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Evaluation of Land Use with Respect to Nitrogen Leaching

P. Cepuder, R. Nolz, V. Aus der Schmitten

Institute of Hydraulics and Rural Water Management, Department of Water, Atmosphere and Environment, Universität für Bodenkultur Wien, peter.cepuder@boku.ac.at

Groundwater contamination is a serious problem. In many plains of Austria ground water is used as a major source for drinking water. Nitrate concentration in the groundwater has increased dramatically during the last decades. Agriculture in particular, due to excessive application of fertilizers, is identified as a significant contributor to this diffuse contamination. In intensively used agricultural areas like the Grazer Feld the risk of groundwater pollution by nitrogen is very high. The agricultural community has become aware of the impact of fertilization and irrigation as well as crop rotation and tillage operations on groundwater contamination. The protection of water resources has reached high priority. Additional information regarding percolation and nitrogen leaching will help in future water management decisions.

Mathematical simulation models have been used, besides field investigation, to estimate effects of alternative land use on soil and water resources. Nitrogen leaching is calculated with EPIC (Environmental Policy Integrated Climate), which is a physically based model for continuous simulation. Desktop-GIS is used to organize, manipulate, analyze and view these mainly spatial data. The linkage of GIS, simulation model and database provides a powerful tool for the calculation of nitrogen leaching.

The research area, the Grazer Feld, is a large flat valley in the southeastern part of the Styrian Alps. The typical soil of the area is a brown meadow soil over fluvio-glacial sediments. The average temperature of the area is 9.8°C, the average annual rainfall is 830mm. Although precipitation is sufficient and well distributed, irrigation can be necessary for many crops in cases of longer dry periods.

Out of the Grazer Feld eight representative communities were selected to provide the basis for the simulation. The total agricultural research area is about 4400 ha, 90%

are intensively used and the rest is grassland. Referring to an existing actual crop-growing database of the cultivated area typical crop rotations were generated. The most commonly grown crop is maize (app. 50%), which is cultivated in crop rotation and in monoculture, as well as pumpkin (app. 20%). Different species of small grains (i.e. winter barley, winter wheat) rank third (app. 16%) continued by soybean, potato, field pea etc.

The first step was the simulation of the actual state. Crop rotation and tillage operations of the last decade were used to simulate percolation and nitrogen leaching as well as crop yields. These results were used to verify and calibrate the model by comparison with real measurements. The second step was the simulation of different scenarios of alternative land use (crop rotation, tillage operation, ...) to detect better agricultural management practices. Yield reduction has to be avoided to ensure the income of the rural population.