

## Analysis of the Effects of Various Parameters on Groundwater Recharge using a Hybrid Method

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### Abstract

Due to the time and space changes of hydrological events in the arid and semi-arid regions, recharge measurement in these areas is very difficult. Hence, groundwater recharge is a complicated phenomenon for which there is not a fixed method to determine. The aim of this research was to develop a method for estimation of groundwater recharge based on a hybrid method. In this study, a hybrid method for calculating recharge was presented by combining empirical methods with a mathematical model, MODFLOW, and AHP analysis. The results showed that the most important parameters affecting groundwater recharge are soil properties, unsaturated thickness, land cover, land slope, irrigation and precipitation, from which the soil properties and precipitation are most important. The results showed that the overall impact of small changes in precipitation and temperature significantly affect the groundwater recharge, and heavy soils are much more sensitive to these changes than light soils. By changing 10% precipitation, the recharge rate is changed between 16% and 77% and by changing 1°C temperature, the recharge rate is changed between 6% and 42%. Also, results showed that precipitation and evapotranspiration changes in four months including December, January, February and March had significant effects on annual recharge rate. Using the results of this research, the vulnerable areas of the plain, appropriate places and time for artificial recharge could be identified. Overall, the results of this study can be useful in various aspects of groundwater management.

**Keywords:** Groundwater recharge, Hybrid Methods, AHP, MODFLOW, Sensitivity analysis, Thornthwaite.

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