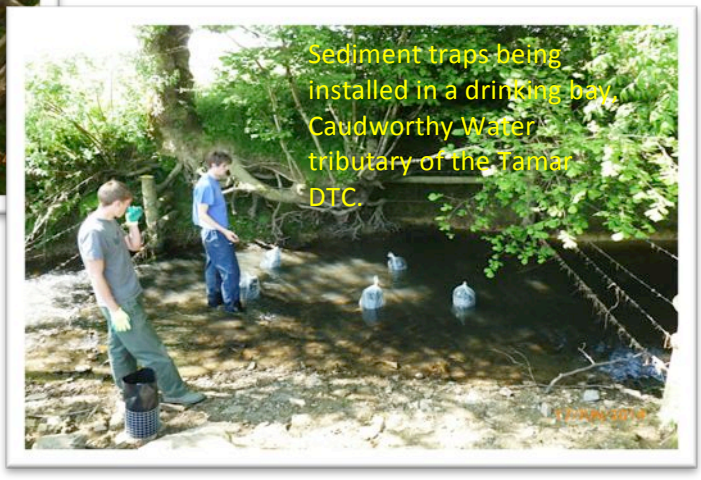
Restricting livestock access to watercourses reduces FIO concentrations during low and high flow events.

The contamination of bathing waters by faecal bacteria poses a threat to the health of bathers and the coastal economies and societies which rely on tourism. Reducing levels of contamination and providing the public with up to date information regarding the risk associated with bathing are key challenges. Faecal indicator organism (FIO) concentrations (*E.coli* and intestinal enterococci) are used as proxies for the abundance of faecal pathogens and the threat to human health. Monitoring in the Caudworthy Water tributary of the River Tamar DTC this summer (June – August 2014), has shown that (1) the access livestock have to the river has a significant effect on the FIO concentrations in water samples, and (2) the number of livestock present on a given day does not correlate with the concentration of FIOs in the accompanying water sample. Simply when livestock are excluded from access to the river, by fencing, FIO concentrations are significantly lower than when livestock have access to the river, either via drinking bays or unrestricted access, both at low and high flow. This suggests that fencing of watercourses to restrict livestock access should be a priority to mitigate microbial pollution of surface water.


Cattle 'loafing' in a drinking bay, Caudworthy Water tributary of the River Tamar DTC.


Sediment traps being installed in a drinking bay, Caudworthy Water tributary of the Tamar DTC.

FIO concentrations 10,000 times higher in sediment than water have been recorded, suggesting that sediment acts as a sink for FIOs. An experiment was designed to investigate whether sediment acts as a sink of FIOs under low flow conditions and a source during high flow events.

The installation of retrievable basket samplers containing 10 kg of sterile sediment in the river bed at three sites on the Caudworthy Water suggested that (1) the settling of FIOs attached to suspended sediment ingressing the river bed during higher flows is a more important process than the redistribution and deposition of FIOs attached to sediment when the river is in a low flow state, and (2) that inconsistencies exist in the co-variance of the two FIOs.

FIOs have been shown to survive in and move between multiple 'pools', (for example soils, sediments, water column) on this basis a simple model linking these pools was developed and the key processes requiring further investigation were identified as being FIO movement into and out of each pool as well as FIO die off within each pool.

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Study Areas Announced for the Sustainable Intensification Research Platform

Study areas for the Sustainable Intensification Platform (SIP) were announced to stakeholders at a meeting in Westminster on 30 September. SIP is a three-year, £4.5m Defra-funded research programme that brings together researchers, policymakers and stakeholders other stakeholders to explore the challenge of *Sustainable Intensification* – i.e. increasing farm productivity and enhancing the environment at the same time. SIP will deliver research on integrated and collaborative approaches that enable farmers to increase food production and farm profitability while improving their environmental performance.

The platform has been established through three projects, which started in May, focusing on sustainable intensification at the scale of the farm, landscape and food-chain respectively:

Project 1) *Integrated farm management for improved economic, environmental and social performance* (led by NIAB)
Project 2) *Opportunities and risks for farming and the environment at landscape scales* (led by the University of Exeter)
Project 3) *Scoping study: the influence of external drivers & actors on the sustainability & productivity of English and Welsh farming* (led by ADAS)

These projects will explore indicators of farm performance, decision support, opportunity mapping and collaborative action between farmers (see table A). They will establish a coordinated set of research activities within a network of study farms and landscapes. The study areas will form a platform to host future research. The focus areas for SIP include the Demonstration Test Catchments as well as a number of other well studied landscapes and research farms which are broadly representative of English and Welsh farming. The selected study farms and landscapes

are geographically spread and representative of both upland and lowland settings and the largest farming sectors in terms of land coverage - arable and upland & lowland grazing livestock

Project 1 will focus on study farms with further testing of approaches being carried out in the associated study landscape (Table B). Project 2 will adopt a two-tiered approach. Three of the study landscapes will be studied in detail while lighter touch work will be conducted in 'Tier 2' landscapes to capitalise on research in the Demonstration Test Catchments.

Table A: Components of the Sustainable Intensification Platform

		PROJECT		
		1) Integrated farm management	**2) Landscape scale opportunities & risks**	**3) Markets & drivers**
WORK PACKAGE	**A) Understanding the system**	Developing farm performance metrics/indicators	Developing land typology (capability & risk)	Resilience of UK farming to external factors
	B) Designing interventions	Identifying practices for high environmental and economic performance	Collaborative, landscape-scale interventions	Influence of food supply-chain on farm management
	C) Socio-economic context	Exploring decision support systems	Developing a farm performance benchmarking system	Identify mechanisms to drive SI through the food chain

Table B: Sustainable Intensification Platform Study Farms and Landscapes

	Experimental Farms	**Landscapes**		**Farm type**	**Area**
Tier 1: Detailed study	**North Wyke (+ Future Farm)**	**Tamar DTC / Taw**		Lowland grazing (beef and sheep (+ dairy))	South West
	Henfaes (Bangor Uni)	**Conwy**		Upland grazing (sheep)	North Wales
	Allerton (GWCT)	**Eyebrook**		Lowland mixed, under HLS (arable + beef and sheep)	Midlands
	Nafferton (Newcastle Uni)	**Tier 2: Higher level study**	**Local area**	Lowland mixed, conventional & organic (arable, veg, dairy/beef, sheep)	North East
	Morley (NIAB-TAG)		**Local area/ Wensum DTC**	Arable	East Anglia
			Eden DTC	Upland mixed	North West
			Avon DTC	Lowland mixed	South
Tier 3: Virtual Network					
Wider virtual network of research sites and farmer groups					National

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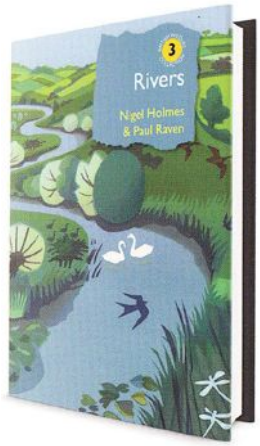
Brian Chambers – Friend, Colleague and DTC Research Advisory Group member

Brian Chambers, who had almost 30 years' experience at ADAS conducting policy-driven research in soil science, died suddenly on Saturday August 30. Having published over 300 scientific papers, Professor Chambers was internationally renowned for his pioneering research on manure management and the minimisation of environmental pollution.

His work with ADAS included research for the Department for Environment, Food and Rural Affairs (Defra), Environment Agency, WRAP, Scottish Executive, and a host of other departments, corporations, independent farmers and growers. He also played an important role in the European and UK Soil Science community serving as President and Fellow of the Institute of Professional Soil Scientists (IPSS), visiting Professor at Cranfield University, a member of British Society of Soil Science, the International RAMIRAN Network and was a FACTS qualified adviser. Brian was a valued member of the DTC Research Advisory Group - we will miss him.



New Book on Rivers Published

A new book on rivers has been recently published by British Wildlife Publishing that may be of interest to some. Written by Nigel Holmes and Paul Raven founder of the Rivers Restoration Centre and former Head of Conservation and Ecology at the Environment Agency respectively, it moves from a general introduction on river-types, through their development and history in Britain, to a detailed analytical comparison of three case studies – the Meon, Dee and Endrick. The book examines the varied ecosystem of rivers as a whole, as it has changed and is changing, and is accessible for a wide readership.

Update on DTC Phase 2

Phase 1 of Component 1 of DTC has been extended for a further 6 months while the procurement of Phase 2 is finalised, following some changes to the process in Defra. This allows existing consortia to safeguard posts in the short term and current monitoring to progress. There will be a competition for phase 2 as a single national DTC project running to 2017/18.

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