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Evaluation of Hydrogeological and Environmental Conditions by Using Hydrochemical analyses and on Sadat Area

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ABSTRACT*: *Salinity of Groundwater in Quaternary aquifer system is determined through field studies as groundwater sampling. The measurements are applied from a large distribution of study area to make clear overview of groundwater quality. In this study, a methodology was estimated and presented based on available hydrochemical data and statistical analyses to map the groundwater quality in the Quaternary aquifer of Sadat area. The quality of groundwater data was analyzed for the following parameters such as pH, Ca, Mg, Na, K, Cl, SO4, TDS and the contour maps were applied to the group of available analyses variables to map the spatial variation of the groundwater quality across the Sadat area. In hydrochemicl analyses of the variables showed that the aquifer quality is the most important factor affecting development in agriculture and industrial fields in the study area. Results of mapping and data analyses could potentially be used for groundwater management purposes in the study area.

KEYWORDS:* *Mollusca; Monacha Cartusiana; Resistance; Pesticides.

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I. INTRODUCTION

There is a necessary to assess groundwater quality because of human activities which make load over on its resources, groundwater protection plays an important role in human health, food supplies and keeping ecosystems safe. Many countries depend on naturally clean groundwater as main source because water treatment is economically infeasible, so that it is important to understand threats to this resource and how to protect it. groundwater quality assessment to give an overview about the base of groundwater change including mapping and data analysis of main impacts [9,11]. to make full use of this resource. To overcome such deteriorations in the groundwater, it must be managed effectively by studying the distribution of hydrochemical parameters, and the response of the flow of water and solvents to environmental and human changes. the one of keys to determining changes in groundwater systems lies in mapping by using contour maps. It is an important role in Assessment of groundwater quality through generating the spatial distribution maps of the chemical indices. In Egypt, Groundwater ranks second fresh water source after the Nile River, where it includes different groundwater aquifers systems. Aquifers ranges from local to regional aquifers (Fig.1), with variable in depth, recharge, media of water body [6]. Egypt is classified an arid area in North-East Africa, but has a large hydro-geologic potential. Most of aquifers in Egypt are formed of unconsolidated or consolidated granular (sand and gravel) material or in fissured limestone. Two categories of groundwater in Egypt, first category renewable groundwater resources which is Located in the Nile Valley and Delta system as Nile aquifer, second category is non-renewable groundwater resources which is located Nubian Sandstone Aquifer at the Western Desert. Nile aquifer covers the Nile Valley region, Delta and the nearest desert edges, representing about 4% of the area in Egypt [6, 7].

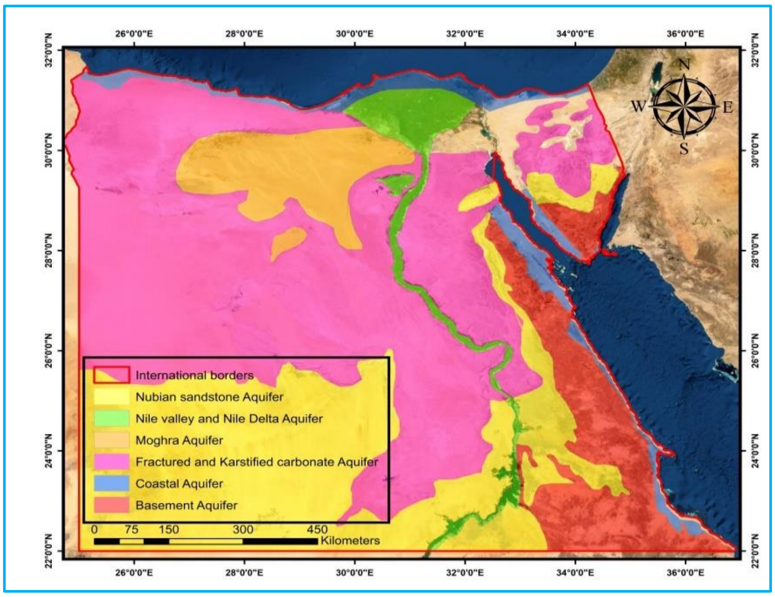

Figure (1): Main groundwater Aquifers in Egypt.

2.Materials and Methods

2.1General Outline of study area

Sadat City is a city in the Monufia Governorate, Egypt. The city is located 94 kilometers northwest of Cairo. and embraces on area of about 600 Km², it is a first-generation new urban community and one of the largest industrial cities in the country. It lies between latitudes 30° 22′ and 30° 32′ N and longitudes 30° 24′ and 30° 42′ E (Fig. 2). The study area is Located in the Nile Valley and Delta system.

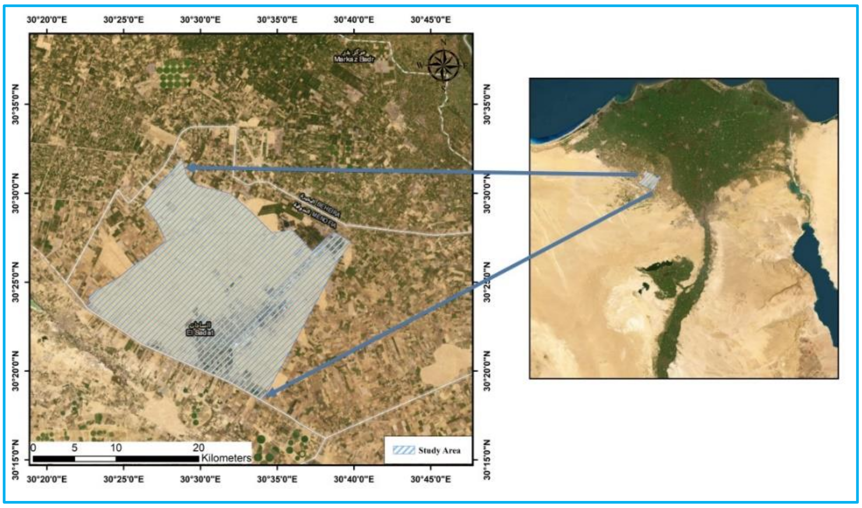

Figure (1): Location of study area

2.1 Geology Outline:

Sedimentary rocks belonging to the Neogene essentially occupy the studied area and Quaternary rocks. The Nile Delta located at east of the studied area formed the tectonic depression, which subjected to general subsidence a thick series of argillaceous strata deposited in the Nile Delta. The northwestern desert has been a positive area during a large part of the Tertiary. During Miocene, sands were deposited in a fluvial environment in the areas Cairo, Alexandria and Qarun. The thickness of these sands ranges between 200 and 1000m, increasing in northward direction. During Pliocene times, a lagoonal facies developed in Wadi El Natrun area and north of it.

The Studied area is essentially occupied by sedimentary rocks belongs to Upper Cretaceous, Tertiary and Quaternary. [12, 13] as (Fig.3).

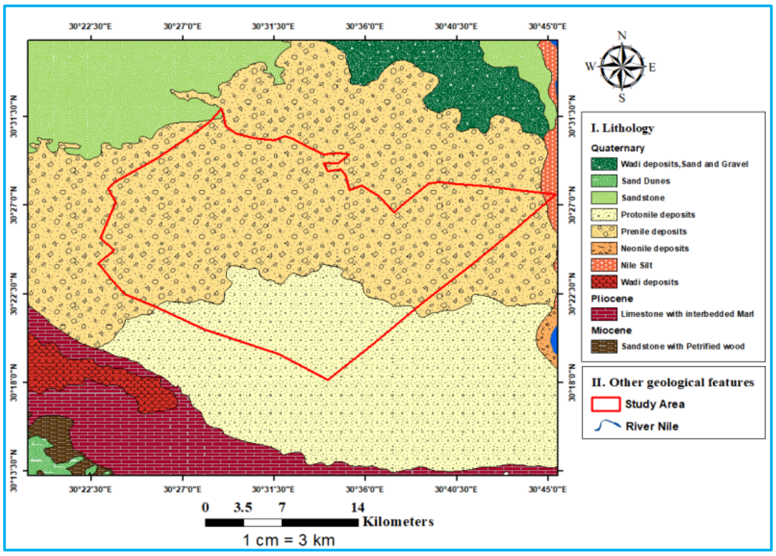

Figure (3): Geologic map of study area

2.2 Regional Hydrogeology

The Quaternary aquifer in the research region consists mostly of fluviatile graded sand and gravel intercalated with clay lenses, with its base determined by lower Pliocene pyretic clay or sandy clay and its upper bounds by the water table. The thickness of Quaternary sediments is varied. [15, 16].

2.2.1 Groundwater Movement and Flow Direction

Measurements of depth to water at groundwater monitoring wells throughout the study area and ground elevations at well sites were used for construction of potentiometric surface map (Fig.3) in the study area. Quaternary aquifer system potentiometric surface map which can be indicated the general view of the groundwater flow directions through depth to water contour lines (Fig.4).Elevation map can be distinguished into three major parts according to high, moderate and low elevations which shows as different colors. In the northern part of the map, the groundwater flow direction is observed to be towards two directions one of them west- southern direction and another to east direction. At the middle part of the map, the groundwater flow direction is observed to north-east. In the southern portion, the groundwater flow is generally towards the north-east direction and east-south direction.

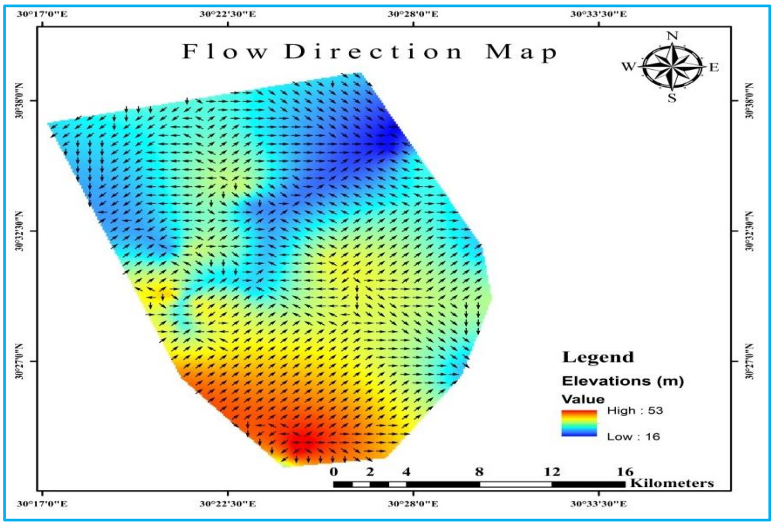

Figure (4): Groundwater flow direction in study area(Sep.2021)

3.Materials and Methods

A methodology for the quality of the change salinity of the freshwater distribution in the quaternary aquifer in Sadat area. Through spatial analysis and contour map [9, 10] for Distribution of dissolved minerals in groundwater.

3.1.Distribution of chemical indices

17 water samples were collected and analyses in (Sep.2021) from the different water sources. (12) Samples from drinking wells and (5) from irrigation wells. The positions of the different water sources were determined using GIS as (Fig.5).

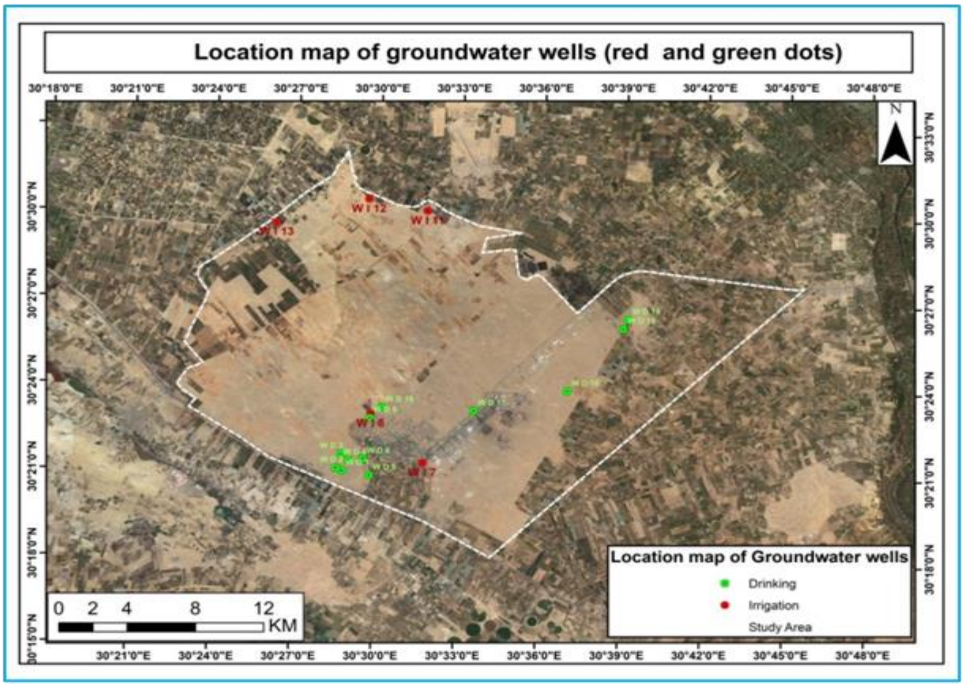

Figure (5): Wells location map of the groundwater in the study area

Using the geodata base construction tool of Arc GIS 10.7 to establish the sampling sites and generate the chemical index spatial distribution maps. For spatial interpolation of chemical indices, the current study utilized the Krigging method. Krigging is an interpolation approach in which estimates are derived from values at neighboring locations based solely on their proximity to the interpolation point.

3.1.1.Hydrogeochemical parameters of groundwater

The physical and chemical parameters of the groundwater quality data were analyzed .water quality for the following 8 parameters such as pH, Conductivity, Ca, Mg, Na, Cl, SO4 and,TDS. All these information were used to interpret the groundwater quality of the Quaternary aquifer in the study area.

3.2. Total dissolved salts (TDS)

Salinity distribution of shallow groundwater resources, it has a medium range and varies between 150 and 1400 (mg/l). The lower value is observed at south-east map, very close to east boundary of green belt, while the higher value is recorded for the most southern wells, close to northwest of Cairo-Alexandria desert road. The higher salinity values recorded at the discharge side of Sadat city. The lower gradient in salt content towards the middle side, relative to that towards Sothern of Sadat city may attribute to the recharge effects of the intensive irrigation practices and irrigation canal systems along the boundary of green belt where solubility occurs and the salt content increases in the groundwater in image (A, B).

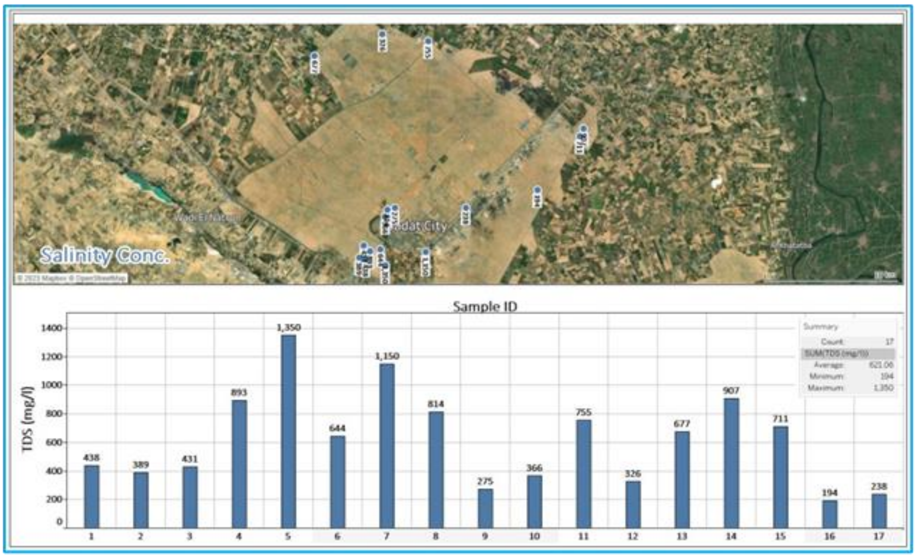

Image (A): TDS distribution map in study area

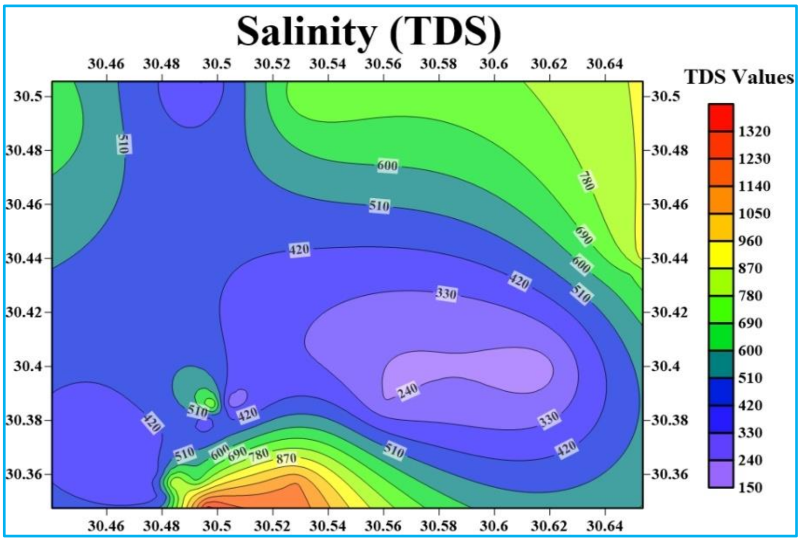

Image (B): TDS contour map in study area

3.3. (pH) of groundwater

The pH scale is used in chemistry to describe how acidic or basic an aqueous solution is. PH values ranges in the area study between 7.5 to 8.6. The high values of pH are located at southern part of Sadat area and the low values are located in central and northern part of Sadat city. pH variations maybe occur in the study area because of minerals, pollutants, soil or bedrock composition, and any other contaminants that interact with a water formations in image(C,D).

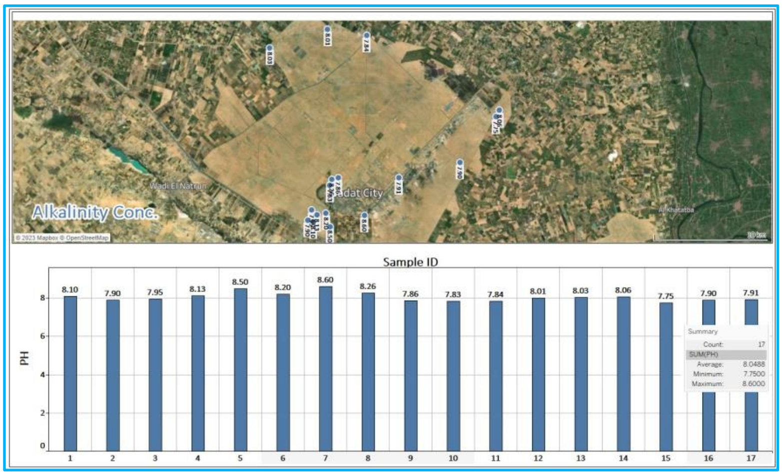

Image (C): P^H distribution map in study area

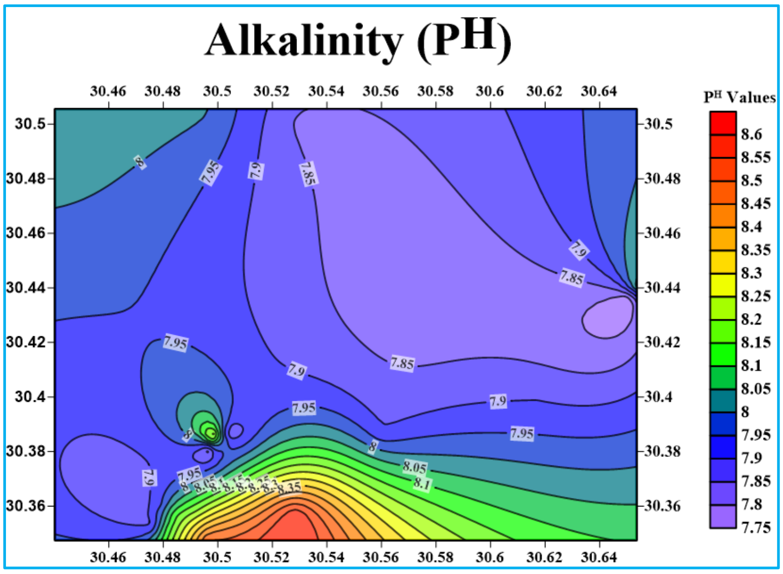

Image (D): P^H contour map in study area

3.4. Spatial distribution of calcium (Ca^{+2})

The concentration of calcium ions in the study area ranges from 20 mg/l minimum and 104 mg/l maximum. Low calcium content is represented in the south-east part of Sadat area and some spots in north part, while the samples with high calcium content are represented in the southern parts of Sadat city. Calcium ion variations maybe occur in the study area because of dissolving calcium from the geologic materials which found in subsurface layers on study area in image (E, F).

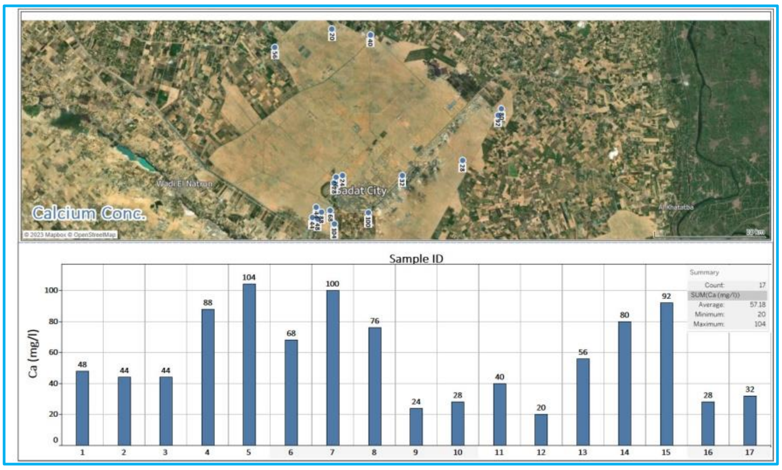

Image (E): Ca^{+2} distribution map in study area

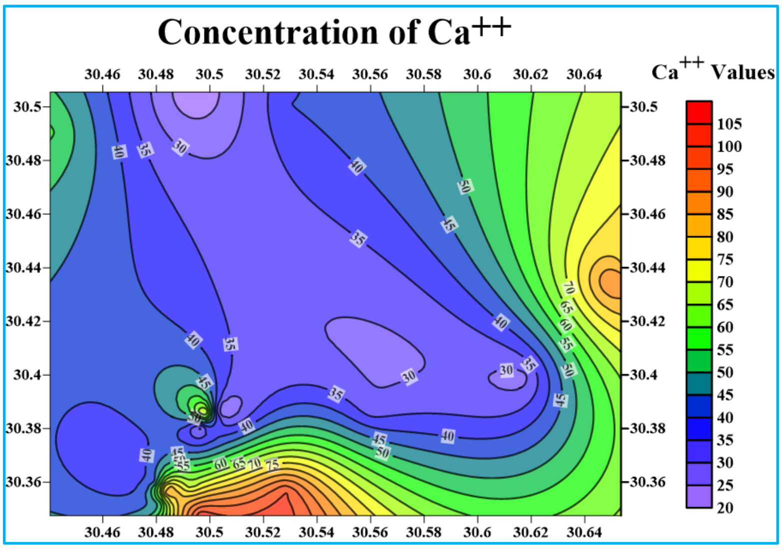

Image (F): Ca^{+2} contour map in study area

3.5. Spatial distribution of Magnesium ($Mg^{+}2$).

Magnesium ion is found in varying values which collected from groundwater samples on the study area. The results showed that the minimum value of the magnesium ion concentration was 12 mg/l represented in some spots on sample map and the highest concentration of magnesium ion is 64 mg/l is represented on the southern of the study area and the average concentration is represented on middle of sample map. This may be attributed to the cation exchange. And Lithological effect may be for the dissolution of carbonate rocks in the catchment area and/or the magnesium rich minerals in the cement materials of the Quaternary aquifer system in the study area in image (G,H).

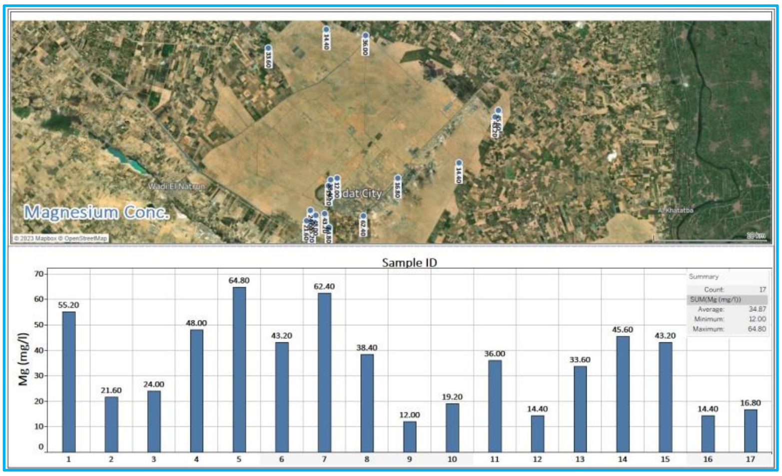

Image (G): Mg^{+2} distribution map in study area

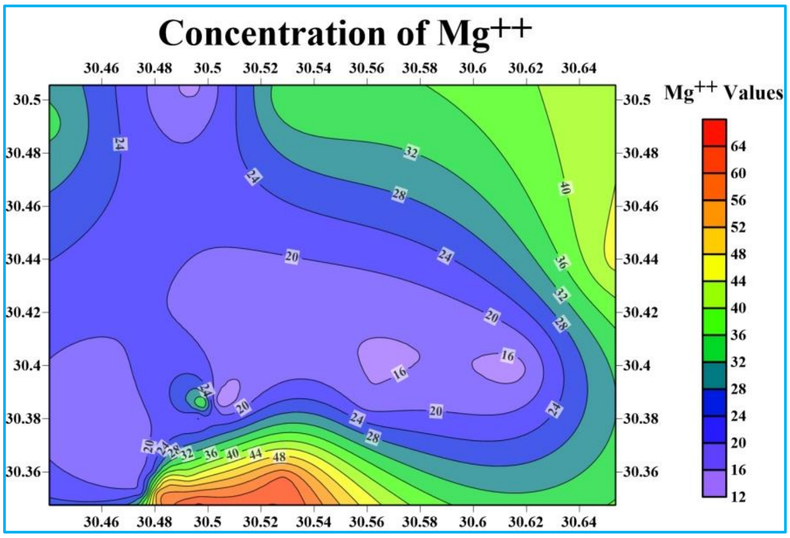

Image (H): Mg $^{+2}$ contour map in study area

3.6. Spatial distribution of Sodium (Na^{+}).

Sodium cation is one of most dominated cations in samples which were collected in the study area. In some samples, the highest concentration of sodium is about 350 mg/l, while the lowest sodium concentration was 45 mg/l.it is found that the north to east parts and southern parts of Sadat city have high concentrations of sodium, while in the southern west and central parts of Sadat area there are concentrations lower than sodium ions. the reason of high concentrations of sodium cation in the study area may be attributed to the great solubility product of evaporates rocks that presented in the fluvial-marine deposits. In addition to clay layers with the fluvial sand often yield water with relatively high sodium content in image (I, J).

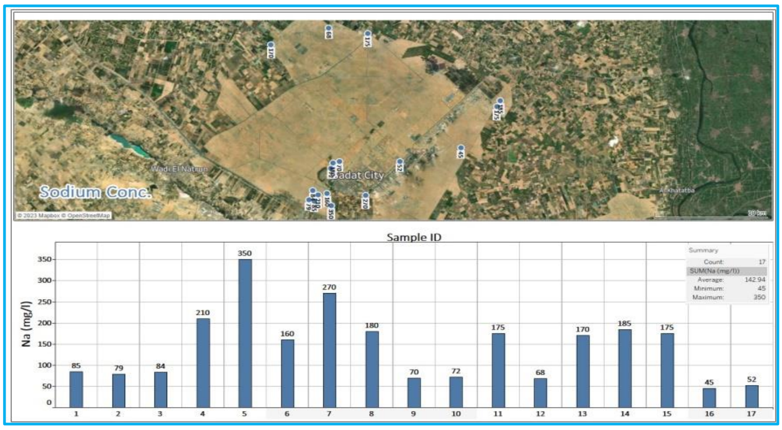

Image (I): Na^+ distribution map in study area

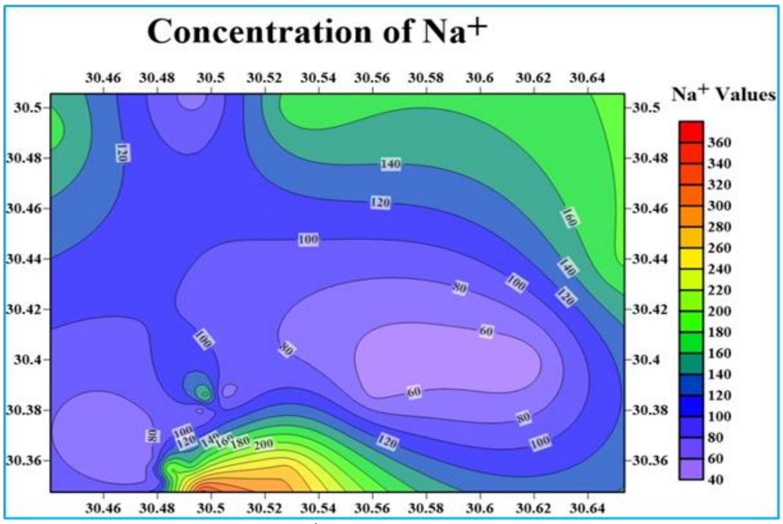

Image (H): Na^+ contour map in study area

3.7. Spatial distribution of Chloride (Cl^-)

Chloride is found by high values in some samples such as sodium concentrations, the highest concentration of chloride is about 410 mg/l, and the lowest value of chloride concentration is about 55 mg/l, while the average is about 184 mg/l.The high values of the chloride ion are observed in the southern part of Sadat city, while the low values of chlorine ion concentration are in the eastern part and medium values of chloride is found in south to west parts. Increasing of chloride concentrations which is found may be attributed to a probable occurrence of evaporate rocks in the lithological units on the study area in image (K,L).

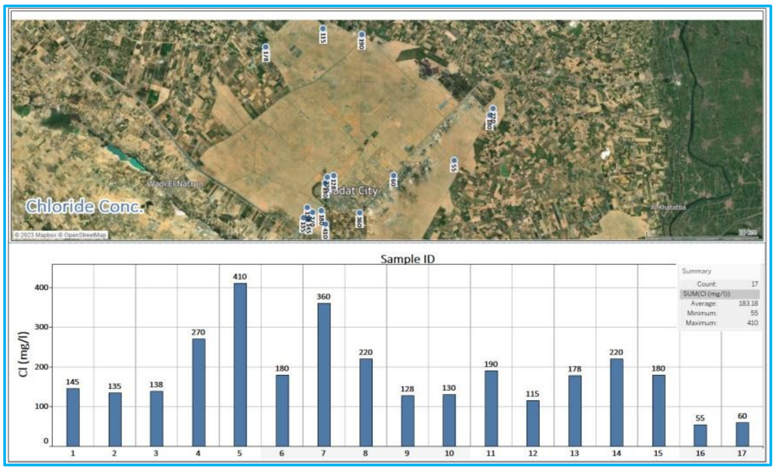

Image (K): Cl^- distribution map in study area

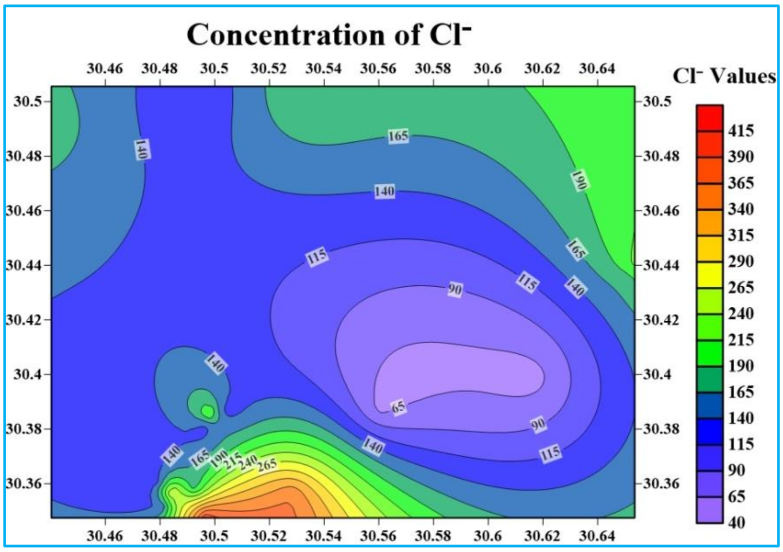

Image (H): Cl^- contour map in study areA

3.8. Spatial distribution of Sulfate (SO_4^{-2})

Sulfate concentration values ranges in measured samples between 22 to 250 mg/l.it is observed that the samples with the higher concentrations are found in the southern parts of the study area and lowest concentrations values are found at the east to south west parts of the study area. This may be caused by presence of evaporate rocks with high concentrations of sulfate. This may be caused by presence of evaporate rocks with high concentrations of sulfate in image (M, N).

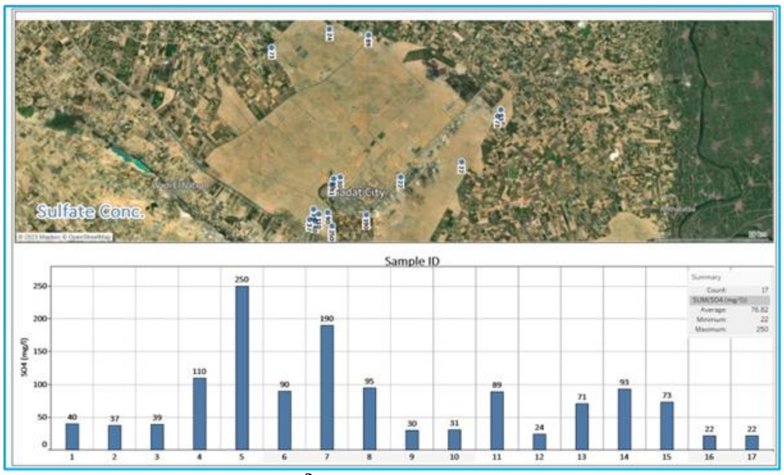

Image (M): SO_4^{-2} distribution map in study area

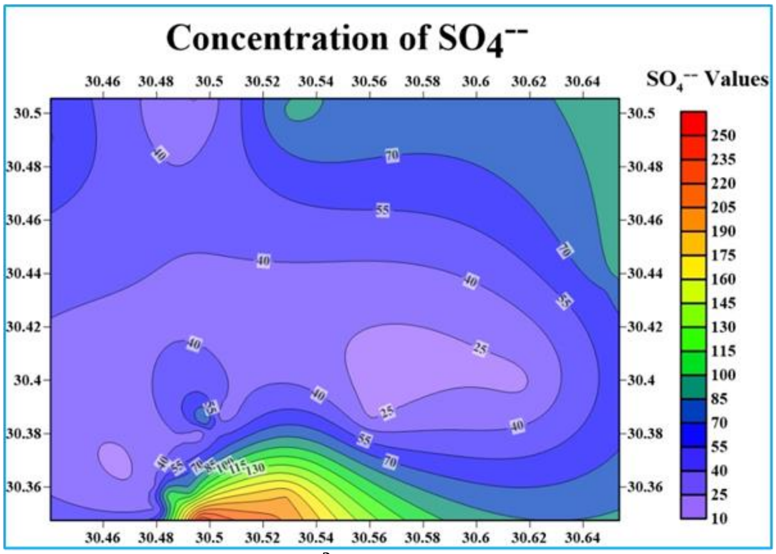

Image (N): SO_4^{-2} contour map in study area

4. Suitability of Groundwater for Use

4.1 Drinking use

The groundwater composition, the minimum and the maximum and the average values were shown In Table (1). The results showed that 6 samples with electrical conductivity values greater than 1500 µS/cm, making them unsuitable for drinking purposes. About the major elements, 3 samples of groundwater samples are found in the study area where sodium concentration exceeds the normal limit of the WHO standards of 200 mg/l. Calcium and magnesium ions concentration in groundwater samples not exceeded the international standards of WHO[18] in all measured samples. Chloride ion concentration is exceeded 250 mg/l in 3 samples of groundwater samples. And 1 sample exceeded the international standards for the concentration of the sulfate ion and more than 250 ppm.

Table (1): Showing Min., Max. And average concentration of different constituents.

Water quality parameters		Groundwater Min	Groundwater Max	Average	(WHO, limits 2017) Acceptable
EC		360	2700	1234	**1500**
Salinity		194	1350	621	**1000**
Major Element	**Na**	45	350	143	**200**
	Ca	24	104	57	**200**
	Mg	12	64.8	35	**150**
	Cl	55	410	183	**250**
	SO_4	22	250	77	**250**

4.2.Irrigation use

Water for irrigation water quality classification based on E.C[17]is given in Table ,(2)which show 29.4 % of samples are good(5 samples), while (with permissible limits(10 samples) and 11.8 % is Doubtful (2 samples % 58.8.

Table (2): Irrigation water quality based on E.C. according to Raghunath,1987.

EC	Water classes	Percentage of samples
< 250	Excellent	None
250 – 750	Good	29.4 %
750 – 2000	Permissible	58.8 %
2000 – 3000	Doubtful	11.8 %

5. Conclusions and recommendations

This research has resulted in improved observation for analysis and pointing to the risk related to increase of groundwater salinity. The overall target of framework is risk assessment of groundwater after increasing number of wells in development areas on Sadat city as well as the objectives have been fulfilled; i) specific objective to study the distribution of hydrochemical analysis when managing groundwater salinity, is met through the map figures to use hydrochemical parameters to produce spatially distributed risk maps which can be used to distinguish areas with significant risk from low-risk areas. The continuous monitoring of groundwater levels in the study area should be monitored through a monitoring network to be chosen and monitoring the quality of groundwater through conducting all physical, chemical and bacterial analyzes to ensure the quality of these water for different uses especially for drinking wells in the study area, It is recommended that should be use modern irrigation techniques to avoid land salinity along Sadat area.

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