Sustainable groundwater management on the small island of Manukan, Malaysia

Abstract

Numerical models are capable of simulating various groundwater scenarios and relate it towards groundwater management. This paper focuses on numerical modeling and water balance approaches in the search for a sustainable management plan in Manukan Island. The impacts of pumping and recharge rates represented by groundwater scenarios were investigated by means of hydraulic heads, chloride concentrations and water balance components. Overpumping and inconsistency in recharge rate are the stresses shown in Scenario A. Scenario B involved with reduction pumping rate by 25% has shown an increase in groundwater levels, chloride concentration and groundwater storage. Scenario C showed the most promising finding compared with Scenarios A and B. Highest hydraulic heads, lowest chloride concentration (1,552.2 mg/L) and positive groundwater storage (254.3 m 3/day) were obtained in Scenario C. Chloride concentration in pumping wells still exceeds World Health Organization International Standard limit in Scenario C which illustrates an additional water treatment is needed. Nevertheless, in view of a compromise groundwater management plan in study area, Scenario C is the best plan so far to protect the groundwater resources in the study area. More understanding of the artificial recharge method (percolation tank) and study site by means of modeling studies is needed. Additionally, further progress is needed in obtaining the water usage data from each part to determine the best pumping rate. A sustainable groundwater management plan is crucial to maintain the natural resources and social benefits as well as to protect the ecological balance of Manukan Island.