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Vadose Zone Monitoring as a Key to Groundwater Protection from Pollution Hazard

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Minimization subsurface pollution is much dependent on the capability to provide real-time information on the chemical and hydrological properties of the percolating water. Today, most monitoring programs are based on observation wells that enable data acquisitions from the saturated part of the subsurface. Unfortunately, identification of pollutants in well water is clear evidence that the contaminants already crossed the entire vadose-zone and accumulated in the aquifer water to detectable concentration. Therefore, effective monitoring programs that aim at protecting groundwater from pollution hazard should include vadose zone monitoring technologies that are capable to provide real-time information on the chemical composition of the percolating water. Obviously, identification of pollution process in the vadose zone may provide an early warning on potential risk to groundwater quality, long before contaminates reach the water-table and accumulate in the aquifers. Since productive agriculture must inherently include down leaching of excess lower quality water, understanding the mechanisms controlling transport and degradation of pollutants in the unsaturated is crucial for water resources management.

A vadose-zone monitoring system (VMS), which was specially developed to enable continuous measurements of the hydrological and chemical properties of percolating water, was used to assess the impact of various agricultural setups on groundwater quality, including: (a) intensive organic and conventional greenhouses, (b) citrus orchard and open field crops , and (c) dairy farms. In these applications frequent sampling of vadose zone water for chemical and isotopic analysis along with continuous measurement of water content was used to assess the link between agricultural setups and groundwater pollution potential. Transient data on variation in water content along with solute breakthrough at multiple depths were used to calibrate flow and transport models. These models where then used to assess the long term impact of various agricultural setups on the quantity and quality of groundwater recharge.

Relevant publications: Turkeltaub et al., WRR. 2016; Turkeltaub et al., J. Hydrol. 2015: Dahan et al., HESS 2014. Baram et al., J. Hydrol. 2012.