*J. Agric. Sci. Mansoura Univ., 33(11): 8317 - 8325, 2008*

# EVALUATION OF WATER QUALITY OF SOME WELLS AND ITS CORRELATION WITH SOME SOIL PROPERTIES IN SINAI

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## ABSTRACT

The limited natural resource of water in Sinia is one of the major problems in agriculture sector. To study and evaluate the different water quality of some wells in North Sinia, a field investigation was performed by chosing 20 sites of soils which irrigated from besidly wells for a long time at El-Arish, Rafah and Sheikh Zuwayid. Water and surface soil samples were taken and analyzed. Simple linear regression relationships were conducted between some properties of wells water and soils.

**The important results could be summarized as follows**:

Irrigation water of wells at all locations have very and severe hazards of salinity and sodicity and they lie in categories between ($C_3 – S_1$) and ($C_4 – S_4$). Water content of soluble Fe, Mn, Cd and Pb are higher than the safty limits in all locations. Soluble $NH_4^+$, $NO_3^-$ and $NO_2^-$ in water wells are less than the critical concentration of safe using.

Soils which were sandy and loamy sandy were found non-saline in most locations as affected by irrigation water quality. Soil content of available Fe, Mn, B, Pb, Cd, $NH_4^+$, $NO_3^-$ and $NO_2^-$ were low in all locations except $NH_4^+$and $NO_3^-$ in soil around well No. 16.

A high negative correlation was found between, soil-pH and both of available Fe and Mn in soil (- 0.634** & - 0.732**) and between $CaCO_3$ and available soil boron (- 0.489*). Also, a high significant postive correlation between water-pH and available soil boron was found (0.656*).

Finally, wells water can be used for irrigation purposes in the area of study under control and with good a management(optimum tillage, adding organic matter and amendements and good croping system etc..).

## INTRODUCTION

There is about 1.2 million feddan available to agriculture in North Sinia Governorate, which cultivated only about 192000 feddans from it. There are 3837 wells which include 54 deepest wells from that, (http://www.kananaonline.com). The limited natural resources of water in Sinia is one of the major problems in agriculture sector.

For crops irrigated infrequently, as is normal when use surface methods and conventional irrigation management, crop yield is best correlated with the average root zone salinity, but for crops irrigated daily, or near daily basis (localized or drip irrigation) crop yields are better correlated with the water-uptake weighted root zone salinity (Rhoades, 1982). According to various survey in India and Africa, 20-50% of wells contain nitrate levels greater than 50 mg/L and in some cases as high as several hundred milligrams per litre (Convey and Pretty, 1988). In the developing countries, it is usually wells in villages or close to towns that contain the highest levels, suggesting that domestic excreta are the main source, though livestock wastes are particularly important in semi-arid areas where drinking troughs are close to wells.

Several physical, chemical and biological soil managements help facilitate the use of saline water in crop production. Physical methods include cultural practices that can be expected to improve or maintain infiltration rates and permeabilty in the surface and root zone during the period of irrigation or rainfall (FAO 1992). Kandel *et al*. (2003) found that high significant correlation between the chemical composition of irrigation water used and soil chemical properties (whole profile), which predict the soil contamination due to irrigation with low quality water.

The aim of this study is to evaluate the different water quality of wells at North Sinia, Egypt and the correlation between some soil properties and water wells properties.

## MATERIALS AND METHODS

To study and evaluate the different water quality of wells in North Sinia which used as sources of irrigation water for irrigation purposes, a field investigation was performed in June 2007 by chosing 20 sites of soils which irrigated from besidly wells for a long time at El-Arish, Rafah and Sheikh Zuwayid, as shown in Table (1) and Fig. (1).

**Fig. (1): locations of study area.**

Distrubed soil samples were taken from the surface layer (0-30 cm) from soil which irrigated from arouned wells. Irrigation water samples were taken from wells and chemically analyzed (EC, pH, and soluble ions), according to Klute (1986). Also, SAR, $Ca^{+2}/Mg^{+2}$, SSP, and $Na^{+}/Ca^{+2}$ parameters were calculated using Richard's equation (1954). Soluble Fe, Mn, Pb and Cd were determined using Perkin Elmer atomic absorption spectrophotometer model 2830. B was detemined by curcumin method according to Dible *et al*. (1954). Soluble $NH_4^+$, $NO_3^-$ and $NO_2^-$ were determined by Kjeldahle method acccording to Cottenie *et al*. (1982). ECe, pH and soluble ions in soil paste extract were determined according to Klute (1986). Particles soil distrrubution was determined by pipette method according to Gee and Bauder (1986). $CaCO_3$ was determined using Collin's calcimeter, and organic matter content as decribed by Walkely and Black according to Klute (1986). Available B in soil was extracted by hot water according to Wear (1965). Available N formes ($NH_4^+$, $NO_3^-$ and $NO_2^-$) were extracted by using $K_2SO_4$ according to Klute (1986). Available soil Fe, Mn, Pb and Cd were extracted by DTPA-method according to Cottenie *et al*. (1982). Correlation coefficient and simple regression between some water propeties and soils were done after Snedecor and Corchran (1972).

**Table (1): Locations of soil samples taken around the wells in Sinia.**

| Well No. | Well Depth, m | Representive area, Fed. | locations | |
|---|---|---|---|---|
| 1 | 60 | 22 | Hode El-Mazraa | El-Arish |
| 2 | 50 | 52 | | |
| 3 | 56 | 30 | El-Amel Village | |
| 4 | 50 | 25 | | |
| 5 | 50 | 28 | | |
| 6 | 50 | 30 | Agricultural Research Farm | Raphah |
| 7 | 60 | 25 | Abo Sinar | |
| 8 | 60 | 17 | | |
| 9 | 50 | 30 | Balha | |
| 10 | 50 | 32 | | |
| 11 | 55 | 27 | | |
| 12 | 50 | 50 | | |
| 13 | 71 | 15 | Kasr El-Sherif | Sheikh Zuwayid |
| 14 | 16 | 22 | El-Sarasra | |
| 15 | 27 | 16 | | |
| 16 | 45 | 20 | Hy El-Zohoar | |
| 17 | 17 | 20 | Hy El-Margda | |
| 18 | 50 | 21 | Lehn Bear | El-Arish |
| 19 | 50 | 40 | El-Mazara | |
| 20 | 50 | 27 | Hode Mazara | |

## RESULTS AND DISCUSSION

**Evaluation of different water quality of wells at North Sinia:**

Mean values of chemical analysis of different water wells at different locations are presented in Table (2). Data showed that, EC values of wells water were high salinity level according to Ayers and Westcot classification (1985), where, EC values in wells No. 14, 15 and 17 were 1.97, 1.75 and

1.44 dS/m, respectively. Also, These water lies in class ($C_3$ – $S_1$) according to Richards (1954), that means it can be used for irrigation pourposes in course soils and resistance type of plant growth to salinity hazard. EC value in well No. 8 is considered high salinity and lie in catogery ($C_3$ – $S_3$), that means it cause salinity and sodicity hazards when it use in irrigation. EC values in wells No. 13, 18, 19, and 20 were severe salinity and lies in catogery ($C_4$ – $S_2$) that means cause high salinity problems and moderate sodicity hazard. EC values in wells No. 2, 4 and 16 are considered severe salinity and lies in catogery ($C_4$ – $S_3$), that means its salinity and sodicity hazards is severe. EC values in wells No. 1, 3, 5, 6, 9, 10, 11, and 12 are considerd very high salinity and sodicity and lies in catogery ($C_4$ – $S_4$) which means that it can be used only in agriculture with some special limitations of soil properties and plant types.

**Table (2): Mean values of chemical analysis of the different irrigation water samples of the wells in Sinai.**

| No. | pH | EC, dS/m | Soluble cations, meq/L | | | | Soluble anions, meq/L | | | | SAR | $Ca^{++}$/ $Mg^{++}$ | $Na^{+}$/ $Ca^{++}$ | SSP | Class |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | $Ca^{++}$ | $Mg^{++}$ | $Na^{+}$ | $K^{+}$ | $CO_3^{--}$ | $HCO_3^{-}$ | $Cl^{-}$ | $SO_4^{--}$ | | | | | |
| 1 | 7.49 | 12.30 | 28.40 | 26.60 | 68.00 | 0.47 | 0.20 | 2.75 | 85.00 | 35.52 | 12.97 | 1.07 | 2.39 | 55.07 | $C_4S_4$ |
| 2 | 7.93 | 9.25 | 19.79 | 21.41 | 51.30 | 0.29 | 0.00 | 2.64 | 62.92 | 27.23 | 11.30 | 0.92 | 2.59 | 55.29 | $C_4S_3$ |
| 3 | 7.80 | 7.29 | 13.20 | 12.66 | 47.38 | 0.25 | 0.00 | 2.42 | 46.03 | 25.04 | 13.18 | 1.04 | 3.59 | 64.47 | $C_4S_4$ |
| 4 | 7.74 | 6.95 | 15.09 | 15.47 | 39.42 | 0.27 | 0.00 | 2.53 | 48.92 | 19.03 | 10.09 | 0.98 | 2.61 | 56.11 | $C_4S_3$ |
| 5 | 7.48 | 14.48 | 23.40 | 26.60 | 94.20 | 0.49 | 0.30 | 2.50 | 91.50 | 50.39 | 18.84 | 0.88 | 4.03 | 65.10 | $C_4S_4$ |
| 6 | 8.14 | 4.33 | 3.70 | 4.70 | 34.70 | 0.12 | 0.40 | 3.40 | 25.00 | 14.42 | 16.93 | 0.79 | 9.38 | 80.29 | $C_4S_4$ |
| 7 | 8.10 | 3.56 | 3.40 | 4.80 | 25.42 | 0.12 | 0.40 | 3.10 | 19.00 | 8.82 | 12.55 | 0.71 | 7.48 | 75.34 | $C_4S_4$ |
| 8 | 8.24 | 1.72 | 1.40 | 1.20 | 14.60 | 0.08 | 0.50 | 2.90 | 7.50 | 6.38 | 12.81 | 1.17 | 10.43 | 84.49 | $C_3S_3$ |
| 9 | 7.95 | 4.32 | 3.20 | 4.40 | 35.60 | 0.14 | 0.40 | 3.40 | 19.00 | 20.54 | 18.26 | 0.73 | 11.13 | 82.14 | $C_4S_4$ |
| 10 | 8.05 | 3.03 | 3.10 | 4.10 | 23.00 | 0.12 | 0.40 | 3.00 | 14.90 | 12.02 | 12.12 | 0.76 | 7.42 | 75.86 | $C_4S_4$ |
| 11 | 8.48 | 4.36 | 2.80 | 4.50 | 36.30 | 0.22 | 0.60 | 2.30 | 21.50 | 19.42 | 19.00 | 0.62 | 12.96 | 82.84 | $C_4S_4$ |
| 12 | 8.14 | 4.44 | 6.00 | 6.20 | 32.00 | 0.25 | 0.40 | 2.50 | 22.00 | 19.55 | 12.96 | 0.97 | 5.33 | 71.99 | $C_4S_4$ |
| 13 | 8.07 | 2.47 | 6.50 | 7.00 | 10.74 | 0.49 | 0.20 | 2.00 | 9.50 | 13.03 | 4.13 | 0.93 | 1.65 | 43.43 | $C_4S_2$ |
| 14 | 8.10 | 1.97 | 5.00 | 5.20 | 9.07 | 0.49 | 0.40 | 2.70 | 6.50 | 10.16 | 3.96 | 0.96 | 1.81 | 45.90 | $C_3S_1$ |
| 15 | 7.93 | 1.75 | 5.24 | 4.48 | 7.62 | 0.26 | 0.00 | 2.20 | 5.77 | 9.63 | 3.46 | 1.17 | 1.45 | 43.30 | $C_3S_1$ |
| 16 | 8.22 | 4.70 | 7.00 | 10.00 | 30.20 | 0.30 | 0.20 | 2.10 | 26.50 | 18.70 | 10.36 | 0.70 | 4.31 | 63.58 | $C_4S_3$ |
| 17 | 8.20 | 1.44 | 4.00 | 4.00 | 6.20 | 0.35 | 0.40 | 3.00 | 4.00 | 7.15 | 3.10 | 1.00 | 1.55 | 42.61 | $C_3S_1$ |
| 18 | 7.98 | 4.35 | 14.00 | 5.00 | 24.20 | 0.49 | 0.40 | 4.50 | 23.50 | 15.29 | 7.85 | 2.80 | 1.73 | 55.39 | $C_4S_2$ |
| 19 | 7.69 | 4.15 | 9.93 | 9.23 | 22.00 | 0.35 | 0.00 | 3.08 | 28.63 | 9.80 | 7.11 | 1.08 | 2.22 | 53.00 | $C_4S_2$ |
| 20 | 7.64 | 4.45 | 12.15 | 11.56 | 20.79 | 0.31 | 0.00 | 4.18 | 28.02 | 12.61 | 6.04 | 1.05 | 1.71 | 46.40 | $C_4S_2$ |

From data obtained in Table (2), it was noticed that, generally, wells can be used for irrigation purposes in this area due to the course texture of soils which irrigated with these water for along time (Table, 4). This is agremeent with that introduced by Oster and Rhoades (1985).

Values of SAR and SSP of different wells are very high in wells No. (5, 9 and 11), moderate in wells No. (1, 2, 3, 4, 6, 7, 8, 10, 11, 12 and 16 ), and low in other wells.

Data in Table (2) also show that, the dominate ions were $Na^{+}$, $Cl^{-}$ and $SO_4^{-2}$ that are reflected on $Na^{+}/Ca^{+2}$ which were high excess twic in most wells except, wells No. 13, 14, 15, 17, 18 and 20. Values of pH indicated that water was found to be slightly alkaline.

Mean values of some heavy metals and micronutrients of different water wells at different locations are presented in Table (3). Data show that, the mean concentration of soluble Fe and Mn are very highly concentration and higher than the safty limits ( 0.5 and 0.2 ppm for Fe and Mn, respectively) as recommended by Cottenie *et al.* (1982) and Alloway (1995). Pb and Cd concentrations in wells of water are higher than the safty limits in most wells except, in those were non-deticitve.

**Table (3): Concentrations of some heavy metals and micronutrients in wells water samples in Sinia.**

| Well No. | mg / L (ppm) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Fe | Mn | B | Pb | Cd | $NH_4^+$ | $NO_3^-$ | $NO_2^-$ |
| 1 | 18.57 | 7.63 | 0.36 | 3.67 | 0.210 | 2.27 | 0.71 | 0.108 |
| 2 | 19.32 | 8.51 | 0.34 | 4.23 | 0.341 | 2.27 | 0.30 | 0.173 |
| 3 | 18.50 | 30.14 | 0.41 | 4.51 | 0.273 | 2.01 | 0.02 | 0.864 |
| 4 | 17.30 | 17.62 | 0.38 | 3.79 | 0.364 | 0.51 | 0.47 | Nd |
| 5 | 16.43 | 13.02 | 0.39 | 3.96 | 0.316 | 5.04 | 0.14 | 0.216 |
| 6 | 27.63 | 5.57 | 2.62 | 5.92 | 1.132 | 1.01 | 0.71 | Nd |
| 7 | 5.95 | 26.51 | 2.14 | 2.91 | Nd | 0.76 | 0.25 | 0.216 |
| 8 | 32.85 | 4.74 | 1.34 | 2.77 | 0.079 | 0.51 | 0.41 | 0.216 |
| 9 | 17.54 | 24.57 | 0.25 | Nd | Nd | 0.76 | 0.57 | 0.216 |
| 10 | 0.97 | 3.21 | 1.49 | 1.88 | Nd | 0.76 | 1.38 | 0.216 |
| 11 | 25.23 | 5.54 | 2.52 | 5.49 | 1.122 | 0.76 | 0.57 | 0.216 |
| 12 | 5.91 | 29.65 | 1.03 | Nd | Nd | 0.76 | 9.01 | 14.75 |
| 13 | 8.73 | 44.96 | 0.32 | Nd | Nd | 0.25 | 3.94 | 0.216 |
| 14 | 7.42 | 42.56 | 0.33 | Nd | 0.018 | 0.50 | 2.66 | 0.216 |
| 15 | 6.31 | 22.42 | Nd | Nd | Nd | 0.76 | 0.14 | 0.324 |
| 16 | 52.96 | 41.14 | 1.23 | Nd | 0.420 | 0.25 | 0.09 | 0.216 |
| 17 | 13.79 | 5.33 | 0.11 | Nd | Nd | 0.51 | 1.73 | 0.216 |
| 18 | 19.49 | 49.07 | 0.43 | 4.59 | 0.371 | 0.51 | 0.02 | 0.648 |
| 19 | 15.62 | 35.07 | 0.28 | 3.67 | 0.285 | Nd | 0.15 | Nd |
| 20 | 16.73 | 37.81 | 0.28 | 3.84 | 0.168 | Nd | 0.20 | 0.108 |

**Nd = non-detective.**

Regarding to soluble B concentration wells No. 6, 7 and 11 has severe problems, where B was higher than 2.0 ppm. On other hand, wells No. 8, 10, 12 and 16 are cause moderate problems of B when it use in irrigation due to the higher concentration of B (≥ 0.75 and < 2.0 ppm) while, concentration of soluble B didn't induce any problems when it use in irrigation at other wells which less than 0.75 ppm.

Regarding to nitrogen formes concentration in wells water ($NH_4^+$, $NO_3^-$ and $NO_2^-$) which refer to it were less than critical concentration according to Ayers and Westcot classification (1985).

**Effect of wells water quality on some soil properties:**

Mean values of chemical and physical properties of soil samples around the different wells are presented in Table (4). Data showed that, EC values of soil were less than 4 mmhos/cm in locations No. 3, 6, 7, 8, 9, 10, 11, 13, 15, 16, 17 and 18. Also, EC values are located in saline soils catogeries according to soil diagnosis by Richards (1954) in locations No. 1, 2, 4, 14, 19 and 20. Soils are sodic-saline around the wells No. 5 and 12. Soils are non-saline in most locations although water quality in these locations are very high salinity and sodicity hazards that due to the soils texture in these locations which the dominate percent of sand over than 80% and reduction in clay content. These results are in semi agreement with those obtained by Miller and Donahue, (1995), Buckman and Brady (1967) and Saskatchewan (1987). They showed that, soil texture plays an important role in all aspects of irrigation, and the role of soil texture with respect to the effect of salinity and sodicity is no exception. Texture is strongly correlated with a soils ability to percolate water (permeability and infiltration), how much water the soil can store (available water holding capacity), and the soil's ability to adsorb or desorb chemical ions (exchange capacity).

**Table (4): Mean values of some soil chemical and physical parameters around the wells in Sinai.**

| No. | pH | $EC_e$, dS/m | Soluble cations, meq/L | | | ESP % | Soil * Diagn-osis | Particle Size distribution, % | | | Texture* | Organic matter % | $CaCO_3$ % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | $Ca^{++}$ | $Mg^{++}$ | $Na^{+}$ | | | Clay | Silt | Sand | | | |
| 1 | 8.4 | 4.38 | 8.75 | 2.96 | 6.88 | 9.84 | S | 12.90 | 3.02 | 84.08 | LS | 0.80 | 13.4 |
| 2 | 8.6 | 6.00 | 11.88 | 3.45 | 11.88 | 11.25 | S | 12.81 | 3.08 | 84.11 | LS | 0.59 | 8.1 |
| 3 | 8.8 | 2.81 | 4.06 | 2.02 | 3.13 | 10.90 | NS | 3.93 | 3.84 | 92.23 | Sa | 0.61 | 3.8 |
| 4 | 8.7 | 5.44 | 12.38 | 3.52 | 9.13 | 9.59 | S | 3.96 | 3.85 | 92.19 | Sa | 0.42 | 4.6 |
| 5 | 8.6 | 6.00 | 8.75 | 2.96 | 8.75 | 15.27 | SS | 3.92 | 3.86 | 92.22 | Sa | 0.49 | 8.1 |
| 6 | 8.8 | 2.75 | 3.75 | 1.94 | 2.50 | 11.04 | NS | 3.96 | 3.88 | 92.16 | Sa | 0.15 | 3.8 |
| 7 | 8.7 | 2.94 | 3.75 | 1.94 | 2.50 | 12.46 | NS | 3.74 | 3.54 | 92.72 | Sa | 0.38 | 4.6 |
| 8 | 8.5 | 3.63 | 4.38 | 2.09 | 1.25 | 14.17 | NS | 7.68 | 4.00 | 88.32 | LS | 0.35 | 5.8 |
| 9 | 8.8 | 2.56 | 3.75 | 1.94 | 2.50 | 10.18 | NS | 3.84 | 4.53 | 91.63 | Sa | 0.48 | 4.2 |
| 10 | 8.7 | 3.19 | 3.75 | 1.94 | 2.50 | 13.47 | NS | 3.89 | 4.55 | 91.65 | Sa | 0.43 | 3.4 |
| 11 | 8.6 | 3.94 | 5.63 | 2.37 | 3.75 | 12.97 | NS | 7.60 | 4.08 | 88.32 | LS | 0.52 | 3.2 |
| 12 | 8.7 | 4.63 | 5.63 | 2.37 | 3.75 | 15.55 | SS | 7.68 | 4.01 | 88.31 | LS | 0.62 | 3.7 |
| 13 | 8.2 | 1.31 | 3.75 | 1.94 | 1.25 | 2.53 | NS | 3.96 | 3.84 | 92.20 | Sa | 0.72 | 2.1 |
| 14 | 7.7 | 4.06 | 7.50 | 2.74 | 3.75 | 10.31 | S | 7.66 | 6.00 | 86.34 | LS | 0.69 | 4.3 |
| 15 | 7.8 | 3.94 | 7.50 | 2.74 | 3.75 | 9.86 | NS | 3.91 | 3.80 | 92.29 | Sa | 0.75 | 4.1 |
| 16 | 8.2 | 2.44 | 4.38 | 2.09 | 2.50 | 8.46 | NS | 3.93 | 3.84 | 92.23 | Sa | 0.80 | 2.1 |
| 17 | 8.4 | 1.94 | 5.63 | 2.37 | 2.50 | 3.42 | NS | 4.07 | 3.82 | 92.11 | Sa | 0.83 | 2.5 |
| 18 | 8.8 | 3.75 | 6.88 | 2.62 | 3.75 | 9.99 | NS | 7.65 | 7.00 | 85.35 | LS | 0.35 | 26.6 |
| 19 | 8.7 | 6.25 | 15.31 | 3.91 | 7.50 | 9.12 | S | 7.68 | 7.02 | 85.30 | LS | 0.55 | 26.5 |
| 20 | 8.6 | 8.75 | 22.47 | 4.74 | 13.69 | 10.27 | S | 7.61 | 7.07 | 85.32 | LS | 0.50 | 26.7 |

*** (S = Saline, NS = non-saline, SS = Sodic-saline, LS = Loamy sand, Sa = Sandy).**

With regarding to soil organic matter, values are low in all locations. Also, values of total calcium carbonate are low except, in locations No. 18, 19 and 20 which excess than 20% that means it is calcarous soils.

Mean values of some available heavy metals and micronutrients in soils around the wells are presented in Table (5). Data show that, mean values of available heavy metals and micronutrients are low in all locations except, the values of $NH_4^+$ and $NO_3^-$ in location No. 16 which were 37.13 and 10.95 ppm, respectively. These trends were correlated with soil texture, organic matter and $CaCO_3$.

**Table (5): Some heavy metals and micronutrients concentrations at (0 – 30 cm) soil samples around the wells in Sinai.**

| Well No. | mg / kg soil | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Fe | Mn | B | Pb | Cd | $NH_4^+$ | $NO_3^-$ | $NO_2^-$ |
| 1 | 3.84 | 3.02 | 0.51 | 1.37 | Nd | 3.78 | 2.07 | 1.19 |
| 2 | 2.56 | 2.37 | 0.80 | 1.27 | Nd | 4.41 | 3.20 | 0.61 |
| 3 | 4.72 | 2.74 | 0.71 | 1.48 | Nd | 6.92 | 4.44 | 1.09 |
| 4 | 4.24 | 2.94 | 0.81 | 1.37 | Nd | 5.04 | 1.96 | 1.48 |
| 5 | 3.79 | 3.02 | 0.71 | 1.27 | Nd | 5.66 | 2.27 | 0.61 |
| 6 | 1.65 | 3.86 | 1.05 | 0.27 | 0.07 | 4.41 | 1.37 | 1.34 |
| 7 | 2.70 | 2.73 | 1.14 | 1.15 | Nd | 4.41 | 4.02 | 2.38 |
| 8 | 2.13 | 4.34 | 1.02 | 1.22 | Nd | 3.15 | 2.17 | 1.04 |
| 9 | 4.85 | 3.15 | 1.15 | 1.29 | Nd | 4.41 | 0.21 | 0.04 |
| 10 | 2.33 | 1.23 | 0.94 | 1.19 | Nd | 3.15 | 1.13 | 1.02 |
| 11 | 3.59 | 2.18 | 1.05 | 1.24 | Nd | 4.41 | 2.48 | 0.68 |
| 12 | 2.73 | 3.06 | 1.06 | 1.03 | Nd | 4.41 | 2.05 | 0.93 |
| 13 | 6.09 | 5.01 | 0.94 | 1.21 | Nd | 3.15 | 0.93 | 0.11 |
| 14 | 12.26 | 8.08 | 1.18 | 1.26 | Nd | 4.41 | 6.09 | 0.61 |
| 15 | 6.81 | 7.89 | 1.01 | 1.21 | Nd | 3.05 | 1.34 | 1.02 |
| 16 | 2.08 | 1.57 | 0.89 | 1.16 | Nd | 37.13 | 10.95 | 0.17 |
| 17 | 3.05 | 3.18 | 0.71 | 1.37 | Nd | 4.41 | 1.09 | 0.82 |
| 18 | 6.40 | 4.30 | 0.72 | 1.59 | Nd | 3.78 | 0.93 | 0.35 |
| 19 | 2.56 | 2.37 | 0.80 | 1.27 | Nd | 5.11 | 0.17 | 1.06 |
| 20 | 4.72 | 3.74 | 0.72 | 1.48 | Nd | 4.10 | 1.96 | 0.37 |

**Nd = non-detective.**

**The relation between some properties of wells water and soils:**

Statistical correlation between water quality of wells and some soil properties are presented in Table (6). Data showed that, there were postive correlation between $EC_{iw}$ and $EC_e$, ESP and soil-pH, but these relations were non significant. Also, there were non significant positive correlation between water-pH and both of available Mn, $NH_4^+$ and $NO_3^-$ in soil, non significant negative correlation with available Fe, and $NO_2^-$, and significant postive correlation at 1% level with available B in soil(0.656**), respectively.

The correlation between soil pH and available heavy metals and micronutrients are postive correlation except, with $NO_2^-$ and non significant except, with Fe and Mn (-0.634** & -0.732**). With regarding to correlation between soil organic matter and available heavy metals and micronutrients are non significant that may be due to the reduction in soil organic matter content in these soils and their arid conditions. Also, the correlation between soil $CaCO_3$ and avialable heavy metals and micronutrients are non significant except, with available soil boron (-0.489*) .

Finally, wells water can be used for irrigation purposes in the area of study under control and with a good management (optimum tillage, adding organic matter and amendements and a good cropping system etc..).

**Table (6): Statistical correlations between some properties of water and soil.**

| Particular X | Particular Y | Linear Regression equations | r |
|---|---|---|---|
| ECiw | ECe | Y = 0.2026X + 3.0094 | 0.398 ns |
| | ESP | Y = 0.2957X + 9.0344 | 0.314 ns |
| | pH-soil | Y = 0.0259X + 8.3840 | 0.282 ns |
| water-pH value | Fe | Y = - 0.7103X + 9.8151 | - 0.076 ns |
| (Available in soil) | Mn | Y = 0.2271X + 1.7292 | 0.033 ns |
| | B | Y = 0.4644X – 2.8047 | 0.656 ** |
| | Pb $NH_4^+$ | Y = - 0.3426X + 3.9649 | - 0.343 ns |
| | $NO_3^-$ | Y = 5.1801X – 35.313 | 0.183 ns |
| | $NO_2^-$ | Y = 2.1635X – 14.699 | 0.231 ns |
| | | Y = - 0.0969X + 1.618 | - 0.148 ns |
| soil-pH value | Fe | Y = - 4.8286X + 45.271 | - 0.634 ** |
| (Available in soil) | Mn | Y = - 4.0668 + 38.168 | - 0.732 ** |
| | B | Y = - 0.1162 X + 1.8857 | - 0.200 ns |
| | Pb $NH_4^+$ | Y = - 0.0486X + 1.6485 | - 0.059 ns |
| | $NO_3^-$ | Y = - 4.2677X + 42.305 | - 0.184 ns |
| | $NO_2^-$ | Y = - 2.8618X + 26.91 | - 0.372 ns |
| | | Y = 0.3668X – 2.277 | 0.214 ns |
| Soil organic matter % | Fe | Y = 3.7999X + 2.0594 | 0.282 ns |
| (Available in soil) | Mn | Y = 1.7035X + 2.5995 | 0.173 ns |
| | B | Y = - 0.2814X +1.0512 | - 0.273 ns |
| | Pb $NH_4^+$ | Y = 0.5712X + 0.920 | 0.393 ns |
| | $NO_3^-$ | Y = 13.074X – 1.2452 | 0.318 ns |
| | $NO_2^-$ | Y = 4.4547X + 0.0847 | 0.327 ns |
| | | Y = - 0.9844X + 1.3889 | - 0.325 ns |
| $CaCO_3$ % | Fe | Y = 0.0145X + 4.0381 | 0.050 ns |
| (Available in soil) | Mn | Y = - 0.0074X + 3.5984 | - 0.035 ns |
| | B | Y = - 0.0108X + 0.9833 | - 0.489 * |
| | Pb $NH_4^+$ | Y = 0.0121X + 1.1373 | 0.388 ns |
| | $NO_3^-$ | Y = - 0.1458X + 7.1428 | - 0.165 ns |
| | $NO_2^-$ | Y = - 0.0863X + 3.2389 | - 0.295 ns |
| | | Y = - 0.0089X + 0.9197 | - 0.137 ns |

**** = significant at 1%, * = significant at 5%, ns = non significant.**

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## تقييم جودة مياه بعض أبار الرى فى سيناء وارتباطها ببعض خصائص التربة

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تعد ندرة الموارد الطبيعية للمياه أحد المخاطر الرئيسسية التى تواجه قطاع الزراعة فى سيناء، لتقييم ودراسة جودة مياه أبار الرى فى شمال سيناء وأثر ذلك على بعض خواص التربة المختلفة أختير عشرين موقعا من التربة تروى بمياه الأبار الموجودة بها وتم أخذ عينات التربة من الطبقة السطحية وعينات من مياه الابار للتحليل.

**أهم النتائج المتحصل عليها:**

- كانت المياه فى كل الابار مرتفعة جدا فى درجة الملـوحة والصـودية ووقعت بين الرتبة ($C_3 – S_1$)، والرتبة ($C_4 – S_4$) . وكان محتواها من الحديد، المنجنيز، البورون، الرصاص، الكادميوم الذائب أعلى من الحدود المسموح بها فى مياه الرى ، بينما كان تركيزالأمونيا، النترات، والنتريت أقل من الحد المسموح به.
- كان قوام الأرض رملية ورملية لومية فى جميع المواقع وكانت غير ملحية فى معظم المواقع التى تروى من مياه الأبار، وكان محتوى التربة منخفضا من كل من الحديد، المنجنيز، البورون، الرصاص، الكادميوم، الأمونيا، النترات، والنتريت الذائب فى جميع المواقع ما عدا الموقع الذى يروى من البئر رقم 16.
- وجدت علاقة ارتباط معنوية سالبة بين رقم حموضة التربة وكل من الحديد والمنجنيز الميسرين وكذلك بين كربونات الكالسيوم الكلية والبورون الميسر فى التربة وعلى العكس من هذا وجدت علاقة ارتباط معنوية موجبة بين رقم حموضة مياه الرى المستخدمة والبورون الميسر فى الأرض.

أخيراً يمكن التوصية باستخدام مياه هذه الأبار فى رى المنطقة المدرروسة وذلك بالتحكم فى ادارة التربة جيدا عن طريق ( الحرث الأمثل- اضافة المادة العضوية والمصلحات، واتباع نظام محصولى جيد......الخ).