

## **5. SUMMARY AND CONCLUSION**

As increasing the demand for water in Egypt, the utilization of ground and well waters has become a logic and important component of total water resources planning and development. The waters of these resources are generally saline.

The objectives of this study were to; (I) monitor wells water quality; determine the factors affecting that quality, as well as (II) evaluate wells water quality in an endeavor to increase the agriculture production through the possible best utilization of a particular well in each region.

**To fulfill these objectives the following works were achieved:**

- 1- The area of this study was divided into six regions; El-Wady Mesaad, El-Tor El-Korom, El-Gebeel and Rass Raie. In each region there are many wells covering it.
- 2- Water samples were monthly collected for two successive years started in January 1994 till December 1995. Water samples were chemically analyzed for, pH, EC, soluble cations and anions. Also, Boron and some trace elements; Fe, Mn, Zn and Cu, were analyzed in four months year; namely January, February, July and August.
- 3- Monitoring water quality and studied the factors affecting it.
- 4- Well waters quality were classified according to the international guides described by USSSL, RUSSL, Indian and FAO assess their suitability for the agriculture purposes.

The obtained results could be summarized as follows:

**1- water characteristics and water classification:**

**a) The general pattern of salinity in the wells at different regions of the studied area was as follows:**

- 1- In El-Wady region, there are three groups of salinity; the first was represented by the wells No. 1,2,3,4 and 6 which having EC values ranged between 1-3  $\text{dSm}^{-1}$ , the second was represented by wells No. 5 and 8 which having EC values ranged between 3-6  $\text{dSm}^{-1}$ , and the third was covered by well No. 7, which having EC values above 6  $\text{dSm}^{-1}$ ; Generally, well water in El-Wady region had salinity hazard according to the international guides, in wells No. 1,2,3,4 and 6 having ( $\text{C}_3$ - $\text{C}_4$ ),  $\text{C}_2$ ,  $\text{C}_2$  and moderate salinity problem is expected according to USSSL, RUSSL, Indian and FAO classification respectively, wells No. 5,7 and 8 having  $\text{C}_5$ ,  $\text{C}_3$ ,  $\text{C}_4$  and severe salinity problems are expected according to USSSL, RUSSL Indian and FAO classification .
- 2- In Mesaad region there are tow salinity grades the first was represented by well No. 11, having EC values ranged between 4.47-5.80  $\text{dSm}^{-1}$ , and the second was represented by wells No. 9 and 10, (EC values more than 6  $\text{dSm}^{-1}$ ). Generally, well water in Mesaad region had salinity hazard and classified as  $\text{C}_5$ ,  $\text{C}_3$ ,  $\text{C}_5$  and severe salinity problems are expected according to USSSL, RUSSL Indian and FAO classification respectively.
- 3- In El-Tor region wells No. 13 and 14 had salinity ranged between 2-3  $\text{dSm}^{-1}$ , whereas the well No. 12 had salinity

values around  $4.94 \text{ dSm}^{-1}$ . Generally well water in EL-Tor region was classified as  $C_4$ ,  $C_3$ ,  $C_3$  and severe salinity problem is expected according to USSL, RUSSL, Indian and FAO classification, respectively.

4- In El-Korom region, wells No. 16 and 17 had the grade of salinity ranged between  $2-3 \text{ dSm}^{-1}$ , and the wells No. 15 and 18 had EC values ranged between  $3-6 \text{ dSm}^{-1}$ . Generally, well water in El-Korom region showed salinity hazard was classified as,  $C_4, C_3, C_3$  and severe salinity problem is expected according to USSL, RUSSL, Indian and FAO classification, respectively.

5- In El-Gebeel region; there are three grades of salinity; the first was represented by the well No. 20 having EC values ranged between  $2.15$  and  $3.25 \text{ dSm}^{-1}$ , the second grade was represented by wells No. 21 and 26 which having EC values between  $3-6 \text{ dSm}^{-1}$  and the third contains wells No. (19, 22, 23, 24, 25, 27 and 28) having EC values more than  $6 \text{ dSm}^{-1}$ . Generally, wells No. 20 and 21 possess salinity hazard classified as  $C_4$ ,  $C_2$ ,  $C_2$  and moderate salinity problem is expected, according to USSL RUSSL, Indian and FAO classification, respectively wells No. (19, 22, 23, 24, 25, 26, 27 and 28) had salinity hazard and classified as,  $C_5, C_3, C_4$  and severe salinity problem is predicted according to USSL, RUSSL, Indian and FAO classification, respectively.

6- In Rass Raica region, all wells in the third grade their EC values were more than  $6 \text{ dSm}^{-1}$ . Generally well water salinity hazard classified as  $C_5$ ,  $C_3$ ,  $C_5$  and severe salinity problem,

according to USSL, RUSSL, Indian and FAO classification, respectively.

**b) Alkalinity or sodicity hazard:**

The general pattern of sodicity in the wells in different regions of the studied area was as follows:

- 1- It was noticed that in EL-Wady region the values of the adj.SAR were relatively low in the wells No. 1, 2, 3, 4 and 6 where the adj.SAR ranged between 4.35 and 13.40, but wells No. 5, 7 and 8 had the highest values of the adj.SAR ranged between 14.84 and 37.61. Generally, wells water No. 1,2,3,4 and 6 had sodicity hazard and were classified as  $S_1$ ,  $A_1$ - $A_2$  and problems are not expected according to USSL, Indian and FAO classification, respectively. Wells No. 5, 7 and 8 showed sodicity hazard were classified as  $S_2$ ,  $A_3$  and severe problem toxicity is expected according to USSL, Indian and FAO classification, respectively.
- 2- Also, it was noticed that in Mesaad region, well No. 10 had the highest values of the adj.SAR ranged between 28.9 and 52.0, but wells No. 9 and 11 had the lowest values of the adj.SAR where they ranged between 14.06 and 31.36. Generally, well water in Mesaad region had sodicity hazard effect according to the international guides of water quality. It was classified as  $S_2$ ,  $A_3$  and severe problem of Na toxicity is expected according to USSL, Indian and FAO classification, respectively.

- 3- In El-Tor region, well No. 12 had the highest values of adj.SAR ranging between 17.59 to 25.10, but wells No. 13 and 14 had the relatively lowest values of the adj.SAR ranged between 7.37 to 15.94. Generally, well water in this region showed sodicity hazard effect in according to the international guides of water quality described as,  $S_1$ ,  $A_2$  and severe problem toxicity is expected according to USSL, Indian and FAO classification, respectively.
- 4- In EL-Korom region, well No. 16, had the relatively lowest values of the adj.SAR. The adj.SAR values ranged between 8.80 to 20.0, but well No. 18, had the relatively highest values of the adj.SAR, ranging between 16.30 to 31.71. Wells No. 15 and 17 had an intermediate values of adj.SAR which ranged between 4.80 to 29.60. Generally, well waters in EL-Korom region had sodicity hazard described as,  $S_2$ ,  $A_2$  and moderate problems are expected in toxicity by sodium according to USSL, Indian and FAO classification, respectively.
- 5- In El-Gebeel wells No. 20 and 21 having the relatively low values of the adj.SRA, ranged between 8.82 and 15.80, wells No. 19, 22, 23, 24, 25, 26, 27 and 28 having high sodicity hazard where their adj.SAR ranged between 21.72 and 53.50. Well No. 25 had the relatively highest values of the adj.SAR, whears the well No. 26 had approximately the relatively lowest values. Generally, well waters in EL-Gebeel region had the sodicity hazard as the two wells of No. 20 and 21 which classified as,  $S_1$ ,  $A_1$ - $A_2$  and severe problem represented by toxicity is expected according to USSL,

Indian and FAO classification, respectively. However, the other eight wells, with the exception of well No. 25, all of them had  $S_2$ ,  $A_4$  and severe toxicity problems are expected according to USSL, Indian and FAO classification, respectively.

6- In Rass Raiea region, well No. 31 had the highest values of the adj.SAR where they ranged between 39.55 and 77.8, but wells No. 29 and 30 had the adj.SAR values ranged between 30.63 and 62.45. Generally, well water in Rass Raiea had sodicity hazard described as,  $S_2$ ,  $A_4$  and severe toxicity problem according to USSL, Indian FAO classification, respectively.

#### **c) Boron and Some trace elements contents:**

Data show that the water of wells in all regions contained B, Fe, Mn, Zn and Cu at the permissible limits in irrigation waters.

### **2- Factors affecting well water quality:**

a) Climate is an important factor in monitoring water quality during year months, all wells in all regions having the highest values of EC during summer months and lowest EC values were recorded through winter season. Thus, the climatic changes had a vital effect on water salinity monitoring. Which was attributed to increasing hot in summer months and increasing crop water requirements and consequently raising well water discharge which leads to increasing the compensation from the sea. In winter months, low

temperature, beside, rainfall should be responsible for decreasing salinity.

b) **Discharge of water**, when the water discharge become high it leads to an increase in the compensation of water from the sea, consequently increasing EC values, this trend was appeared in wells close to the Suez Gulf such as wells in Rass Raiea region.

**c) Distance from the Suez Gulf:**

The distance from the Suez Gulf played a main role in water quality where salt or saline water moves from the Suez Gulf to the areas near it or to the wells by wind. When the discharge becomes high it leads to an increase the compensation of water from the sea. This was clear in water of both wells in Measaad, El-Gebeel and Rass Raiea regions. Most of wells are existed near to the Suez Gulf and their EC values were high.

**Conclusions and recommendations:**

This study aimed at drawing a cropping map for this area to increase the agriculture production through the possible best exploitation of particular wells in each region according to their salinity grade and the guides of plant salt tolerance. The salinity was grouped to three grades, the first EC values lie between 1 to 3  $\text{dSm}^{-1}$ , the second EC value between 3 to 6  $\text{dSm}^{-1}$  and the third grade of EC values above 6  $\text{dSm}^{-1}$ .

About, 62.5 % of wells in El-Wady, 66 % in El-Tor, 50 % in El-Korom wells and 10 % in El-Gebeel region are belonging to the first grade.

Approximately of 25 % El-Wady wells, 33 % of Mesaad, 33 % El-Tor 50 % El-Korom and 20 % in EL-Gebeel region area located in the second grade.

In the third grade, about 12.5 % of El-Wady, 66 % of Mesaad, 70 % of EL-Gebeel and 100 % of Rass Raiea regions are existed.

From the above mentioned results and under the prevailing conditions of the studied area (light texture, good drainage, and dry climate) it could be concluded that with proper irrigation and fertilizer management, problems associated with salinity and sodicity, up to a certain level, could be alleviated or overcome with crops semi-tolerant or tolerant to salinity and high yield could be attained. Therefore, waters with marginal quality could be used successfully for irrigation with some agricultural control measure such as:

- a) Applying sufficient water for leaching, and addition of soil or water amendments (such as gypsum).
- b) Growing crops which are semi-tolerant or tolerant to salinity
- c) Using modern irrigation systems which are effective in water distribution.
- d) Addition of organic matter.