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Overview: management of groundwater at salinisation risk

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ABSTRACT

Natural waters contain dissolved minerals from interactions with atmospheric and soil gases, mixing with other solutions, and/or interactions with the biosphere and lithosphere. In many cases, these processes result in natural waters containing solute or salinity above concentrations recommended for a specified use, which creates significant social and economic problems.

Groundwater salinization can be caused by natural phenomena and anthropogenic activities. For the first case, we can distinguish terrestrial and marine phenomena. Approximately 16% of the total area of continental earth is potentially involved in groundwater salinization. Seawater intrusion can be considered to be the primary phenomenon for study in terms of groundwater salinization.

The primary marine phenomena are (a) seawater intrusion and (b) downward intrusion.

Major underground sources of salt water of terrestrial origin can be distinguished as (c) connate groundwater, (d) juvenile groundwater, (e) the dissolution of soluble minerals of natural soils and rocks, (f) evapotranspiration effects in shallow groundwater, and (g) saline fluids from anthropogenic activities.

There are different measures, actions and practices for managing groundwater when the natural resource is exposed to salinization. Some of these measures have a mitigation objective. Other measures have a more adaptive approach and accept the high groundwater salinity but adjusting the groundwater use so that it is not harmful.

The complexity of these approaches generally increases due to difficulties caused by groundwater quality and quantity degradation and increased demand for quality water. Moving from the lowest to the highest complexity, these approaches are the engineering approach, the discharge management approach, and the water and land management approach.

The engineering approach is realized on the local scale with the purpose of controlling the salinization, optimizing the well discharge with specific technical solutions and/or completing works to improve the quality and/or quantity of the discharged fresh groundwater.

The discharge management approach includes a coastal aquifer and defines rules concerning groundwater utilization and well discharge.

The water and land management approach should be applied on the regional scale. This approach becomes necessary when one or more need creates an overall framework of high-quality water scarcity. These conditions, sometimes combined with an awareness of negative environmental effects, force people to accept new water saving practices and land use modifications. As the natural effects of salinization can be enhanced by a multiplicity of human actions, the discharge management approach and the water and land management approach should generally be applied by water authorities or institutional and governmental organizations that are responsible for groundwater quality and availability.

This research classifies the sources of groundwater salinization and defines in detail different management approaches to protecting the groundwater through salinization mitigation and/or groundwater salinity improvements. By focusing the attention on the effect of seawater intrusion, practical solutions are proposed.