# Spatial coordination in payment for ecosystem service schemes: an integrated ecological and economic perspective (Ref IAP2-18-09)

## University of Glasgow: Institute of Biodiversity, Animal Health and Comparative Medicine

## In partnership with University of Stirling, Biological & Environmental Sciences.


| | |
|---|---|
| **Supervisory Team** | • Nick Hanley, University Of Glasgow<br>• Kirsty Park, University of Stirling |



| | |
|---|---|
| **Key Words** | **Payments for ecosystem services; spatial coordination; participation; ecological-economic modelling.** |


## Overview

Payment for Ecosystem Service (agri-environment) schemes aim to deliver conservation benefits by paying landowners to change their land management in a way in which ecosystem quality and biodiversity outcomes are enhanced. Entry into a PES scheme is voluntary, and payments are intended to be conditional on the delivery of additional environmental benefits over time. For some kinds of ecological objective, having neighbouring patches of land (e.g. adjacent farms) enrolled can deliver higher benefits than having enrolled patches scattered on the landscape. Examples of such objectives include species re-introductions, wetlands restoration, invasive species management and the creation of wildlife corridors. However, such spatial coordination is unlikely to emerge from most PES scheme designs under standard contract designs unless the opportunity costs of conservation and the ecological benefits of site management are strongly spatially correlated in a particular way. For many landscapes, we are unlikely to be able to rely on this spatial correlation pattern to generate "enough" coordination.

For this reason, interest has developed in re-designing PES schemes to provide incentives for neighbouring landowners to enrol together. Two main suggestions have been (i) the Agglomeration Bonus and (ii) spatially-connected conservation auctions. Additionally, some European countries (e.g. the Netherlands)now have PES schemes that are only available to farmers who enrol as part of a collective of neighbours, whilst paying for environmental outcomes rather than for changes in land management has recently been adopted by the National Trust in the UK. The fact that the UK is leaving the Common Agricultural Policy means that opportunities are available for changes in policies which determine how the production of "public goods" in the countryside are funded and incentivised.

*European Curlew. Photo credit: Corine Bliek*

This PhD will integrate ecological and economic principles and modelling to investigate three specific research questions related to spatial coordination of conservation actions, with a specific focus on UK agri-environment policy:

1. Using increases in waders in UK farmland habitats as an environmental metric, how much does spatial coordination of participation in agri-environment schemes enhance environmental

benefits, relative to scattering enrolment randomly across a landscape?

2. Given the empirical relationship between spatial coordination and environmental benefit identified in (1), what designs of agri-environment contracts would get closest to an ecologically-optimal pattern of spatial coordination, based on voluntary enrolment?

3. What are the net economic and ecological gains from employing the spatially-coordinating contracts identified in (2) compared to a payment-for-environmental-outcomes scheme, where contract payments are related to bird counts on a farmers' land, rather than changes to land management. Such payment-for-outcome schemes could be entered into by groups of farmers, or by individual farmers – contracts for groups may have additional spatial coordination benefits.

*Agricultural liming. Photo credit: Emma Sheard*

## Methodology

The PhD will make use of spatial and time series data sets relating to ecological indicators, biodiversity outcomes, land use and farmland management for the UK. These data have already been acquired by the supervisory team for a suitable sub-set of UK farmland areas, as part of a Leverhulme Trust-funded project linking wader numbers to land management in UK wetlands. The student will use ecological models (for example, GLMMs and/or Structural Equation Models) to identify the links between farmland management and biodiversity outcomes based on a number of indicators (e.g. species abundance , diversity) and how these outcomes covary over space.

She/he will then make use of spatially-explicit datasets on (i) farmland management and (ii) farmland prices to generate distribution maps showing the spatial correlation and covariance of conservation costs and biodiversity outcomes in the case study sites. She/he will then construct an economic simulation model of farmer decision making as a function of agri-environment contract design. This will be linked to conservation outcomes using the parameters estimated from the ecological modelling. The farm management simulation models can be used to show how changes in the design of agri-environment schemes in terms of incentives for spatial coordination and/or paying for environmental outcomes relate to changes in biodiversity outcomes.

The supervisory team and student will work with Dr Martin Dallimer (University of Leeds), who is part of the Leverhulme-funded project team noted above.

## Timeline

| *Project months* | *Tasks* |
|---|---|
| *1-6* | *Training in ecological modelling; training in environmental economic methods;* |
| *7-12* | *Data sets assembly and processing* |
| *13-18* | *Estimating ecological models* |
| *19-24* | *Spatial mapping of conservation costs and benefits* |
| *24-30* | *Construction, testing and running of economic simulation model* |
| *31-36* | *Further simulation work; final write up* |
| *36-42* | *Submission* |
| *ALL:* | *Transferable skills training; team meetings in Glasgow, Stirling and Leeds.* |

## Training & Skills

The PhD training will have three main components:

*1)* *Environmental economics:* the student will take the "Economic Tools for Nature Conservation" course run as part of the Masters programmes at IBAHCM.

*2)* *Data analysis, ecological modelling & informatics.* These skills will be gained through targeted training courses within the IAPETUS consortium (e.g. *Programming* and *Analysis of Environmental Data in R, GIS & Remote Sensing for Environmental Managers*), and through external providers where appropriate.

*3)* *Complementary training in transferable skills*. Training in core scientific skills (data management, analysis, presentations, paper writing) provided as part of the PhD programme within IBAHCM at Glasgow.

## References & Further Reading


Armsworth, Paul (2014) "Inclusion of costs in conservation planning" *Annals of the New York Academy of Sciences.*

Armsworth P, Acs S, Dallimer M, Gaston K, Hanley N and Wilson P (2012) "The costs of simplification in conservation programmes" *Ecology Letters,* Volume 15, Issue 5, Pages: 406–414.

Hanley N, Acs S., Dallimer M, Graves A, Morris J, Gaston K and Armsworth P. (2012) "Farm-scale ecological and economic impacts of agricultural change in the uplands." *Land Use Policy*, 29 (3), 587-597.

Parkhurst, Gregory M., and Jason F. Shogren. 2007. Spatial incentives to coordinate contiguous habitat. *Ecological Economics* 64 (2): 344-55.

White, B & Hanley, ND 2016, 'Should we pay for ecosystem service outputs, inputs or both?' *Environmental and Resource Economics*, vol 63, no. 4, pp. 765-787.


---

## Further Information


Prof. Nick Hanley: Nicholas.Hanley@glasgow.ac.uk
Telephone 0141 330 4433
Web:
https://www.gla.ac.uk/researchinstitutes/bahcm/staff/nicholashanley/

Prof. Kirsty Park: k.j.park@stirling.ac.uk
Telephone 01786 467799
Web: https://www.stir.ac.uk/people/256433