Institution: University of East Anglia

Unit of Assessment: 7 – Earth Systems and Environmental Sciences

Title of case study:

Catchment Management Policy and Practice

1. Summary of the impact

Current Defra policy on river catchment management has been informed by our interdisciplinary research over a 10-year period, much of it addressing the challenges posed by the EU Water Framework Directive. Outcomes from our research are reflected in the policies proposed in the 2011 *Water for Life* White Paper and also in the multi-million pound investment plans of water companies. We have also influenced a whole-community framework for catchment management in the UK that was piloted in 2011 and has now been extended to 100 catchments across England.

2. Underpinning research

Diffuse water pollution from agriculture in the form of nutrients (nitrogen and phosphorus), pesticides and suspended sediment seriously affects catchment ecosystem services and poses challenges for integrated policy, control strategies and scientific assessment. Following the EU Water Framework Directive (in 2000), the protection of EU water resources and improvement in the health of aquatic ecosystems experienced a major change in approach which required that surface water and groundwater bodies should be considered holistically at the river basin scale.

Water4All and WaterCost projects: Between 2003 and 2006, **Hiscock** and **Lovett** led the EU Interreg IIIB *Water4All* and *WaterCost* projects funded through the Environment Agency to investigate land-use practices which would cost-effectively reduce agricultural impacts on groundwater quality. These projects reviewed north European catchment-based approaches to protecting groundwater resources, founded on the concept of a 'groundwater protection cycle'. This 'cycle' involved the planning and implementation of mitigation measures coordinated by a stakeholder group. Publication of the *Water4all Sustainable Groundwater Management Handbook* and the associated journal article [1] identified that targeted land use change within water supply zones can achieve improvements in water quality while maintaining agricultural production.

ChREAM project: Methodological advances in the use of GIS to unite hydrological and economic assessments of land use change, together with the development of economic valuation methods and stakeholder engagement in catchment management, formed the basis of the RCUK Rural Economy and Land Use (RELU)-funded *Catchment Hydrology, Resources, Economics And Management (ChREAM)* project (2006-2009). This research analysed the consequences of land use change for farm incomes, the resultant diffuse pollution leaching to waterways, ecological consequences and the impacts upon water user groups and recreation values [2&3].

Catchment Management for the Protection of Water Resources project: Building on the findings from our *Water4All* and *WaterCost projects*, the RCUK RELU-funded *Catchment Management for the Protection of Water Resources* project (2007-2010) analysed the governance arrangements necessary to deliver effective catchment-wide protection of rural land and water resources. Researchers compared catchment management regimes in the UK, Europe, USA and Australia, derived transferable lessons and tested them in two case studies in England [4]. The research led to the development of a catchment management 'template' of governance principles based on a dual-track, adaptive management cycle for use in the UK and elsewhere. Learning from international experience, the project also developed decision support tools such as the *Ecosystem Health Report Card* and the *Extended Export Coefficient (ECM+)* model to make complex water quality and ecological data more meaningful to stakeholders [5].

The Wensum Demonstration Test Catchment project: In 2009, Defra set up three Demonstration Test Catchment (DTC) projects as a national research platform with the aim of providing information to better predict and control diffuse pollution from agriculture while maintaining sustainable food production. The Wensum DTC project is led by UEA and builds on

previous research in the River Wensum using hydrochemical and stable nitrogen isotope methods to understand the sources and transport of diffuse pollution in this groundwater-dominated catchment [6].

Key researcher involvement:
The UEA research team consists of Professor **Kevin Hiscock** (at UEA since 1989), Professor **Andrew Lovett** (since 1990), Professor **Ian Bateman** (since 1989), Dr **David Benson** (Senior Research Associate and Lecturer, 2008-13), Professor **Brett Day** (since 2001), Professor **Andrew Jordan** (since 1992) and Dr **Tobias Krueger** (Senior Research Associate 2008-13).
Research and dissemination activities were carried out in collaboration with colleagues principally at the University of London (SOAS) and CEH Wallingford.

3. References to the research

(UEA authors in bold) {Scopus citations}

[1] **Hiscock**, K., **Lovett**, A., **Saich**, A., **Dockerty**, T., Johnson, P., **Sandhu**, C., **Sünnenberg**, G., **Appleton**, K., Harris, B. & Greaves, J. (2007) Modelling land-use scenarios to reduce groundwater nitrate pollution: the European *Water4All* project. *Quarterly Journal of Engineering Geology and Hydrogeology* **40** 417-434 doi:10.1144/1470-9236/07-054 {9}

[2] **Fezzi**, C., Rigby, D., **Bateman**, I.J., **Hadley**, D. & **Posen**, P. (2008) Estimating the range of economic impacts on farms of nutrient leaching reduction policies. *Agricultural Economics* **39** 197–205 doi:10.1111/j.1574-0862.2008.00323.x {13}

[3] Hutchins, M.G., **Fezzi**, C., **Bateman**, I.J., **Posen**, P.E. & Deflandre-Vlandas, A. (2009) Cost-effective mitigation of diffuse pollution: Setting criteria for river basin management at multiple locations. *Environmental Management* **44** 256-267 doi:10.1007/s00267-009-9306-8 {15}

[4] **Benson**, D., **Jordan**, A. & Smith, L. (2013) Is environmental management really more collaborative? A comparative analysis of putative 'paradigm shifts' in Europe, Australia, and the United States. *Environment and Planning A* **45** 1696-1712 doi:10.1068/a45378 {2}

[5] **Krueger**, T., Page. T., Hubacek. K., Smith. L. & **Hiscock**, K. (2012) The role of expert opinion in environmental modelling. *Environmental Modelling & Software* **36** 4-18 doi:10.1016/j.envsoft.2012.01.011 {20}

[6] **Wexler**, S.K., **Hiscock**, K.M. & **Dennis** P.F. (2011) Catchment-scale quantification of hyporheic denitrification using an isotopic and solute flux approach. *Environmental Science & Technology* **45** 3967-3973 doi:10.1021/es104322q {3}

Key Research Funding:

i. **The Fowey River Improvement Auction**: Payment for Ecosystem Services (PES) – PES Pilot Research Projects. Funder: Defra, 2011-12, **£25K**. Awarded to **Day**, **Bateman**, **Hiscock**, **Lovett**.

ii. **The Wensum Demonstration Test Catchment**: Design and implementation of a monitoring approach and conceptual model for the Wensum Demonstration Test Catchment. Funder: Defra, Environment Agency & Welsh Assembly Government, 2009-14, **£2.5M**. Awarded to **Hiscock**, **Lovett**, **Boar**.

iii. **Catchment Management for the Protection of Water Resources**: Developing a catchment management template for the protection of water resources: exploiting experience from the UK, eastern USA and nearby Europe. Funder: ESRC-RELU, 2007-10, **£598K**. Awarded to: **Hiscock**, **Benson**, **Jordan**, Smith (SOAS-U. London), Bailey (U. Kent).

iv. **Catchment Hydrology, Resources, Economics and Management (ChREAM**): Integrated Modelling of Water Framework Directive Impacts upon Rural Land Use and Farm Incomes. Funder: ESRC-RELU, 2006-09, **£943K**. Awarded to: **Bateman**, Neal, Kay, Leeks, **Day**, **Turner, Jickells, Andrews**, **Lovett**, Rigby, Jones.

v. **WaterCost**: Identifying cost-effective measures for the management of groundwater quality. Funder: EU Interreg IIIB through the Environment Agency, 2006-07, **£22K**. Awarded to:

Lovett, **Hiscock**.

vi. **Water4All**: Understanding movements of pollutants through a catchment area. Funder: EU Interreg IIIB through the Environment Agency, 2003-05, **£108K**. Awarded to: **Hiscock**, **Lovett**.

4. Details of the impact

Policy Input: During the course of the catchment research detailed above we provided policy input through, for example, contributions by **Bateman** to the UK Foresight *Land Use Futures* project (corroborating source [7]) and advice through representing the RELU Programme's interdisciplinary research on managing land and water use for sustainable catchments to the Office of Science and Technology's review of *River Basin Management Plans* (corroborating source [8]). In addition, both written and oral evidence was submitted to the House of Lords EU Select Committee's inquiry into EU Freshwater Policy in 2011, in which an adaptive and collaborative management cycle was recommended. This evidence was repeatedly cited in their Lordships' final reports to the UK Government and the European Commission (corroborating source [9]).

The Tamar Catchment Management Plan: At a regional level, the *Catchment Management for the Protection of Water Resources* project's 'template' and recommendations have informed the *Tamar Catchment Management Plan* coordinated by the Westcountry Rivers Trust (corroborating source [10]). The Environment Manager for South West Water, a major stakeholder in this catchment plan and who had the opportunity to experience use of the social-participatory modelling tool *ECM+*, is quoted in an ESRC review of the impact of RELU-funded research as stating that:

> "*… with the [catchment] model on the screen, all the stakeholders are able to work out jointly-owned solutions to water quality …..We can all share in the design of improvements, rather than criticising each other. This is completely new and not seen before.*" (corroborating source [11]).

Adoption of the Catchment Management Approach: The impact of the RELU-funded research contributed to the announcement of a new catchment management approach by Defra and the Environment Agency on World Water Day, 22 March 2011. At this launch event, **Hiscock** (UEA) and Smith (SOAS) presented key findings from the RELU *Catchment Management for the Protection of Water Resources* project and highlighted the components of a template for catchment management and supporting tools for catchment assessment, planning and knowledge exchange. The Parliamentary Under Secretary for Natural Environment, Water and Rural Affairs, Richard Benyon, announced the adoption of the 'catchment management approach' and explained its role in meeting the goals of the EU Water Framework Directive. Following a project launched in 2011 involving 25 pilot catchments, in May 2013 Defra published its policy framework *Catchment Based Approach: Improving the quality of our water environment* inviting partnerships to manage 100 catchments covering the whole of England. In response to these policy developments, water supply companies have also embraced the catchment-based approach as demonstrated by an industry-led conference organised by the Chartered Institution of Water and Environmental Management (CIWEM) in November 2011, at which CIWEM recognised:

> "*That major research studies by the University of East Anglia (RELU) … have shown over and over again the basic, and common core principle for effective and integrated catchment management and partnership working*" (corroborating source [12]).

The Fowey River Improvement Auction: As one of the first NGOs to lead a catchment-based approach in engaging partners in solving water quality problems, the Westcountry Rivers Trust, together with UEA led by **Day**, piloted the Fowey Reverse Auction under South West Water's *Upstream Thinking* project. In this project, £360k of the water company's funds were distributed to farmers in the Fowey catchment as a first national demonstration of Defra's *Paying for Ecosystems Services Action Plan* (corroborating source [13]).

Demonstration Test Catchments: The Defra Demonstration Test Catchments (DTCs) programme was set-up in 2009 to inform policy initiatives about the catchment-based approach. It aims to demonstrate new partnership working in undertaking catchment research for managing land and water to protect valuable ecosystem services and ensure the long-term sustainability of

agriculture. Given previous experience of collaborative working under the RELU programme, the contract for the Wensum DTC was awarded to UEA and is led by **Hiscock** and **Lovett** (corroborating evidence [14]). The Wensum DTC actively promotes knowledge exchange through its *Wensum Alliance* (www.wensumalliance.org.uk) in sharing research results with catchment partnerships in East Anglia.

5. Sources to corroborate the impact

[7] UK Foresight *Land Use Futures* Project (2010) *Understanding the spatial nature of land use value*. Report to the Government Office for Science, London.
Bateman is listed on page 38 as a contributor to the evidence base.

[8] Advice to the Office of Science and Technology review of river basin management plans can be found in POST (2008) *River Basin Management Plans*.
Postnote 320. Parliamentary Office of Science and Technology, London.
Box 7 and Endnote 11 on page 4 summarises evidence from the UEA-led RELU *Catchment Management for the Protection of Water Resources* project.

[9] House of Lords European Union Committee (2012) *An indispensable Resource: EU Freshwater Policy*. 33rd Report of Session 2010-12
Appendix 2: *List of Witnesses* includes UEA staff **Benson** and **Jordan** and Appendix 8: *A 'Template' for Catchment Management* is taken from the UEA-led RELU *Catchment Management for the Protection of Water Resources* project.

[10] Tamar Plan Working Group (2012) *The Tamar Plan*
Held on file at UEA
Krueger and the application of the social-participatory modelling tool *ECM+* for pollution source apportionment are cited on pages 20 and 21.
Appendix 6: *Engagement Plan*, page 92, lists the *Report Card* as a supporting activity under the Plan with UEA as the envisaged delivery partner.

[11] Economic and Social Research Council (2012) *Societal and Economic Impact Evaluation – RELU*. ESRC, Swindon.
Available at: http://www.esrc.ac.uk/_images/ESRC_RELU_REPORT_%20Part_TWO_tcm8-22270.pdf
The quote from Martin Ross, Environment Manager for South West Water, is a reference to the application of the social-participatory modelling tool *ECM+* and appears on page 10, supported by footnote 12 which references UEA staff **Krueger**.

[12] *Catchment Delivery: Towards More Effective Environmental and Societal Benefits*. CIWEM Conference, London, 23 November2011.
Available at: http://www.coastms.co.uk/conferences/450
The quote from CIWEM on Adoption of the Catchment Management Approach appears in the introduction to the conference programme, with UEA being part of the:
"*quantum shift in thinking in the last six years about effective environmental programme delivery in the water and other sectors*".

[13] *Innovative Payments for Ecosystem Services by South West Water*
The case study on page 13 of the Environmental Sustainability Knowledge Transfer Network (KTN) 2011/12 Annual Report cites UEA and UEA staff **Day** as providing the expertise needed to design and run the reverse auction.

[14] *Demonstrating Catchment Management: Learning from the Demonstration Test Catchment Projects*
Available at http://www.demonstratingcatchmentmanagement.net/
A link to the *Wensum Demonstration Test Catchment* project (see 'The Wensum in Norfolk') is provided from the homepage of the national Demonstration Test Catchments project website.