MARSOL Policy Brief

Essentials on Managed Aquifer Recharge for policy makers and water managers

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Water scarcity is one of the key issues our society faces today. Although there is enough freshwater on our planet, it is unevenly distributed and often not properly managed. Despite uncertainties in global climate projections, the anticipated reduction of renewable freshwater resources can be as high as 50% within the next 100 years hitting regions that already suffer from water scarcity and droughts. At the same time, large water quantities are lost to the sea as surface run-off and river discharge, discharge of treated and untreated wastewater, or discharge of excess water from various sources during periods of low demand. These alternative water resources in principal can be used to increase water availability in general, in periods of high demand, or as a strategic reserve.

What is Managed Aquifer Recharge?

Managed Aquifer Recharge (MAR) refers to the intentional infiltration of excess water into the subsurface through engineered systems for temporal storage or to influence gradients. Water can be recovered in times of high demand. In principal, large storage capacity is available in shallow aquifers, either due to thick unsaturated zones or due to already depleted water resources in extensively exploited aquifers. In addition, water quality can be improved due to chemical and biological reactions during flow of the infiltrated water through the unsaturated and saturated zone. MAR can be a key Water Resources Management tool for tackling water scarcity in Europe, and in water scarce regions worldwide by linking water reclamation, water reuse and integrated water resources management in a long-term strategy.

Water sources for MAR and technical solutions

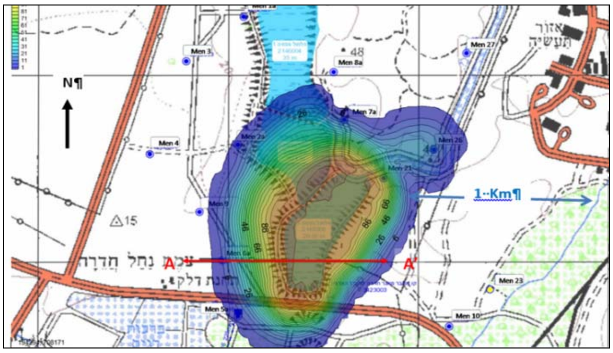
Available water sources for MAR include stormwater, surface runoff, treated waste water, water from streams and lakes, ground-water from remote aquifers, or desalinated water. These water sources have different qualities and require different technical solutions for infiltration and recovery. Various technical designs are available and a vast experience with the operation of such sites has been gained. In principle, direct injection of water through wells, or indirect infiltration through surface ponds, infiltration basins, ditches, wetlands, river beds, or shafts are applied. Operational times of installations range from 50 years in the case of the Menashe site in Israel, where runoff water is infiltrated, to recent installations. It was demonstrated that the technical solutions are well understood, operate efficiently, and are cost effective.

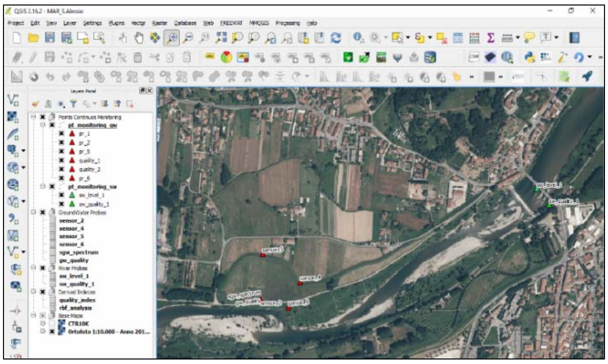
What about water quality?

Quality aspects of water sources used for MAR are of major concern. Especially the presence of micropollutants, such as pharmaceuticals, in treated waste water and in receiving surface waters has to be considered. In particular direct MAR methods using such waters, i.e. injection of reclaimed water through wells directly into the saturated zone, may have a high risk to contaminate native groundwater and typically require a thorough pretreatment or long retention times in the aquifer before recovery. By infiltrating water through the unsaturated zone, MARSOL could show that natural attenuation processes for contaminants can substantially improve water quality. The capacity to retain pollutants in indirect MAR techniques, however, differs considerably depending on the hydraulic and geochemical factors on each specific site.

Monitoring and modelling of MAR sites

Monitoring of MAR sites is crucial for performance evaluation and management of sites. Various monitoring tools were applied in MARSOL, targeting hydrodynamics in the saturated and unsaturated zone, water quality and clogging issues. Collecting data in high spatial and temporal resolution and making them available in real time requires appropriate data transmission and storage techniques. Wireless sensor networks including suitable data storage and visualization techniques, i.e. web based data management platforms, allow to feed decision support systems (DSS). Monitoring is typically accompanied by modelling that allows an outlook on the performance of a certain MAR approach in the future. In addition modelling allows evaluating alternative scenarios for MAR operation and enables MAR optimization (predictive tool).



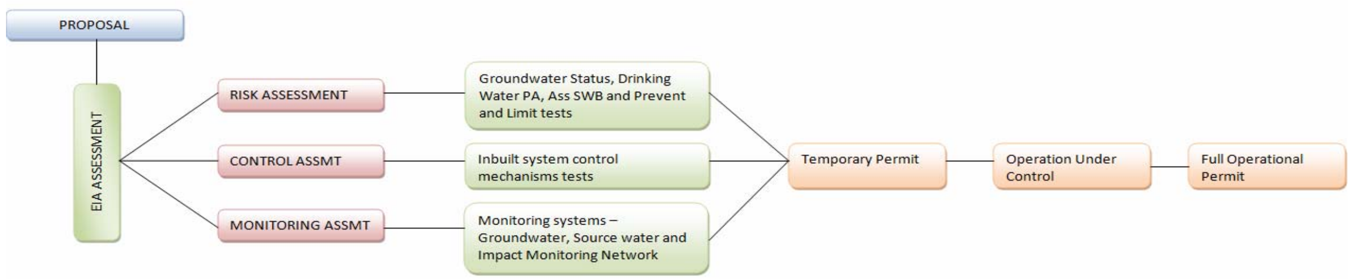


What are the costs?

MAR operations have to be economically feasible and apply simple engineered solutions that are easy to maintain, otherwise it will not be implemented. The financial feasibility of MAR projects depends on a number of parameters affecting their costs, such as capital expenses and operating costs, and the revenues potentially derived from the sales of the water for a variety of uses. However, water has also social and environmental values that are difficult to quantify. The benefit of a MAR project should not be solely based on market revenues. MAR projects can improve the quality of lives of the people benefiting from an increased availability of water, and recharged water can contribute to sustained ecosystem services. A thorough cost-benefit analysis is required to justify a MAR installation. However, MARSOL could prove that MAR can be a cost effective tool.

Legal Framework

The Water Framework Directive (2000/60/EC) considers 'artificial recharge' of groundwater as one of the water management tools that can be used by EU Member States to achieve a good groundwater status. It has to be ensured, however, that the necessary regulatory controls are in place to warrant that such practices do not compromise quality objectives established for the recharged or augmented groundwater body. It is also acknowledged by the Groundwater Directive (2006/118/EC) that it is not technically feasible to prevent all input of hazardous substances into groundwater, in particular minor amounts which are considered to be environmentally insignificant and thus do not present a risk to groundwater quality. For such cases the Groundwater Directive, under Article 6(3)(d), introduces a series of exemptions. Artificial recharge is considered as one of these exemptions. MARSOL suggests a Regulatory Framework based on risk assessment, control mechanisms and monitoring as a tool which can facilitate the application of the Water Framework and Groundwater Directives on MAR. It is the intention of such a regulatory framework to provide clear guidelines to Member States on the application of MAR techniques.



The MARSOL project

The main objective of the EU FP7 project MARSOL was to demonstrate that MAR is a sound, safe and sustainable strategy that can be applied with great confidence. With this, MARSOL aimed to stimulate the use of reclaimed water and other alternative water sources in MAR and to optimize WRM through storage of excess water to be recovered in times of shortage. MARSOL operated eight demonstration sites in six countries around the Mediterranean (Portugal, Spain, Italy, Greece, Malta, Israel) applying various technologies, i.e. infiltration ponds, river bed infiltration, direct injection wells, canals, river bank filtration, to infiltrate various water sources, i.e. river water, surface runoff, treated waste water, desalinated sea-water.

More information can be found on: *www.marsol.eu*

The MARSOL Partners

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