Geophysical Research Abstracts
Vol. 15, EGU2013-4042, 2013
EGU General Assembly 2013

Adaptation to the impact of sea level rise in the Northeastern Nile Delta, Egypt

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Northeastern Delta is one of the most promising developmental areas in Egypt. This area is characterized by a prominent watershed having abundant water resources (especially groundwater). Currently, this area undergoes a rapid environmental degradation, such as land subsidence, water and soil salinaization. It accommodates about 60% of the total arable lands of the Delta, and inhabited by about 45 % of its total population. In addition, the northern part of this area comprises about 25% of the total Mediterranean wetlands. In this area a number of desalination plants were installed to desalinate brackish water and inject the brine to the aquifer using deep wells. This work aims to evaluate the environmental impact of injecting brine water on groundwater quality. Also, the impact of climate change and sea level rise are considered.

The work is a combination of field work and simulation processes of groundwater flow and seawater intrusion using numerical models. The field work was used to collect and analyze data, information pertaining to the groundwater resources, interpretation of aerial photos and satellite images and preparation of ground water potential maps has. This was followed by detailed test boring wells as chemical analysis of seawater intrusion detection and pollution flow mapping were done. Numerical models (MODFLOW and MT3D) were used to evaluate both current and future situation of the groundwater flow and seawater intrusion in the Nile Delta aquifer in the studied area. The aquifer in the studied area is divided into five barrier beds according to its hydrological characteristics.

The increase in extraction rates of brackish water and increasing the salinity of groundwater were experienced in details. Different scenarios to mitigate the severe salinity effect of injected brine water of high salinity rejected from desalination process. The brine water is assumed to be injected into deep wells to different depths and observation of changes in salinity and flow directions through 30 years period were carried out. A merged model combines extraction rates from brackish water, brine water injection into the aquifer, seawater intrusion considering sea level rise, will give finally an integrated simulated view of the aquifer in the vulnerable area and set a strategically plane for a sustainable management of the aquifer in order to mitigate the impact of climate change, sea level rise and water resources scarcity in this vital area.