ARC '16

مؤتمر مؤسسة قطر
السنوي للبحوث
QATAR FOUNDATION
ANNUAL RESEARCH
CONFERENCE

Towards World-class
Research and Innovation

Energy and Environment Pillar

http://dx.doi.org/10.5339/qfarc.2016.EEPP1703

Vulnerability Assessment of Groundwater Aquifers in Qatar

Husam Baalousha

Senior Scientist, Qatar Environment & Energy Research Institute (QEERI), Tel: +974 44547367, PO Box: 5825, Doha, Qatar, QA

Email: hbaalousha@qf.org.qa

Qatar peninsula is an arid country with limited water resources. With little rainfall of approximately 80 mm per year and no surface water, aquifers are the only source of natural water in Qatar. The groundwater aquifer receives around 50 million m^3 per year as natural recharge, whereas annual groundwater abstraction is more than 220 million m^3, mainly used for agriculture. Groundwater occurs in a form of fresh lenses mainly in the northern part of the country, sitting atop of brackish and saline groundwater. Seawater has progressively intruded inland over the last decades because of over-pumping. As a result, the water table has dramatically dropped to unprecedented levels and salinity increased, in addition to other adverse environmental impacts. Because of its karstic nature, Qatar aquifer is prone to different sources of adverse environmental impacts. The concept of aquifer vulnerability is based on the idea that some areas above an aquifer provide more resistant to contamination than others (Vrba and Zaporozec 1994). Mapping groundwater vulnerability using hydrogeological settings gives a clear understanding of natural variation from one point to another within an aquifer. Vulnerability mapping is a powerful tool that can be used for groundwater protection and land management. In this study, vulnerability map was created based on hydrogeological parameters, land use and natural groundwater quality. All maps have been prepared and manipulated within Geographical Information System (GIS). The final vulnerability map was obtained as a sum of different rated maps using Raster Calculator. Two different approaches were used to create vulnerability maps (a) DRASTIC approach, which depends on general hydrogeological settings, and (b) EPIK approach, which focuses on karst hydrogeology. DRASTIC approach uses seven rated maps of: depth to water table, recharge, aquifer media, soil media, topography, vadose zone and hydraulic conductivity to calculate a weighted index map of vulnerability (Aller et al., 1987). EPIK approach is based on (1) epikarst, (2) protection cover, (3) infiltration rate and (4) karstic network. Depth to water table varies from a few meters near the coast to tens of meters further inland and recharge occur mainly in the many land depressions that spread all over the country. These land depressions vary in diameter from a few meters to more than two kilometers. These depressions were formed as a result of land collapse due to cavities underneath. The cavities are the result of dissolution of limestone over thousands of years. In all cases, these depressions have a

Cite this article as: Baalousha H. (2016). Vulnerability Assessment of Groundwater Aquifers in Qatar. Qatar Foundation Annual Research Conference Proceedings 2016: EEPP1703 http://dx.doi.org/10.5339/qfarc.2016.EEPP1703.

high weight in vulnerability assessment. Soil may provide some sort of aquifer protection depending on its type and thickness. The dominant soil in Qatar is lithosol, which is composed of rocky soil and provide no protection. Some loamy sand exists in farm lands, which is normally derived by rainfall runoff and provide some protection cover. Aquifer media comprises limestone with dolomite, chalk and clay of variable thicknesses. Three main layers of limestone occur in Qatar. These layers are from top to bottom (1) Dam and Dammam Formation, (2) Rus Formation and (3) Umm Alraduma Formation. Results of aquifer tests show aquifer is highly heterogeneous, which is typical in karst environment with high variation of hydraulic conductivity values. A thick layer of gypsum occurs within the middle layer of limestone (Rus) in the southern part of the country and has a great implication on water quality. This layer is soluble in water, which deteriorates the groundwater quality. All the previously discussed hydrogeological settings have been used to create vulnerability maps in Qatar. While DRASTIC laid more weight on coastal sediments, as they appear to be highly vulnerable in the final map, EPIK approach laid more weights on karst formations in the middle of the country. DRASTIC approach shows high vulnerability areas occur along the coastline and in land depressions Results of both approaches show the high vulnerable areas are those were land depressions occur.