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Assessment of the Anthropogenic Activities and Climate Change Impacts, on Groundwater Resources, Qatar

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Abstract
Qatar is a peninsula, located in the eastern part of the Arabian Platform, surrounded by seawater from three directions, North, East and West. It is geographically situated in the northern hemisphere desert belt, and in the arid climate zone, with very hot humid summers, and relatively wet mild winters, where, water is scarce and so precious, therefore, Qatar National Vision 2030, considers water security, among the top priority future challenges to the national sustainable development.
Before the discovery of oil, water demands for domestic and agricultural purposes, were met only from groundwater, as it was the only available supply of conventional freshwater at that time. The first desalination plant was then constructed in 1953, to produce freshwater supplies for domestic uses, so as to satisfy the needs of the highly growing number of populations in the last fifty years, while most of the agricultural activities are still groundwater dependent.

Groundwater was heavily pumped from the freshwater lenses, of the two Tertiary coastal carbonate aquifers, in the northern groundwater province. These aquifers have been subjected to continuous steep rise of overexploitation since the early seventies, exceeded the recharge rate from the low amount of precipitation (annual average of 80 mm/yr.). this ever increasing overexploitation resulted in a remarkable lowering of the hydraulic heads, and facilitated salt water intrusion, due to the landward flow of sea water and vertical upward saltwater flow. Accordingly, and due to this imbalance between abstraction and recharge, these freshwater lenses started to shrink, causing high deterioration of groundwater in terms of quality and quantity.

Groundwater in Qatar is threatened by the uncontestable interaction and consequences of climate variability and change on the hydrologic cycle, and the anthropogenic effects as well.

The major driving forces could be summarized as follows:
-very scanty and sporadic rainfall in winter (ranging from 50 to 80mm/y)
-high temperature and high humidity in summer.
-high wind speed and high evaporation rate.
-the known projected sea level rise.
-vast increase of population growth.
-rapid increase in the number of farms.
-high rate of groundwater abstraction.

This research was an attempt to study the relationship between the response of groundwater aquifers to the main variable climate elements, and the growing stress of the anthropogenic activities since the early seventies.

The data of this study was collected from geological, hydrogeophysical and hydrogeochemical investigations, in addition to the long-term readings of the groundwater elevations, their responses to recharge mechanisms and the calculated groundwater balance..
The main outcomes of this preliminary assessment showed:
•strong correlation and relationship between recharge from rainfall, percolation, net gain, net loss and total withdrawal and the calculated groundwater budget, for the period 1955-2010.
•delineation of the freshwater/saltwater interface, by the application of the electrical resistivity measurements, coupled with the groundwater chemistry data.

The results of this assessment also revealed and confirmed the high potential impact of climate change and anthropogenic effects on the groundwater reserves of the Northern Province, indicated by the following:
•remarkable inland advancement of the saline front estimated by 4-5 Km/yr.
•average annual Increase of groundwater salinity estimated by about 39% for the period 1980-2009.
•shrinking and decrease of freshwater lenses area, estimated by about 51.3% for the period 1982-2009.

Based on the above, the current status of the freshwater lenses of the northern groundwater province is unsustainable, and very risky, calling for urgent action, and mitigation measures, in order to save these strategic reserves, and to avoid complete depletion of the lenses in a course of a decade.