Does gypsum reduce phosphorus losses in an agricultural catchment?

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Many inland and coastal water bodies in Finland fail to achieve the good ecological state demanded by the Water Framework Directive by 2015, unless nutrient loading from agriculture is drastically reduced. Novel remedies may provide a means by which nutrient losses from arable land to surface waters can be effectively reduced particularly at high risk sites. The use of gypsum as a soil amendment dates back to ancient Greeks but its use for phosphorus (P)-control is relatively new. In the ongoing TraP project, gypsum is broadcasted on soil surface and the effect of this measure on P losses from arable land is evaluated using laboratory and field studies and modeling. The gypsum originates from fertilizer plant using Finnish igneous apatite free of Cd and radioactivity.

The study area, Nummenpää catchment (2.4 km^2, 41% fields), is located in southern Finland. The fields are mainly on clayey soils and the dominant plants include spring cereals and cabbage. Gypsum was spread (4.1 t ha^{-1}) on 91% of the field area in autumn 2008. Runoff quantity was monitored by a V-notch weir and runoff quality manually and with the aid of automatic sensors (YSI 600, SCAN spectrolyser) before, during and after the gypsum amendment. Turbidity measured by the sensors correlated well with the concentrations of particulate P as analysed in the laboratory. In addition, sensor-measured electric conductivity correlated with sulphate concentration in runoff.

Soil analyses showed that conductivity and sulphate concentrations increased significantly in the plough layer after the gypsum amendment, but pH and the concentrations of P, K, Mg and Ca were not affected. When normalized by the changes in runoff volume, the loss of particulate P was some 60% lower after the gypsum amendment. Dissolved P was also reduced, although the scatter in the results was higher. To reliably single out the effect of gypsum from other contributing factors, the monitoring at the site should be continued.

Based on the estimated sulphate flux, a maximum of 30% of gypsum was leached within the first year after application. That about 70% of gypsum remained in the soil, suggests that desired effect may still continue. The elevated sulphate losses may pose a risk of enhanced benthic release of P in sulphate-poor lakes, which may restrict the potential application areas to catchments discharging into sea, which is inherently rich in sulphate.