Cairo University
Faculty of Science
Chemistry Department

Water Resources Evaluation and Environmental Assessment of the Southwest Area of the Nile Delta

A Thesis

By

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CHEMISTRY DEPARTMENT

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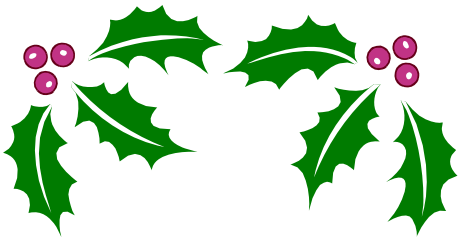
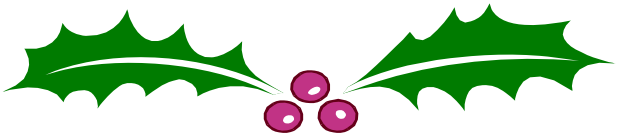
In The Name Of Allah The Most Merciful The Most Compassionate

I BEGIN THIS THESIS



Dedication To My Parents



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ABSTRACT

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Title of Thesis:

Water Resources Evaluation and Environmental Assessment of the Southwest Area of the Nile Delta.

Degree: (M. Sc.), The degree of Master of Science in Analytical Chemistry, Faculty of Science, Cairo University, 2009.

The present work has been conducted on the groundwater resources of the western Nile delta fringes including South El-Khatatba, El-Sadat City, Southern part of Wadi El-Natron and Wadi El-Farigh areas. It includes both hydrochemical, isotopic and hydgeological characteristics of the system for identifying and assessing the factors and processes that control salinity and recharge that may serve as a basis for gaining new insights relating to the groundwater management and environmental problems. The investigation relies on the results of analyses of major cations (Na^+, K^+, Ca^{2+} and Mg^{2+}), major anions (Cl^-, SO_4^{2-}, HCO_3^-), minor ions (NO_3^-) and environmental isotopes (^{18}O, ^2H, ^3H and ^{14}C) of about 120 groundwater samples collected from the three aquifers in the study area (Quaternary, Pliocene and Miocene aquifers).

The ranges of TDS and ionic constituents, ionic orders and hypothetical salts combination deduced from the studied groundwater samples show the presence of several water types covering the whole range of salinity evolution. The hydrochemical processes that control groundwater salinization have been investigated; based on the relevant ionic ratios and the chemical equilibrium between water and minerals; it was indicated that (Na^++ K^+) on one side and (Ca^{2+} +Mg^{2+}) on the other side are interrelated through ionic exchange and inverse ionic exchange reactions. The saturation indices were calculated to estimate of the extent to which a groundwater has reached chemical equilibrium under dissolution of the minerals within the aquifer matrix using SOLMINQUE hydrochemical programme.

The evaluation of the groundwater samples for various uses (drinking, domestic, irrigation, and industrial) indicated that the Miocene samples are of the most suitable followed by Quaternary and Pliocene.

The main source of recharge is the direct contribution from the Nile system for both Quaternary and Miocene of South El-Khatatba area. Mixing between paleometeoric

water or old Nile water, that was flooding the area prior to High Dam construction, with the present day Nile water characterizes most of the Miocene samples and some of the Quaternary and Pliocene ones). The major recharge of the Miocene aquifer comes from a combination of isotopically depleted paleonile water fed during the late Holocene times (5500 -8000 y.b.p.) of $\delta^{18}O$ about -4.2 ‰ with the relatively enriched mixture of recent/sub recent Nile water of $\delta^{18}O$ about 1.5 ‰.

The DRASTIC method was applied for the quantitative assessment of the pollution vulnerability of the studied groundwater based on seven parameters of relevance to recharge and flow. The vulnerability is generally high particularly for the sites which are located in Wadi El-Natron, Wadi El-Farigh and South El-Khatatba areas. Sensitivity analysis was performed using the map-removal sensitivity method. The fuzzy pattern recognition and optimization method was applied for assessment of groundwater vulnerability to pollution as it has significant advantages over DRASTIC approach.

Key words: Environmental assessment, Water resources, Southwest area of Nile Delta.

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Statement

This thesis is submitted in partial fulfillment of the requirements of M.Sc. Degree. In addition to the work carried out in this thesis, the candidate has accomplished with success the post graduate studies during the academic year 2004-2005 in the following topics:

1. Techniques of Molecular Structure.
2. Advanced Analytical Chemistry.
3. Quantum Chemistry.
4. Group Theory.
5. Surface Chemistry
6. Electrokinetic Phenomena.
7. Polymer Chemistry.
8. ElectroChemistry of Molten Salts and Metallurgy.
9. Nuclear Chemistry.
10. Chemistry of the Solar Cell.
11. Statistical Thermodynamics.
12. Advanced Inorganic Chemistry.
13. Polarography and Voltammetry.
14. Thermal analysis and X-ray.
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16. Modern Electrochemistry.
17. Chelatimetry.
18. Catalysis.
19. Thermodynamics.
20. German Language.

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