Summary and conclusions

Fourteen water samples were collected from the different hand dug wells located in the South Eastern Desert of Egypt bounded by longitudes 34˚ 31̀ and 35˚ 26̀ E and latitudes 22˚ 19̀ and 24˚ 51̀ N.

The thesis contents three chapters:

Chapter I: Introduction: includes the surveying literature review about underground water, physical and chemical properties, environmental isotopes (stable and radioactive) and the main targets of the thesis.

Chapter II: Experimental: includes the location of the studied area, water sampling, chemical analysis of ground water and instrumentations.

Chapter III: Results and discussion: contains the results and their discussions and suggests some steps for the studied area.

The investigated water samples were characterized by odorless, colorless and tasteless. The depth of water wells ranges between 1.5 and 35m. The pH of most water wells varied between 6.5 and 8.5, which indicates slightly alkaline nature. Meanwhile, the total salinity varied between 396 and 7874 ppm .

Sodium represents the most dominant ions among the cations followed by calcium and magnesium ones. The chloride concentration is the most dominant ions among the anions followed by bicarbonates and sulfates ones.

The genesis of the water was detected using three graphs (Sulin's, Ovitchinikov's and Piper's). Using Sulin's graph, the water wells No. 6, 7, 8, 10 and 13 plotted in $CaCl_2$ triangle denoting secondary alkalinity

and reflecting the old marine water, while water wells No. 1, 3, 4, 5, 11 and 12 presented in $MgCl_2$ triangle denoting secondary salinity which may indicate prolonged water rock interaction with the aquifer and reflecting to the young marine. The water well samples No. 2 and 9 plotted in Na_2SO_4 and considered mixed water, while well No. 14 was presented in $NaHCO_3$ and considered meteoric water.

The Ovichinkhov's graph, showed that water well samples No. 3, 5, 6, 7, 10 and 13 lied in the triangle number VI, characterized by high chloride and low bicarbonate water. The water wells No. 8 and 12 lied in the triangle number V, characterized by high Na^+ and K^+ as well as low Ca^{++} and Mg^{++}. While, the water wells No. 1, 4 and 11 lied in the triangle number VIII, characterized by low chloride and high bicarbonate water. On the other hand, the water wells No. 2 and 14 lied in the triangle number II, characterized by high bicarbonate and high Na^+ and K^+. Only, well No. 9 lied in the triangle number IV, which characterized by high chloride and high Na^+ and K^+.

According to Piper's trilinear diagram, water wells No. 2, 8, 9, 12 and 14 presented in the fourth diamond zone IV which is represented by Na_2SO_4 and $NaHCO_3$ indicated meteoric water characters. The third zone III included water well samples No. 1, 3, 4, 5, 6, 7, 10, 11 and 13 which represented by $CaSO_4$, $MgCl_2$, $MgSO_4$ and $CaCl_2$ of marine surface water salinity characters.

The evaluation of ground water for different purposes was based on the following parameters; T.D.S., cations, anions and trace elements.

1-Depending on the permissible limit of cations and anions in drinking water of ECAFE and UNESCO and WHO organizations showed that wells No. 5, 6, 7, 11 and 14 are suitable for drinking water,

while, wells No. 1, 2, 3, 4, 8, 9, 10, 12 and 13 are not suitable for drinking water.

2-All water samples are not suitable for laundry purposes except Gahliya well (No. 14).

3- All water samples are not suitable for irrigation purposes except wells No. 5, 6, 7, 11 and 14.

4- Wells No. 5, 6, 7, 11 and 14 are excellent for all classes of live stock and poultry with T.D.S. less than 1000 ppm.

5- All water samples are not suitable for most industrial reqirements (paper and textile) because T.D.S. is high. In case of petroleum industry all water samples are suitable except wells No. 1, 2, 3 and 4.

6- All water samples are not suitable for building purposes because SO_4^{2-} concentration is higher than 300 ppm, except wells No. 5, 6, 7, 11 and 14 wells with SO_4^{2-} ranges between 34.65 and 250 ppm.

Trace elements was also determined to evaluate the suitability for drinking and irrigation, where some waters are under the permissible limits by the organizations FAO, EPA, WHO, PHS and NAS.

1-Iron (Fe^{2+}), all water samples are suitable for drinking water except wells No. 2, 3, 6, 8, 9 and 10, and they are suitable for irrigation.

2-Lead (Pb^{2+}), all water samples are suitable for drinking water except well No. 1, they are suitable for irrigation.

3-Cadmium (Cd^{2+}), all water samples are suitable for drinking water.

4-Zinc (Zn^{2+}), all water samples are suitable for drinking and irrigation.

5-Nickel (Ni^{3+}), all water samples are suitable for drinking, and they are suitable for irrigation except well No. 9.

6-Copper (Cu^{2+}), all water samples are suitable for drinking and irrigation.

7-Manganese (Mn^{2+}), all water samples are suitable for drinking and they are suitable for irrigation except well No. 2.

The uranium content in the investigated water samples have in the native form except wells No. 3 and 11 where they have 0.13 and 2.0 ppb, respectively, which is lower than the recommended line for uranium content in drinking water (120ppb) according to WHO (1984).

The thorium content of the studied ground water samples ranged between 0.0007 and 0.028 ppb. The lowest value was recorded in well No. 7 and the highest one is recorded in well No. 10. They are lower than the recommended guideline for thorium.

The environmental isotopes (D, ^{18}O) and radioactive isotope (^{3}H) could be applied for water samples of the investigated ground water to focus on the origin, source of recharging, the water rock interaction between aquifers and water, factors controlling on the chemical composition and the age dating for the ground water.

There are three different sources of recharging; paleo-water, local precipitation and rain water. Accordingly, there are four origin water recharge samples; older, subolder, subrecent to older and subrecent recharge. The lower tritium content of studied water samples was related to mixing of ground water with paleo-water absent from tritium or recharging of ground water from rain water before "Thermonuclear bomb test-1963". While the low values of IS (ionic strength) support the low rate of evaporation to produce the observed stable isotopes (D and ^{18}O) depletion.

So, it must be suggested some steps for the investigated studied ground water samples:

1- It must be dug the wells after a wide study for area.
2- Resume the consumption from the aquifers used which have saline character and selected the suited crops for the type of soil.
3- It must be recorded the consumption rate from the aquifer to suit the recharge rate yearly for given the balance by safely way.
4- It must be known the isotopic composition for ground water continuously to evaluate the type of water and pollution sources if present.