Institution: University of Hertfordshire

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

Title of case study: Contributing to agricultural climate change mitigation

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

Since 2005 the Agriculture and Environment Research Unit has undertaken an extensive programme of research related to mitigating the climate change impacts arising from agricultural land management policies and practices. The research findings that identified the impact on climate change of various policies, schemes and farming initiatives have been instrumental since 2008 in providing UK policy makers, farmers and their advisors with data and tools that helped to formulate improved climate change mitigation policies. They also contributed to the development of key guidance materials that supported the implementation of these policies on the farm.

2. Underpinning research (indicative maximum 500 words)

The university's Agriculture and Environment Research Unit (AERU) is a team of four full-time core senior researchers: Dr John Tzilivakis (18 years at UH), Dr Andrew Green (13 years) and Dr Doug Warner (12 years), with Dr Kathy Lewis (19 years) as team leader. AERU's remit is to carry out research related to understanding the environmental impact of agriculture and, in particular, agricultural policy to enable more scientifically informed policy development. Since 2005 AERU has examined the effect of farm land management practices on climate change. Many such practices could mitigate climate change by improving long-term carbon storage in soil and vegetation, i.e. carbon sequestration, whereby carbon is captured from the atmosphere through natural processes. However, some farm practices may also lead to stored soil carbon being released when soil is disturbed. AERU has sought to identify how these practices can mitigate climate change and help the UK and European governments meet greenhouse gas emission targets.

AERU's research contributed significantly to the Environmental Stewardship (ES) scheme, which pays English farmers to protect and enhance biodiversity and the environment. For Defra, AERU developed an approach for assessing all scheme-advocated farming practices and identifying those best able to reduce carbon emissions or increase sequestration without compromising its key aims. The scheme was subsequently modified, and the 2006 project repeated in 2011 to ensure that AERU's recommendations remained valid. In 2012, Natural England commissioned related work to consider whether farmers taking land out of production under the scheme might intensify greenhouse gas production elsewhere, displacing rather than reducing emissions. This study found that the concerns were largely invalid.

AERU also contributed to the Nitrate Vulnerable Zone Action Programme (NVZAP), a statutory programme that all farmers in designated areas must observe to minimise nitrate leaching to water bodies. Under the legislative process, the costs and environmental benefits of the programme's measures had to be understood, and particularly how these would affect greenhouse gas emissions and UK emission targets. Aiming for a consistent approach across the different policy instruments, Defra asked AERU to apply the same ES Scheme assessment methodology to NVZAP. The study found that NVZAP would reduce carbon emissions, and helped it to become law.

In 2010, the National Trust commissioned AERU to produce a Carbon Land Management Plan for its 5,300ha Wallington Estate in Northumberland. Again, the same methodology was employed to identify specific land management practices that the estate could use to encourage carbon sequestration and preserve existing carbon stocks. The resulting 'blueprint' provides guidance to farm tenants on other Trust estates (Section 3, Ref. 1).

Between 2009 and 2012, AERU'S methodology was turned towards reducing the impact on climate change caused by European farming activities. IMPACCT, the first of two European Commission

projects, developed a carbon balance model for integrated whole-farm assessment, encouraging practices that would decrease greenhouse gas emissions and increase carbon sequestration, within a sustainable balance of environmental, social and economic objectives. Unlike other carbon accounting tools, IMPACCT – freely available to all EU farmers – goes beyond estimating net greenhouse gas emissions, being designed for high sensitivity to farming practice changes and developing farm-specific, pragmatic and cost–benefit optimised mitigation plans (Ref. 2).

'OSCAR' (2011–12) extended the methodology EU-wide, aiming to identify whether land management measures encouraged by the European Rural Development Programme (RDP), via farm subsidies and grants, could be optimised to mitigate climate change and enable greater adaptation to its effects whilst considering the diverse agricultural industries, landscapes, climates and environments within the EU-27. In November 2012, the European Commission launched the resulting tools, aiming to help all RDP Managing Authorities evaluate national programmes and optimise them for carbon emission reduction.

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

1. Warner, D.J., Worrall, F., Bell, M. and Lewis, K.A. (2011) A Land Carbon Management Plan for the Wallington Estate. (Commissioned Report.) National Trust. 194 p. (Hard or electronic copy can be supplied on request.)

2. Lewis, K.A., Green, A., Warner, D. and Tzilivakis, J. (2013) Carbon accounting tools: Are they fit for purpose in the context of arable farming? *International Journal of Agricultural Sustainability*, 11 (2) pp.159–175 doi: 10.1080/14735903.2012.719105

   – *REF2 output*

Key Research Awards

Natural England, 2012, ~£25,000, 'Measuring the extent to which greenhouse gas emission savings achieved by environmental stewardship are displaced'.

European Commission, 2011–12, £350,000, 'OSCAR – Optimal Strategies for Climate change Action in Rural areas'.

National Trust, 2010–11, ~£20,000, 'A land management plan for the Wallington Estate'.

European Commission, 2009–10, ~£180,000, 'IMPACCT: The climate change mitigation potential of an EU farm: towards a farm-based integrated assessment'

Defra, 2011, ~£30,000, 'Current and potential climate change mitigation effects of environmental stewardship', project 2.

Defra, 2007–8, ~£25,000, 'Impact of the proposed NVZ Action Programme on greenhouse gas emissions'.

Defra, 2006–7, ~£25,000, 'Current and potential climate change mitigation effects of environmental stewardship', project 1.

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

AERU's 2006–12 research, described above, has significantly improved the scientific understanding of ways to reduce agriculture-related net greenhouse gas emissions and help meet national and European targets. Since AERU identified modifications in specific farming practices to encourage greenhouse gas emission reductions and enhance the carbon storage in soils and biomass, various policy instruments have incorporated the recommended changes, and a range of guidance materials for farmers, their advisors and policy makers have been developed.

For example, the Environmental Stewardship scheme evaluations highlighted a number of prescribed practice alterations that would reduce net emissions. These included: reducing soil cultivation depth to decrease fuel consumption; encouraging springtime manure application to improve crop nutrient availability and reduce ammonia emissions; prohibiting the application of inorganic nitrogen fertilisers to rush pastures, in order to reduce soil emissions; and increasing the width of non-cropped margins around woodland to eliminate soil disturbance and so increase carbon sequestration. The study also recommended additional practices that the scheme should encourage, such as hedgerow restoration. Defra accepted all of these recommendations, and they are an established part of the ES Scheme.

It is difficult to quantify the impact on reducing greenhouse gas emissions, but one rough indicator can help place it in perspective: in 2009, 2.44 million ha of farmland was managed under ES agreements. If management of just 5% of this land shows a modest 0.5% increase in soil organic carbon in the top 10cm of soil, roughly an additional 22t/ha carbon dioxide is sequestered, or around 2.7 million tonnes in total – equivalent to approximately 0.5 million passenger flights around the earth (40,000 kilometres). AERU's research is specifically mentioned as a guidance source for the South West Climate Action Plan 2008–2010, which describes the activities required to support the region mitigate and adapt to the impacts of climate change. A Defra publication reviewing the success of the agri-environment schemes also references it, and a Natural England contact has stated that AERU's ES scheme work is at the heart of their evidence base for this subject area.

Since November 2012, Rural Development Programme (RDP) Managing Authorities in EU member states have been using the OSCAR project's guidance manual and online software to optimise the design of national programmes to ensure that, as well as delivering the main RDP objectives of restoring and enhancing the competitiveness of rural areas and farming, they also deliver climate change benefits. Contacts at Defra and Natural England have stated that AERU's OSCAR and Environmental Stewardship work will be used to support their the ES Schemes development work in the next financial phase of the Common Agricultural Policy.

AERU's research has also influenced farming methods across Europe. Farmers must comply with all aspects of the ES scheme to receive subsidies and grants, which consequently creates climate change benefits. Natural England and Defra have used the ES research to formulate a suite of land management guidance material for farmers and other land managers, aiming to reduce agricultural greenhouse gas emissions on their land. For example, Natural England published a farmers' guidance manual and a poster entitled 'Making the most of Environmental Stewardship'. A Technical Information Note for land managers and advisers (TIN107) explained how the right farming practices can make a significant difference to greenhouse gas reductions.

AERU's National Trust work generated guidance material for farmers on the Wallington estate, including detailed maps showing where to spatially target specific practices, and step-by-step guidance material to help mitigate emissions. Trialled by an independent consultant, this material has been used with regional Natural England and National Trust advisors, to extend the reach of the research to National Trust estates across England and Wales.

Farmers are encouraged to monitor and manage their carbon emissions by using carbon calculators. Lack of sensitivity to farming practices omits potential reductions to the carbon balance, and renders them unsuitable for action plan development. AERU's research is changing this. Its calculator (IMPACCT), freely available to farmers, was designed specifically for formulating mitigation and adaption plans. Core data from this research programme informs other publicly available calculators. As a contact at Natural England can confirm, the CALM tool, a widely disseminated, third-party software tool, has implemented AERU's data to upgrade and make it more useful to ES Scheme farmers. It is used by farmers worldwide; the CALM website (www.calm.cla.org.uk) also reports that land managers use it to help secure supermarket contracts and reach grain quality assurance standards.

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

– All corroboratory sources can be supplied in hard and/ or electronic copy on request

1. D. Abson et al. (2010). Valuing Regulating Services (Climate Regulation) from UK Terrestrial Ecosystems – Report to the Economics Team of the UK National Ecosystem Assessment. <http://uknea.unep-wcmc.org/LinkClick.aspx?fileticket=mqogOQhILso%3D&tabid=82>

– AERU work referenced (as 'AEA') on pp. 31 & 38

2. Defra (2009) Analysis of Policy Instruments for Reducing Greenhouse Gas Emissions from Agriculture, Forestry and Land Management (Project RMP/5142). Final report by ADAS to Defra. <http://archive.defra.gov.uk/foodfarm/landmanage/climate/documents/climate-ag-instruments.pdf>

– AERU work (Defra Project BD2302) referenced on pp. 87, 128, 129

3. M. MacLeod et al. (2010). Review and Update of UK Marginal Abatement Cost Curves for Agriculture. Final Report Prepared for The Committee on Climate Change. <http://downloads.theccc.org.uk.s3.amazonaws.com/0610/pr_supporting_research_SAC_agriculture.pdf>

– AERU work referenced (as University of Hertfordshire) on pp. 73, 98

4. Natural England (2012). Technical Information Note (TIN): Environmental Stewardship and Climate Change Mitigation. Natural England TIN107.

– AERU work (cited as 'Warner') referenced on pp. 3, 4, 6, 7, 8, 10, 12, 13, 15

5. Natural England (2009). Agri-environment Schemes in England 2009. A Review of Results and Effectiveness. <www.naturalengland.org.uk/Images/AE-schemes09_tcm6-14969.pdf>

– AERU work referenced (as University of Hertfordshire) on pp. 86 and 116

6. Natural England (2009). No charge? Valuing the Natural Environment. <www.sehn.org/tccpdf/ecosystem%20value-14259.pdf>

– AERU work (Defra Project BD2302) referenced on pp. 4, 28

7. Natural England (2008). Carbon Management by Land and Marine Managers. Research Report NERR026.

– AERU work (Defra Project BD2302) referenced on pp. 44, 45, 59

8. South West Regional Assembly (2008). South West Climate Change Action Plan 2008–10. <http://www.southwest-ra.gov.uk/media/SWRA/Climate%20Change/Climate_Change_Action_Plan.pdf>

– AERU work (Defra Project BD2302) referenced in Appendix I, sect. 10.1

9. Lewis, K. A., Tzilivakis, J. Warner, D., Green, A. et al. (2013). Optimal design of climate change policies through the EU's rural development policy. OSCAR Study Final Report and Appendices.

– AERU work referenced (as 'Warner' (2008 or 2011)) in main report, p. 100; in Appendices, pp. 17, 18, 20, 37

Institutional Corroboration

Letters of corroboration from two of the organisations mentioned in section 4 are available on request. Details are provided separately.