

OECD FELLOWSHIP SUMMARY REPORT

Name: Helen Jarvie

Subject Title: Evaluating the impacts of phosphorus-based nutrient management on the quality of surface waters: a case study of integrated poultry-beef production

Theme No: I. The Natural Resources Challenge

Host Institution: Department of Crop, Soil & Environmental Sciences, University of Arkansas, USA

Host Supervisor: Professor Andrew Sharpley

Dates of Fellowship: 12 December 2011 to 28th May 2012

Consent: I consent to this report being posted on the Co-operative Research Programme's website.

1. Relevance

- **To the Co-operative Research Programme objectives**
This project addresses an international strategic research and management need to demonstrate how and where phosphorus (P)-based nutrient management works most effectively and the implications for targeting and achieving water-quality improvements in receiving waters. The study provides evidence to help stakeholders develop realistic expectations of agricultural best management practice (BMP) outcomes, particularly in relation to lags between BMP implementation and water quality improvements. The research will help inform policy makers and environment agencies about the links between agricultural BMPs and water quality responses. The research strengthens scientific knowledge and helps to identify the role of ‘legacy’ P stores and to evaluate whether an apparent lack of improvement in water quality may be due to re-equilibration of watershed ecosystems, inadequate remediation, or to the confounding effects of other rural phosphorus sources.
- **To the Theme**
This project contributes directly to the OECD Co-operative Research Programme Theme 1 (The Natural Resources Challenge) by investigating sustainable land stewardship and efficient use of manure/fertiliser resources through nutrient management best practice, with the aim of protecting the quality and ecology of surface water resources.
- **To agricultural and food policy**
Across the OECD countries, there is increasing financial and legal liability on farmers to manage fertiliser and manure resources more sustainably, whilst the wider community is increasingly required to consider what constitutes a healthy river and how to meet the costs of restoring river environments, whilst maintaining sustainable food production. Research on the water quality impacts of intensive livestock farming is of international agricultural and food policy relevance, given increasing global demands for meat and dairy products, particularly in developing countries.

2. Objectives of the fellowship

The objectives of the fellowship were to evaluate the water-quality impacts of P-based nutrient management at the watershed scale, through analysis and modelling of long-term water-quality and land-use datasets for the Illinois River Watershed in northwest Arkansas and southeastern Oklahoma.

3. Major achievements (up to three)

(1) An “Environmental Issues” paper, submitted to Journal of Environmental Quality, discussing the current issues and uncertainties surrounding P-based nutrient strategies to control eutrophication in rivers and their associated downstream ecosystems:

Jarvie, H.P., Sharpley, A.N., Withers, P.J.A. Scott, J.T., Haggard, B.E., Neal, C. “Phosphorus Mitigation to Control River Eutrophication: Murky Waters, Inconvenient Truths and ‘Post-Normal’ Science”.

(2) Production of a research paper for submission to Environmental Science & Technology, examining the role of in-stream retention of P in the Illinois River Watershed. Using chloride as a conservative tracer of wastewater effluent, we provide new evidence that (i) in-stream retention of effluent P can effectively mask the presence of point source P inputs in the water quality record and (ii) by not accounting for the contributions of retained and remobilized effluent P to river storm-flow P loads, existing source apportionment methods may over-estimate the contributions of agricultural P sources to river P loads in mixed land-use watersheds.

Jarvie H.P., Sharpley, A.N., Haggard, B.E., Scott, J.T., Bowes, M.J. “Within-river phosphorus retention: a missing piece in the watershed phosphorus puzzle?”

(3) Initiation of new research and monitoring to examine the transmission and attenuation of nutrients, from agricultural sources, in karst terrain. Karst groundwater quality exerts a major control on the water quality of the Illinois River and this study will provide new insights into how water pathways, with a range of water residence times, influence nutrient transport and delivery. This landscape and water flow pathways has similarities and the results relevant to large areas of the UK. This work brings together cross-disciplinary collaborative expertise from the Dept. of Crop, Soil and Environmental Sciences, Department of Geology and the Arkansas Water Resources Center, and my home institution, the Centre for Ecology & Hydrology in the UK. Additionally, involvement in local and regional meetings has increased my knowledge of pressures facing farmers and how research can be used to help alleviate these pressures.

4. Follow-up

- **Is a publication envisaged? Will this be in a journal or a publication? When will it appear?**
Yes, in addition to the two publications mentioned above, at least three other joint publications are underway or envisaged. It is expected that these will be published within the next 12-18 months.
- **Is your fellowship likely to be the start of collaboration between your home institution and your host?**
Yes, this fellowship has enabled us to establish collaborative research and monitoring which will extend long beyond my OECD fellowship. We anticipate many years of collaborative research, publications and scholar exchange.
- **Is your research likely to result in protected intellectual property, novel products or processes?**
The results of this research will be published in international ISI peer-reviewed journals and therefore will be in the public domain.

5. Satisfaction

- **Did your fellowship conform to your expectations?**
This fellowship has surpassed my expectations and has proved to be a most rewarding and enjoyable experience. The opportunity to work within a vibrant and supportive agricultural/soils/water research team, with strong collaborative links with hydrogeologists, water quality specialists and aquatic ecologists at the University of Arkansas and wider US contacts, has widened my understanding and experience of watershed management and has stimulated new research and publications. I have had great support from both my host and home laboratories. My host has provided access to a wealth of existing water quality data which enabled me to “hit the ground running” and analysis of these data has already generated collaborative publications. My host institution also provided the opportunity to set up new research studies and monitoring which, in partnership with some complementary tracer measurements from my home laboratory, are yielding new results and insights into agricultural nutrient transport in groundwater-dominated watersheds.
- **Will the OECD Co-operative Research Programme fellowship increase directly or indirectly your career opportunities? Please specify.**
Yes, I am certain that this new research, the collaborative links established and the publications that this will generate will continue to be a great stimulus to my research career into the future
- **Did you encounter any practical problems? No**
- **Please suggest any improvements in the Fellowship Programme.**

I cannot think of any improvements; the Fellowship Programme worked very efficiently and the staff were very helpful.

6. Advertising the Co-operative Research Programme

- **How did you learn about the Co-operative Research Programme?**
From colleagues and an internet search
- **What would you suggest to make it more “visible”?**
Perhaps the CRP could be made more visible by advertising through the relevant professional societies in OECD member countries and at international meetings.
- **Are there any issues you would like to record?**
I would like to thank the OECD, Professor Andrew Sharpley, the Department of Crop Soil and Environmental Sciences at the University of Arkansas, and my line management at the Centre for Ecology and Hydrology, for the opportunity and encouragement to undertake this fellowship.