A Conceptual Framework for Managing Nitrate Contamination of the Gaza Coastal Aquifer, Palestine

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Abstract

Public concern over the groundwater quality of the Gaza Aquifer has grown significantly in recent years and has focused increasingly on anthropogenic sources for the problem. The Gaza Aquifer is an important source of water to over 1.1 million residents and is utilized extensively to satisfy agricultural, domestic, and industrial water demands. Evidence indicates that the nitrate levels routinely exceeded the maximum contaminant level (MCL) of 10 mg/L NO_3-N in 90 percent of the drinking water supply wells. A recent survey shows that 124 out of 640 infants (children under the age of 6 months) have methemoglobin levels above 20 percent. Degradation of groundwater quality in the Gaza Aquifer due to nitrate pollution and the continuously increasing demand for potable water motivated the restoration of the aquifer. Restoration efforts have intensified the need for developing protection alternatives and management options such that nitrate concentrations at the critical receptors are below the MCL. Protection alternatives include a restriction on the use of fertilizers and proper treatment and disposal of wastewater. In order to develop efficient protection alternatives, the aquifer response to these alternatives should be simulated correctly, perhaps through the use of mathematical models. This paper presents a generic conceptual framework for an inclusive approach to modeling and management of groundwater contamination from nitrate for Gaza Aquifer. The framework incorporates an assessment of the existing data and future monitoring needs, conceptual models of groundwater flow and nitrate fate and transport, and characterization of model related uncertainties. In addition, the proposed framework utilizes optimization and decision-making tools to study the impact of different management alternatives considering both environmental and socio-economic aspects.

Keywords: Nitrate, GIS, groundwater, contamination, agriculture, vulnerability, conceptual model