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Managed Aquifer Recharge suitability mapping combined with field examination and numerical simulation in the Danube-Tisza Interfluvium, Hungary

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The Danube-Tisza Interfluvium is one of the largest areas covered by wind-blown sand in Hungary. Two major morphologic region types are the flat-bottomed valleys of the Danube and Tisza rivers and a central elevated ridge region, characterized by sand plains, dunes and deflationary depressions. The area is poor in surface waters, mainly artificial channels can be found. Previously many lakes were present, but most of them dried out due to water abstraction, climate change, forestation and canalization related water level reduction. Water management problems in the broader area have been known for decades, many plans have been made to address water scarcity, but none have materialized (Kovács et al. 2017). These plans usually tried to solve water shortage with large scale engineering solutions, e.g. to pump water up from the Danube River Valley through surface channels to the ridge region (Nagy et al. 2016). This is very expensive, influences the ecological pattern, moreover water can easily infiltrate from the channels and would not reach the higher regions in the required amount (Silva Cisneros, 2019).

The aim of the research was to examine the suitability of Managed Aquifer Recharge methods, then a local scale field research was carried out in order to find local scale solutions. Finally the results were checked by numerical simulation to contribute to the solution of water shortage of this ecologically important area.

Firstly, a MAR surface infiltration suitability map was constructed, that shows areas with favorable hydraulic conductivity at the upper 10 m and low water levels, which means that there is a reservoir in the unsaturated zone to store infiltrated water. Based on suitability mapping, a local research area was selected which showed promising potential. Geophysical measurements (ERT – Electrical Resistivity Tomography, RMT – Radio-magnetotellurics) were performed, shallow wells were surveyed, and additional wells were drilled by hand driller. The results obtained during the field sampling contributed to the preliminary characterization of the area from a geological and hydrogeological point of view. In order to understand the effects of artificial channels and the possible water recharge methods a saturated-unsaturated flow model and different scenario models were built up in 2D.

This local scale case study was a first step towards the further aim of this research, which is to understand the effects of man-made changes on groundwater flow systems in the broader area and suggest appropriate local scale MAR solutions accordingly.

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