MAPPING VULNERABILITY OF SOILS TO NITRATE LEACHING AT DIFFERENT SCALES, USING DIFFERENT MODELS

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ABSTRACT

The increase of soil degradation at an alarming rate all over the world requires modelling and quantification of the regional extent and severity of these processes. The various scale soil information systems and the inherent techniques of GIS provide unique basis for studies of environmental degradation in modeling of changes in soil characteristics e.g. mapping the vulnerability of soils to degradation or pollution. The produced maps may increase awareness on the potential nature, severity and extent of soil degradation at regional scales, and also permit identification of environmental hot spots (sensitive, vulnerable, conflict areas).

After the growing season, a part of the nitrogen remains in forms sensitive to changes of the conditions, such as nitrate. In years with above-average precipitation a significant amount of nitrate can leave the rooting zone. Integration of knowledge related to environmental conditions of a certain area with the soil, water, and crop management practices helps to prevent the simultaneity of the unfavourable processes leading to nitrate leaching, thus water resources may be protected from nitrate pollution of agricultural origin. In our work we present approaches for the evaluation of the vulnerability of soils for nitrate leaching.

In two pilot areas -with different physiographical conditions- a methodological approach was initiated. A deterministic model family was introduced for the evaluation of the land vulnerability for nitrate hazard in a scale of about 1:25,000. Compilation of vulnerability maps is a result of an iteration where data characteristics (availability, scale, informativity) and model parameters are in interaction.

Spatial categorization (zoning) of land according to its sensitivity to a given pollution is generally required by decision-makers. This involves regionalization of the resulted mapping units which are characterized by vulnerability values generally on nominal scale. Our other approach, which is also presented here, solves this problem together with the ’pure’ mapping procedure.

A stochastic model is put forward for the evaluation of the land vulnerability for nitrate leaching. According to the deterministic approach the severity of a given vulnerability feature can be characterized by some categories, but generally there is no obvious way for determining the classes. According to the stochastic approach, the units of an intersected map (featured by the relevant, influencing factors) are elements

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of a multidimensional factor space which can be clustered, however the number, shape and location of the clusters is apriori unknown. A sequence of non-hierarchical clustering may provide different partitions. For choosing an optimum and parsimonious model over the set of these competing stochastic models, information theoretic criteria are suggested to be used. The resulted optimum classification provides the vulnerability categories which are defined on the map units, thus providing the vulnerability map

Application of the latter method is also presented in national scale for mapping N-leaching hazard in Hungary at a scale of 1:1M