

# Public Goods from Agri-Environmental Schemes

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Leaving the EU gives the UK an opportunity to rethink farm subsidies. The new Agricultural Bill sets out the government's plans on replacing the current subsidy system of 'direct payments' to farmers, which is based on total area of land farmer, with a new Environmental Land management (ELM) scheme which will reward farmers for undertaking environmental measures that assist in the delivery of 'public goods'. There are a wide range of public goods associated with agriculture (Cooper et al., 2009), many of which are environmental, such as agricultural landscape, farmland biodiversity, water quality, water availability, soil functionality, climate stability (greenhouse gas emissions and carbon storage), air quality, resilience to flooding and fire. In addition, there are a range of more social public goods, such as rural vitality, farm animal welfare and health and food security. Although increasing numbers of best management practices (BMPs) and land management interventions have been studied and implemented globally, including in the UK, via a range of agri-environment schemes, the evidence-base for which land management activities/interventions and BMPs have worked best to deliver environmental benefits is not always clear and often not consolidated. For example, while many interventions to protect water quality have been found to be highly effective at the plot and field scale (e.g. Kay et al., 2009) this is not the case at the catchment scale (Kay et al., 2012; Worrall et al., 2009). In addition, a recent evidence review on how land management interventions improved soil health and thus generated a wide range of public goods found many knowledge gaps (Chapman et al., 2018).

This project, therefore, will provide insights into which agri-environment interventions improve soil health and in turn contributes to water quality improvements, climate change mitigation (via carbon storage) and flood protection. It will also consider the relationship between such interventions and food and fibre production, and whether food and fibre production is compatible with public goods provision. The main questions this project will address are:

1. What land management activities deliver public goods while also producing sustainable food and fibre yields?
2. What conditions are necessary for these activities to deliver public goods?
3. At what extent/scale should certain activities take place for the delivery of public goods across a catchment scale?

The aim of this project is to identify the inter-linkages between farm scale interventions/changes in land management promoted by the current UK and European agri-environmental schemes (e.g. planting and maintenance of hedgerows, grass leys in arable systems, (Fig. 1), buffer strips) and the public goods these provide.



Figure 1 (a) grass-clover ley strip within an arable field at the University of Leeds farm, and (b) newly planted hedge on a sheep farm in the Yorkshire Dales.

## Objectives:

In this project, you will synthesize existing knowledge and produce new scientific evidence linking specific farm level interventions (e.g. planting new hedgerows, introducing grass leys into arable fields) on a soil health and vegetation; as well as on a range of public goods / ecosystem services affected by these. The project can take either an experimental approach, using the University of Leeds Farm and recent major investment in monitoring equipment within the Farm, a modelling / remote sensing approach (e.g. flying and using data from a hyper-spectral drone on and around the University Farm), or a combination of the two. Specific objectives of the project include:

1. Synthesize existing quantitative information linking different characteristics of a field-level intervention (e.g. hedgerows age, specific composition, slope) to soil and vegetation physical properties, ecosystem functioning and ecosystem services provision
2. (with an experimental approach) design and carry out a controlled experiment in the University Farm to measure the effect of field-level intervention on those impacts
3. (with a modelling approach) use numerical spatial and high-resolution catchment hydrological model(s) and/or remote sensing (satellite/drone) imagery to elucidate the impact of interventions on public goods at different spatial scales
4. Consider the implications of new agri-environmental schemes on public goods delivery post-Brexit

## Fit to NERC Science

This project is aligned with the NERC terrestrial research area. The project aligns to the following NERC research areas: (i) ecology and biodiversity; (ii) plant & crop science and (iii) terrestrial environment. Public goods is a topic of conservable interests in the UK and internationally, and take central role in the UK DEFRA 25-year Environment Plan.

## Potential for high impact outcome

The project will directly address major evidence gaps linking agri-environmental schemes and delivery of public goods, making the research timely and likely to produce several outputs, including 3–4 publications, at least one of which we anticipate being suitable for submission to a high-impact journal.

## Training

The student will work under the supervision of Dr. Guy Ziv within the Ecology and Global Change research cluster in the School of Geography and Prof. Pippa Chapman within the River Basins research cluster in the School of Geography. The project provides a high-level of training in (i) soil science and experimental methods; (ii) numerical simulations and remote sensing; (iii) statistics and analytical skills. The student will be supported throughout the studentship by a comprehensive PGR skills training programme that follows the VITAE Research Development Framework and focuses on knowledge and intellectual abilities; personal effectiveness; research governance and organisation; and engagement, influence and impact. Training needs will be assessed at the beginning of the project and at key stages throughout the project and the student will be encouraged to participate in the numerous training and development course that are run within the university to support PGR students, including statistics training (e.g. R, SPSS), academic

writing skills, grant writing etc (<http://www.emeskillstraining.leeds.ac.uk/>). Supervision will involve regular meetings between all supervisors and further support of a research support group.

## Student profile:

The student should have a keen interest in soil science, ecology and ecosystem services with a strong background in a physical geography, environmental sciences, remote sensing or related discipline. Strong analytical/statistical/fieldwork skills are desirable but not essential, as full training will be provided during the PhD.

## References

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