eGROUNWATER
Working paper 10

Co-managed aquifer recharge with stakeholder cooperation

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In brief – In the region of Castilla y León, Spain, the case of aquifer overexploitation due to intensive agriculture and irrigation has been studied in two water bodies. This overexploitation has consequences on the quantity and quality of available resources, but it also creates conflict due to competition over the resource between stakeholders. The innovative solution lies in the establishment of Managed Aquifer Recharge (MAR) and the creation of groundwater user communities, therefore involving users and populations in the co-management of the resource. A variety of positive effects to this approach have been observed, including the mitigation of aquifer overexploitation, although groundwater extraction remains very intensive.

This document should be cited as follows :

A Vion-Loisel, 2023, Co-managed aquifer recharge with stakeholder cooperation, Egroundwater working paper 10, 5 pages. Available at https://egroundwater.com

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This project is part of the PRIMA programme supported by the European Union's Horizon 2020 research and innovation programme

PRIMA PARTNERSHIP FOR RESEARCH AND INNOVATION IN THE MEDITERRANEAN AREA

Horizon 2020
European Union Funding
for Research & Innovation

Introduction to the problem

The need for the innovation explored in this report arose from the apparent pressure on aquifers due to intensive agriculture and irrigation in the two case studies that the paper we base this report on investigates (UNESCO, 2021). These case studies are two water bodies located in the region of Castilla y León in the Spanish part of the Duero river basin (los Arenales and Medina del Campo water bodies), where a groundwater decline of respectively about 25m and 30m was observed between 1972 and 2002. Furthermore, both water bodies are considered to be in poor status under the EU water framework directive due to diffuse pollution and the high concentration of nitrates. In fact, irrigation agriculture is the main driving force of the local economy in both case studies, which is a factor for aquifer intensive exploitation, and can explain the high nitrate pollution. Some above legal arsenic concentration levels have also been found. This aquifer over abstraction contributes to the environmental deterioration of the area, and the inability to meet the demand for urban and agricultural water with available groundwater resources. In addition to problems of water quantity and quality, the area is facing another type of risks, namely conflict between stakeholders due to competition over resources.

The innovation

The innovative solution

One of the solutions identified in the Duero River Basin Plan in order to reverse the poor status of water bodies to good condition was the establishment of Managed Aquifer Recharge (MAR) and the creation of groundwater user communities (Comunidades de Usuarios de Aguas subterráneas, or CUAS). According to NGWA, managed aquifer recharge is “the purposeful recharge of water to aquifers for subsequent recovery or for environmental benefit”. It is stated in Spanish regulation that in the case of water bodies in poor condition, the water authorities need to coordinate actions and reach an agreement with CUAS, therefore opening space for collaboration in decision making.

The solution studied in this report consists of a bottom-up, non-hierarchical network model of governance using both technological and management solutions; namely the use of MAR as a hard structural measure, coupled to a strong collaborative action with CUAS as a softer measure to address aquifer intensive use and overexploitation and help re-balance the system to a sustainable resource extraction level. The innovation lies in the bottom-up approach that is taken to Managed Aquifer Recharge, where both users and the population are effectively engaged in the co-management of the resource, and in the co-management of the introduced solutions in which all inhabitants take part. Hence this approach is considered as a way to reduce impacts from intense groundwater extraction and solve water availability, security and quality issues in the areas studied, by relying on converting data into valuable information for better shared decision making by all stakeholders.

Actors involved

The role of these water communities at water body level is to hold information meetings with the end-users, invite individual agents to join collective institutions for each groundwater body, and develop rules to help share groundwater resources in homogeneous zones. Then, there

is the possibility to create CUAS for each groundwater body which can include farmers and citizens, and culminate in a binding collaboration agreement between each CUAS and the Duero river basin agency, i.e. a public private partnership (PPP). Therefore, CUAS are public legal corporations responsible for managing the water use rights they have been granted, and for reporting to the water authority on this water use. Moreover, under Spanish regulation, MAR with natural waters requires the constitution of a community of beneficiaries, of which CUAS can be considered. The role of beneficiaries is to participate in the management and maintenance of the infrastructure to ensure irrigation occurs with good quality groundwater.

Three key stakeholders types are involved in the 4 CUAS selected as part of the case studies: the Duero River Basin authority (or CHD, which is an autonomous body responsible for water management); members of the CUAS and water end-users; and so called “stakehomers”, which are included in the public participation schemes. Stakehomers are described as “a group of agents that represent the local population, researchers and people involved in the development of the systems (not in the management), who participate occasionally through legal public consultation or communication channels, including social networks”. This constitutes a Public-Private People Partnership (PPPP).

- ## Impacts of the innovative approach

The conclusions included in this report are based on insights gathered from the mixed methods used in Chapter 1 of the third series of Global Water Security Issues (GWSI), namely literature review, case study approach, interviews, workshops and follow up surveys. However, many of the lessons learned can be extrapolated to other areas when adapting to the local context.

Positive impacts of MAR included facilitating operations including the consideration of an ecological flow-rate; increasing crop quality, their yield and associated income generated, as well as easing market access. MAR techniques also contributed to mitigating aquifer overexploitation which directly reduced electricity or fuel cost from well pumping by lowering energy consumption, and had an impact on flood reduction by storing excess water.

Thanks to MAR, the 25m groundwater decline registered between 1972 and 2002 recovered to a 15m decline in the 18 years that followed. Overall, it contributed to increasing the number of hectares in irrigation, and securing a good technique to help address the previous intensive exploitation of the aquifer. Hence, it supported agricultural development, promoting sustainable water resources management schemes, and the subsequent increase in agricultural production due to a greater water availability for irrigation, and thus economic growth in these cases. Additionally, MAR has socio-economic benefits (see table 1). The success of MAR has been considered to be linked to the collaborative style of governance and trust among the different actors involved.

Table 1-4 *Some indicators for MAR outcomes (Source: MARSOL, 2016b)*

	Region of Castilla y León	Municipalities in the case study areas
Density of working age population (unit: inhabitants between 20 and 64 years old per square kilometer)	7.4 inhabitants./km²	17 inhabitants/km²
agroindustry (unit: related jobs workers per square kilometer)	3.73 w/km²	11.29 w/km².
Number of companies in the area (Unit: nº of companies per square kilometer)	0.46	1.28
Population growth	-6% decrease in the region -	+28% increase since MAR began

Table 1. Socio-economic benefits of MAR. Source: UNESCO, 2021

Difficulties encountered and lessons learned

- ## Difficulties

In terms of difficulties encountered, conflict arose among different stakeholders who considered that the extraction of water from the river was excessive. To try to resolve this, meetings and workshops have been hosted, organized by political parties, partners of European projects and local municipalities to discuss the different points of view. However, currently a court decision is needed to find an agreement. Also, although positive impacts have been observed as a result of this combination of hard and soft measures approach, the extraction of groundwater remains very intensive with an exploitation index greater than one, which could be brought down by further aquifer recharge experiences.

- ## Lessons learned

The lessons learned from co-managed MAR include the need for careful and expert management, as well as regular monitoring and evaluation in order to help users to constantly reflect and learn from their experiences. Furthermore good information and dissemination materials and activities are required such as maps, panels, or brochures, informing groundwater users on the aquifer, money saved thanks to MAR activities (electricity, pumping cost, etc.) or workshops. They can also reinforce trust and collective action. Additionally, increasing the channels of communication, the exchange of experiences in other locations, and avoiding the use of technical language are believed to be important elements. Overall, trust, cooperation, sharing of information, and a high level of transparency were mentioned as critical elements for the success of this approach.

- Information needs

The kind of information and data necessary and provided for example by farmers include internal water management practices and volumes used to irrigate each crop, the evolution of the groundwater level in their wells, the volume diverted from rivers (respecting essential environmental flows), volumes flowing along the MAR canals, infiltration ponds, and the reuse of reclaimed water from wastewater treatment plant for MAR. Furthermore, sensors located in different areas collect data which helps guarantee a bilateral flow of information and provide a robust support of science-based figures and proven facts for, e.g., negotiations with the water authorities.

Hence, an essential element is the access to good technical information, ideally in almost real time (for example groundwater level fluctuations). This is difficult since, at the moment, access to some information requires a specific and written information request. Consequently, easier access to local groundwater-related data and information is necessary, especially as more widely available information contributes to increasing farmers' risk awareness which could influence their desire to participate in decision making. Some potential solutions identified were new digital technologies such as mobile applications or websites displaying the monitoring network information. Additionally, external advice such as from specialized research centres can be sought from CUAS.

References

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