

Efficiency of measures in agriculture to reduce nitrate concentrations in groundwater

Context and objectives

In Switzerland, zones with intense agriculture often overlap with productive alluvial aquifers that are important for drinking water supply. In these regions, elevated nitrate concentrations are common, with values above regulatory limits in 45% of the stations of the Swiss Groundwater Monitoring Network. In different regions of Switzerland, land use changes have been implemented to reduce nitrate levels. A radical transformation of arable land to meadows usually leads to a strong improvement of the groundwater quality, but also to a loss of agricultural production. In one of the largest projects in Switzerland, the Gäu-Olten project, it was attempted to find a balance between good groundwater quality and agriculture production, by adapting agricultural practices while still growing crops. However, it remains uncertain if the taken measures are sufficient. The goal of the MSc thesis is to investigate the relationship between agricultural practice and groundwater quality in this project region. In addition, it will also be evaluated how quickly the effect of land use changes becomes detectable in groundwater by considering the travel time of water through the vadose zone and aquifer.

Research approach and methodology

The detailed research approach will be defined jointly with the student. The following methodologies might be employed: (a) development of a conceptual model of the hydrogeological functioning of the project region, (b) investigation of the water quality immediately below agricultural fields which use different crops and agricultural practices using novel field methods such as inclined boreholes equipped with sensors and sampling ports, (c) characterization of groundwater quality patterns in the project area, (d) potentially, numerical modeling to simulate how quickly an improvement of water quality propagates through the subsurface.

Partners and collaboration

The project will be supervised by Prof. D. Hunkeler and Dr. V. Ponsin from UNINE. The MSc thesis is part of a large project with various partners including the Federal Office of the Agriculture, the Environmental Office of the canton Solothurn, the Institute for Organic Agriculture (FiBL), ETHZ and Agroscope. The MSc student has the possibility to participate in project meetings and get to know the role of different partners and stakeholders in such a project. The field work will be carried out in the region between Oensingen and Olten, where different land use changes have been implemented over an area of 1000ha. In this region, an important alluvial aquifer is located that supplies groundwater for around 50'000 persons.

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