

Introducing economy into suitability mapping of MAR scheme

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ABSTRACT

During phase 1 (desktop study based on available information and data collection) of the course of a MAR project, an analysis of suitability maps is generally done in order to identify the most suitable location for a given MAR scheme. Most of the approaches found in the literature rely on the construction of suitability maps using spatial multi-criteria analysis (SMCA) and focus on the aptitude of the aquifer to store water, the infiltration capacity of soils, the distance from the targeted surface resource or the available space (derived from landuse) necessary for building such a MAR scheme. At this stage of the project, only physical parameters are considered and no economic analysis is ever carried out.

The objective of this study is to introduce economy in this first phase by producing a distributed map of total costs of an infiltration basin scheme. Both capital costs (water abstraction, transfer, land acquisition, basin construction) and operational costs (energy, maintenance, monitoring, water pre-treatment) are taken into account.

In a first step, an objective of volume to be recharged is defined. A cells grid is applied on the study area and, using a GIS tool the following distributed data are extracted for each cell: (i) Distance D between cell and the nearest surface water point; (ii) Head change H between cell and the nearest surface water point (using DEM); (iii) the soil infiltration rate on the cell (value obtained from permeability maps) and (iv) Land value. Other parameters are not distributed and are then fixed. In a second step, from these parameters and data, a distributed cost function is developed to map the levelised costs of recharged water for a given operating life duration of MAR scheme and discount rate. The cost function is applied for all the surface streams that can be used for recharge purpose. Afterwards, the minimum cost is kept in order to build a map of levelised costs (in €/m³ recharged).

The methodology has been applied to a case study (500 km² area). The cost function can be used in order to illustrate how the various parameters (distance from the surface stream, head difference, pre-treatment cost...) impact the levelised costs. The costs map can be mixed with other types of suitability maps in order to identify the most suitable location for a MAR scheme taking into account economic and financial aspects.