Potential phosphorus (P) and nitrogen (N) leaching from a clay soil with varied past levels of excessive P inputs

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On average, Swedish arable soils are currently close to phosphorus (P) balance, but widely varying excessive P accumulation has taken place in the past on animal farms. Manure overloading is a particular problem on fur farms rearing mink (Mustela vison) and foxes (Alopex lagopus and Vulpes vulpes), although the P in such manure is sometimes regarded as sparingly soluble and less prone to leaching. However, laboratory trials with simulated rain on lysimeters containing heavy clay (60%) topsoil from a former fur farm indicate that potential leaching of P in dissolved reactive form (PL-DRP) can be very high.

A series of soil analyses used in the EU to map the risk of P leaching has indicated that soil P extracted with acid ammonium lactate (P-AL) is a better indicator of PL-DRP (Pearson correlation coefficient 0.94) than the ratio of P-AL to phosphorus sorption index (P-AL/PSI) (Pearson correlation coefficient 0.88) or the degree of P saturation in the AL extract (DPS-AL) (Pearson correlation 0.72). The DPS-AL index was found to be less useful for the mink farm soil, since the former sites of the fur cages had an increased content of easily dissolved iron (Fe-AL) and aluminium (Al-AL) without a corresponding increase in P sorption capacity. In addition, both PL-DRP and P-AL were negatively correlated to the clay content (Pearson correlation coefficient -0.67 and -0.71 respectively), as a result of coarser soil texture around the site of the most intensive animal keeping. Potential leaching of DRP was also positively correlated to leaching of total organic carbon (TOC) (Pearson correlation coefficient 0.85) but not to leaching of total nitrogen (TotN). An additional clear correlation was found between concentrations of particulate-bound P (PP) and turbidity in the leachate during simulated rain events (Pearson correlation coefficient 0.92) and to P-AL in the soil (Pearson correlation coefficient 0.67).

The upper 5 cm soil layer proved to be the main source (mean 74%) of PL-DRP at this site, which had been under grass and thus undisturbed for the past 8 years. Similarly the upper 5 cm soil was indicated to be the main source (mean 80%) of PP. On average, addition of pig slurry corresponding to the Swedish maximum permissible animal density increased PL-DRP by 45%, potential TOC leaching by 33% and the risk of TotN leaching by more than 300%.