



ARTIFICIAL RECHARGE OF AQUIFERS AND WATER REGENERATION IN DEGRADED WETLANDS

The situation of Spanish wetlands had reached a critical point during the 20th century, as its size had been reduced by 60% (MOPTMA, 1990 and 1995, Casado & Montes, 1995). Moreover, most of them had been significantly changed.



Examples of wetlands regenerated by means of techniques of artificial recharge of aquifers in Bolivar, Adelaide (South Australia), Phoenix, Arizona (USA) and Spandau, Berlin (Germany).

The main causes have been over-exploitation of aquifers, forest repopulation, and growing urban development.



Since Spain ratified the RAMSAR International Agreement (1971) in 1982, and helped by Law 4/1989 on Conservation of Natural Areas and Wild Flora and Fauna, wetland conservation has been fostered through various techniques, among which it is worth noting artificial recharge of aquifers.

This system has been applied in other countries for decades, as is shown by the following examples from Adelaide, Berlin, and Arizona, in general by means of induced artificial recharge.



↑ La Iglesia lagoon (SG-1), catalogued as of special interest by the Castilla y León Regional Government.

← Photographs from 2004 and 2007 after two years of water regeneration by means of artificial aquifer recharge operations.

The need for recuperation is justified by the great environmental value of the wetlands and their high biodiversity. They act as carbon drains, stabilise the climate, regulate the hydro-geological cycle and hydrogeochemical cycles, they have purifying properties, and they moderate the effect of floods. In addition, a large part of them have a great hydro-dependence on the aquifers, affecting their ground water table.

Wetlands provide rich and productive benefits, as well as providing other values through their resources, such as: water, wood, fibre, fish, crustaceans, very productive soils, medicinal plants, wildlife, etc. Furthermore, these areas can act as a means of transport and as a tourist attraction.

For human health, they provide food by being very productive ecosystems, and pharmaceutical products by having medicinal properties in the water and mud. They also act as filters or traps for some pathogenic microorganisms. In addition, they provide mental well-being, leisure and culture, which gives them extra added value.

Restoration of wetlands by means of artificial recharge in Spain

In Spain there has been little experience in water generation in wetlands. Within this we could mention the work carried out in the Tablas de Daimiel National Park since the 1980s. It has been possible to safeguard this wetland thanks to artificial recharge from eight drillings, which has enabled the survival of an aquifer declared as overexploited.

In the Los Arenales aquifer, in 2004, work began on water regeneration of the Coca-Olmedo Complex wetlands (La Iglesia and Las Eras lagoons), in Segovia, Valladolid, with water from the Cubeta de Santiuste reservoir artificial recharge facility.



The Tablas de Daimiel National Park has had eight boreholes to regenerate it by means of recharge management since the 1980s.

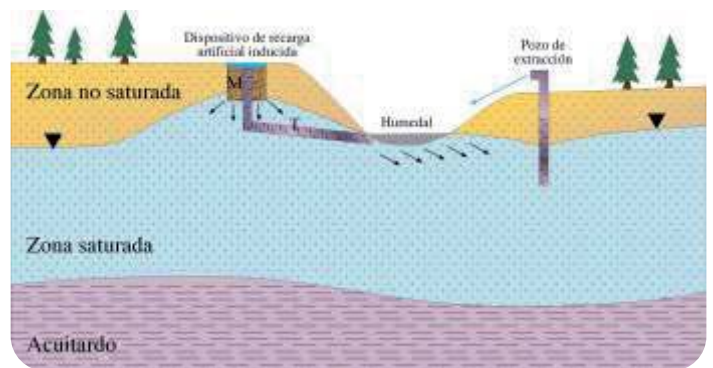
In the county of Carracillo, the El Señor Lake is also being regenerated with artificial recharge waters.

The process, still in its early stages, has many more advantages than drawbacks, as shown by the monitoring indicators. For example, it has been possible to safeguard the halophile bacteria that are endemic in this Complex. All of these advantages have involved the active participation of the public company Tragsa.



To achieve adequate water regeneration, it is necessary to simulate the natural underground flow path, and hence create a similar artificial trajectory. It is thus necessary to study the solubility of the materials and the flow of water through the aquifer, and the processes of interaction.

Del Señor lagoon in Gomezserracín, Carracillo County, Segovia.



Generic design of an induced artificial recharge facility to increase the salinity of the artificial recharge water until it has similar characteristics to those of the water of the area. The contact surface is regulated, as is the time of interaction with the saline material of the terrain, precipitated by the rise of deep underground flows.

Results of the experiments

Analysing the results obtained on applying induced artificial recharge, it can be said that the ecological state has improved, since the artificial recharge water was made to be chemically similar to the lagoons original waters. For this quality to be maintained, it is advisable to apply some kind of protection.

To appreciate the changes, a system of environmental indicators has been designed that are related to the identification of effects, the study of the transient nature, and the intervention and the activity carried out. It is worth noting the following positive effects.

- Improvement in the management of resources.
- Reduction of the decreases in water level produced by pumping.
- Qualitative improvement in the waters.
- Purification of pathogenic vectors.

In summary, applying these techniques requires highly detailed technical studies, with their resulting economic cost. These activities must seek to be coherent in terms of ecology, landscape, territory, society and institutions.



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