Filter fences for erosion control in the aftermath of potatoes

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Introduction

We have all seen sediment and soil spilling onto roads and into rivers and lochs in wet autumns, when erosion control from land after high risk arable crops such as potatoes can be a serious challenge. This is an issue for :

- farmers who lose valuable topsoil, and risk non-compliance with cross-compliance rules set by SGRPID
- landusers downstream who may need to dredge streams to maintain drainage and reduce flood risk
- the ecological quality of our rivers and lochs which are more likely to have excessive growth of aquatic plants and algae through nutrient inputs associated with soil erosion.

With climate change predictions suggesting wetter autumns to come, preventing eroded soil entering watercourses will continue to be a challenge for farmers who want to deliver local produce in a sustainable way.

Minimising erosion to comply with regulations, when land is not sown in autumn, is currently achieved with grubber or plough. These measures are often adequate, but on sloping fields in difficult autumns, achieving good control can be difficult for the most conscientious farmer.

Reference: Scottish Government (2012). Good Agricultural and Environmental Condition (GAEC) requirements for cross-compliance for single farm payments. http://www.scotland.gov.uk/Resource/0039/00397775.pdf
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Filter Fences

Recent research at James Hutton Institute in association with SAC has investigated the potential of filter fences - a technology used in the building trade to prevent sediment loss from building sites. A preliminary trial in 2010/11 at Baldardo farm in the upper Lunan catchment, Angus, Scotland, successfully demonstrated the potential of this method. Despite post-harvest contour grubbing an estimated 80 tonnes of soil containing 60-70 kg P was trapped from a 17ha field after potatoes. A further trial was undertaken in 2011/12 on the adjacent field with post-harvest cultivation treatments comprising:

- T1. full grubbing;
- T2. Partial grubbing (6m widths every 40 metres);
- T3. A non-cultivated treatment.

T1 and T2 are compliant with the GAEC requirements for receipt of single farm payments (Scottish Government, 2012).

The material used was a close knit, UV stabilised polyethylene net with mesh aperture of 1.2mm, dug in and pinned to a 146m line of fence posts installed along the field contour at the foot of a field with average slope of 10-11%.The fence was divided into 9 upslope plots, each with an area of 0.4-0.6ha. It was installed in November 2011 and removed in February 2012.

Sediment accumulation was measured with a graduated cane, and with an RTK hand held global positioning system. The RTK system enabled measurements of land surface elevation with a vertical accuracy of ~3cm. Deposited sediment was sampled for bulk density and P content (total P, available P (by modified Morgan's extraction- SAC's advisory method), and water soluble P).

Results

Large volumes of sediment were captured by the filter fences (Figure 1).

The RTK surveys showed increases in elevation with sediment accumulation (Figure 2).

The average sediment retention volume (measured by graduated cane) is shown in Figure 3.

Accumulated sediment had a similar chemical quality and bulk density to the field soil but contained less coarse (>2mm) material.

The field soil and most of the accumulated sediment, was of High P status (based on modified Morgan's test, the method used by the SAC advisory service).

Declines in total P were observed with increasing distance, upslope, from the filter fences (Figure 4) with soil containing highest P adjacent to fences.

Figure 1 Deposition fan on 25 November 2011 on a filter fence plot with no cultivation upslope. Note the upslope spurs at the edge of each plot, to constrain lateral movement of sediment between plots.

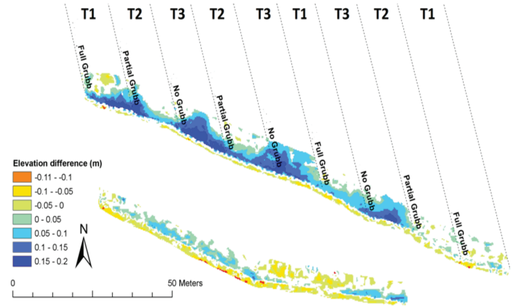

Figure 2 RTK measurements of land elevation change in 2011-12 filter fence trial from November 2011 to February 2012.

Figure 3 Estimated volume of sediment deposited in front of filter fences as a function of upslope cultivations (n=3), in m^3/ha of upslope plot (Nov 2011-Feb 2012)

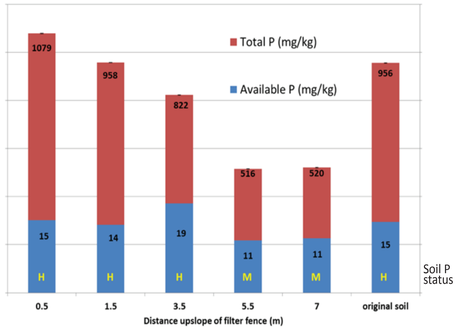

Figure 4 Soil P status of sediment collected by filter fences, compared with original soil. Available P by Modified Morgan's, SAC's advisory method.

Discussion

The filter fence method was clearly effective on moderate slopes, after high risk crops, on this soil type. How much potential does the method have? What are the costs and benefits of the method? These are questions that still need to be fully resolved, but we have estimated that:

- Based on the percentage of fields in potatoes on moderate slopes, in the upper Lunan catchment, we estimate that the potential for mitigation of P loss to Rescobie loch (a popular fishing venue in the catchment) by employing filter fences, is 70-360 kg P year, depending on how well we assume fields are connected to surface waters. The higher end of this range exceeds the target P load reduction required to return Rescobie loch to good ecological status.
- Costs of installation, reinstatement after 3 months, and materials are around £12/m of filter fence. Length of fence required will vary with field shape and size, but typically 50-100m. If 50 tonnes of soil are retained that would otherwise have been lost to the field, at £15/tonne, this represents £750 benefits to the farmer, before considering off site benefits.
- Depending on cultivation treatment, the cost:effectiveness for P removal was £24-£71/kg P, which is competitive with other solutions (such as buffer strips) while being more flexible (the method can follow erodible crops around the catchment).

More work is needed to establish what is the riparian connectivity and the erosion risk as a function of slope, and to evaluate the potential of the method for other catchments across a wider range of soil types. Benefits for alleviation of flood risk have yet to be assessed.