The effects of vegetated buffer zones on erosion and nutrients in surface runoff

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In Finland, 15-m-wide buffer zones and 3-m-wide buffer strips under permanent vegetation have been established along watercourses and lakes to decrease loads of eroded material and nutrients from cultivated soils. On the buffer zones and strips, soil tillage and application of manure and fertilizers are not allowed. The buffers also retain eroded soil particles and nutrients from surface runoff.

The effects of 10-metre wide annually cut grass buffer zones (GBZs) and non-cut vegetated buffer zones under natural vegetation (VBZs) on losses of eroded material, total P, particulate P (PP), dissolved reactive P (DRP), NH_4-N, NO_3-N and total N in surface runoff on a clay field have been studied for 17 years at Jokioinen, SW Finland. The results have been compared with those from 70-m-long and 18-m-wide plots without a buffer (NBZs). On the source area of the experimental field, spring grain was grown in the period 1991–2002 and the grass was grazed by cows in 2003–2005. Since 2006, there has been cultivated grain by direct sowing method. Surface runoff to a depth of 0.3 m was collected in a modified collector trench at the lower end of each plot. The water volume was measured with a tipping bucket, and representative water samples were collected for analyses.

The buffer zones decreased surface runoff losses of eroded material, total P and total N by 60, 40 and 40–60% on cereal field. However, the DRP load was 90% higher from the field with non-harvested VBZ than from the field without buffers or with annually harvested GBZs. The high loss of DRP from the VBZ was most likely due to phosphorus leaching from the soil surface and high mass of decaying grass residue on the VBZ in spring. Also in laboratory experiments, the extraction DRP in leachates from grass was significantly increased after the first freeze-thaw-cycle. On the pasture, the annual losses of eroded material and nutrients in surface runoff from the NBZ plot were significantly smaller than those during the cereal production. According the first results, on the direct sowing field the buffer zones may not be as important as on the autumn ploughed fields.

The buffer zones seem to be one tool in mitigating erosion and total nutrient losses from surface runoff on clay soils. However, to decrease the DRP losses, the vegetation of buffer zones should be cut and the residue removed.