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A simple approach to identify critical source areas for phosphorus leaching in the Netherlands

C van der Salm, O.F. Schoumans, D. Walvoort, P. Groenendijk, and M Pleijter
Wageningen Univeristy and Reseach Centre, Alterra, Wageningen, Netherlands (caroline.vandersalm@wur.nl)

High soil phopshorus contents in agricultural soils in the Netherlands cause excessive losses of P to surface waters. The reductions in P application rates in the present manure policy are not sufficient to reach surface water quality standards resulting from the European Water Framework Directive in all catchments by 2015. Accordingly, additional measures have to be considered to further reduce P loading to surface water. For a cost effective implementation of these measures an instrument to identify critical source areas for phosphorus leaching is indispensable. In the Netherlands phosphorus leaching at a national scale is simulated with a comprehensive mechanistic simulation model (STONE, Wolf et al., 2005) focusing on changes in P leaching with time. The identification of critical source areas requires simulations at a high spatial resolution. STONE is less suitable for this purpose, because of the large number of input parameters required by this complex model. For this reason, a simple model (PLEASE: Phosphorus LEAching from Soils to the Environment; Schoumans et al., in prep.) has been developed based on the same mechanistic process description for inorganic P as the complex model STONE and a simplified description of the lateral flow of water from soil to surface waters. With this model P leaching to surface waters can be calculated using readily available information of field characteristics like depth of the groundwater table, precipitation surplus and P status and phosphorus adsorption capacity of the soil.

To evaluate the performance of the model, it was applied to the Netherlands using the same input as the national model. Parameterised in this way, PLEASE is a metamodel of STONE. The model was also tested on two small catchments: a catchment with sandy soils and high P accumulation and a clay catchment with a moderate P accumulation. The application at the national scale showed that the overall order of magnitude of the calculated leaching fluxes was quite comparable with results of the complex model. However, for individual fields, differences between the two models are sometimes considerable due to differences in the distribution of the lateral water fluxes with depth. The application at the catchment scale showed a good agreement between measured and simulated year average discharge of water and phosphorus. The simulated maps of P leaching for the two catchments appeared to be plausible with highest P leaching fluxes in intensively used agricultural fields in wet areas close to brooks and rivers.

Wolf, J. et al. (2005), The integrated modeling system STONE for calculating nutrient emissions from agriculture in the Netherlands. Environmental Modeling and Software 18, 597-617.

Schoumans, O.F., P. Groenendijk and C. van der Salm (in prep.). PLEASE: A simple procedure to determine P losses by leaching