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A SIMULATION/OPTIMIZATION APPROACH TO MANAGE GROUNDWATER RESOURCES IN THE GAZA AQUIFER (PALESTINE)

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Summary. Gaza aquifer is the main source of water for supplying agriculture, domestic, and industrial purposes in the Gaza Strip. Recently, the rapid increase on water demand to fulfill the needs of the continuous population growth made the aquifer overexploited, leading to huge crises of water scarcity and contamination by seawater intrusion. To relieve and narrow the huge deficit between water demand and supply, the use of artificial resources, such as stormwater and reclaimed wastewater, has been investigated. To manage sustainable aquifer development under effective recharge operations and water quality constraints, a decision support system based on a simulation/optimization (S/O) approach has been developed and applied to the Gaza coastal aquifer. The S/O approach is based on the coupling of the density-dependent variably saturated groundwater model CODESA-3D with the Carroll's FORTRAN Genetic Algorithm Driver. The optimization model incorporates two conflicting objectives using a penalty method: maximizing pumping rates from the aquifer wells while limiting the salinity of the water withdrawn. Two aquifer management models (with and without artificial recharge) have been considered for the inner region of the coastal aquifer within a 1 year time interval. Results of the no-injection optimization model identified the optimum spatial distribution of pumping rates at the 16 control wells, showing an average increase of 0.11 m (+9.2%) in water table levels and a marked decrease of 65% in the total extracted salt mass, while keeping the 99% of total abstraction, with reference to current non-optimized conditions. Results of the mixed injection-pumping optimization model identified optimum recharge locations among 9 configurations (3 different spatial locations and 3 rates of 0.5, 1 and 1.5 Mm3/year, respectively) and the spatial distribution of pumping rates at the wells, allowing to withdrawal the 95% of the total current pumping rate, while lowering the total extracted salt mass up to 25% and increasing water table levels in a range of 0.15-0.49 m, with reference to current non-optimized conditions. The last model allowed also to increase up to 20% the total pumping rate, while keeping the total extracted salt mass under 50% of current values with relatively stable water table levels. Further development is foreseen to extend the result to the whole aquifer system, including also economic costs into the multi-objective management model.

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