Preliminary results of Rooftop Rainwater Harvesting and shallow well infiltration pilot project in the Danube-Tisza Interfluve, Hungary

Zsóka Szabó,
Tibor Ridavits, Endre Csiszár, Judit Mádl-Szőnyi
1. Introduction and aims

- Due to **climate change**, weather conditions are becoming more extreme, with longer periods of drought and flood causing environmental, agricultural and consequent social and economic problems.

- **Managed Aquifer Recharge** is a suitable way to reduce these inequalities and helps mitigating the related consequences.

- **The research aim** is to find local scale solutions to the water management problems of the Danube-Tisza Interfluve and evaluate how MAR can contribute to the water shortage of the area.

![Schematic figure of rooftop rainwater harvesting and shallow well infiltration](https://inowas.com/mar/)
2. Study area

Location of the local study area around the town of Kerekegyháza (modified from Kohán & Szalai, 2014)

Water level changes between 1956-60 and 2002 (VITUKI, 2002)

Reasons of groundwater level reduction (based on Pálfai, 2010 and Nagy et al., 2016)

- climate change (precipitation and evaporation)
- deep groundwater abstraction
- shallow groundwater abstraction
- land use changes
- changes in agricultural water management
- other
3. Research background

- Water management problems in the broader area have been known for decades
- One of the most recent plans was to move water from the Danube Valley Channel to the center of the ridge, through existing channels and lakes (Nagy et al., 2016)
- Too expensive and not effective enough as the water can easily infiltrate from the channels and it would not reach the higher regions in sufficient amount
- Water chemical considerations, groundwater dependent ecosystems
4. Experimental pilot site

**Source water**
rainwater collected from the roof of a family house (in an agricultural small town)

**Pretreatment**
filtration before the water reaches the tube system

**Aquifer**
unconfined shallow aquifer, consisting of sand, with low water table and high TDS, not used by the residents anymore

**MAR method**
shallow well of 6.3 m depth, reaching the water table (water level is around 0.5 m in the well)
5. Preliminary results

Water level changes

Legend
- SW
- P1
- P2
- Precipitation

Water level [m a.s.l.]

Date [m/d/y]

Precipitation [mm]
5. Preliminary results

Changes in specific electrical conductivity
Water chemistry

- Decreasing TDS, Cl\(^{-}\), SO\(_4\)\(^{2-}\) and NO\(_3\)\(^{-}\) content in the shallow well

- Last sampling time: hydrochemical facies is very similar in the shallow well and the monitoring wells, however in P1 and P2, TDS is higher (twice the amount) and Mg\(^{2+}\) content is also significant (similar to the first samples from the shallow well)
5. Preliminary results

Changes in temperature
6. Conclusions

- The **water table increased** 20 cm in the first two months due to only 10 m$^3$ of infiltrated water, however water level decreased ~20-40 cm due to a **longer drought in spring**

- The infiltration events are also detectable in the monitoring wells → **good communication** (~3.5 days of travel time)

- **TDS, Cl$^-$, SO$_4^{2-}$ and NO$_3^-$ content decreased** in the shallow well, however the monitoring wells are indicating TDS increase (dominantly Mg$^{2+}$ and HCO$_3^-$)
6. Conclusions

- The water table increased 20 cm in the first two months due to only 10 m$^3$ of infiltrated water, however water level decreased ~20-40 cm due to a longer drought in spring.
- The infiltration events are also detectable in the monitoring wells → good communication (~3.5 days of travel time).
- TDS, Cl$^-$, SO$_4^{2-}$ and NO$_3^-$ content decreased in the shallow well, however the monitoring wells are indicating TDS increase (dominantly Mg$^{2+}$ and HCO$_3^-$).

7. Further plans

- Continuing the pilot project for at least one hydrological year.
- More detailed hydrochemical measurements of the shallow well and monitoring wells.
- Sampling of the rainwater and the water reaching the well from the PVC hoses.
- Flow and transport modeling to understand the processes occurring underground.
6. Conclusions

- The **water table increased** 20 cm in the first two months due to only 10 m$^3$ of infiltrated water, however water level decreased ~20-40 cm due to a **longer drought in spring**
- The infiltration events are also detectable in the monitoring wells → **good communication** (~3.5 days of travel time)
- **TDS, Cl$^-$, SO$_4^{2-}$ and NO$_3^-$ content decreased** in the shallow well, however the monitoring wells are indicating TDS increase (dominantly Mg$^{2+}$ and HCO$_3^-$)

7. Further plans

- Continuing the pilot project for at least one hydrological year
- More detailed hydrochemical measurements of the shallow well and monitoring wells
- Sampling of the rainwater and the water reaching the well from the PVC hoses
- **Flow and transport modeling** to understand the processes occurring underground
- Extending the results of the pilot to the whole town to increase the water table without any negative side effects (settlement scale modeling + feasibility study)
Thank you for your kind attention!

The ENeRAG project has received funding from the European Union’s Horizon 2020 research and innovation programme under Grant Agreement No. 810980