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Assessment of Groundwater Aquifer Impact from Artificial Lagoons and the Reuse of Wastewater in Qatar

Authors : H. Aljabiry, L. Bailey, S. Young

Abstract : Qatar is a desert with an average temperature 37^{0}C, reaching over 40^{0}C during summer. Precipitation is uncommon and mostly in winter. Qatar depends on desalination for drinking water and on groundwater and recycled water for irrigation. Water consumption and network leakage per capita in Qatar are amongst the highest in the world; re-use of treated wastewater is extremely limited with only 14% of treated wastewater being used for irrigation. This has led to the country disposing of unwanted water from various sources in lagoons situated around the country, causing concern over the possibility of environmental pollution. Accordingly, our hypothesis underpinning this research is that the quality and quantity of water in lagoons is having an impact on the groundwater reservoirs in Qatar. Lagoons (n = 14) and wells (n = 55) were sampled for both summer and winter in 2018 (summer and winter). Water, adjoining soil and plant samples were analysed for multiple elements by Inductively Coupled Plasma Mass Spectrometry. Organic and inorganic carbon were measured (CN analyser) and the major anions were determined by ion chromatography. Salinization in both the lagoon and the wells was seen with good correlations between Cl^-, Na^+, Li, SO_4, S, Sr, Ca, Ti (p-value < 0.05). Association of heavy metals was observed of Ni, Cu, Ag, and V, Cr, Mo, Cd which is due to contamination from anthropological activities such as wastewater disposal or spread of contaminated dust. However, looking at each elements none of them exceeds the Qatari regulation. Moreover, gypsum saturation in the system was observed in both the lagoon and wells water samples. Lagoons and the water of the well are found to be of a saline type as well as Ca^{2+}, Cl^-, SO_4^{2-} type evidencing both gypsum dissolution and salinization in the system. Moreover, Maps produced by Inverse distance weighting showed an increasing level of Nitrate in the groundwater in winter, and decrease chloride and sulphate level, indicating recharge effect after winter rain events. While E. coli and faecal bacteria were found in most of the lagoons, biological analysis for wells needs to be conducted to understand the biological contamination from lagoon water infiltration. As a conclusion, while both the lagoon and the well showed the same results, more sampling is needed to understand the impact of the lagoons on the groundwater.

Keywords : groundwater quality, lagoon, treated wastewater, water management, wastewater treatment, wetlands
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