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Soil and Water: a larger-scale perspective

Source: Ockenden, M.C., Deasy, C., Quinton, J.N., Surridge, B. & Stoate, C. (2014). Keeping agricultural soil out of rivers: Evidence of sediment and nutrient accumulation within field wetlands in the UK. *Journal of Environmental Management* 135: 54–62. DOI:10.1016/j.jenvman.2014.01.015

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Artificial wetlands on farmland help to prevent soil loss and recapture agricultural by-products

Small field wetlands are a simple and effective way to reduce soil erosion and nutrient pollution, recent research suggests. The authors adapted Norwegian designs for the UK environment and created a series of small rectangular lakes on the edges of agricultural fields. After three years, the wetlands had prevented tonnes of soil from leaving the land, and helped alleviate some of the nutrient run-off that would have affected neighbouring waterways.

Soil degradation, erosion and nutrient pollution are major problems caused by industrialised agriculture. In the UK, the Department for Environment, Food and Rural Affairs (Defra) has estimated the financial costs of flooding and pollution from degraded soil to be at £0.2–£0.3 billion (€0.28–€0.42 billion) per year, while excessive quantities of nutrients such as nitrogen and phosphorus can have damaging effects on wildlife in freshwater ecosystems. Improving inland water quality is one of the key aims of the European Water Framework Directive.

Field wetlands are artificially constructed water bodies, such as lakes or ponds, ideally positioned on unproductive areas of farmland and in the path of existing water run-off channels. They help to collect earth that gets washed from fields by rain, and provide the possibility for excess nutrients to be filtered by micro-organisms before reaching larger water courses. They also help to prevent flooding, and create a habitat for waterfowl and amphibians.

The researchers noted that this technique has not been widely adopted in the UK, partly because of preconceptions that field wetlands need to be large to be effective — previous research has suggested that they should occupy 2% of a water catchment area. However, this study looked at the use of wetlands with a smaller footprint, taking up between 0.025–0.1% of each catchment area, which is equal to 2.5m^2–10m^2 per contributing hectare.

Over the course of two years, 10 small field wetlands were constructed in four farms in Cumbria and Leicestershire. One of the farms had sandy soil, one had clay-heavy soil, and two others were silty. Surveys of the depth and type of sediment deposited into the sites were taken together with measurements of the levels of nitrogen, phosphorus and carbon.

It was found that the soil type of the farmland had a big impact on the quantity of sediment that was collected in the wetlands — over a three year period, the sandy site accumulated 70 tonnes, the silty sites 40 tonnes, whilst the clay-based site collected just 2 tonnes. There were many factors that influenced these results. If heavy rain happened to fall on a field at a time when there were no crops, sediment run-off would increase dramatically. Also, some soil types are inherently more susceptible to erosion than others — sandy soils are more prone to wash away due to rain than clay soils.

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Artificial wetlands on farmland help to prevent soil loss and recapture agricultural by-products *(continued)*

The nutrient analysis showed that the smaller the particles of sediment, the higher the concentration of nutrients collected in the wetlands. However, the overall levels of nutrients in the collected sediment were not significantly different to those in the fields. This means that the deposited soil can be recycled, but would not be useful as a fertiliser.

In addition to the reduction of excessive and harmful inputs in the agricultural process, the researchers say that small field wetlands are an affordable and effective form of sustainable water and land management, particularly in areas where the construction of larger wetlands would be problematic. Larger wetlands are still preferable, however, as they allow longer times for sediment and nutrient accumulation from water runoff. In a comparison between two Swedish studies, the annual accumulation of phosphorous was 0.2 kg per hectare for a small field wetland (0.3% of the catchment area), and 2.8 kg per hectare for a large field wetland (2% of the catchment area).

The response from farmers involved in the study was very positive, as it gave new purpose to waterlogged land, and the continual accumulation of sediment was a visual reminder of the wetland's effectiveness.

The researchers acknowledge that recent policies are starting to encourage better farmland management practices, but these systems need to be adopted on a much bigger scale if they are to have a significant impact on rural water and soil quality.