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Increasing reliability and safety of Managed Aquifer Recharge schemes for tackling water scarcity

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In Mediterranean areas, limited or no-availability of surface water during late spring/summer period makes groundwater an essential resource for drinking, irrigation, and industrial purposes, while supporting wetlands, as in the case of the lower River Cornia coastal plain (Tuscany, Italy). There, large aquifer exploitation resulted in a large water balance deficit. Within the LIFE REWAT project, Managed Aquifer Recharge (MAR) was identified as a solution to counterbalance the stressed hydrologic system.
The intentional recharge of aquifers, although being a widespread used tool at global scale for increasing water supply, is not always supported by adequate monitoring systems aiming at guaranteeing safety of recharging operations.
A pilot MAR two-stages infiltration basin for harvesting flood-water from the Cornia River is in operation in Suvereto (Italy). The MAR scheme fulfil all of the requirements of the new-issued Italian regulation on artificial recharge of aquifers (DM 100/2016), and as such a central element consists in the hi-tech high-frequency automated and remotely controlled system for operating the plant and monitoring water quantity and quality.
The MAR scheme diverts excess surface water from River Cornia by means of a pumping system first into a settling pond and then into a larger fine sands and gravel basin. The automated operating system allows diversion from the Cornia River using: i) the data acquired by a level sensor at a Cornia River hydrometer - this to avoid that diversion takes place at flow conditions lower than the minimum ecological flow; ii) the data acquired from a S::CAN Spectrolyser probe providing the spectral signature of the surface water and parameters of interest, such as turbidity, nitrates, TOC, DOC, UV254 and color, so to guarantee that good quality water (on legal basis) is used for recharge. A head sensor in the infiltration basin regulates the basin filling in order to avoid overflow.
The effectiveness and impact of the intentional recharge process on the aquifer is then monitored using: i) a multi-parameter probe placed in a piezometer downstream - whose role is to highlight any negative change in the aquifer system, and ii) a further series of sensors gathering T, h and EC positioned in piezometers downstream the MAR scheme for recording the variations induced in the aquifer by the recharge process. Thresholds are set and alarm messages are sent to the managing technical staff in order to inform and to allow timely reaction to inconveniences. The control unit hosting the database and recording the gathered data may be accessed from everywhere with basically any kind of device. Discrete groundwater sampling takes place monthly.
The implemented MAR scheme works at about 5000 m3/day recharging rate. This is an innovative example of nature-based solution for the management of water resources. The monitoring infrastructure may increase social perception of MAR as an opportunity, diverting it form the common view of a threat to the safety of aquifers.

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