Accumulation of legacy phosphorus in farmland ponds: implications for nutrient management and water quality

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Farmland ponds provide important ecosystem services within the agricultural landscape. Increasingly, however, they are being utilized to intercept runoff and erosion in order to offset downstream water quality problems and reduce flood risk. As a result, farm pond sediments act as important biogeochemical sinks for water pollutants, especially phosphorus (P) (Figure 1). In fact, the accumulation and recycling of incoming ‘legacy P’ seriously threatens both the permanence and ecology of farm ponds.

Figure 1. Phosphorus transport includes terrestrial and aquatic processes. Figure adapted from Pierzynski et al. (2000)

The University of Reading (UoR) farm ponds provide a unique opportunity to tackle this problem through a combination of field-, laboratory-, and desk-based approaches. The PhD will focus on the following issues:

1. The effectiveness of farmland ponds in nutrient retention within the context of historical land-use and management records.
2. The flow pathways and processes in the nearby fields that control the transport of so-called legacy nutrients through the agricultural landscape. Legacy nutrients are those which have accumulated in the soil, possibly over decades, and can act as a continuing source to downstream freshwater ecosystems for years, decades or even centuries.
3. The current and projected levels of eutrophication in the farmland ponds.
4. The potential to utilize the legacy nutrients, through recycling pond sediment back to farmland soils.
The project will involve:

- Fieldwork at the UoR farms to collect pond sediment cores, monitor pond water and sediment chemistry, construct records of historical land use and management, and map field topography.
- Laboratory analysis of the sediment cores for radionuclides and other chemical markers to determine sediment source and potential release of the sediment-bound P to the overlying pond water.
- Combining field and laboratory data sets for determinations and predictions of the trophic status of farm ponds.
- Glasshouse studies to determine the potential fertilizer P replacement value of pond sediment if it was recycled back to land.

Training opportunities:
You will develop cross-disciplinary skills in laboratory experimentation, fieldwork, data management, multidisciplinary working and communicating research to a non-academic audience. Project specific training will be given on the in situ sampling and monitoring of sediment and water quality (CEH Wallingford), and on key analytical methods; e.g. a range of spectroscopic techniques and gamma spectrometry (UoR). You will also receive training from the Environment Agency, including policy-development and knowledge-exchange opportunities through invitations to Catchment Sensitive Farming meetings and local catchment-based fora.

Student profile:
This project would be suitable for students with a background in Environmental Science, Physical Geography, Environmental Chemistry, Geochemistry or a closely related science.