Analysis of groundwater-level response to heavy rainfall and recharge potential in the shallow aquifer, central Taiwan

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Due to the limited surface water resources, groundwater has long been regarded as an alternative source of surface water, especially for irrigation water use in the Choushui River alluvial fan, the most important agricultural area in central Taiwan. The purpose of this study was to evaluate the ground water-level response to rainfall and determine the recharge potential for shallow aquifer in this area. Heavy rainfall events and related borehole water levels were cross-correlated to investigate short-term variations in groundwater-level response times. The time lags yielding significant correlations were determined by using the cross-correlation function (CCF), and the water-level rise for each observation well was estimated and used for regression analysis with rainfall amount, land use, thicknesses of low permeability topsoil materials, and aquifer hydraulic conductivity. In general, for most of the observation wells in this area, the time lag for a significant water-level response was about 1 day, suggesting that some preferential flow occurring. However, the wells with high water-level rise were mainly disturbed in the proximal-fan. Pearson correlation analysis showed that recharge potential of upland was better than that of paddy field, which low permeability of plow sole was existed to limit the downward water movement. The correlation between water level rise and different rainfall amount, thicknesses of low permeability topsoil material, and aquifer hydraulic conductivity was varied from proximal-fan to distal-fan, indicating the complexity of hydrogeological conditions in this area. The results of the study provide statistical support for delineation of recharge potential zones and formulating agricultural water management strategies.
Key words:Groundwater, Irrigation, Cross-correlation function, Recharge potential