

# Demonstration Test Catchments



## Newsletter - Autumn 2015

Welcome to the Autumn 2015 edition of the DTC Newsletter highlighting a few activities and progress over the past 3 months and information on related projects with links for you to follow up on more detailed information about individual items and topics of interest.

*If you don't synthesise knowledge, scientific journals become spare-parts catalogues for machines that are never built – Arthur R. Marshall*

### DTC mitigation methods and farm economics update

A range of on-farm mitigation methods has been implemented across the DTCs:



1. DTC-funded capital works e.g. roofing, concrete yards, drains, farm track improvements

**Figure 1:** Salle Farm – filter bed of bio-bed showing irrigation lines - sprayer filling building is behind. The sprayer is filled undercover and washings are treated in the bio-bed

2. South West Water-funded capital works in the Tamar DTC - e.g. roofed manure stores, farm tracks.



**Figure 2:** Muck store in the Caudworthy Water catchment north of Launceston. Note concrete surfaces and rainwater goods to channel run-off and exclude rainwater

3. Eden Rivers Trust works in the Eden DTC e.g. re-contouring access routes, run-off management



**Figure 3:** Combined methods in the Lowther catchment – in-fill of low area, improved drainage and ditch bank fencing combine to enable access to grazing land that would otherwise be unavailable for many weeks in this high rainfall area

4. Catchment Sensitive Farming Capital Grant Scheme (CSFCGS) works, mainly concreting, roofing, tracks and river bank fencing
5. Catchment Sensitive Farming options: non-capital, e.g. integrated nutrient planning
6. Voluntary measures: mainly changes to practices, but some capital works, such as river bank fencing

The farm economics analysis in phase 2 of DTC covers the on-farm methods that have involved capital spending, including yard works involving roofs, slurry and silage stores and yard surfaces through to livestock tracks and river bank fencing. All of the DTC areas have been visited to obtain a first-hand impression of their characteristics and their diffuse pollution problems gaining an understanding of the challenges on the farms in the catchments.

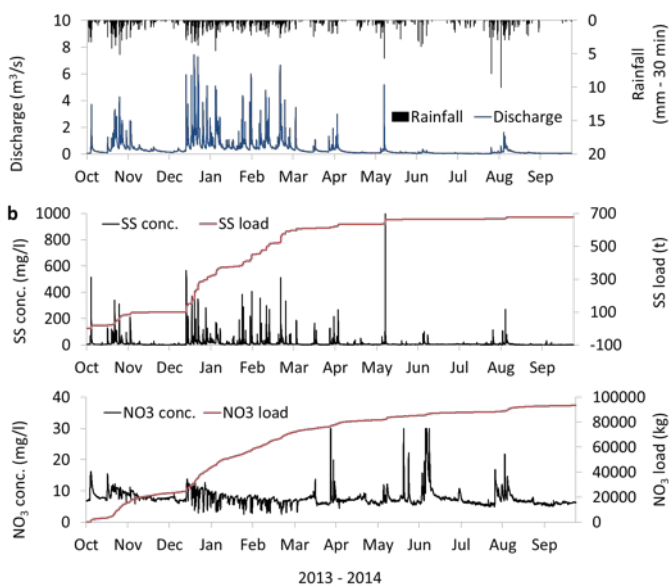
Our MSc student, Andy Boulding, carried out much of the analysis for his dissertation. We obtained detailed invoice data for 46 selected CSFCGS cases, which then had to be scanned from original invoices drawn from archived files and then transferred to a spreadsheet.

Further analysis will be required and some data is yet to be acquired. Close liaison with Defra has been carried out as a result of which a short list of 20 priority on-farm mitigation methods have been identified. These are of most interest for updating the costs. Most of these priority methods involve changes to practices, but some involve capital expenditure.

Up-to-date and representative cost data are required by the Water Framework Directive and the analysis during phase 2 of DTC will be used to inform and update Defra policy on diffuse pollution mitigation.

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## Estimating the monetary cost of nutrient and sediment loss at the farm-scale in the River Eden catchment



High resolution monitoring of river discharge, along with suspended sediment (SS), phosphorus (P), nitrate (NO<sub>3</sub>) and ammonium (NH<sub>4</sub>) concentrations, provide us with valuable insights into the physical and chemical system dynamics controlling their regimes while also allowing for the accurate calculation of annual pollutant loads. These data can help scientists and decision makers target mitigation efforts appropriately and inform catchment management plans. However, annual sediment and nutrient loads have little resonance with farmers and landowners whom are, after all, fundamentally responsible for the delivery of diffuse water

pollution from agriculture (DWPA) amelioration schemes.

A number of DTC scientists have been working in collaboration with the Catchment Sensitive Farming Officer (CSFO) for the Eden, and the Eden Rivers Trust, to find robust solutions to diffuse

pollution. Nutrient loads were converted into equivalent quantities of P and N inorganic fertilisers, which have a direct cost associated with them. SS loads were assumed to be of the same value of topsoil with the cost of delivery and spreading acknowledged. The average farm holding in the Eden catchment is ca. 100 ha, therefore all data and values were standardised by area to best represent the farm scale. Based on data collected in the Morland catchment (12.5 km<sup>2</sup>) during the 2013-14 hydrological year (a relatively wet one), the calculated costs to replace lost:

- Phosphorus = £1271/farm
- Nitrogen =  
£7384/farm
- Topsoil = £2050/farm

Thus, the total cost per-farm per-annum is £10,705. That equates to £134,000 for the Morland catchment per annum – and that's just accounting for what's measured in the river! Other important points to consider include potassium and potash not accounted for here; the cost of soil compaction and associated reduced productivity, reduced infiltration and muddy floods/increased flood risk.



A key message derived from this work that is being actively used by the Eden CSFO is that of improved and increased slurry storage capacity on farms. The potential benefits include better slurry application timing to reduce losses to river; reduced need for inorganic fertiliser and therefore a lower cost to the farm, and an improvement in soil organic matter. In conjunction with Durham University, a short animated film is being made by the CSFO, which will be used to convey this message to the farming community.

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### Can a modelling toolkit help salmonid population management in the Tamar catchment?

Defra-funded research has applied water quality models within a GIS framework to the River Tamar (an Environment Agency Salmon Index River) to generate current and future river water quality scenarios for the seasons associated with salmonid sensitive life stages. The models combine land use data (from satellite imagery and agricultural census) with parameters such as hydrology and soil type, to estimate the amount of different chemicals in the water discharged from both diffuse sources (e.g. agricultural land) and point sources (e.g. sewage treatment plants). The models simulate water quality along the river network providing information on present day conditions and generating future scenarios representing changes in land use/management (e.g. increases in wetland area and implementation of riparian buffer strips) and climate (e.g. rainfall and temperature).

The work was carried out in consultation with the Westcountry Rivers Trusts (WRT) for the current and future land use scenarios and with the Environment Agency (EA) regarding the salmonid data from juvenile monitoring programmes. The river water quality outputs, including nutrients, flow and suspended sediment, were analysed in relation to the salmonid population abundance data to assess which seasonal river water quality parameters are affecting juvenile Atlantic salmon and trout abundance in the Tamar catchment and how these parameters are likely to change under future land-use and climate scenarios. The engagement of local stakeholders (WRT, the Rivers Trust, EA, local Fisheries and Anglers' Associations and local industry) was obtained by delivering a workshop in March 2015, to present methods and preliminary findings and receive their feedback on the catchment needs. The project final report is near completion.

The Centre for Environment, Fisheries & Aquaculture Science (CEFAS) is leading on this collaborative project with the Centre for Ecology and Hydrology. For further information see: <http://sciencesearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=18941&FromSearch=Y&Publisher=1&SearchText=SF0268&SortString=ProjectCode&SortOrder=Asc&Paging=10#Description>

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### New 'Saving Eden' website goes live

The site is one of the central pillars of the Eden Rivers Trust's 'Saving Eden' communications strategy and tactical plan. A significant amount of investment has been invested into its design, functionality and compatibility with a range of devices (from PC's to mobiles). Over the coming weeks the content will be increased and improved. A Tumblr Blog offers the opportunity to share stories, news, videos, views etc.

The website has been funded by the Heritage Lottery Fund and is part of the £2.5M Cherish Eden project. A major achievement of the project is the ERT Apprentice Eden Programme which is run in partnership with Newton Rigg / Askham Bryan College. The apprentices are all coming to a successful conclusion of their level 2 programme in Conservation Management and are already proving to be popular with local employers in land based industries. You can watch an inspirational video about the apprentices on the new website in the 'about us' section. Click on the following link: <http://www.edenrivertrust.org.uk/apprenticeships-investing-future>

If you have any feedback on the website the ERT would love to hear from you - please send comments directly to:

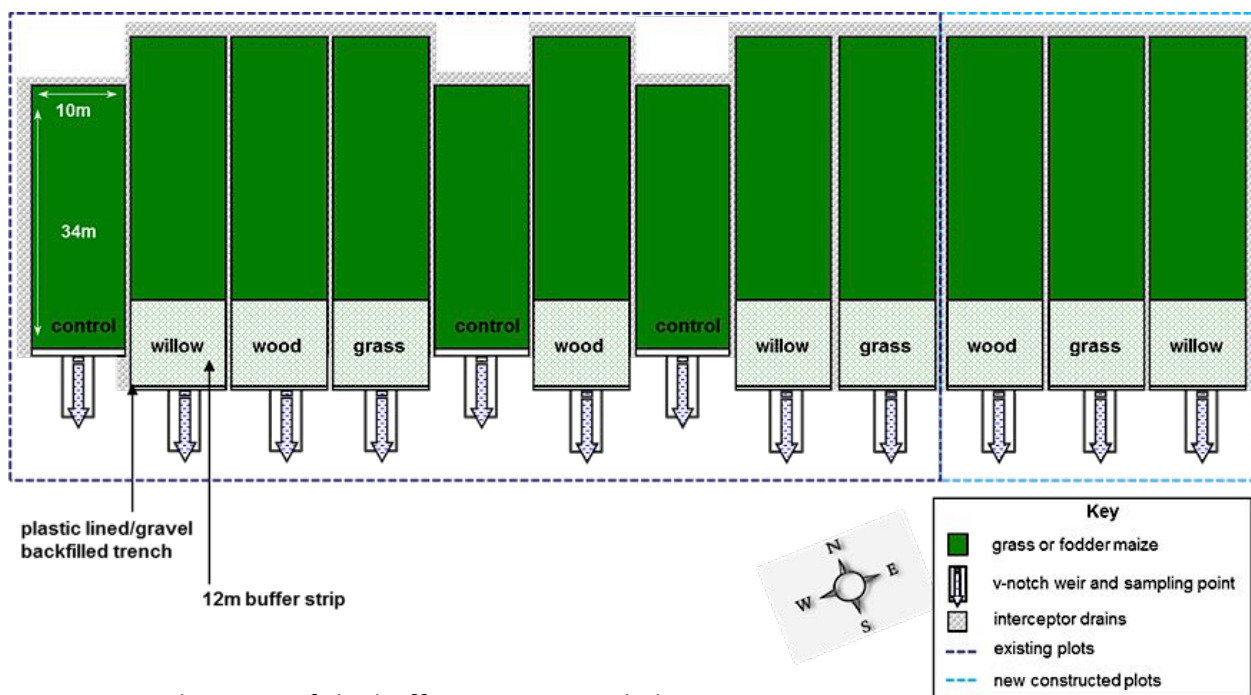
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### New project - Impacts of different vegetation in riparian buffer strips on hydrology and water quality

The Biotechnology and Biological Sciences Research Council (BBSRC) along with the Natural Environment Research Council (NERC) and 12 industry partners are to fund six research projects to improve the sustainability of UK farming. The grants totalling £4.7M were funded in the first round of the Sustainable Agriculture Research and Innovation Club (SARIC), which was developed by BBSRC and NERC, together with industry, to support innovative projects that will provide

solutions to key challenges affecting the efficiency, productivity and sustainability of the UK crop and livestock sectors.

Among the funded studies is work to improve the drought tolerance of wheat, research to determine the best foodstuffs for ruminant animal health and production, and a project focused on optimising the use of buffer strips to enhance hydrology and water quality. This latter project – ‘understanding the impacts of different vegetation in riparian buffer strips on hydrology and water quality’ – is led by Professor Adie Collins of Rothamsted Research. Riparian buffers continue to feature strongly in the revisions to agricultural policy under CAP reform (2014-2020) and the need to improve information on the efficacy of different buffer vegetation types, especially during the establishment phases, remains a priority for agri-industry and stakeholders working on catchment management. The 5 year study which combines expertise across the Rothamsted Research campuses will expand an existing research facility at North Wyke, Devon, established during a previous Defra funded project to examine the impacts of novel deep rooting



**Figure 4:** Schematic of the buffer experimental plot facility at Rothamsted Research, North Wyke, Devon.

grasses, willow and mixed deciduous trees as vegetation treatments for riparian buffers. Part of the study will assess riparian buffer performance in reducing runoff and water pollution problems associated with fodder maize as a high-risk crop. The measurement programme will assess impacts on hydrology and pollutant emissions with a strong focus on pesticides, using a working partnership with South West Water. New information on the economics will be collected and combined with the empirical data on buffer performance to permit preliminary scaling up using modelling.



**Figure 5:** Photographs of the buffer experimental plot facility at Rothamsted Research, North Wyke, Devon.

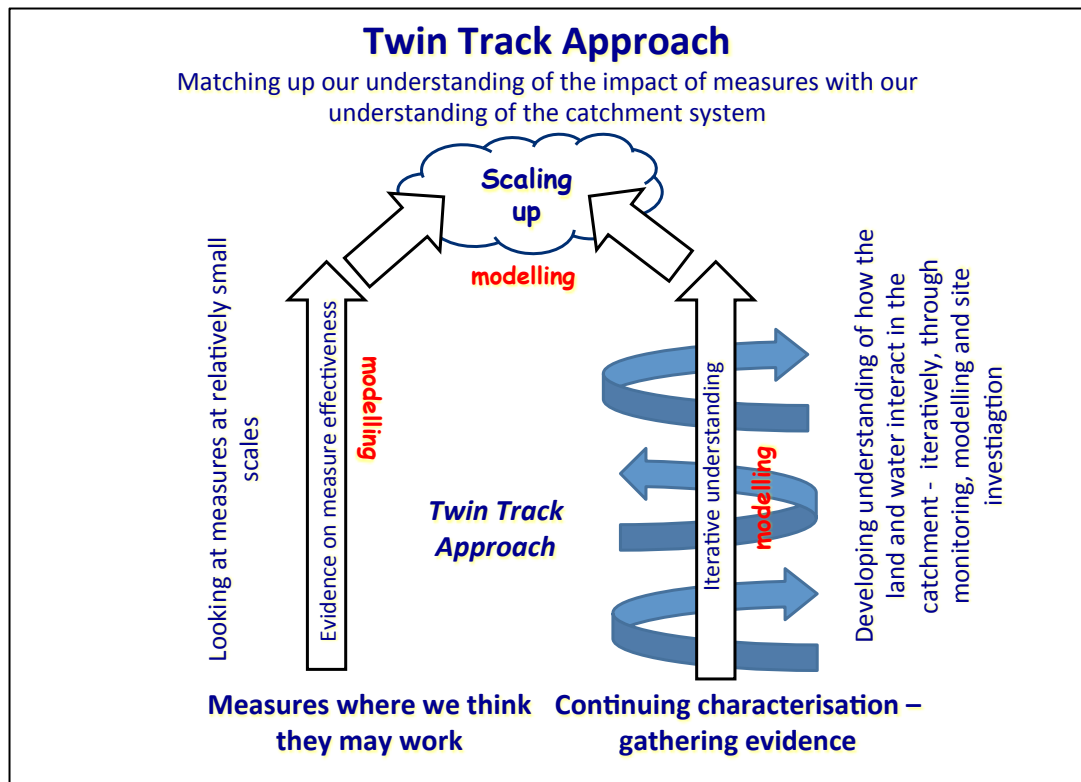
The second call for SARIC applications with up to £5M available in research grants and research translation grants has recently closed. The theme of the call is ‘predictive capabilities for sustainable agriculture’. The Economic and Social Research Council (ESRC) is contributing to this call.

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### **The ‘Twin-Track’ approach to characterisation and understanding the contribution of groundwater to surface water catchments**

Most of the rivers and streams in the UK have a medium to high component of their baseflow which is due to groundwater inflows, whether shallow sub-surface seepage or from deeper groundwater. It’s the reason that surface waters keep flowing in dry summers; in fact ‘rivers are simply outcrops of groundwater’ where they drain major aquifers such as the Chalk and Triassic sandstones. The groundwater component can have a major influence on river water chemistry and hence the natural freshwater ecology. Groundwater can transport pollutants from significant distances, combining surface inputs where the soils are permeable across large areas and ultimately forming both reservoirs of pollutants and pathways for pollutant fluxes, particularly nitrate and the less absorbent pesticides.

The DTC catchments are situated on differing and variable geological terrain. Where the underlying geology is quite complex, and therefore understanding the contribution of groundwater and sub-surface pollutant fluxes to the surface water system is correspondingly difficult, the twin track approach is helpful. This approach recognises that it is not possible to understand the complexity of any given catchment in its entirety and so measures need to be put in place on a ‘best endeavours’ basis (i.e. best on common sense, local knowledge etc.) but work should continue to understand the catchment in terms of the critical pollutant sources, pathways and receptors. There needs to be a continual iteration between the trial and error approach of best endeavours and the understanding developed through investigation and monitoring, often being aided and brought together with modelling. The diagram below attempts to reflect this approach:



The shallow geology in the Eden catchment is particularly complex. Work in the DTC programme has focused on understanding the extent of connection between groundwater in shallow superficial deposits and the stream network. Alongside geophysical work, the project has undertaken a programme of drilling. The latest drilling work has focused on the Morland sub-catchment where a range of mitigation measures have been installed as part of multiple



initiatives, including the DTC project. The aim of the drilling work in Morland is to better understand the influence of groundwater on stream discharge and on pollutant loads leaving the catchment. If groundwater does play an important role, there are potentially significant implications for the timescales over which mitigation measures in the catchment can be expected to influence stream status.

During the latest drilling work, water-saturated zones were found at five locations in the Morland catchment. Boreholes in these saturated zones will be instrumented to record changes in groundwater level in relation to stream stage. Water samples from these boreholes will also be analysed for a range of pollutants that may influence stream status, alongside parameters that enable estimates of groundwater age to be made.

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## DTC on the road in Europe

Since the last newsletter, researchers working on the DTC have been attending conferences on key areas of catchment science across Europe.

'Catchment Science 2015' was held in Wexford, Ireland at the end of September and DTC was well represented. Maria Snell, Mary Ockenden (Lancaster University) and Adie Collins (Rothamsted Research) all gave invited presentations. Maria talked about 'real time ecology' to understand the nutrient and community dynamics of headwater streams, using the example of near-continuous, in-situ data from the Eden DTC programme to explore how headwater community dynamics can be used to inform catchment mitigation and management. Mary



followed on with 'Assessing the impacts of climate change on phosphorus transfers in a headwater agricultural catchment', investigating potential impacts of climate change on nutrient transfers to the stream. Adie began the session with a paper entitled 'Linking agricultural fine sediment pressure and impacts on aquatic ecology for informing catchment management'. There was also an opportunity to visit the research sites in the

Irish Agricultural Catchments Programme and to share experiences on the application of high frequency monitoring to catchment research and management (see photo). You can access all the abstracts here: <http://www.teagasc.ie/agcatchments/catchmentscience2015.asp>

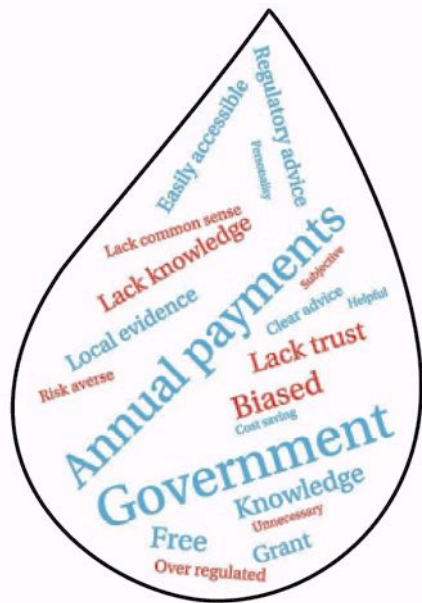
Mary also presented on 'Phosphorus transfers in a headwater agricultural catchment: present and future' at the IWA International Conference on Diffuse Pollution and Eutrophication in Berlin.

The second International Interdisciplinary conference on Land Use and Water Quality in Vienna (LuWQ 2015) brought together scientists, managers and policy makers involved in the policy cycle for water quality improvement. This conference was the follow-up to the successful LuWQ 2013 conference held in The Hague in June 2013. DTC had had a strong presence at The Hague and, ensuring continuity, two PhD researchers in DTC and a research associate attended LuWQ this September to provide an update on research findings. The conference's main aim was to provide a forum for the exchange of scientific knowledge, research on system knowledge, modelling and uncertainty, along with helping to build networks between a) soil/water related scientists, agro related scientists, social scientists, ecological scientists and economists, and b) scientists, water managers and policy makers.

Emilie Vrain (University of East Anglia) contributed to the conference session on 'Decision-making on Programmes of Measures', presenting her research findings on the factors influencing farmer uptake of mitigation measures. Emilie's presentation provided a variety of different methods to visualise the results from her most recent farmer survey from three of the DTC catchments. She presented her results on: farmer decision-making processes for measure uptake; factors acting as barriers to uptake; and farmer attitudes towards different advice providers. This visually engaging presentation sparked great interest amongst the audience, especially regarding the 'word clouds' which were used to summarise the vocabulary farmers used during interviews when describing why they would or would not listen to particular advisors for mitigation measure advice (see the figures below for an example of the word clouds).



## Natural England



## Rivers Trust



Matilda Biddulph (University of Northampton) presented her research findings in one of the sessions titled 'Field research and data interpretation'. Her informative presentation provided an insight into testing the efficacy of on-farm pollution mitigation measures in agricultural catchments of the Hampshire Avon DTC, explaining how a number of pragmatic methods were employed as a user-friendly toolkit for monitoring watercourses. Interesting comparisons could be made between the different approaches researchers use for water monitoring, highlighting the benefits of attending such conferences on the cutting edge of science.

Mike Hollaway (Lancaster University) also presented a paper on 'modelling the effect of climate, land use and land management changes on water quality in a headwater agricultural catchment'.

The conference was an excellent opportunity to exchange knowledge between nations, learning not just how fellow EU members are tackling the issues of water quality to meet Water Framework Directive targets, but also how countries further afield are researching solutions to the interdisciplinary topic of land use and water quality.

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**Book Review – 'Catchment and River Basin Planning: Integrating Science and Governance'** - edited by L Smith, K Porter, K Hiscock, M J Porter and D Benson and published by Routledge in their Earthscan Studies in Water Resource Management series, 2015.

The recent revival of catchment management as a practical concept for water resource management in the UK and the publication of the 2<sup>nd</sup> River Basin Management plans for the Water Framework Directive at the end of this year makes this book timely. The book is based on two successful research projects undertaken as part of the Rural Economy and Land Use (RELU) programme and is written by a combination of researchers and practitioners, some with long experience of more integrated approaches than the more recent attempts in the UK.

The book is divided into three parts. The first introduces the challenges faced in catchment management and the concepts for addressing them. It sets a framework for comparing and analysing the nine case studies that follow in the second section. Three are taken from the US (Upper Susquehanna, New York City watershed and Hudson river), one from Australia (S E Queensland), three from northern Europe (Aalborg, Denmark, Lower Saxony, Germany and Drenthe Province, Netherlands) and two from the British Isles (Ballinderry and Loweswater). The case studies are mostly long-standing and cover a wide range of scales (from 22000 to 8 km<sup>2</sup>) with the management issues involving a variety of ecosystem services, drinking water quality often to the fore. The approaches taken, and which are seen to achieve success, vary accordingly but there are a number of common principles which can be established and which the authors have drawn together. The third part sets these commonalities out in terms of, *inter alia*, integrating knowledge with decision-making, forming collaborations and partnership working, using communications tools effectively, developing a balance between formal and informal governance arrangements, offering a plethora of advice based on practicalities which have been known to work.

The book will be particularly useful to those engaged in Catchment Partnerships through Defra's Catchment Based Approach (CaBA) programme, whether in pointing out ways forward or giving confidence that persistence with building communities of practice will gain success in the longer term - anyone starting in catchment management will soon realise that developments do not happen overnight! We are particularly poor in the UK at taking learning from elsewhere and applying it to our own problems. This book shows that there are commonalities of approach to the management of complex systems such as river and groundwater catchments, no matter what the geology, landscape, legal system, culture or problems to be addressed. People are at the heart of achieving success and the sooner we realise that the sooner we might make progress.

I recommend this volume. It is well written and can be read as a whole or used as a reference book for dipping into. Hopefully a future volume on the subject will have many more UK case studies to draw on, some of which may have taken the information and principles set out in this book for their inspiration.

Although Kevin Hiscock (one of the joint leads of the Wensum DTC Consortium) is an editor and chapter co-author, he had no hand in writing this review (by Bob Harris)!

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### **DTC Findings influence revised greening rules for 2016**

Updated guidance on EU greening rules to help farmers applying for Basic Payment Scheme payments in 2016, make their 'greening' calculations were published at the end of September. The rules cover three areas – crop diversification, Ecological Focus Areas (EFAs) and measures to maintain permanent grassland. One of two key changes to the greening rules is that oilseed radish can now count (as part of a mix) as an EFA catch and/or cover crop. This addition was influenced by the findings from the cover crop trials which have been carried out on the Sawle Estate on the Wensum as part of the DTC programme. See previous newsletters for summary information on the cover crop research work or visit the Wensum DTC website – [www.wensumalliance.org.uk](http://www.wensumalliance.org.uk).

### **And it's goodnight from him, and goodnight from her and... him.**

Dan McGonigle (Defra Programme manager) is off for pastures new, at least for 2 years at the end of November. Dan is taking a sabbatical at Bioversity International based in Rome to manage their research initiative on Productive and Resilient Farms, Forests and Landscapes.

Faye Outram left the DTC team on the Wensum at the beginning of October where she has been working since the early days of the project, latterly as a post-doc. She starts a new job working in intellectual property and technology transfer at UEA... but there are still papers in the pipeline!

...and Bob Harris has decided to call it a day at the end of the year and spend more time with his vegetable garden in Shropshire after 6 enjoyable years as secretariat/co-ordinator of DTC. The revised contacts and roles for DTC in 2016 and beyond in Defra and the EA are being finalised and will be publicised in the next newsletter.