Finnish trends in P balances, soil test P and other factors behind agricultural P load to surface waters

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Abstract

Soil test P concentration has a major influence on the dissolved P concentration in runoff from agricultural soils. Thus, trends in soil test P partly determine the development of pollution potential of agricultural activities. We reviewed the changes in soil test P and P balances in Finnish agriculture and assessed the current development of P loss potential after two Agri-Environmental Programmes (AEP) since 1995. AEP has covered up to 95% of the cultivated field area and included restrictions of the P use in both chemical fertilizers and animal manures. Meanwhile, after Finland joined EU in 1995, the economic factors have also favoured lower use of commercial fertilizers. The average field balance of phosphorus in Finland has decreased from +35 kg ha^{-1} of the 1980s to about +8 kg P ha^{-1} today. As a consequence, the 50-yr upward trend in soil test P concentrations has probably levelled out in the late 1990s, as suggested by sampling of about 1600 fields and by a modelling exercise. Soil test P concentrations may also slowly decrease in the future, because they are currently at a level at which annual P fertilization is unlikely to give yield responses. Currently, soils that benefit from annual P applications are more often found in farms specialized in cereal production, whereas farms specialized in non-cereal plant production and animal production have higher soil test P concentrations. An imbalance in P cycling between plant (feed) and animal production is obvious. A major concern in the future will be the fate of manure P in those regions where animal production intensity is further increasing. AEP has also included optional measures to decrease erosion and particulate P losses, such as vegetative buffer zones, wetlands and reduced soil tillage. Currently about 20-25% of the field area in southern Finland is annually under reduced tillage, while the area under ploughing is around 60%. There are no nation-wide estimations on the efficiency of reduced tillage to cut erosion and P losses, but as compared with ploughing, plot experiments have shown a 10-60% reduction for erosion, with lower or even negative impacts on P losses. The potential of buffer zones and wetlands to reduce P losses has been tentatively estimated to reach a 10% reduction, at maximum, of the total agricultural load of P in Finland. Irrespective of AEP, economic pressures have contributed to doubling of the average size of the farms since 1995, with an increasing share of rented land. Such crucial management practices as liming and reconstructions of the subsurface drainage systems have been largely neglected on the rented land. This development includes risks for the structure of clayey fields in southern Finland with negative consequences on soil erosion and particulate P losses. Considering the current trends in agriculture it is not surprising that national monitoring of small- to medium-scale catchments did not show any clear changes in P losses from agriculture in 1990–2004.