Institution: University of Hertfordshire

Unit of Assessment: Panel A (6): Agriculture, Veterinary and Food Science

Title of case study: Making a difference to agricultural environmental management

1. Summary of the impact (indicative maximum 100 words)

Since 1994 the university's Agriculture and Environment Research Unit has undertaken an extensive programme of research on the environmental impacts of agriculture. This has been instrumental in providing agricultural practitioners, policy makers and researchers from around the world with a range of tools that have helped to deliver agri-environmental policy objectives on farms. These tools have aided farmers in improving their environmental performance, provided evidence to support policy objectives, and helped improve the accuracy and comparability of environmental risk assessments.

2. Underpinning research (indicative maximum 500 words)

The Agriculture and Environment Research Unit (AERU) is a team of four core full-time researchers: Dr John Tzilivakis (18 years at the university), Dr Andrew Green (13 years) and Dr Doug Warner (12 years), with Dr Kathy Lewis (19 years) as team leader. AERU was established in 1995 to undertake a major project that developed a computer-based environmental management system for farms. This system, known as Environmental Management for Agriculture, or EMA (see section 3, Refs 1 & 2), was groundbreaking in several ways. First, it was one of the first computerised decision-support systems designed specifically for farmers at a time when on-farm computer use was uncommon. Second, making use of a wide range of environmental impact models, it could identify and rank environmental issues according to severity, thereby pinpointing those that should be tackled on-farm. It also provided site-specific advice for impact mitigation and management and thus, for the first time in the UK, brought the concept of environmental management systems onto farms.

AERU released the software commercially in 1998. Despite initial scepticism, EMA quickly became popular with farmers and their advisers, and four updated versions subsequently followed. The software won several awards during its lifespan and sold over 3,600 copies on CD-Rom. Although now 'retired', EMA continues to underpin a programme of interrelated research projects and the development of various spin-off products. Two of these in particular have made a real difference to the British and international agricultural communities (in Europe, USA, Australia, south America, and many other locations).

Part of the original EMA package evaluated the environmental impact of pesticides using a simple risk-assessment model driven by a database of physico-chemical parameters. This was successfully evaluated as part of the 1999 EU-funded CAPER project (section 3, Ref. 4, and Key Research Award 3), leading to the development of a more sophisticated and innovative version under the Defra-funded p-EMA project (1999–2000) (Ref. 4). The lessons learnt about the delivery of complex systems to farmers were further exploited in the EU-funded FOOTPRINT project, a Europe-wide modelling software development initiative in which AERU's role was to develop a risk assessment tool for farmers and their advisors. A key part of all these decision-support tools was the embedded pesticide database and, due to demand from academics, researchers, regulators and industry, it has been constantly maintained and expanded. It is now available as a free online resource – the Pesticide Properties Database (PPDB) – for pesticide researchers and policy makers worldwide (Ref. 5).

One of EMA's support facilities was a comprehensive electronic library of environmental management and guidance documents. This brought together, and electronically hyperlinked, over fifty key documents, including codes of practice developed by a range of different organisations across the UK. Like the PPDB, this library – the Agricultural Document Library (ADLib) – has been

constantly maintained and expanded and is also available online. ADLib currently holds over 2,500 documents as well as photographs, video and audio files from almost 100 organisations; it is used as a technology transfer mechanism, delivering support and guidance information to end users.

3. References to the research (indicative maximum of six references)

Peer-Reviewed Publications

A selection of AERU publications arising from the research described above:

1. Lewis, K.A. and Bardon, K.S. (1998). A computer based informal environmental management system for agriculture. *Environmental Modelling and Software*, 13(2):123–137. doi: 10.1016/S1364-8152(98)00010-3.
2. Lewis, K.A. and Tzilivakis, J. (2000). The role of the EMA software in integrated crop management and its commercial uptake. *Pest Management Science*, 56(11):969–73. doi: 10.1002/1526-4998(200011)56:11<969::AID-PS239>3.0.CO;2-F
3. Lewis, K.A., Brown, C.D., Hart, A., Tzilivakis, J. (2003). p-EMA (III): Overview and application of a software system designed to assess the environmental risk of agricultural pesticides. *Agronomie*, 23(1):85–96. doi: 10.1051/agro:2002076
4. Reus et al. (2002) Comparison and evaluation of eight pesticide environmental risk indicators developed in Europe and recommendations for future use. *Agriculture, Ecosystems and Environment*, 90(2):177–87. doi: 10.1016/S0167-8809(01)00197-9
5. Lewis, K.A. and Green, A. (2011) The Pesticides Properties Database, *Chemistry International. Journal of the International Union of Pure and Applied Chemistry* (IUPAC), 33(3):30–1. <http://www.iupac.org/publications/ci/2011/3303/ic.html>
6. Tzilivakis, J. and Lewis, K.A. (2007) The Agricultural Document Library (ADLib) and its applications. Paper presented at European Federation for IT in Agriculture (EFITA) conference, Glasgow, September. Copy supplied on request, or available at: <http://researchprofiles.herts.ac.uk/portal/en/publications/the-agricultural-document-library-adlib-and-its-applications%2882233793-bae5-47dc-9823-94dc7b52fdda%29.html>

Key Research Awards

1. EMA, 1994–2006: core funding from Defra (previously MAFF); Scottish government; Milk Development Council; Horticultural Development Council. **Total value: £550,000**.
2. p-EMA project, 1999–2001: funded by Defra, carried out collaboratively with partners at the Soil Survey and Land Research Centre and Central Science Laboratory. **Value: £160,000**.
3. EU CAPER project, 1999: a consortium of eight European partners assessed and compared different approaches to evaluating pesticide risk, including the pesticide risk assessment method AERU developed for EMA. **Value of award to UH: c. £22,000**.
4. EU FP6 FOOTPRINT, 2005–09: developed a farm-based pesticide environmental fate and ecotoxicological risk assessment model for identifying mitigation potential which included the PPDB. **Value: £57,000**.
5. Defra, since 2007: Licensing ADLib for the Whole Farm Appraisal, a regulatory auditing and information system for farmers. **Total value of award, 2007–13: c.£385,000**.

4. Details of the impact (indicative maximum 750 words)

The Environmental Management for Agriculture software, developed in the late 1990s, was the first true environmental management system for farmers. Two key spin-off outputs, with a clear line back to EMA, have had a significant impact in making data and information readily available to agencies working in environmental protection or the farming industry, nationally and internationally.

1. The Online Pesticide Properties Database (PPDB)

The online Pesticide Properties Database (PPDB), launched in 2007, introduced a single, globally available, comprehensive pesticide data resource. Pesticide risk parameters had previously proven difficult to collate, with data being scattered across organisations and publications, often unreliable, and frequently commercially protected. Databases had significant gaps, providing information only on more common substances, and no resource included data on pesticide breakdown products, although they were often significant for risk assessments. Project-specific databases were developed for each university, governmental, NGO or commercial research task: this was time-consuming, costly, and frequently under-resourced. Data paucity and access to journals – a significant problem in developing countries – also led to data quality concerns, and inevitably affected risk assessments.

PPDB therefore plugged an information gap, saved pesticide researchers considerable time and funding bodies money, and provided much-needed information on data quality. The harmonised dataset also allows for more consistency in pesticide risk assessments.

Access has increased exponentially since 2008, when 132,000 pages were downloaded, rising to 989,000 in 2012 and expected to easily exceed 1 million in 2013. The database is used worldwide, but predominantly in Europe, North and South America, Australia and India, by end users working at, for example, pesticide manufacturers, agricultural consultancies and universities. A random literature search for 2009 to February 2012 found over 100 journal publications citing the PPDB as a main data source. It is licensed for offline use to major organisations who protect and manage natural resources, such as the US Geological Survey; the French Geological Survey organisation BRGM; and pesticide companies including Bayer, Monsanto and Syngenta. The Danish Environmental Protection Agency use the PPDB as the key data source for calculating their national pesticide impact indicator, which underpins their pesticide tax and farm advisory systems. Waitrose Foods use a similar approach with the PPDB to inform their global crop protection policy.

The PPDB is globally acknowledged as possibly *the* most comprehensive resource of its type. The eminent International Union of Pure and Applied Chemistry (IUPAC), for example, endorses the database and provides access to it via its own website, and a well-respected pesticide scientist at the US Department of Agriculture has stated that the PPDB 'has become the best [pesticide] database available in the world' (see section 5, 'Institutional Corroboration').

2. The ADLib Resource

Many British organisations such as Defra, Natural England, the Farmers Union, the Environment Agency and ADAS produce guidance material for farmers and their advisors, disseminating it chiefly via direct mailshot and their websites. Farmers and their advisors must therefore actively search for information from these sources, or be alerted to new and relevant publications by a third party.

By holding documents produced by these and other organisations in electronic hyperlinked form, ADLib addressed this issue, becoming a knowledge transfer service to the British agricultural industry and quickly disseminating key and new information to end users. It underpins Defra's online farming support services delivered by GOV.UK, a government-funded website for information about government services that provides access to key documents, forms, best practice information, etc. This service has over 17,000 registered users and, according to online traffic analysis, many more that are unregistered.

ADLib also provides the support material for the Agriculture and Horticulture Development Board (AHDB) ihub, which offers free access to climate change mitigation and adaptation advice for the UK farming industry. Other organisations offer ADLib to their members: the Fertiliser Advisers Certification and Training Scheme (FACTS), for example, provides its 2,000-strong membership with access to fertiliser best-practice support material and scheme-specific documentation.

ADLib overcomes issues such as copyright, format variety, maintenance costs and version management by bringing together previously scattered information from government agencies and

departments, as well as small specialist organisations. It offers timely and targeted delivery of advice to farmers and their advisors, saving them time and money when seeking appropriate information, and ensuring they are kept up-to-date. In the words of a Defra contact, 'ADLib has significantly added to the user experience of our web portal . . . [It] allows customers free-to-the-user access to a wealth of specially tailored online information that would require additional, extensive searches otherwise' (see section 5, 'Institutional Corroboration').

5. Sources to corroborate the impact (indicative maximum of 10 references)

Peer-Reviewed Papers

An extensive list of peer-reviewed papers – used as resources by, for example, food companies, farming organisations and environmental agencies – citing the PPDB as a main data source has been compiled. Following are three selected papers on farming methods (copies on request):

Adriana Nario et al. (2009) Pesticide risk management using indicators for vineyards in the central valley of Chile, *Integrated Environmental Assessment and Management*, 5(3):476–82.

Douglas A. Haith (2011) National assessment of pesticide runoff loads from grass surfaces. *Journal of Environmental Engineering*, 137(9):761–70.

Claudio Ioriatti et al. (2011) Evaluation of the environmental impact of apple pest control strategies using pesticide risk indicators, *Integrated Environmental Assessment and Management*, 7(4):542–49.

Reports

Danish Environmental Protection Agency (2010) *The Agricultural Pesticide Load in Denmark 2007–2010*. Miljøstyrelsen, ISBN 978-87-92779-96-0. (PPDB cited on p. 13). Available online:

<http://www2.mst.dk/Udgiv/publikationer/2012/03/978-87-92779-96-0.pdf>

Institutional Corroboration

1. PPDB

Since 2008 AERU has received around 20 letters or emails from individuals and organisations explaining how they use the PPDB and the benefits they have gained. These include Uniliver; United States Geological Survey – National Water Quality Assessment Unit; and the Institute of Food Safety, Netherlands. Two representative pieces of correspondence are from the Danish Environmental Protection Agency (2012) and the US Department of Agriculture (2009) (staff member cited in section 4, paragraph 5). Full details are supplied separately.

2. AdLib

Contact details are supplied separately of two ADLib users who can corroborate the claims made above regarding their use of this resource, including the Defra end user cited in section 4, final paragraph.

Web Statistics

1. PPDB website traffic, as outlined in section 4, is collated and monitored via an online tracking system. This system logs, on a daily basis, the number of users, total page downloads and returning visitors, as well as a range of information on the user's IP address and country of origin.

Summary information is available on the AERU website, and login access can be provided on request: <www.herts.ac.uk/aeru/knowledge_transfer/data_services.htm>

2. AHDB ihub: as above, website traffic information can be accessed and verified via the AERU website; login access can be provided on request.