MARSoluT
Managed Aquifer Recharge ITN

MARSoluT Policy Brief

Essentials on Managed Aquifer Recharge for policy makers and water managers

Background

Water Management in Europe is facing an uncertain future, as established management frameworks are being challenged by the pressures resulting from climate change. Prolonged dry periods are increasing the occurrence of droughts and associated water scarcity, an increasing number of high intensity rainfall events is resulting in flooding, associated with comparably low groundwater recharge. In addition, the projected increase in temperatures are generating increased water demands.

Despite uncertainties in global climate projections, the anticipated reduction of renewable freshwater resources especially in Southern Europe can be as high as 50% until 2100, hitting regions that anyway already suffer from water scarcity and droughts. At the same time, large water quantities are lost to the sea as surface runoff 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 principle can be used to increase water availability in general, in periods of high demand, or as a strategic reserve. Ensuring a high level of resilience in the water sector is increasingly becoming a priority for the EU and concepts have to be developed and implemented.

This is not only relevant for ensuring security in the provision of water services, but also in view of the contribution of water to the energy sector, food production, and ecosystems. Increased resilience is generally addressed through the application of traditional tools such as water demand management and water supply augmentation measures. But it can also be addressed through the restoration and augmentation of existing natural freshwater resources.

Managed Aquifer Recharge is one of the tools which can support a move towards a more water resilient Europe, improving the quantitative (and qualitative) status of groundwater whilst enabling the reservoir capacity of aquifer systems to be exploited for balancing water storage between wet and dry periods. In doing so, surplus water resources during wet periods for which there is no immediate use can be stored, and made available during dry periods when water resources are scarce. With this the sustainable use of groundwater resources can be promoted, ensuring their contribution to water security in Europe for the future.

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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.

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Is Managed Aquifer Recharge safe?

Quality aspects of water sources used for MAR are of major concern, especially the presence of micropollutants, such as pharmaceuticals, in treated wastewater and in receiving surface waters. In particular direct MAR methods, using such waters through the introduction of reclaimed water through wells directly into the saturated zone, may have a high risk to contaminate native ground-water and typically require a thorough pretreatment or long retention times in the aquifer before recovery.

However, it has been shown that chemical and biological reactions, as the infiltrated water flows through the unsaturated and saturated zones, can improve water quality. The capacity of the unsaturated zone to retain pollutants in indirect MAR techniques varies considerably depending on the hydraulic and biogeochemical factors of each specific site as well as on the pollutants present.

Infiltration basins can be designed to incorporate reactive layers which can aid the improvement of water quality to make MAR a trusted technology. In addition, water quality requirements can be coupled to intended use in a ‘fit for purpose’ approach. Careful and tailored design of MAR systems and monitoring of MAR sites is therefore crucial for performance evaluation and management of sites. However, water quality is still the key issue in implementing MAR systems, as the regulatory background is not well defined.

Legal challenges

The Water Framework Directive (WFD, 2000/60/EG) and the Groundwater Directive (GWD, 2006/118/EC) set obligations upon Member States to both safeguard the quantitative and the qualitative status of groundwater. Article 4(1)(b) of the WFD provides for the environmental objectives to be achieved by Member States in respect of groundwater. Specifically, WFD Article 4(1)(b) lays down (i) an obligation to 'implement the measures necessary to prevent or limit the input of pollutants into groundwater, and to prevent the deterioration of the status of all bodies of groundwater', subject to limited exceptions, while in WFD Article 4(1)(b) it concurrently lays down (ii) an obligation to 'protect, enhance and restore all bodies of groundwater' and to 'ensure a balance between abstraction and recharge of groundwater'.

Article 191(2) of the Treaty on the Functioning of the European Union (TFEU, 02016E/TXT) states that 'Union policy on the environment shall aim at a high level of protection taking into account the diversity of situations in the various regions of the Union'. It is acknowledged that vulnerability to climate change is becoming increasingly widespread throughout the Union, giving rise to a potential conflict between these two seemingly complementary obligations.

Managed Aquifer Recharge may become an inevitable necessity moving forward and thus some elements of legal uncertainty require addressing. These relate mainly to (i) the lack of a formalized position with regards to the 'prevent and limit' concept, (ii) to judgements of the Court of Justice of the European Union and grey areas in the law, and finally (iii) to monitoring issues.

It is acknowledged by the GWD 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 GWD, under Article 6(3)(d), introduces a series of exemptions. Artificial recharge is considered as one of these exemptions.

With this, the basis for the broader application of MAR is given. However, applications of MAR in various regions of the EU are still scarce, mainly as a result of the uncertainties of legal aspects. European guidelines are needed to build up the trust in MAR technologies and to ensure stakeholders that MAR is a measure well supported by EU Member States and the Commission.

The MARSoluT project received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement no. 814066.
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