Freshwater Resources Characterization and Vulnerability to Climate Change of the Shela Aquifer in Lamu, Kenya

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ABSTRACT

Salinization of coastal groundwater systems causes a severe deterioration both in amount and quality of fresh groundwater resources. In order to support the sustainable use and management of fresh groundwater, quantification and characterization of this coastal resource is important in view of the population growth anticipated in many African countries. Analytical methods were used to determine; (1) the shape and volume of the freshwater lens, (2) the elevation of the water table, (3) the depth of the freshwater/saltwater interface in the Shela aquifer, and (4) the expected change of volume resulting from change of recharge and sea level rise driven by climate change. The results of the analytical modelling have shown that the average hydraulic conductivity is 0.755 m/d, the average water table elevation is 2 m above sea level and the average depth of the freshwater/saltwater interface is -80 m.a.s.l. The volume of the aquifer is ≈124 x 10^6 m^3 when discharge from the Shela well field is factored in. Climate change is expected to have an impact on the recharge and ultimately the aquifer's volume; under the A1b conditions, the volume is expected to increase to 199 x 10^6 m^3 whereas in the A2 scenario it is expected to decrease to 27 x 10^6 m^3. The saltwater intrusion indicator *M* for today's conditions (0.004) decreases to 0.5*M* in the A1b scenario by 2100 while it increases to 24.9*M* in the A2 scenario for the same time period, indicating an extremely higher vulnerability to saltwater intrusion in the latter scenario. A simple linear correlation with the expected population growth of 1.25 million people by 2050 shows the aquifer failing as a water source by 2033.

Keyword: Analytical Solutions, Groundwater, Saltwater Intrusion, Vulnerability, Climate Change