

SPATIAL VARIATION OF THE PHYSICO-CHEMICAL PARAMETERS, TRACE METAL CONCENTRATIONS AND RADON LEVELS IN GROUNDWATER OF QATAR: A COMPARATIVE VIEW BETWEEN PAST AND THE PRESENT

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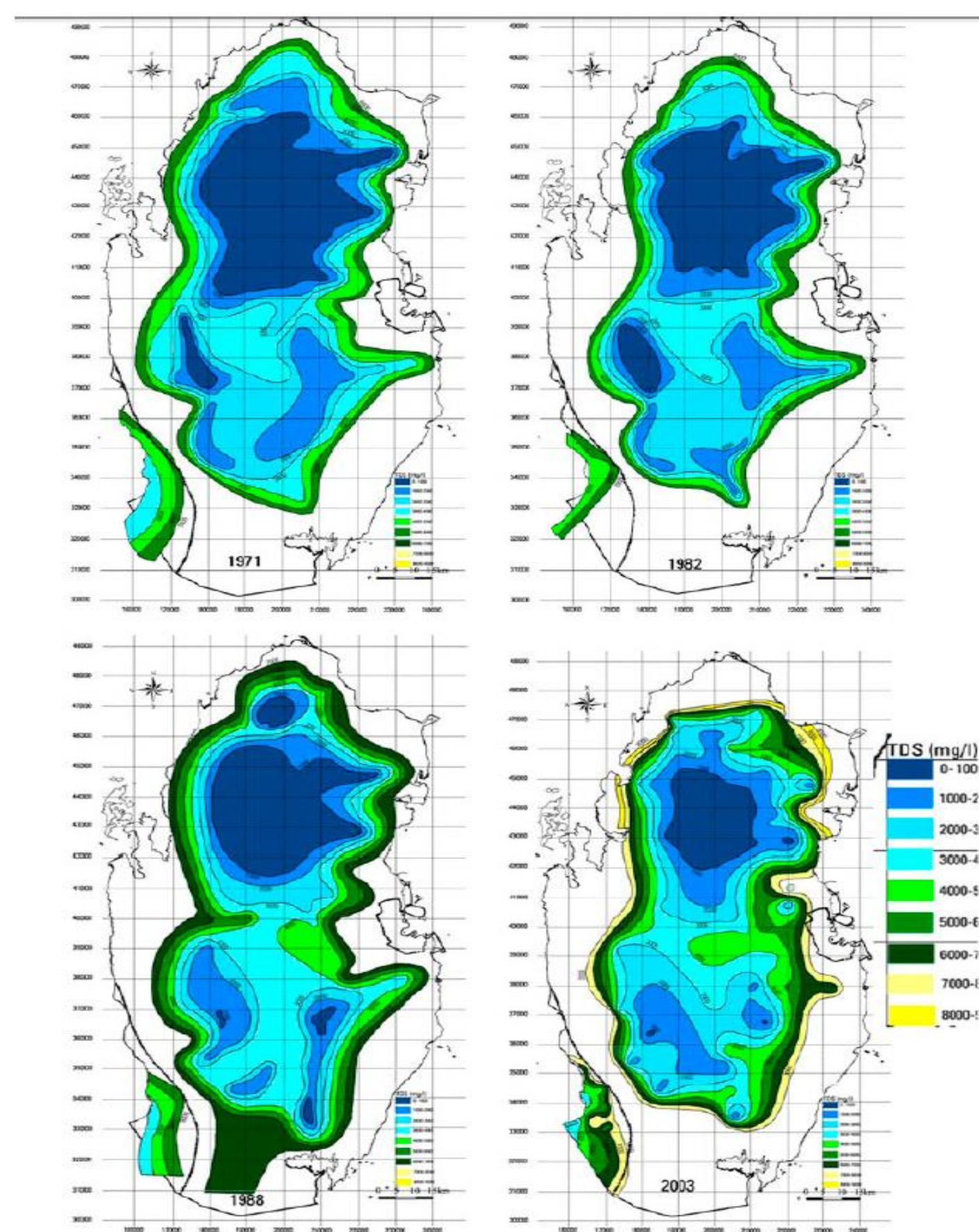
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Abstract

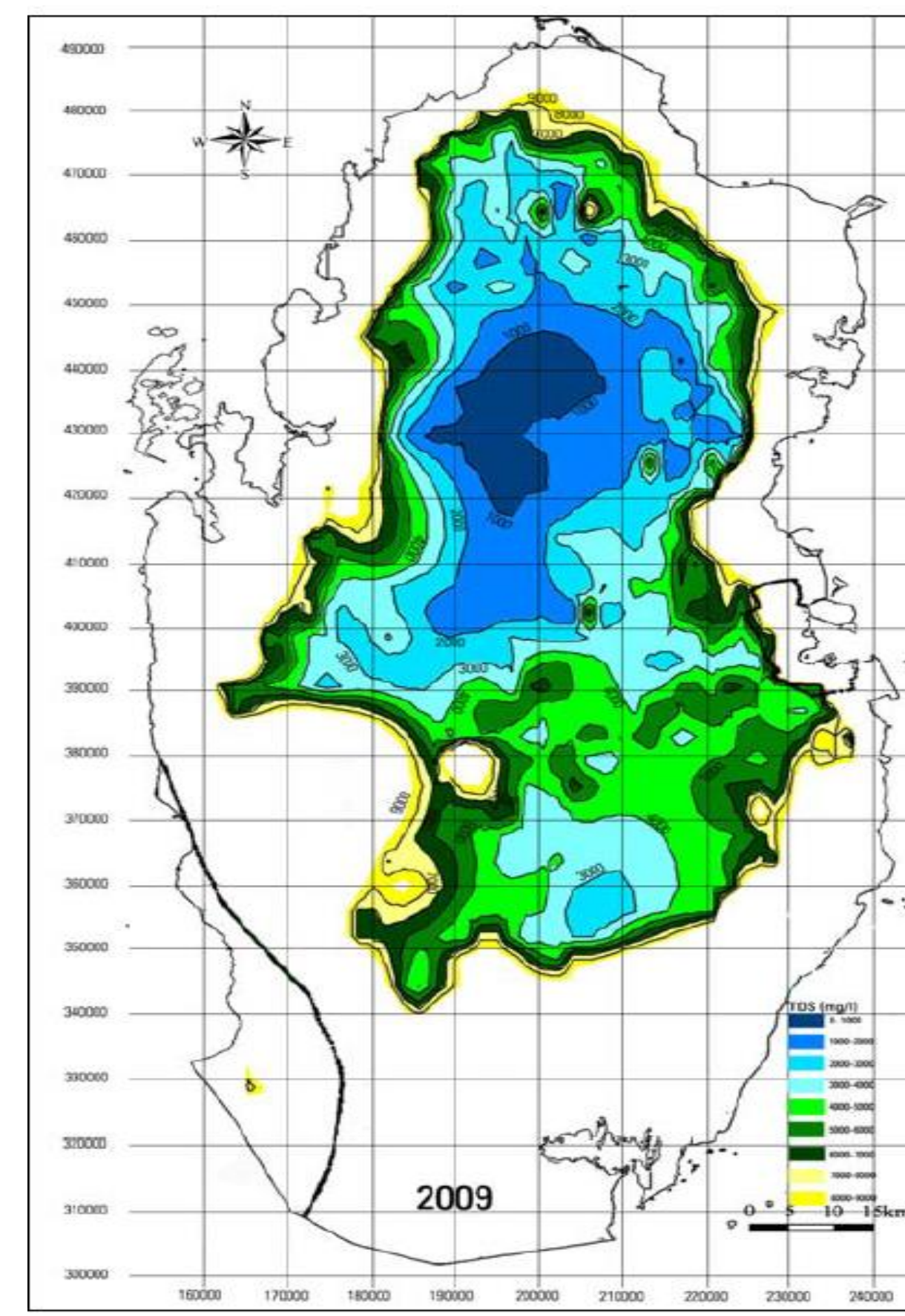
Despite having few studies about NORMs and radon levels in Qatar, there is no extensive study ever reported investigating their levels in the groundwater (GW) of Qatar. This work gives an insight about NORMs and radon levels in the GW wells of Qatar. Eighty GW wells were sampled in order to give a representative coverage across the map of Qatar. Radon concentrations in GW were determined using RAD7 RAD-H₂O procedure. The analysis of the Qatari GW has shown some alarming results. Out of the 80 GW wells studied, 42, 29 and 46 wells exceeded Qatar guidelines. The radon level measurements of the Qatari GW were between 2.71 and 330 Bq/L with a mean value at about 20.6 Bq/L which is greater than the US EPA's maximum contamination level of 11 Bq/L. A total of 32 and 33 exceedances to the US EPA's MCL of 11 Bq/L and EPA's drinking water guidelines, respectively were observed. The high NORMs and radon levels can be attributed to low GW recharge owing to very low precipitation, and extensive GW exploitation. This perhaps leads to aging of the residual water wherein radon goes to equilibrium state with their parents (Ra-226). Another important factor that contributes to radon in GW is the sedimentary bedrock, which has shown elevated levels of radon. The results from this work might be useful for decision makers establish a comprehensive policy for GW management in Qatar.

Introduction

- Qatar is an arid peninsula, characterized by its desert nature and total absence of natural surface water resources.
- Rainfall is the sole source for aquifer recharge; however, annual rainfall in Qatar is one of the world's lowest (76 mm) whereas the annual natural evaporation is about 2000 mm.
- The estimated freshwater lens in 2009 was about 11% of its size in 1971.
- The freshwater lens area in 1971 was estimated at about 15% of Qatar's area whereas in 2009, the area has declined to 2% only.



Salinity level of Qatari groundwater across the map of Qatar between 1971 and 2009



TDS iso concentration map depicting salinity level of GW in Qatar in 2009

Methodology

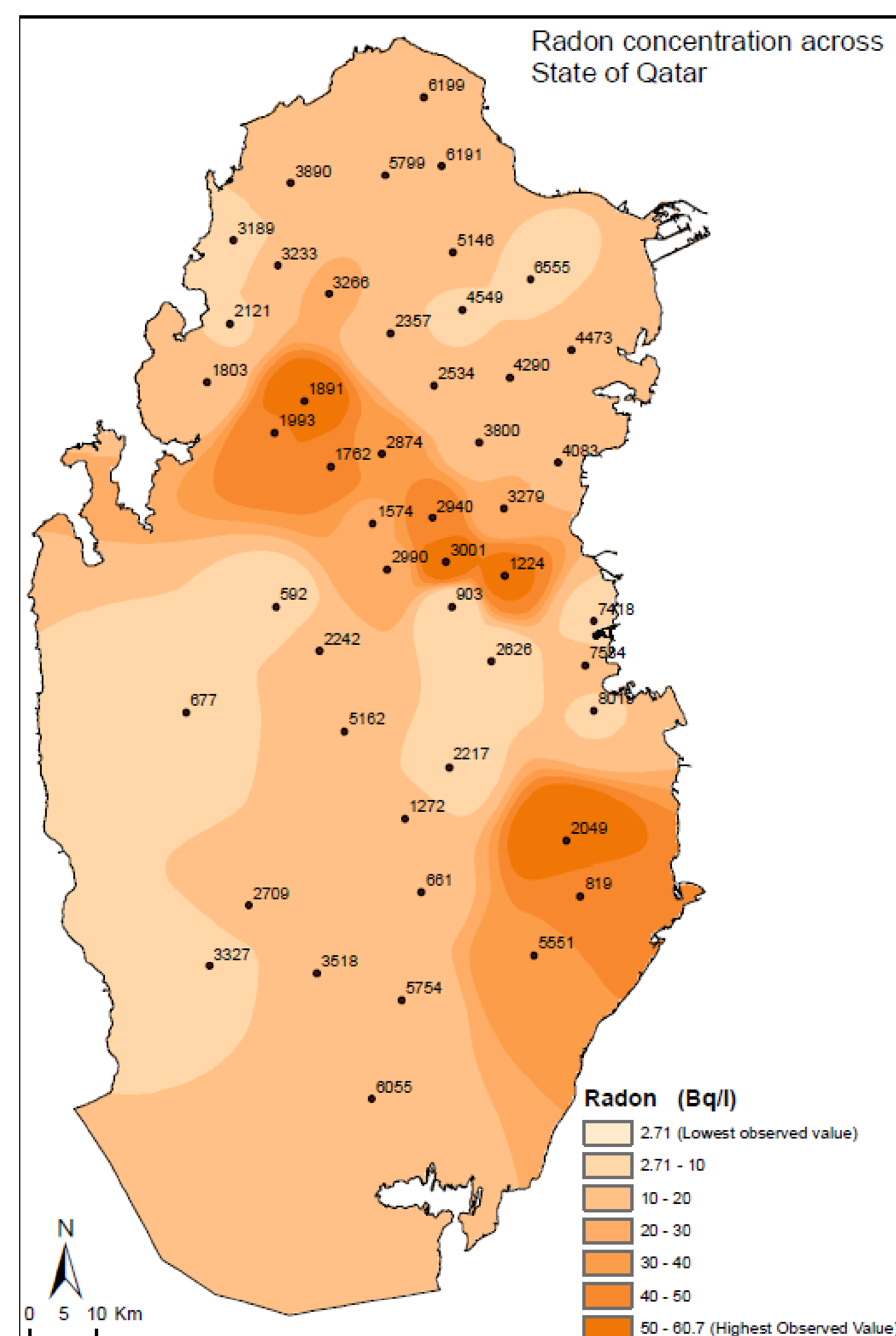
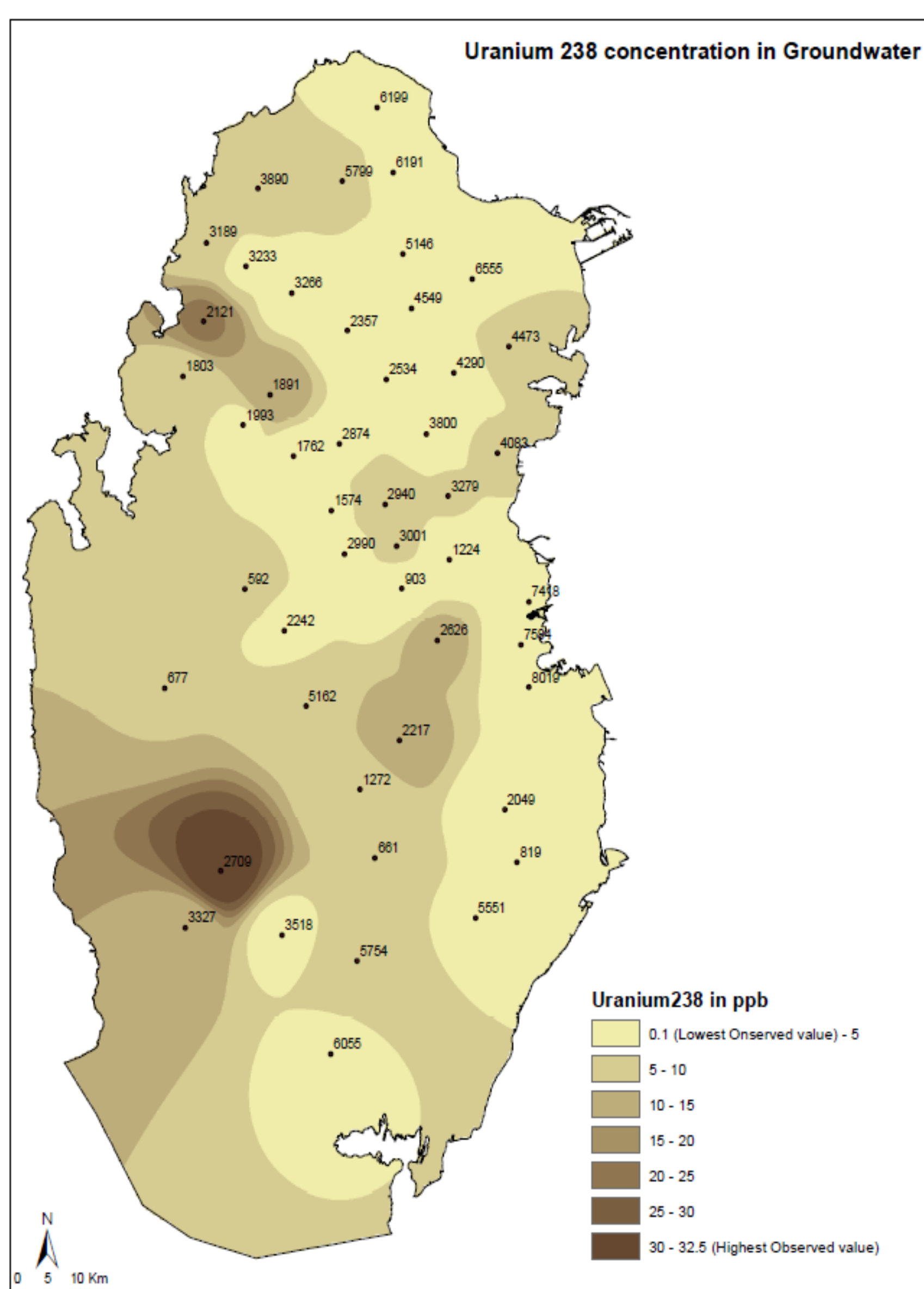
Samples selection: Sites containing the sampling wells were selected based on the geographic location and well basin type, and the usage of the water from well (agricultural, domestic, industrial). The sampling of GW was done to ensure that the sample is representative of the water column at the site rather than stagnant water in the well.

Physicochemical Parameters: Standard method was followed for in-situ measurement of physical parameters such as pH, Temperature and SEC, using multi-parameter instrument.

Chemical Analysis: The chemical analysis of the GW samples was conducted using inductively-coupled plasma (ICP) mass spectrometry (MS) and the ion chromatography (IC).

Radon levels Measurements: RAD7 Radon Detector (Durridge, UK) was used in the present work.

Results and discussions



Spatial variation in the levels of U-238 and radon in GW of Qatar

The maximum contaminant level (MCL) for radon in public drinking water as set by the US-EPA is 11 Bq/L.

Studies from literature reporting Radon levels in GW globally and regionally

Water type	Country	Radon level (Bq L ⁻¹)	Reference
Groundwater	China	Average: 41 Maximum: 127	Xinwei (2012)
Groundwater	Saudi Arabia	0.76–4.69	Alshahri (2012)
Groundwater	Saudi Arabia	1.45–9.15	S. S. Althoyaib (2014)
Groundwater	Iraq	2.84±3.06	Al-Alawy and A Hasan 2018
Groundwater	Palestine	2.9-23.4	Al Zabadi (2012)
Groundwater	UAE & Oman	0.2-17	A. Murad (2013)
Groundwater	Iran	21.77	Binesh (2012)
Groundwater	Iraq	8.02-11.6	Tawfiq (2013)
Groundwater	Jordan	0.28- 44.3	Emad Akawwi (2014)
Groundwater	Saudi Arabia	10–95	Shabana (2016)
Groundwater	Qatar	1.7-60.7	Present study

Conclusions

- An overview of NORMs and the radon levels in the GW of Qatar was given.
- The NORMs and radon levels in Qatar was found to be quite high with numerous exceedances to the US EPA's MCL and EPA's drinking water guidelines.
- The results from this work might be useful for decision makers establish a comprehensive policy for GW management in Qatar.