Middle East Journal of Applied Sciences
Volume: 12 | Issue: 03| July – Sept. | 2022

EISSN: 2706 -7947 ISSN: 2077- 4613
DOI: 10.36632/mejas/2022.12.3.25
Journal homepage: www.curresweb.com
Pages: 242-269

Evaluation of Water Types and Soil Characteristics for Selection Suitable Crops in Sarabiyum, Esmalia Area, Egypt

Yasser A. M. Abdulhady[1] and Ahmed S. A. Sayed[2]

[1]Hydro Geochemistry Department, Desert Research Center, Water Treatment and Desalination, El-Mataryia, Cairo, Egypt.
[2]Pedology Department, Desert Research Center, El –Mataryia, Cairo, Egypt.

Received: 03 August 2022 **Accepted:** 05 Sept. 2022 **Published:** 20 Sept. 2022

ABSTRACT

The focusing of paper was aiming to the relation between groundwater types and soil characteristics to select the plant suitability index. Potential sources of groundwater recharge of both water and solutes to the quaternary aquifer and the upward flow of groundwater from the underlying Miocene aquifer system. Water samples were analyzed for their physical, chemical properties, besides of the major chemical compositions, ionic ratio A) HCO_3/Cl;B) Na/Ca ;C) Na/Cl;D) Ca/Cl;E) Mg/Cl;F) K/Cl;G) SO_4/Cl;H) Mg/Ca;I) Ca/SO_4;J) Ca/HCO_3;K) CEV;L) SAR;M) Na/(Ca+Mg);N) $HCO_3/(Cl+SO_4)$;O) $Ca/(SO_4+HCO_3)$ was used to delineate saline water intrusion. The chemical reactions responsible for the chemical constituents and salinity in the aquifer include silicate weathering, evaporate dissolution, and carbonate precipitation. Most of groundwater samples appear to lie at/or close to equilibrium with clay minerals where clay minerals are quite common in the local soils of the quaternary aquifer. Irrigation management led to a better use of the available groundwater. Soil texture is variable from clay to coarse sand at the soil surface. Hypothetical salts combination and sodium adsorption ratio in groundwater & fresh water of Ismailia canal and soil profiles were tested. In using our lands for reclamation, one should evaluate the soil resources for land suitability for crops. Land suitability maps are prepared using the Geographic Information System, and the soil properties are analyzed and evaluated for most irrigated crops in Ismalia Land suitability maps are prepared using the Geographic Information System (GIS), and the soil properties are analyzed and evaluated for most irrigated crops in Ismalia. Results indicated that the area under investigationis currently suitable (S2) and marginally suitable (S4) for semi-annual and permanent crops. The main limitations revealed in the soils were soil texture, drainage, and soil salinity.

Keywords: Hydrogeochemical facies, Hypothetical salts, Ionic ratios, Soil profile and analysis, Groundwater contamination, Soil fertility, Suitability of agriculture crops,Soil & water quality

1. Introduction

Land reclamation has been done in Egypt with great exertions to increase it. Investments have been increased to turn country from poor desert into green productive area. Land reclamation is progress in Egypt due to the presence of high groundwater aquifers content with moderate quality and deep sandy soil texture. Some wastewater of domestic industrial or agricultural activities had seepage to groundwater aquifers. The quality of groundwater depends on the load and behavior of the contaminants in addition to geological and hydrogeological factors that monitoring the flow and scuttle of the contaminants. Groundwater chemistry is largely a mission of the bedrock composition of the aquifer through which it flows. The hydro chemical processes and hydro geochemistry of the groundwater modify spatially and temporally, depending on the geology and chemical composition of the aquifer. Hydro geochemical processes such as dissolution, precipitation, ion exchange processes and the

Corresponding Author: Yasser A. M. Abdulhady, 1Hydro Geochemistry Department, Desert Research Center, Water Treatment and Desalination, El-Mataryia, Cairo, Egypt.
E-mail: yasser_vip6@hotmail.com- ORCID.org/0000-0002-7816-4190

presence time with flow path control the chemical composition of groundwater (Apodaca *et al.,* 2002; Martinez and Bocanegra, 2002; Etu-Efeotor and Odigi, 1983; Amajor, 1986 and Amadi *et al.,* 1989). Hydro chemical evolution of groundwater using chemical data from environmental geochemistry are Studied. Increasing of population and rapid urbanization has made groundwater the basic origin of water supply. Understanding of the hydro geochemical processes that take place in the aquifer system is major priority. To improve water management of area will establish a basis for developing an appropriate monitoring programme and therefore (Etu- Effeotor, 1981; Udom *et al.,* 1999 and Nwankwoala *et al.,* 2007). It has become necessary to study the quality of groundwater and the processes that control the concentration of major constituents in the area. Therefore, it is very pressing that adequate hydro-geological and hydro chemical data be studied; in order to assess the hydro chemical characteristics, study the ionic interactions as well as the hydro geochemical facies distribution. Achieving these aims will establish a basis for developing an appropriate monitoring programme and therefore improved management of the groundwater resources of the area. Because of the real complication and site location of the soil-water-pollutant interactions, groundwater has been polluted; contaminants' fate in the aquifers is doubtful (Foster and Chitlon, 2003). Thus, pollution prevention and control should be a clue component of groundwater management. As a result of human activities, aquifer pollution risk assessment are studies more likely to be polluted, have been used as tools for groundwater pollution prevention and control (Shrestha *et al.,* 2016). Last studies were implemented on geomorphology and geology of the study area. Some studies were noted in the articles of Barron (Baron, 1907; Sandford and Arkell, 1939; Murray *et al.,* 1951; El Shazly *et al.,* 1975; El Ibiary, 1981; Said, 1981; ElFawal and Shendi, 1991 and EL-Fawal, 1992). An old entombed branch of the inherited Nile River and this branch is occupied by Ismailia Fresh-water Canal. Physio-chemical weathering greatly restructured the land surfaces morphology, particularly, the physical weathering due to the commanding desert conditions predominant in the study area. Formalization of desert barrier, sand dunes, and collection of sand drifts are common characteristic of wind effects during the recent desert conditions in the area north of Ismailia Fresh-water Canal. The sediments of the study area are generally of fluviatile source but blend towards the east and southeast with fluvio-marine sediments. The study area is adjusted by agricultural land rest on flood, silty and loamy fine sand soil. The eastern boundary of the study area is described by elongated and parallel, shallow sand dunes with separate shallow water logged area in between. The subsurface soil was noted by two main stratigraphic units; the deeper fluvio-marine shallow flood plain units.

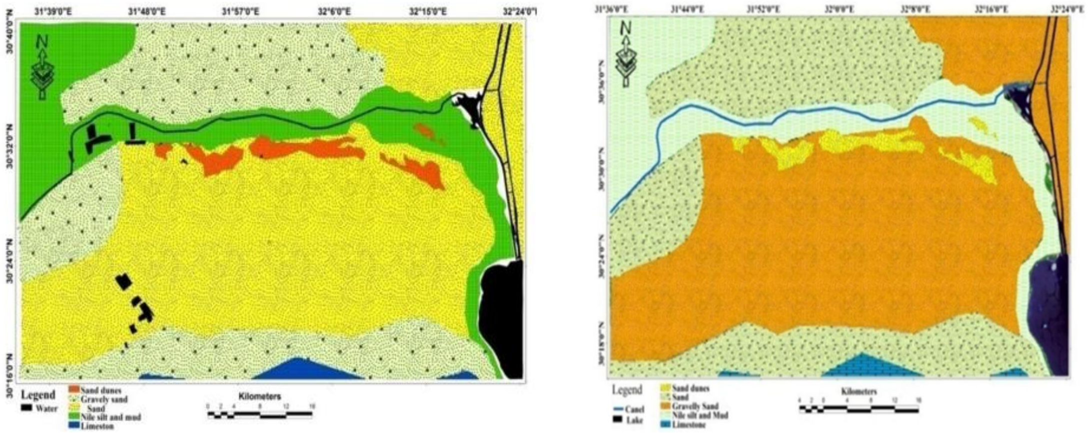

Fig. 1: Geologic and soil map of study area (after Geriesh, 1994) [19]

Hydrogeological features adjusting

Geriesh, (1989) studied geology of the target area. Surface water and groundwater are connected that each other by hydrologically systems. The quality and quantity of one is adjectives on others. Groundwater flow system is very vital for save of surface water bodies (Toth, 1999). The hydrogeological setting of the study area is greatly influenced by the Nile sedimentary processes. Groundwater around Ismailia Canal takes place in two major aquifer units; the upper permeable unit and the lower highly permeable unit. The upper unit is of Nioltic origin and consists of fine to medium sands with silt and clay caps of slimy characters especially to the east. The eastern part of this unit is created under lagoon to fluvio-marine conditions and is characterized by salty component due to high of evaporation percent (Zoetbrood, 1984). The deposits of the western part of the study area have better hydraulic possession and could be hydrologically connected with the lower aquifer. It consists of gravelly sand deposits of pure fluviatile origin and achieves thickness more than 150 meters. It is formed of pure sand and gravel of high hydraulic properties and low salt contents. Water bearing formations in the study area existing mostly under unconfined conditions, but in some locations semi-confined conditions may exist due to the intercalation of clay lenses. Groundwater flow is almost from west to east and outward of Ismailia canal course. The canal likes as an effective stream in most parts. There is some water collecting lens in the low due to seepage of Ismailia Canal. In the present study, a trial has been made to assess the groundwater availability of the unconfined aquifer around Ismailia canal area. Hydro-geochemical and environmental parameters are used to represent the availability of agriculture the suitable crops.

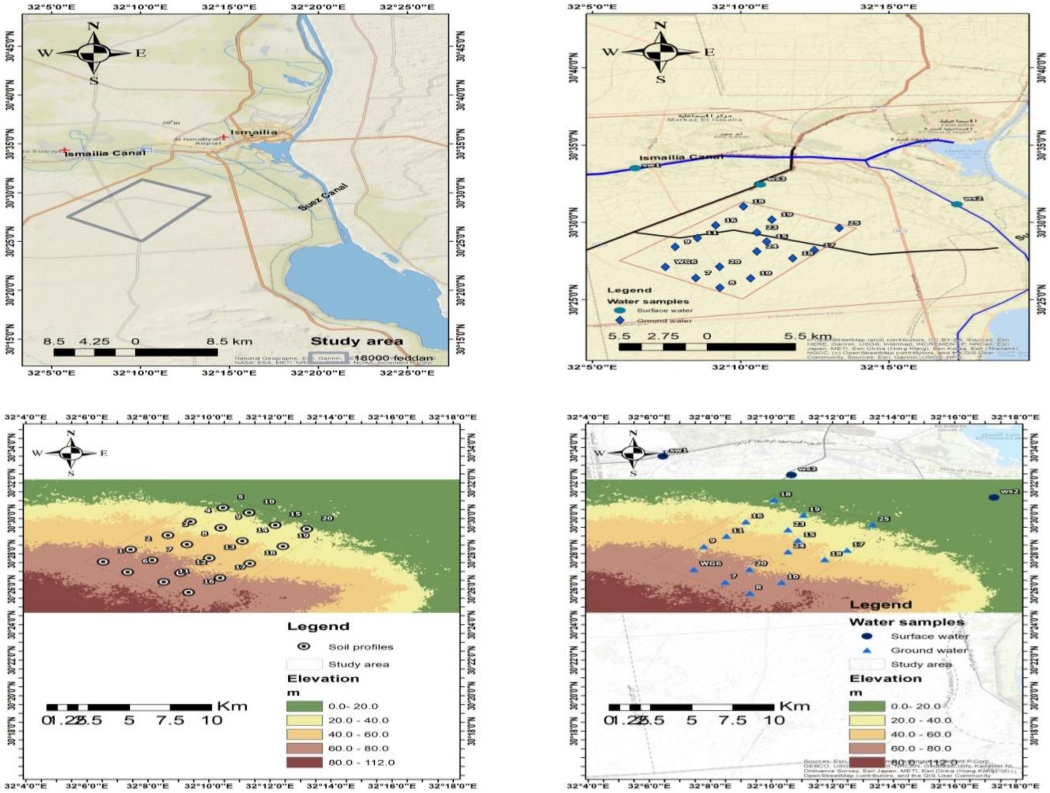

Fig. 2: Location map of target study area

The relation between water quality and soil characteristics is focused in this study. It is found that the shallow depth to groundwater around Ismailia canal causing that area more vulnerable to pollution especially with it's heavily population capacity. We found that landfills, agricultural drains are already situated around Ismailia canal. Meanwhile, the northern and southern surrounding areas far from the main course of Ismailia canal have deeper depth to groundwater that causing attenuation for the pollution potential. By the comparison between the depth to groundwater map and water table map of the unconfined aquifer in the study area and the flow directions of the water table map, it can be complemented that the seepage from Ismailia canal to the surrounding areas with losing stream conditions but at some local parts it likes as earning stream. In general, Ismailia canal could be noted as recharge origin for the unconfined aquifer of the study area, the lower data of precipitation in the study area result in less opportunity to leaching the contaminants in the study area. The Nile silt and mud around the main root of Ismailia canal reduce the intrinsic weakness to contamination. The target areas have sand, gravelly sand and sand deposits which increase pollution content. The soil media with gravelly sand sediments show moderate influence on total groundwater pollution. Watery soil extract in the area is mainly made up of mixtures of earth alkaline and alkaline metals and predominantly $Cl^{-1}/SO4^{2-}$ water type. This work is aimed at evaluation of the groundwater quality of the quaternary aquifer with relationship of soil characteristics profiles in reclaimed areas for sustainable development. Twenty water and soil profiles samples representing the surface water and groundwater samples with soil profiles were collected. The hydro-chemical characteristics, geochemical classification, geochemical evolution and statistical analyses as well as groundwater quality were done. This work is aimed at evaluation of the groundwater quality of the quaternary aquifer with relationship of soil characteristics profiles in reclaimed areas for sustainable development. This study attempts to evaluate the different water types, hydro geochemistry of the main source of water supply in the area as well as determine the groundwater characteristics. The most relevant controls on the water quality and ionic processes which control the groundwater composition of the aquifer systems in the area will also be studied. Also provides an opportunity to observe a detailed profile of the dominant hydro geochemical facies distribution and processes of groundwater, with a view to predicting their water character.

2. Materials and Methods

2.1. Reagents and quality assurance

For preparing the standard solutions under a clean laboratory environment analytical chemical grade and deionized water were utilized. Plastic bottles were cleaned through soaking in diluted HNO3 solution, flushing with deionized water, furthermore drying in an oven the plastic bottles were completely washed with aliquots of the sampled waters, prior to collection. All single standard solutions of different elements were gotten from Merck. Using of calibration standards concentrations of 1g/L (Germany). By using ICPMS (Inductively Coupled Plasma-Mass Spectrometry) the percentage of Recovery for the previously mentioned elements analyzed varied between 90% and 106%. The measurements were repeated thrice; the calculated range, median and mean were reported.

2.2. Sampling and analytical procedures

In the field, the samples were gathered from every location in polyethylene bottles. One sample from every location was preserved by acidifying to pH 1.5 with 1 mL of concentrated HNO_3 acid for heavy & trace elements analysis. For field measurements (total dissolved solids (TDS), pH and redox potential (Eh) are mentioned. Methods for preparation of Standard Methods are noted for the Examination of Water and Wastewater. The samples were brought to the Central Laboratory for Environmental Quality Monitoring in a cool box with cooling elements for analysis. The current study started by surveying Twelves water and soil points (three surface water samples and seventeen groundwater samples) from the area under investigation. Twelves soil profiles represent the area understudy were chosen to represent of selected sites. These profiles, which are located at Ismailia area and were, dug wide open to a depth of 150 cm unless opposed by water table. Soil profiles were expected to reflect the wide variations soils in the Famers. Morphological description of the soil was undertaken according to the criteria established by Field Book for Describing Sampling soils, (Schoeneberger *et al.,* 2002) for soil. The collected soil samples, amounted Twelves, represented the consequent morphological variations throughout the entire depths of the soil profiles. Soil samples were collected and processed for laboratory analyses. Particle size distribution was carried out either by dry sieving for coarse textured samples, or by the pipette method for heavy – textured ones, (Gee and Bauder, 1986). Total dissolved solids (TDS) were determined by evaporating a measured volume of filtered water sample to dryness at 105 ± 2° C, after that weighing the solid residue. The total calcium carbonate was measured by treating the samples with HCl and the evolved CO_2 was measured (Page *et al.,* 1982). Values of pH and electrical conductivity (EC) were measured in 1:2.5 soil water suspensions and supernatant, respectively. The organic matter was measured using Walkley-Black Wet method. Trace and heavy elements (Al, B, Cd, Co, Cu, Fe, Mn, Ni, Pb and Zn) were detected by plasma optical emission mass spectrometer (ICP). The analytical methods can be grouped as volumetric and instrumental. The analysis methods includes measurement of major cations and anions, carbonates (CO_3^{2-}), bicarbonates (HCO_3^-), chloride (Cl^-), calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^+), potassium (K^+), sulfate ($SO4^{2-}$). Minor, trace and heavy metals which include aluminum (Al), boron(B), cadmium (Cd), cobalt (Co), chromium (Cr), copper (Cu), iron (Fe), molybdenum (Mo), manganese

Table 1: Relationship between soil depth and Particle size distribution (%)

Profile No	Depth Cm	$CaCO_3$ %	Gravel %	Particle size distribution (%)					
				2--1 mm	1--0.5 mm	0.5-0.25 mm	0.25-0.125	0.125-0.063	<0.063
S2	0---15	2.54	1.50	17.90	42.40	24.90	11.40	1.90	1.50
	15--50	4.65	0.90	3.70	20.40	38.60	25.90	7.40	4.00
	50--100	5.83	0.80	5.90	30.90	58.90	2.90	0.40	1.00
	100-150	1.43	0.50	7.87	15.62	25.62	26.24	18.25	6.40
S3	0--30	3.45	0.80	2.60	6.80	25.20	40.00	22.20	3.20
	30--100	1.43	0.50	4.20	19.10	35.70	28.60	7.70	4.70
	100-150	1.09	0.60	5.90	30.90	58.90	2.90	0.40	1.00
S4	0--15	2.40	4.60	4.40	19.20	33.70	40.70	1.00	1.00
	15--90	3.12	1.30	6.40	31.40	56.40	3.40	0.90	1.50
	90--150	3.54	2.50	5.27	7.14	29.20	43.16	13.61	1.62
S5	0--30	1.35	1.70	6.90	22.90	42.90	20.40	3.40	3.50
	30--100	8.09	1.50	0.90	12.90	69.90	13.90	0.90	1.50
	100-150	3.54	2.40	0.40	12.40	72.40	13.40	0.40	1.00
S28	0--30	1.64	0.90	2.40	7.00	25.60	38.60	22.20	4.20
	30--100	4.60	2.50	17.40	28.40	27.90	16.40	4.40	5.50
	100-150	1.25	4.50	3.70	20.40	38.60	25.90	7.40	4.00
S26	0--30	6.60	4.60	58.90	30.90	5.90	2.90	0.40	1.00
	30--100	3.55	2.50	22.40	29.90	18.90	17.40	5.40	6.00
	100-150	4.18	1.80	16.90	54.90	24.40	2.40	0.40	1.00
S25	0--50	3.10	1.70	69.90	12.90	0.90	13.90	0.90	1.50
	50--100	3.45	1.70	7.90	23.40	31.90	24.90	7.90	4.00
	100-150	3.45	2.50	6.90	22.90	42.90	20.40	3.40	3.50
S24	0--30	5.16	2.40	6.40	22.40	45.40	19.90	2.90	3.00
	30--100	4.57	0.50	6.20	15.90	35.60	31.10	8.80	2.40
	100-150	7.04	2.60	6.51	11.20	28.94	34.63	16.94	1.78
S23	0--30	4.78	0.50	8.50	18.90	41.80	27.50	3.20	0.10
	30--100	2.43	0.40	12.60	22.50	33.70	27.80	2.60	0.80
	100-150	4.56	0.30	7.40	23.40	40.40	20.90	3.90	4.00
S22	0--30	3.20	0.60	19.40	54.40	22.90	1.90	0.40	1.00
	30--100	2.54	0.80	19.90	44.40	23.40	10.40	0.90	1.00
	100--150	7.42	0.19	6.51	11.20	28.94	34.63	16.94	1.78
S18	0--50	2.80	0.60	17.50	28.50	28.00	16.50	4.50	5.00
	50--100	3.85	0.60	7.50	18.50	53.50	17.50	1.50	1.50
	100-150	4.60	0.80	0.50	12.50	72.50	13.50	0.50	0.50
S19	0--30	5.80	0.60	4.00	28.50	55.60	6.70	4.10	1.10
	30--100	2.60	0.90	10.84	19.13	41.91	18.51	7.08	2.53
	100-150	3.60	0.60	11.24	12.25	25.32	26.93	18.82	5.44
S17	0--30	4.30	0.23	27.53	28.65	25.35	11.62	3.19	3.66
	30--100	2.20	0.60	19.70	32.22	27.32	14.97	4.08	1.71
	100-150	3.90	0.80	7.50	18.50	53.50	17.50	1.50	1.50
S7	0--30	5.60	1.30	6.51	11.20	28.94	34.63	16.94	1.78
	30--100	7.30	2.60	12.60	22.50	33.70	27.80	2.60	0.80
	100-150	2.80	0.80	7.50	18.50	53.50	17.50	1.50	1.50
S8	0--50	4.30	1.20	14.27	25.11	37.61	15.96	5.63	1.42
	50-100	3.60	0.90	7.87	15.62	25.62	26.24	18.25	6.40
	100-150	2.80	0.60	19.70	32.22	27.32	14.97	4.08	1.71
S11	0--40	8.90	1.20	27.53	28.65	25.35	11.62	3.19	3.66
	40--100	5.60	0.80	19.70	32.22	27.32	14.97	4.08	1.71
	100-150	7.60	1.20	7.50	18.50	53.50	17.50	1.50	1.50
S10	0--35	6.60	1.80	6.51	11.20	28.94	34.63	16.94	1.78
	35--90	8.40	0.60	12.60	22.50	33.70	27.80	2.60	0.80
	90-150	5.20	0.80	7.50	18.50	53.50	17.50	1.50	1.50

(Mn), nickel (Ni), nitrate (NO_3), lead (Pb), strontium (Sr), vanadium (V) and zinc (Zn) (Onken and Sunderman, 1977; Fishman and Friedman, 1985, Barer *et al.,* 2000 and A.S.T.M. ,2002). Chemical analysis results are expressed in milligrams per liter (mg/L), mL equivalents per liter (meq/l. Chloride (Cl^-), calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^+), potassium (K^+), sulfate (SO_4^{2-}), nitrate (NO_3^{2-}) achieved either by using ion chromatography (Dionex, ICS-1100). The locations (longitudes and latitudes) of the collected water samples were edited using global positioning system (GPS) Some parameters as depth to water, temperature T°C, EC and pH were conducted in situ for collecting water samples because some of these parameters (EC and pH) are likely to change on transit (Hem, 1985).

2.3. Agricultural soil suitability model (ALMAGRA) - land evaluation program

The ALMAGRA model is counted on the soil analysis of edaphic factors that affect productivity of semiannual crops such as alfalfa and permanent crops like peach, citrus and olive. The edaphic soil factors including the effective soil profile depth (p), soil texture (t), soil drainage (d), soil carbonate content (c), soil salinity (s), sodium saturation (a) and degree of profile development (g) are used as diagnostic criteria (Micro-lIES web).

2.4. Relationship between soil depth and particle size distribution (%) with $CaCO_3$ content

The particle size distribution percent in different soil samples differs from eastern to western sites of target area. Nearest samples to Ismailia canal contains of fine to coarse sandy particles with low gravels content which differs according to sieving analysis. But farest sample sites from canal showed increasing in soil particle size which intercalated with silty clay minerals with different sizes from surface to subsurface. In the most site samples, the $CaCO_3$ content was in a standard ranges with low risk on the agriculture efficiency.

3. Results and Discussion

3.1. Water type and hydro-chemistry of study area

To identify the hydro-chemical characteristics of the Miocene groundwater in the study area, it must discuss the salinity of the groundwater, hydro-chemical coefficients, hydro-chemical facies, and hypothetical salts combinations analyses. Groundwater's chemistry has predominantly been depended on the chemical structure of host rock. The outcomes from the groundwater analysis were utilized as a tool to recognize the processes and mechanisms influencing the groundwater's chemistry from the examination area. Chloride is the most useful parameter for evaluating atmospheric input to water as it shows very little fractionation. Cation exchange may account for a reduction in the Na concentration, and halite dissolution may account for high concentration of Cl (Matheis *et al.,* 1982). Dissolved species and their relations with each other can reveal the origin of solutes and the processes that generated the observed composition of water. The Na/Cl relationship has often been used to identify the mechanism for salinity distribution and saline intrusions (Sami, 1992 and Panteleit *et al.,* 2001). The Na+ and Ca2+ shows a good correlation indicating that Cl- and for the most part, Na+ are probably derived from the dissolution of disseminated halite in fine-grained sediments. The high Na/Cl ratios are probably controlled by water-rock interaction.

3.2. Chemical analysis of major cations & anions of groundwater and fresh water

3.2.1. Major ionic content of water samples

Table 2 showed the routine analysis of Ismailia canal water and groundwater of target area. The chemical analysis of fresh water explained that the balance content of Ca/Mg higher 1. The hydro chemical categories of surface water were Bicarbonates > Sulphate > Chloride. The salinity of surface water ranged from 250 to 302 ppm and pH ranges from 7.8 to 8.2 that indicate to high alkalinity content (high bi-carbonate content). The total dissolved substances content of groundwater of target area varies from 1870 and 5240 ppm. This indicates to a high difference in salinity values from sites near to Ismailia canal (fresh water) in east and samples was far from canal. The chemical nature of bedrocks in our target area contains limestone with intercalated with salty clay with different earthy minerals. The increasing of dissolution and leaching process occurred with time, this will lead to problems in future for the western sites of target area (recommended points).

Table 2: chemical analyses of major cations & anions of groundwater and fresh water of Ismailia canal

ID		**pH**	**EC µs/cm**	**TDS Mg.L^{-1}**	**Soluble Cations meq/l**				**Soluble Anions meq/l**			
					K^{+}	**Na^{+}**	**Mg^{++}**	**Ca^{++}**	**Cl^{-}**	**SO$_4^{--}$**	**HCO$_3^{-}$**	**CO$_3^{--}$**
Surface fresh water samples of Ismailia canal												
WS1		7.90	503	302	0.12	2.00	1.05	2.29	0.58	1.04	3.09	0.89
WS 2		8.20	416	250	0.11	1.87	0.94	2.14	0.38	0.77	2.62	0.65
WS 3		7.80	476	286	0.12	2.00	0.98	2.19	0.47	0.86	2.80	0.75
Mean		7.96	465	279	0.12	1.95	0.99	2.20	0.48	0.89	2.83	0.76
Median		7.90	476	286	0.11	1.87	0.98	2.19	0.47	0.89	2.80	0.75
Minimum		7.8	416	250	0.11	1.87	0.94	2.14	0.38	0.77	2.62	0.65
Maximum		8.2	503	302	0.12	2.0	1.05	2.29	0.58	1.04	3.09	0.89
Groundwater samples of study area												
WG6	**S1**	7.3	5950	3570	0.566	42.012	11.569	10.921	57.210	5.110	2.001	0.400
WG7	**S11**	6.8	8016	4810	0.714	53.664	13.743	14.740	64.741	15.987	2.800	0.350
WG8	**S16**	7.4	5400	3240	0.369	35.369	9.120	8.532	41.320	9.542	2.674	0.400
WG9	**S2**	7.7	5250	3150	0.310	35.140	9.863	7.210	42.687	9.471	2.887	0.400
WG10	**S17**	8.0	4466	2680	0.425	33.550	8.453	5.321	42.541	3.410	2.900	0.500
WG11	**S3**	7.3	4800	2880	0.377	32.278	7.220	7.401	39.001	5.655	2.714	0.400
WG12	**S18**	7.1	5250	3150	0.462	33.781	7.554	7.668	41.563	6.201	2.601	0.500
WG15	**S14**	6.8	5618	3371	0.500	34.136	9.102	11.378	42.413	11.887	2.354	0.400
WG16	**S4**	7.0	6100	3660	0.599	44.016	9.700	9.597	50.148	12.674	2.331	0.500
WG17	**S19**	6.6	4656	2794	0.760	28.640	9.701	9.102	36.021	10.300	2.542	0.300
WG18	**S5**	7.0	8503	5102	0.514	59.423	13.233	11.510	70.634	12.421	2.214	0.500
WG19	**S10**	7.1	4398	2639	0.522	32.780	8.877	7.639	41.456	5.736	2.190	0.500
WG20	**S12**	7.9	3116	1870	0.360	22.714	6.650	6.840	30.620	1.201	3.021	0.500
WG23	**S9**	6.4	6500	3900	0.742	45.864	11.741	10.112	58.987	5.500	2.310	0.300
WG24	**S15**	7.1	5166	3100	0.702	36.450	9.706	7.640	48.147	3.745	1.987	0.500
WG25	**S20**	7.6	8733	5240	0.730	79.970	16.011	15.851	92.478	20.400	1.958	0.500
Mean		7.2	5745	3447	0.54	40.61	10.14	9.46	49.99	8.70	2.46	0.43
Median		7.1	5325	3195	0.51	35.25	9.70	8.81	42.61	7.83	2.44	0.45
Minimum		6.4	3116	1870	0.31	22.714	6.65	5.321	30.62	1.201	1.958	0.3
Maximum		8.0	8733	5240	0.76	79.97	16.011	15.851	92.478	20.4	3.021	0.5

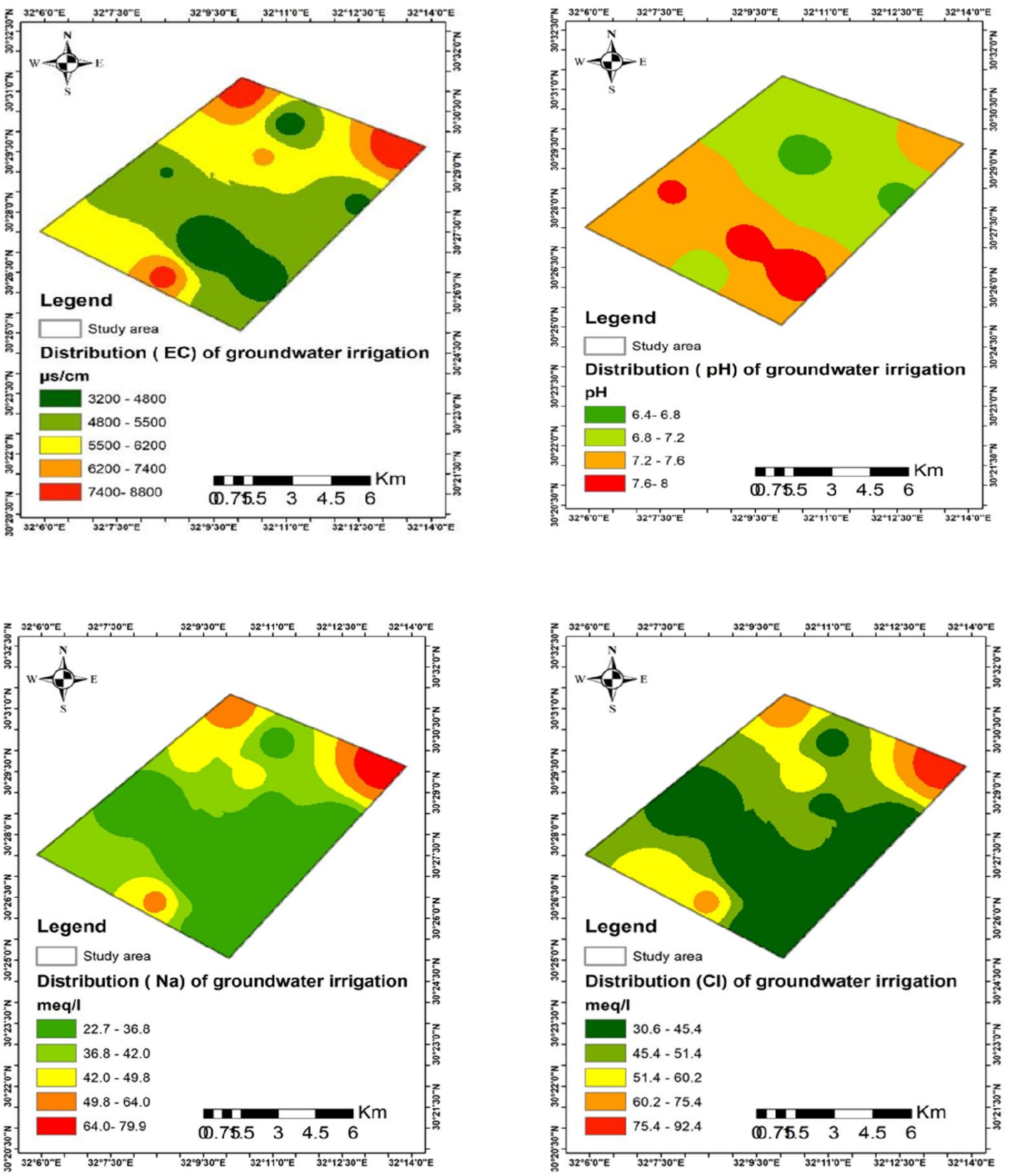

Fig. 3: Showed maps for groundwater characteristics and Na/Cl meq/l distribution

3.3. Major ionic content of soil samples

From the complete soil analysis (sieving analysis) showed the variation soil texture from sites near to Ismailia canal and sites far from canal. In eastern side of target area, along the soil profile with depth has fine sandy soil to course in subsurface samples. But, direction from east to west target area we found different soil texture from coarse sandy with intercalated silt and clay in depth subsurface. In some soil profile, sodium content in surface sector had a high value and subsurface sodium content had low value in the same profile. This proposed to the water salinity effect by farmers. Moreover, in case of high sodium content in subsurface than surface it may be caused by alkali or earthy mineral and silty clay minerals dissolution and leaching process. In site S3 showed in water table level, low sodium and chloride content however the upper sector had high salty content. This is possible caused by soil characteristics of clay content which is used as insulating layer. In S5 site, Na/Cl (salty content) increased from surface to subsurface. This may be found connection between sandy permeable layers.

In S26 the Na content 294 ppm and Cl content 302 ppm, it may be caused by the presence of salty clay minerals layer.

Table 3: Relationship between soil depth and soluble cation and anions concentration

Profile No	**EC Ds/m**	**Depth Cm**	**Soluble cation and anions meq/l**							
			Na $^{+}$	**K^{+}**	**Ca^{++}**	**Mg $^{++}$**	**Cl^{-}**	**CO$_3$ $^{-}$**	**HCO$_3$ $^{-}$**	**SO$_4$ -**
S2	3.51	0--15	26.60	0.54	9.77	4.44	36.60	tr.	1.50	3.25
	2.33	15--50	11.67	0.73	6.75	2.64	14.91	tr.	2.00	4.88
	2.10	50--100	10.77	1.10	5.85	1.74	14.01	tr.	1.10	4.35
	1.45	100-150	3.20	16.00	8.66	3.71	9.25	tr.	2.00	20.32
S3	2.92	0--30	18.20	0.41	7.43	2.84	19.20	tr.	2.00	7.68
	0.75	30--100	2.95	0.97	3.32	1.52	4.41	tr.	2.00	2.35
	0.89	100-150	5.95	0.60	2.16	1.06	7.81	tr.	1.00	0.96
S4	1.86	0--15	13.84	0.83	3.48	1.74	18.35	tr.	1.00	0.54
	1.03	15--90	3.20	1.60	8.66	3.71	9.25	tr.	2.00	5.92
	0.42	90--150	3.18	0.00	1.00	1.40	3.18	tr.	1.00	1.40
S5	1.63	0--30	11.83	0.83	3.48	1.74	16.20	tr.	1.00	0.68
	4.69	30--100	20.90	0.21	5.60	6.55	26.30	tr.	2.00	4.96
	2.06	100-150	14.30	0.73	6.75	2.64	14.91	tr.	2.00	7.51
S28	13.16	0--30	213.00	2.14	28.29	15.78	218.60	tr.	2.00	38.61
	3.03	30--100	21.30	0.73	6.75	2.64	21.20	tr.	2.00	8.22
	2.37	100-150	14.30	0.73	6.75	2.64	16.00	tr.	2.00	6.42
S26	2.49	0--30	12.30	0.76	6.75	3.10	15.20	tr.	2.00	5.71
	13.48	30--100	294.00	16.00	28.29	15.78	302.00	tr.	2.00	50.07
	7.25	100-150	53.40	1.83	13.31	7.26	63.70	tr.	1.00	11.10
S25	2.96	0--50	16.38	25.20	7.56	4.76	15.40	tr.	3.36	35.14
	1.80	50--100	10.60	16.30	4.89	3.08	9.96	tr.	6.34	18.57
	0.85	100-150	5.05	7.76	2.33	1.47	4.74	tr.	3.02	8.85
S24	0.43	0--30	3.18	3.29	0.99	0.62	2.01	tr.	1.28	4.79
	2.72	30--100	16.38	25.20	7.56	4.76	15.40	tr.	9.80	28.70
	0.39	100-150	7.20	0.25	3.18	1 04	2.82	tr.	1.00	6.81
S23	1.14	0--30	3.20	16.00	8 66	3.71	9.25	tr.	2.00	11.66
	0.86	30--100	4.72	0.34	2.55	0 88	4.83	tr.	2.00	0.78
	0.80	100-150	6.67	0.66	3.91	1.43	8.48	tr.	2.00	2.19
S22	0.94	0--30	4.20	2.49	5 66	1.93	6.86	tr.	1.00	0.76
	1.11	30--100	6.24	2.18	2.57	1.17	7.72	tr.	1.00	3.44
	0.26	100--150	2.60	0.44	0 86	0.30	1.47	tr.	1.00	0.87
S18	2.39	0--50	13.60	0.73	6.75	2.64	18.90	tr.	2.00	2.82
	4.66	50--100	19.09	0.21	8.60	6.55	23.27	tr.	2.00	9.18
	3.11	100-150	20.30	0.54	8.00	4.44	30.90	tr.	1.00	1.38
S19	5.39	0--30	53.40	1.83	13.31	7.26	63.70	tr.	1.00	11.10
	2.89	30--100	18.70	0.54	9.77	4.44	28.30	tr.	1.00	4.15
	1.46	100-150	8.90	1.60	8.90	3.71	9.20	tr.	2.00	11.91
S17	0.61	0--30	4.72	0.34	2.55	0 88	4.83	tr.	2.00	0.78
	7.71	30--100	69.80	1.83	20.30	7.26	90.50	tr.	1.00	7.69
	4.05	100-150	28.60	0.21	20.02	6.55	30.20	tr.	2.00	23.18
S7	1.64	0--30	14.60	0.83	3.48	1.74	17.90	tr.	1.00	1.75
	6.69	30--100	60.20	1.83	13.31	7.26	67.00	tr.	1.00	14.60
	2.31	100-150	15.60	0.54	9.77	4.44	28.30	tr.	1.00	1.05
S8	1.27	0--50	9 94	0.52	2.32	10.50	11.91	tr.	1.00	0.43
	1.39	50-100	12.80	0.83	3.48	1.74	17.60	tr.	1.00	0.25
	0.53	100-150	3.65	0.26	1.66	0.52	3.09	tr.	2.00	1.00
S11	1.70	0--40	13.84	0.83	3.48	1.74	18.35	tr.	1.00	0.54
	1.82	40--100	9.54	0 41	7.43	2.84	17.31	tr.	2.00	0.50
	1.89	100-150	13.84	0.83	3.48	1.74	18.35	tr.	1.00	0.54
S10	4.40	0--35	46.00	1.83	13.31	7.26	60.20	tr.	1.00	7.20
	4.30	35--90	44.00	1.20	13.20	7.00	61.20	tr.	1.00	3.20
	3.51	90-150	53.40	2.00	14.20	8.10	63.70	tr.	1.00	13.00

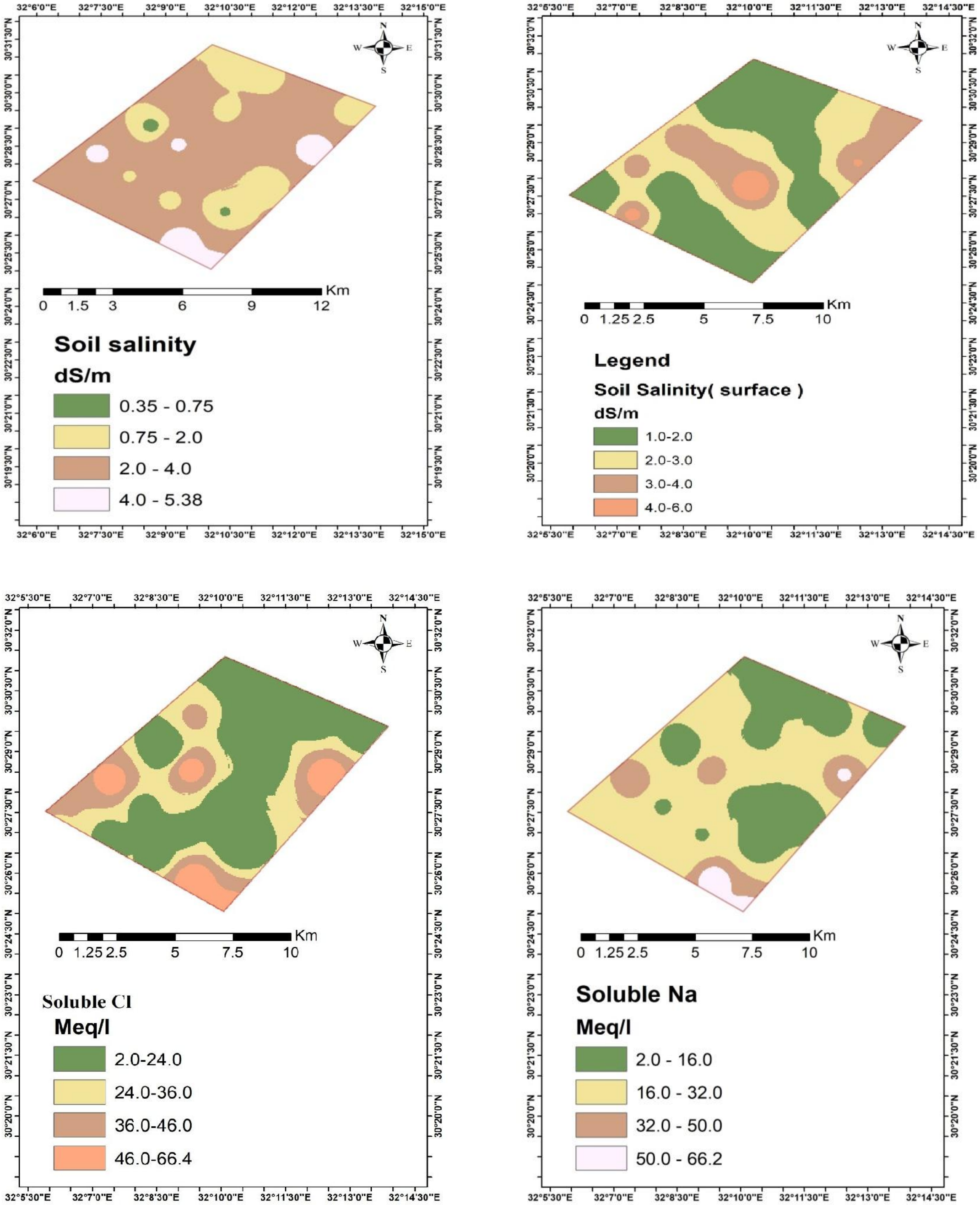

Fig. 4: The difference salinity between soil surface and soil with depth / Na/Cl meq/l distribution

3.4. Chemical analysis heavy metals concentration of groundwater and fresh water of Ismailia canal

Table 4 Explain the heavy metals concentrations in surface and groundwater samples. The heavy metals content in all samples of surface water in a limited standard ranges. In groundwater samples some sites have moderate values of iron content but in standard range, in general, there no any harmful effect on the productivity of different crops.

Table 4: Chemical analysis of heavy metals concentration in groundwater and fresh water of Ismailia canal

ID	Al	Cd	Co	Cr	Cu	Fe	Mn	Mo	Ni	Pb	V	Zn
Std. Irrigation	5	0.0051	0.05	0.08	1	5	0.4	0.07	0.02	0.01	0.005	3
Surface Fresh Water Samples of Ismailia Canal												
WS1	0.09	0.017	ND	0.06	0.24	0.14	0.02	0.057	ND	0.109	ND	0.01
WS 2	0.11	0.024	ND	0.047	0.361	0.162	0.03	0.098	ND	0.13	ND	0.021
WS 3	0.241	0.038	ND	0.032	0.87	0.17	0.06	0.061	ND	0.176	ND	0.032
Mean	0.14	0.02	ND	0.04	0.5	0.16	0.04	0.07	ND	0.13	ND	0.021
Median	0.11	0.02	ND	0.04	0.4	0.16	0.02	0.06	ND	0.13	ND	0.021
Minimum	0.09	0.017	ND	0.03	0.24	0.14	0.02	0.06	ND	0.109	ND	0.01
Maximum	0.24	0.038	ND	0.06	0.87	0.17	0.06	0.098	ND	0.176	ND	0.032
Groundwater samples of study area												
WG 6	0.14	0.011	ND	0.024	0.201	0.523	0.102	ND	ND	0.057	ND	0.015
WG 7	0.186	0.012	ND	0.083	0.387	0.49	0.147	ND	ND	0.091	ND	0.027
WG 8	0.235	0.025	ND	0.01	0.814	0.321	0.21	ND	ND	0.05	ND	0.013
WG 9	0.074	0.036	ND	0.078	0.27	0.247	0.268	ND	ND	0.066	ND	0.007
WG 10	0.18	0.017	ND	0.069	0.332	0.536	0.204	ND	ND	0.019	ND	0.019
WG 11	0.233	0.036	ND	0.001	0.822	0.399	0.147	ND	ND	ND	ND	0.016
WG 12	0.122	0.088	ND	0.017	0.201	0.52	0.11	ND	ND	ND	ND	0.018
WG 15	0.167	0.015	ND	0.036	0.387	0.474	0.174	ND	ND	0.015	ND	0.017
WG 16	0.25	0.056	ND	0.09	0.814	0.301	0.203	ND	ND	ND	ND	0.006
WG 17	0.041	0.034	ND	0.08	0.27	0.263	0.286	ND	ND	0.16	ND	0.005
WG 18	0.103	0.07	ND	0.054	0.332	0.517	0.203	ND	ND	ND	ND	0.018
WG 19	0.25	0.069	ND	0.013	0.822	0.378	0.171	ND	ND	ND	ND	0.014
WG 20	0.108	0.019	ND	0.019	0.201	0.534	0.104	ND	ND	ND	ND	0.011
WG 23	0.16	ND	ND	0.033	0.387	0.488	0.149	ND	ND	0.141	ND	0.063
WG 24	1.02	0.019	ND	0.084	0.721	3.97	0.249	ND	ND	0.573	ND	1.62
WG 25	1.2	0.012	ND	0.01	0.855	4.51	0.227	ND	ND	0.341	ND	1.74
Mean	0.3	0.03	ND	0.04	0.5	0.9	0.18	ND	ND	0.15	ND	0.22
Median	0.17	0.02	ND	0.03	0.4	0.5	0.18	ND	ND	0.07	ND	0.01
Minimum	0.04	0.01	ND	0.01	0.2	0.24	0.01	ND	ND	0.015	ND	0.005
Maximum	1.2	0.088	ND	0.09	0.855	4.51	0.286	ND	ND	0.57	ND	1.74

3.5. Relationship between soil depth and micro-nutrients

The presence of available iron / copper / zinc and manganese metal in the subsurface layer in allowed range and more vaporable nutrients to plant.

Table 5: Relationship between soil depth and micro-nutrients

Profile No	Depth Cm	Available micro- nutrients / ppm			
		Fe	Cu	Zn	Mn
S2	0---15	3.21	0.211	1.66	2.01
S3	0--30	1.839	0.221	0.76	1.244
S4	0--15	0.836	0.134	0.847	1.054
S5	0--30	3.129	0.113	0.671	1.267
S28	0--30	3.679	0.117	0.712	1.074
S26	0--30	2.665	0.089	0.68	0.671
S25	0--50	0.979	0.106	0.57	0.712
S24	0--30	3.278	0.214	1.667	2.035
S23	0--30	1.823	0.223	0.72	1.332
S22	0--30	2.201	0.131	0.871	1.304
S18	0--50	3.222	0.254	1.723	2.423
S19	0--30	2.022	0.096	0.613	0.549
S17	0--30	3.129	0.113	0.671	1.267
S7	0--30	2.99	0.365	0.821	1.324
S8	0--50	3.211	0.325	0.854	1.222
S11	0--40	3.289	0.4015	0.9031	1.4564
S10	0--35	3.0139	0.3679	0.8276	1.3346

3.6. Chemical analysis of groundwater and fresh water of Ismailia canal

3.6.1. Surface water of Ismailia canal (fresh water boundary)

From chemical analysis showed that the salinity value in an allowed range for fresh water (table 5). The total suspended substance (TSS) concentration was in a permissible limit for agriculture. The major analysis that effect on groundwater quality from Esmalia canal were pollution chemical or microbial that affect directly on the productivity on crops. Chemical oxygen dissolved (COD) concentration varied from 4.5 to 6.7 ppm and this data in permissible limit for good agriculture irrigation. The BOD (biochemical oxygen dissolved was a pollution guide in water, but the low value in surface water in Ismailia canal not much and less risk effect on plant. The total nitrogen (TP) and total phosphorous (TP) concentration were in a permissible limit.

3.6.2. Chemical and biological analysis of Groundwater

The total suspended substance (TSS) concentration ranges from 2.30 to 7.0 ppm which was in a permissible limit for agriculture and means no an undesired mineral precipitation. In some groundwater sites found less chemical and biochemical contaminations. It is possible seepage of municipal or anaerobic bacteria pollution. The total nitrogen (TN) ranges from 19 to 45 ppm. It is probably by harmful traditional habitats of fertilization. Total phosphorous (TP) concentration was in a permissible limit.

Table 6: Chemical analysis of groundwater and fresh water of Ismailia canal

ID	pH	EC µs/cm	TDS Mg.L^{-1}	TSS Mg.L^{-1}	COD Mg.L^{-1}	BOD Mg.L^{-1}	SAR	TN Mg.L^{-1}	TP Mg.L^{-1}
Surface fresh water samples of Ismailia canal									
WS1	7.9	336	202	5.02	4.50	2.84	0.25	2.2	0.10
WS 2	8.2	351	211	4.87	6.70	4.60	0.26	2.6	0.16
WS 3	7.8	370	222	5.49	5.90	3.82	0.27	3.3	0.20
Mean	7.9	352	211	5.12	5.7	3.75	-	2.7	0.15
Median	7.9	351	211	5.02	5.9	3.82	-	2.6	0.16
Minimum	7.8	336	202	4.87	4.5	2.84	-	2.2	0.1
Maximum	8.2	370	222	5.49	6.7	4.60	-	3.3	0.2
Groundwater samples of study area									
WG 6	7.3	5950	3570	3.24	12.60	7.50	4.43	25.50	0.12
WG 7	6.8	8016	4810	4.69	13.40	9.00	5.03	29.30	0.65
WG 8	7.4	5400	3240	2.45	12.60	6.70	4.21	22.40	0.74
WG 9	7.7	5250	3150	2.34	13.70	8.10	4.25	21.10	0.59
WG 10	8.0	4466	2680	3.70	15.10	10.90	4.52	20.70	0.48
WG 11	7.3	4800	2880	4.91	14.90	6.30	4.22	22.30	0.66
WG 12	7.1	5250	3150	5.21	22.40	12.50	4.33	35.87	1.97
WG 15	6.8	5618	3371	4.67	17.63	10.24	3.77	19.78	1.10
WG 16	7.0	6100	3660	6.70	11.01	9.70	5.01	32.58	0.96
WG 17	6.6	4656	2794	2.31	10.63	8.26	3.30	33.63	1.54
WG 18	7.0	8503	5102	3.40	9.78	6.54	5.97	36.55	0.80
WG 19	7.1	4398	2639	5.90	16.60	10.21	4.03	26.78	3.10
WG 20	7.9	3116	1870	7.01	18.07	12.32	3.09	28.01	0.65
WG 23	6.4	6500	3900	5.10	9.14	5.10	4.91	30.49	0.76
WG 24	7.1	5166	3100	6.82	35.11	18.63	4.38	45.73	8.01
WG 25	7.6	8733	5240	5.14	32.54	19.04	7.08	39.87	7.54
Mean	7.19	5745	3447	4.6	16.6	10.06	-	29.41	1.85
Median	7.1	5325	3195	4.8	14.3	9.35	-	28.65	0.78
Minimum	6.4	3116	1870	2.31	9.14	5.1	-	19.78	0.12
Maximum	8	8733	5240	7.01	35.11	19.04	-	45.73	8.01

WS: water surface; WG: Ground Water; COD: Chemical oxygen demand; BOD: Biological oxygen demand; SAR: sodium adsorption ratio; TSS: Total suspended solids

3.7. Water and soil ionic ratios relations

Mineralogical composition can exert an important control on the final water chemistry. As groundwater flows through the strata of different mineralogical composition, the water composition undergoes adjustments caused by imposition of new mineralogical controlled thermodynamic constraints (Edet, 1993). Major ions constitute the most significant part of the total dissolved solids present in the groundwater and the concentration of these ions in groundwater depends mainly on the hydro chemical processes that place in the aquifer system. Major ions in the groundwater present a definite spatial trend. Generally, the chemical composition of groundwater is primarily dependent on the type of chemical reaction as well as the geochemical processes taking place within the groundwater system. Water types are often used in the characterization of waters as a diagnostic tool (Lakshmanen *et al.,* 2003). The amount of each ion in water is dependent on the rock mineralogy. However, the use of major ions chemistry to identify rock mineralogy can be useful but must be applied carefully. Mineral precipitation, ion exchange and evaporation can modify chemical composition. In many cases, the source rock minerals may be deduced from the water composition. Using ionic ratios in groundwater, it is possible to indicate the minerals of source rock types. For this purpose, the concentrations of the various constituents are converted to meq L-1 to be able to combine the various ions in a chemically meaningful way (Appelo and Postma, 1993; Howard and Lloyd, 1983; Tellam and Lloyd; 1986; Lloyd and Tellam, 1988 and Ikeda 1989). In this study, most of the ion ratios have been calculated (table 5). Ionic ratios of ground waters have been often used to evaluate intrusion from fresh water boundary (Ismailia canal) and (Suez Canal boundary).

3.7.1. HCO_3/Cl ionic ratio

The values of HCO_3/Cl in surface water higher than 1. It indicated that the dominant categories was $HCO_3>SO_4>Cl$. Analytical result presents the abundance of these ions in the following order: CA > Mg > K > Na = $HCO_3> SO_4 > Cl$. In subsurface groundwater samples had the HCO_3/Cl index equal or less than 1. It meant that the highest salinity values increased from east to west of target area. The increasing of chloride content with decreasing of HCO_3 in groundwater affected directly to decrease of ionic ratio. The dissolution and leaching interaction of bedrocks with groundwater changed the quality from site to another. HCO_3/Cl used as indicator for salinization due to the seawater encroachment.

3.7.2. Na/Ca ionic ratio

The range values groundwater samples of Na/Ca ratio varied from 4 to 6 and for fresh water (Ismailia canal) ionic ratio about 1. According to data, when the sodium content increased, increase of ionic ratio value as Na > Ca >Mg. But in fresh water the balance of ionic ratio is occurred as Ca>Mg>Na. Ratios of Na/Ca, indicating cation exchange reaction can show some mixed behavior but it mostly increases with increase in TDS, which is a good indicator revealing the salinization process.

3.7.3. Na/Cl ionic ratio

The value of Na/Cl ionic ratio of fresh water was larger than groundwater. It indicated that the chloride ion was the dominant ion and also high content than Na. The presence of Cl ion may be increased in water sample through dissolution and leaching of halite bedrocks.

3.7.4. Ca/Cl ionic ratio

The Ca/Cl ionic ratio in fresh water was larger than 4. It may be caused by increase of calcium content than Cl so the calcium ion was a dominant ion. But in groundwater samples the Ca/Cl ionic ratio had a low value under 1 where the Cl ion was a dominant ion related to increase if water salinity.

3.7.5. Mg/Cl and SO_4/Cl ionic ratio

The value of Mg/Cl ionic ratio indicated that the larger magnesium content than chloride in fresh water. In groundwater samples the increase content of chloride content observed. This may be caused by seawater intrusion or increase halite bedrock dissolution. The value of SO_4/Cl ionic ratio had larger than 10 in freshwater $HCO_3>Mg>Cl$ and less than 1 in groundwater samples $Cl >Mg> HCO_3$.The results for the SO_4/Cl ratios and the Ca / Mg concentrations are consistent with intrusion of seawater into the shallow aquifers. Generally, some ionic ratios appeared useful to delineate degree of salinization effect for the ground waters, but it should be noted that they may be disturbed by certain artifacts in the course of the groundwater samplings or chemical analysis.

Table 7: Ionic ratios of ions in groundwater and fresh water of Ismailia canal

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
WS1	8.75	1.17	8.67	7.42	25.7	4.83	16.6	3.47	0.45	0.85	3.47	0.26	0.26	0.50	0.29
WS2	8.55	1.18	7.00	5.91	23.8	3.45	17.0	4.03	0.35	0.69	4.03	0.21	0.24	0.47	0.23
WS3	8.17	1.15	7.17	6.25	23.3	3.92	16.6	3.73	0.38	0.77	3.73	0.23	0.24	0.46	0.25
6	0.03	3.85	0.73	0.19	0.20	0.01	0.09	1.06	2.14	5.46	0.27	4.43	1.87	0.03	1.54
7	0.04	3.64	0.83	0.23	0.21	0.01	0.25	0.93	0.92	5.26	0.15	5.03	1.88	0.03	0.78
8	0.06	4.15	0.86	0.21	0.22	0.01	0.23	1.07	0.89	3.19	0.14	4.21	2.00	0.05	0.70
9	0.07	4.87	0.82	0.17	0.23	0.01	0.22	1.37	0.76	2.50	0.23	4.25	2.06	0.06	0.58
10	0.07	6.31	0.79	0.13	0.20	0.01	0.08	1.59	1.56	1.83	0.32	4.52	2.44	0.06	0.84
11	0.07	4.36	0.83	0.19	0.19	0.01	0.14	0.98	1.31	2.73	0.16	4.22	2.21	0.06	0.88
12	0.06	4.41	0.81	0.18	0.18	0.01	0.15	0.99	1.24	2.95	0.17	4.33	2.22	0.05	0.87
15	0.06	3.00	0.80	0.27	0.21	0.01	0.28	0.80	0.96	4.83	0.15	3.77	1.67	0.04	0.80
16	0.05	4.59	0.88	0.19	0.19	0.01	0.25	1.01	0.76	4.12	0.11	5.01	2.28	0.04	0.64
17	0.07	3.15	0.80	0.25	0.27	0.02	0.29	1.07	0.88	3.58	0.20	3.30	1.52	0.05	0.71
18	0.03	5.16	0.84	0.16	0.19	0.01	0.18	1.15	0.93	5.20	0.17	5.97	2.40	0.03	0.79
19	0.05	4.29	0.79	0.18	0.21	0.01	0.14	1.16	1.33	3.49	0.23	4.03	1.98	0.05	0.96
20	0.10	3.32	0.74	0.22	0.22	0.01	0.04	0.97	5.70	2.26	0.24	3.09	1.68	0.09	1.62
23	0.04	4.54	0.78	0.17	0.20	0.01	0.09	1.16	1.84	4.38	0.24	4.91	2.10	0.04	1.29
24	0.04	4.77	0.76	0.16	0.20	0.01	0.08	1.27	2.04	3.84	0.29	4.38	2.10	0.04	1.33
25	0.02	5.05	0.86	0.17	0.17	0.01	0.22	1.01	0.78	8.10	0.13	7.08	2.51	0.02	0.71

A) HCO3/Cl ;**B)** Na/Ca ;**C)** Na/Cl ;**D)** Ca/Cl ;**E)** Mg/Cl ;**F)** K/Cl ;**G)** SO4/Cl ;**H)** Mg/Ca ;**I)** Ca/SO4 ;**J)** Ca/HCO3 ;**K)** CEV ;**L)** SAR ;**M)** Na/(Ca+Mg) ;**N)** HCO3/(Cl+SO4) ;**O)** Ca/(SO4+HCO3)

Table 8: Ionic ratios of ions in soil profile samples

Profile No	Depth cm	HCO_3/ Cl	Na/ Ca	Na/ Cl	Ca/ Cl	Mg/ Cl	K/ Cl	SO_4/ Cl	Mg/ Ca	Ca/ SO_4	Ca/ HCO_3	Na /(Ca+Mg).
S2	0---15	0.04	2.72	0.73	0.27	0.12	0.01	0.09	0.45	3.01	6.51	0.61
	15--50	0.13	1.73	0.78	0.45	0.18	0.05	0.33	0.39	1.38	3.38	0.65
	50--100	0.08	1.84	0.77	0.42	0.12	0.08	0.31	0.30	1.34	5.32	1.06
	100-150	0.22	0.37	0.35	0.94	0.40	1.73	2.20	0.43	0.43	4.33	0.10
S3	0--30	0.10	2.45	0.95	0.39	0.15	0.02	0.40	0.38	0.97	3.72	0.86
	30--100	0.45	0.89	0.67	0.75	0.34	0.22	0.53	0.46	1.41	1.66	0.58
	100-150	0.13	2.75	0.76	0.28	0.14	0.08	0.12	0.49	2.25	2.16	2.60
S4	0--15	0.05	3.98	0.75	0.19	0.09	0.05	0.03	0.50	6.44	3.48	2.29
	15--90	0.22	0.37	0.35	0.94	0.40	0.17	0.64	0.43	1.46	4.33	0.10
	90--150	0.31	3.18	1.00	0.31	0.44	0.00	0.44	1.40	0.71	1.00	2.27
S5	0--30	0.06	3.40	0.73	0.21	0.11	0.05	0.04	0.50	5.12	3.48	1.95
	30--100	0.08	3.73	0.79	0.21	0.25	0.01	0.19	1.17	1.13	2.80	0.57
	100-150	0.13	2.12	0.96	0.45	0.18	0.05	0.50	0.39	0.90	3.38	0.80
S28	0--30	0.01	7.53	0.97	0.13	0.07	0.01	0.18	0.56	0.73	14.15	0.48
	30--100	0.09	3.16	1.00	0.32	0.12	0.03	0.39	0.39	0.82	3.38	1.20
	100-150	0.13	2.12	0.89	0.42	0.17	0.05	0.40	0.39	1.05	3.38	0.80
S26	0--30	0.13	1.82	0.81	0.44	0.20	0.05	0.38	0.46	1.18	3.38	0.59
	30--100	0.01	10.39	0.97	0.09	0.05	0.05	0.17	0.56	0.57	14.15	0.66
	100-150	0.02	4.01	0.84	0.21	0.11	0.03	0.17	0.55	1.20	13.31	0.55
S25	0--50	0.22	2.17	1.06	0.49	0.31	1.64	2.28	0.63	0.22	2.25	0.46
	50--100	0.64	2.17	1.06	0.49	0.31	1.64	1.86	0.63	0.26	0.77	0.70
	100-150	0.64	2.17	1.07	0.49	0.31	1.64	1.87	0.63	0.26	0.77	1.47
S24	0--30	0.64	3.21	1.58	0.49	0.31	1.64	2.38	0.63	0.21	0.77	5.18
	30--100	0.64	2.17	1.06	0.49	0.31	1.64	1.86	0.63	0.26	0.77	0.46
	100-150	0.35	2.26	2.55	1.13	0.31	0.09	2.41	0.40	0.47	3.18	0.54
S23	0--30	0.22	2.02	0.35	1.14	0.40	1.73	1.26	0.36	0.36	1.74	0.61
	30--100	0.41	1.85	0.98	0.53	0.18	0.07	0.16	0.34	3.27	1.28	0.71
	100-150	0.24	1.71	0.79	0.46	0.17	0.08	0.26	0.37	1.79	1.96	1.19
S22	0--30	0.15	1.80	0.61	0.56	0.28	0.36	0.11	0.32	1.77	1.78	1.20
	30--100	0.13	2.43	0.81	0.33	0.15	0.28	0.45	0.46	0.75	2.57	2.08
	100--150	0.68	2.45	1.77	0.35	0.20	0.30	0.59	0.36	2.01	2.10	0.9
S18	0--50	0.11	2.01	0.72	0.36	0.14	0.04	0.15	0.39	2.39	3.38	0.76
	50--100	0.09	2.22	0.82	0.37	0.28	0.01	0.39	0.76	0.94	4.30	0.34
	100-150	0.03	2.54	0.66	0.26	0.14	0.02	0.04	0.56	5.80	8.00	0.57
S19	0--30	0.02	4.01	0.84	0.21	0.11	0.03	0.17	0.55	1.20	13.31	0.55
	30--100	0.04	1.91	0.66	0.35	0.16	0.02	0.15	0.45	2.35	9.77	0.43
	100-150	0.22	1.00	0.97	0.97	0.40	0.17	1.29	0.42	0.75	4.45	0.27
S17	0--30	0.41	1.85	0.98	0.53	0.34	0.07	0.16	0.32	3.27	1.28	0.10
	30--100	0.01	3.44	0.77	0.22	0.08	0.02	0.08	0.36	2.64	20.30	0.47
	100-150	0.07	1.43	0.95	0.66	0.22	0.01	0.77	0.33	0.86	10.01	0.22
S7	0--30	0.06	4.20	0.82	0.19	0.10	0.05	0.10	0.50	1.99	3.48	2.41
	30--100	0.01	4.52	0.90	0.20	0.11	0.03	0.22	0.55	0.91	13.31	0.62
	100-150	0.04	1.60	0.55	0.35	0.16	0.02	0.04	0.45	9.30	9.77	0.36
S8	0--50	0.08	1.90	0.64	0.19	0.88	0.04	0.04	4.53	5.40	2.32	0.36
	50-100	0.06	3.68	0.73	0.20	0.10	0.05	0.01	0.50	13.92	3.48	2.11
	100-150	0.65	2.20	1.18	0.54	0.17	0.08	0.32	0.31	1.66	0.83	4.23
S11	0--40	0.05	3.98	0.75	0.19	0.09	0.05	0.03	0.50	6.44	3.48	2.29
	40--100	0.12	1.28	0.55	0.43	0.16	0.02	0.03	0.38	14.86	3.72	0.45
	100-150	0.05	3.98	0.75	0.19	0.09	0.05	0.03	0.50	6.44	3.48	2.29
S10	0--35	0.02	3.46	0.76	0.22	0.12	0.03	0.12	0.55	1.85	13.31	0.48
	35--90	0.02	3.33	0.72	0.22	0.11	0.02	0.05	0.53	4.13	13.20	0.48
	90-150	0.02	3.76	0.84	0.22	0.13	0.03	0.20	0.57	1.09	14.20	0.46

A) HCO_3/Cl ;**B)** Na/Ca ;**C)** Na/Cl ;**D)** Ca/Cl ;**E)** Mg/Cl ;**F)** K/Cl ;**G)** SO_4/Cl ;**H)** Mg/Ca ;**I)** Ca/SO_4 ;**J)** Ca/HCO_3 **k)** Na/(Ca+Mg).

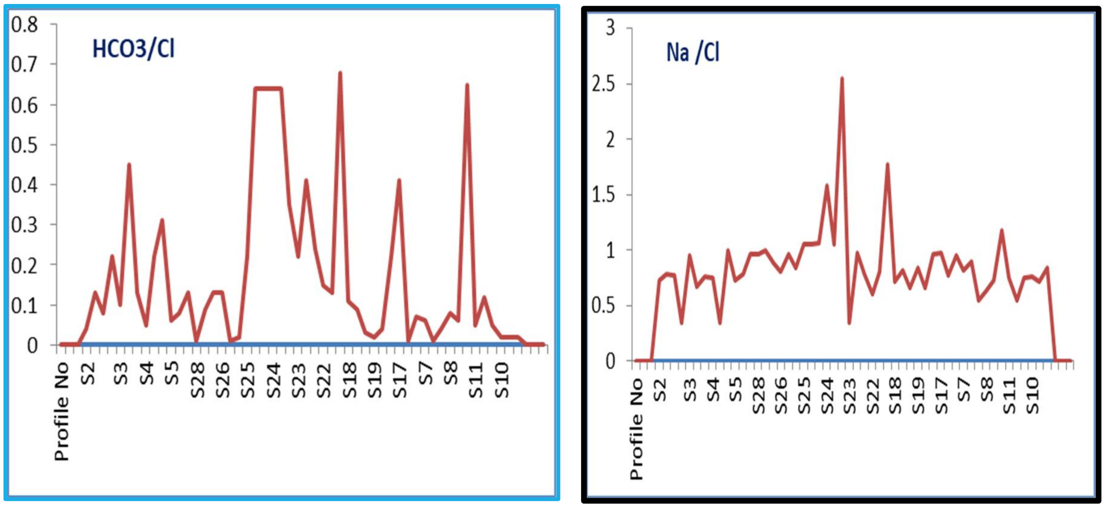

Fig. 5: HCO_3/Cl and Na/Cl ionic ratios of soil samples of target area

The fig.5 showed that the ionic ratio was less than 1. This indicate to the slightly effect of chloride concentration on the suitability of soil and plant except S26, S25, S24, S22, S17 and S11. The ionic ratio Na/Cl in most soil samples did not affected by salinity elevation except to S24, S23, S22 and S18.

3.8. Comparison of soil profiles and water types in Sodium adsorption ratio (SAR)

In table 7 Sodium concentration is very important parameter for irrigation water quality because high level of sodium concentration in irrigation water produces an alkaline soil (Todd and Mays, 2005) describes that SAR is an important parameter for the determination of the suitability of irrigation water because it is responsible for the sodium hazard. High level of sodium in water causes the undesirable effects of changing soil properties and reducing soil permeability. SAR value of irrigation water quantifies the relative proportions of sodium (Na^+) to calcium (Ca^{2+}) and magnesium (Mg^{2+}) and is a measure of alkali/sodium hazard to crop. The SAR values in the study area can be calculated by the following equation given by Hem, 1991 as:

$SAR= Na+ / \{Ca^{2+} + Mg^{2+} /2\}0.5$

Where, the concentrations are expressed as milli-equivalents per liter.

What SAR provides a beneficial pointer of water irrigation potential detrimental effects on soil structure and permeability? The concentration of the constituents is expressed in (meq/l). The irrigation water classification according to SAR values into the following categories; According to (Richards,1954) based on SAR values, irrigation water is classified into four groups: low (SAR<10), medium (SAR, 10–18), high (SAR, 18–26), and very high (SAR >26). With respect to the all river waters of the study area are located in the C1S1 (low salinity and low alkalinity) field. The calculated SAR values vary from 0.069 to 2.15 and lie in excellent SAR class. High level of sodium in irrigation waters may change the soil properties and reduce its fertility due to salinization and alkalization processes (Dehayer *et al.,* 1997). All SAR values were less than 10 and this indicated more suitability for agriculture (Richards, 1954 and USSL, 1954).

3.9. Relationship between soil characteristics and water types

3.9.1. Hypothetical salt combination of hydro-chemical samples

The combination between major anions and cations reveals formation of one, five and three main groups of hypothetical salts combinations for the surface water and groundwater (table 5). Regarding the hypothetical salt combination in al Ismailia canals (irrigation water), water samples, one main assemblage are detected (I), the presence of Na_2SO_4 salt in this assemblage is a true indication fresh water recharges. But the presence of $MgCl_2$ and $MgSO_4$ salts indicates mixed water conditions. So, such water acquires its chemical composition from leaching and the dissolution of terrestrial salts processes. The majority of the water samples (80 %) in the study area is characterized by the assemblage of hypothetical salt combination (IV) regardless of their total salinities, where three sulphate salts (MgCl,

$MgSO_4$ and $CaSO_4$) which reflects the effect of leaching and dissolution of terrestrial salt with some contribution of cation exchange process as well as downward infiltration of the excess irrigation water of the cultivated soils and seepage of irrigation canals, that leads to the increase of water salinity. Table (5) showed the different hypothetical salts freshwater and groundwater. The presence Na_2SO_4 > $NaHCO_3$ > Mg $(HCO_3)_2$ > Ca $(HCO_3)_2$ indicated the intercontinental origin supply (Nile River). The presence of Mg ion in groundwater samples with increasing salinity value and this is because sea water intrusion of Suez Canal. The discussion of the nature of ionic salts in soil depth was more attractive for scientists, in which the formation of different salts indicated to water type and quality. The origin source of water in soil extracted would give us the sea water intrusion or water mixing between (salt& fresh water). The main focusing of an article was study of movement salinity in soil depth and relation between fresh water (Ismailia canal) and sea water intrusion from Suez Canal. The formation of $MgCl_2$ in hypothetical salts combination indicated to sea water intrusion and old sea water formed in ground water in this area. The presence of $MgCl_2$ in sites W8/W12/W15 indicated that the presence of sea water intrusion in groundwater in these areas. $MgCl_2$ was the dominant hypothetical salts. Hypothetical salts of irrigation water had the same hypothetical salts symbol IV. The appearance of $CaCl_2$ formed in W12 because the high soil salinity. In brief, the most groundwater sites were suitable for specified crops with limitation and water management program (Advanced Purification Engineering Corp, 2016) [47].

Table 9: Hypothetical Salts Combination in groundwater and fresh water of Ismailia canal

		Hypothetical Salts Combination								
	Hypo.ID	**NaCl**	**Na_2SO_4**	**$NaHCO_3$**	**$MgCl_2$**	**$MgSO_4$**	**$Mg(HCO_3)_2$**	**$CaCl_2$**	**$CaSO_4$**	**$Ca(HCO_3)_2$**
WS1	**I**	10	18	11	ND	ND	19	ND	ND	42
2WS	**I**	9	17	13	ND	ND	19	ND	ND	42
3WS	**I**	10	18	13	ND	ND	18	ND	ND	41
6WG	III	51	14	ND	ND	18	ND	ND	15	2
7WG	III	43	22	ND	ND	17	ND	ND	16	1
24WG	I	54	11	3	ND	ND	18	ND	ND	14
25WG	I	71	1	1	ND	ND	13	ND	ND	14
16WG	I	66	3	1	ND	ND	15	ND	ND	15
8WG	IV	67	ND	ND	5	1	12	ND	ND	15
12WG	VI	69	ND	ND	15	ND	ND	13	2	1
15WG	IV	63	ND	ND	5	1	11	ND	ND	21
9WG	I	48	1	19	ND	ND	19	ND	ND	14
10WG	I	42	1	28	ND	ND	18	ND	ND	11
11WG	I	23	1	45	ND	ND	15	ND	ND	16
23WG	I	48	6	14	ND	ND	17	ND	ND	15
18WG	I	47	5	19	ND	ND	16	ND	ND	14
19WG	I	49	5	13	ND	ND	18	ND	ND	15
17WG	I	52	5	4	ND	ND	20	ND	ND	19
20WG	I	50	9	4	ND	ND	18	ND	ND	19

Hypothetical Salts No.	**Hypothetical Salts Combination**
I	NaCl , Na_2SO_4 , $NaHCO_3$, $Mg(HCO_3)_2$ and $Ca(HCO_3)_2$
II	NaCl , Na_2SO_4 , $MgSO_4$, $Mg(HCO_3)_2$ and $Ca(HCO_3)_2$
III	NaCl , Na_2SO_4 , $MgSO_4$, $CaSO_4$ and $Ca(HCO_3)_2$
IV	NaCl , $MgCl_2$, $MgSO_4$, $Mg(HCO_3)_2$ and $Ca(HCO_3)_2$
V	NaCl , $MgCl_2$, $MgSO_4$, $CaSO_4$ and $Ca(HCO_3)_2$
VI	NaCl , $MgCl_2$, $CaCl_2$, $CaSO_4$ and $Ca(HCO_3)_2$

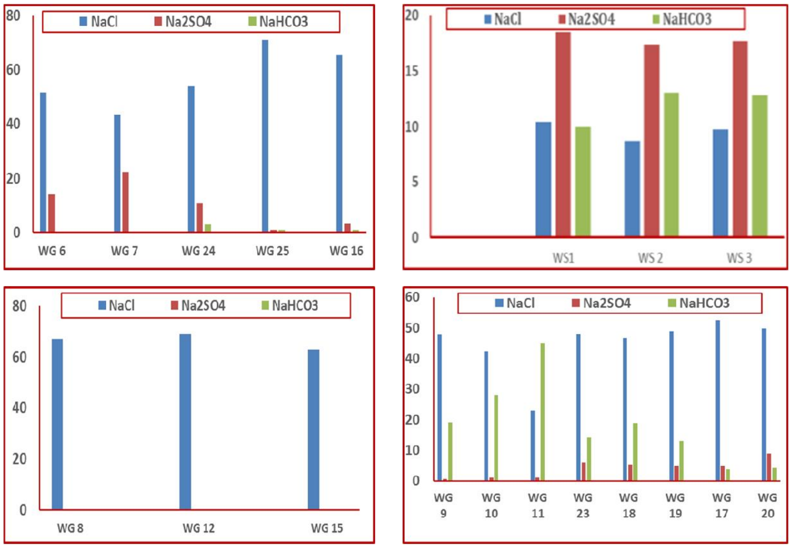

Fig. 5: Relationships among different hypnotical Na-salts in surface and groundwater samples

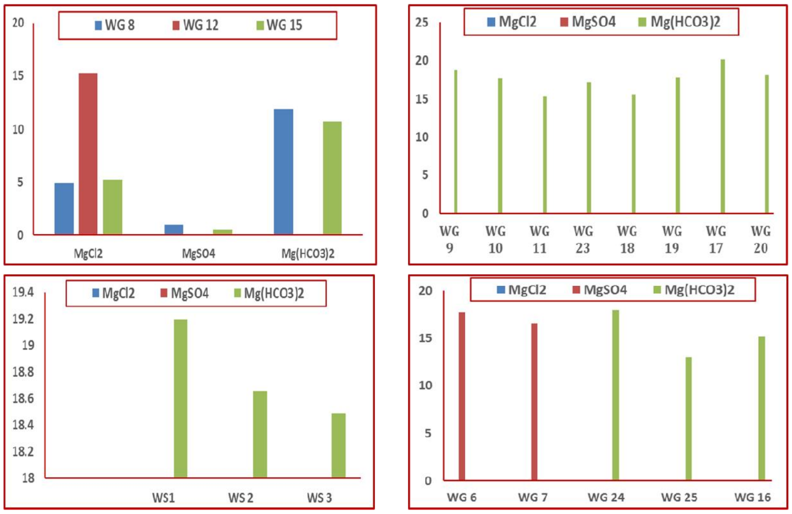

Fig. 6: Relationships among different hypnotical Mg-salts in surface and groundwater samples

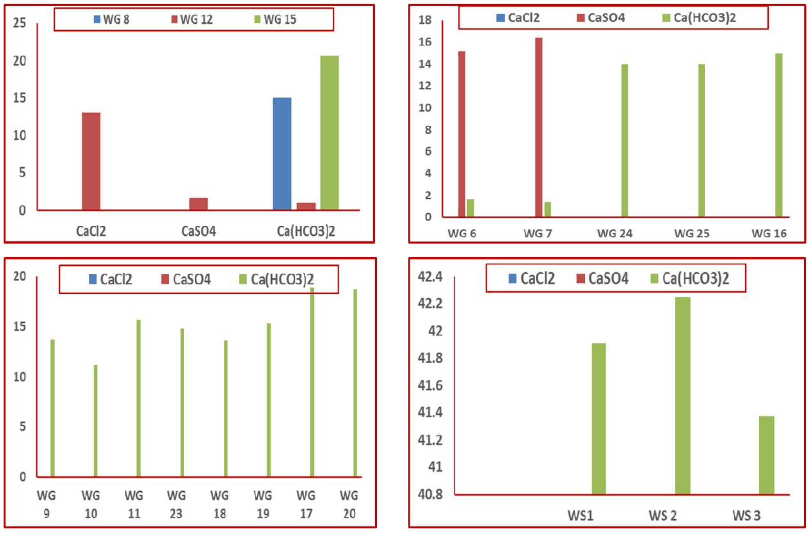

Fig. 7: Relationships among different hypnotical Ca-salts in surface and groundwater samples

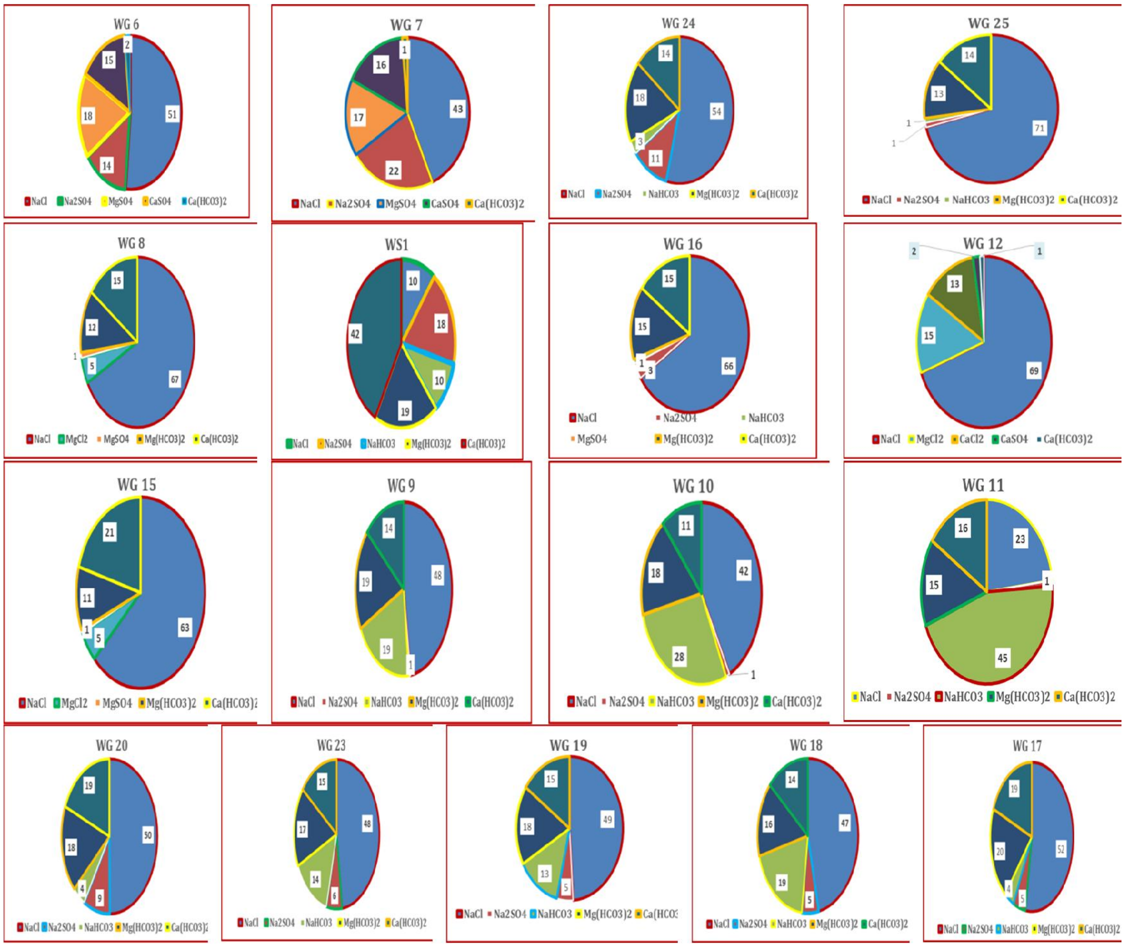

Fig. 8: Different comparison of some hypothetical compounds

3.10. Soil of exchangeable sodium percentage (ESP) & Cation exchange capacity (CEC)

The exchangeable sodium percentage (ESP) measures the proportion of cation exchange sites occupied by sodium. Soils are considered sodic when the ESP is greater than 6 and highly sodic when the ESP is greater than 15(Michiel and Gerhardus, 2019). There are slightly differences in ESP values from site to another. The western sites far from Ismailia canal had ranged from 6 to 10 % (slightly sodic). But the nearest sites to fresh water boundary had non-sodic rate. This is because the seepage of fresh water from Ismailia canal. Most Profiles showed slightly difference of the exchangeable sodium percentage (ESP) values from up to down and this may be indicated to the homogeny of soil particles and acceptable water quality irrigation. Profile S28 may be affected by sodic rate in first soil sector and low ESP values different sectors to reach 150 cm. This may be excessive use of pesticides by farmers. Cation exchange capacity (CEC) is the total capacity of a soil to hold exchangeable cations. CEC is an inherent soil characteristic and is difficult to alter significantly. It influences the soil's ability to hold onto essential nutrients and provides a buffer against soil acidification. Organic matter has a very high CEC. The clay mineral and organic matter components of soil have negatively charged sites on their surfaces which adsorb and hold positively charged ions (cations) by electrostatic force. This electrical charge is critical to the supply of nutrients to plants because many nutrients exist as cations (e.g. magnesium, potassium and calcium). In general terms, soils with large quantities of negative charge are more fertile because they retain more cations (McKenzie, *et al.,* 2004). However, productive crops and pastures can be grown on low CEC soils. The main ions associated with CEC in soils are the exchangeable cations calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^{+}) and potassium (K^{+}), and are generally referred to as the base cations. Profiles (S10 & S11) had high CEC%, this might be the clay minerals found in different soil depth which increase the sodic content in al profile. Soils with a higher clay fraction tend to have a higher CEC. Sandy soils rely heavily on the high CEC of organic matter for the retention of nutrients in the topsoil. Organic matter has a very high CEC as in profiles (S10 & S11) (Rayment and Higginson, 1992). N (Nitrogen), P (Phosphorous), and K (potassium) are the most important nutrients for crop production in agriculture. However, inappropriate agricultural management and land use practice scan turn these nutrients into agricultural pollution sources, hampering the development of sustainable crop production systems and adversely affecting the environment. Specifically, rapid population growth and an increasing demand for the transformation of natural ecosystems into farm land have caused urgent ecological and soil degradation problems (Foley *et al.,* 2005). Land use affects different aspects of soil nutrient cycling, such as mineralization, leaching, absorption, and fixation. For example, the conversion of grassland to farm land has been reported to increase the number of soil pores (Lipiec *et al.,* 2006) and to change the soil water content and concentrations of soil nutrients (McLauchlan, 2006). This conversion also promoted mineralization of soil nutrients and nutrient loss via leaching. Soil nitrogen, Phosphorous and other nutrients significantly decreased when grassland was reclaimed to farm land (Yang *et al.,* 2008 and Meng *et al.,* 2008). In contrast, the content of soil nutrients increased in abandoned farmland (Deng *et al.,* 2013). The nitrogen compounds ranged from 31 to 96 ppm. These values may be found through seepage of different fertilizers as urea or others. For phosphorous element, the amount ranged from 0.15 to 6.00 ppm. For potassium ranged from 29 to 344 ppm. These values were suitable and good results for different crops.

Relationship between degree of dispersion and exchangeable sodium percentage

Rating	Exchangeable sodium percentage	Soil dispersion test
Non-sodic	<6	No dispersion evident after 24 hours. Aggregates slaked but not dispersed (milky) clay.
Slightly sodic	6–10	Dispersion (milky halo) evident after 24 hours. Soil aggregates slightly disperse.
Moderately sodic	6–10	Dispersion (milky halo) evident after several hours. Soil aggregates partially disperse.
Highly sodic	>15	Dispersion (milky halo) evident in less than 30 minutes. Soil aggregates completely disperse.

Table 10: Relationship between soil depth and organic matters & nutrients and sodium ratios

Profile No	Depth Cm	CEC	SAR	ESP	OC	OM	N	P	K
				%				ppm	
S2	0---15	3.05	8.71	10.92	0.56	0.97	62.1	5.1	280
	15—50	5.10	8.16	10.35					
	50—100	3.60	8.05	10.24					
	100-150	4.80	7.75	9.93					
S3	0—30	5.60	8.43	10.63	0.27	0.46	70.1	1.92	298
	30—100	3.60	7.43	9.60					
	100-150	2.10	7.49	9.66					
S4	0—15	2.40	7.94	10.13	0.63	1.10	59.2	0.82	78.2
	15—90	2.23	7.55	9.73					
	90—150	5.60	7.27	9.44					
S5	0—30	4.19	7.83	10.02	0.43	0.75	51.7	1.96	289
	30—100	3.19	9.25	11.48					
	100-150	3.60	8.03	10.22					
S28	0—30	3.40	13.18	15.53	0.52	0.90	44.2	0.15	117.3
	30—100	5.60	8.48	10.69					
	100-150	3.90	8.18	10.37					
S26	0—30	4.20	8.23	10.43	0.43	0.74	35	0.64	29.9
	30—100	4.33	13.33	15.68					
	100-150	2.05	10.44	12.70					
S25	0—50	3.19	8.45	10.65	0.54	0.95	35.1	0.44	57.5
	50—100	3.80	7.91	10.10					
	100-150	4.20	7.47	9.65					
S24	0—30	5.10	7.28	9.44	0.32	0.56	66.1	5.92	287.4
	30—100	3.20	8.34	10.54					
	100-150	3.60	7.26	9.43					
S23	0—30	4.51	7.61	9.78	0.39	0.68	76.1	2.9	298
	30—100	3.60	7.48	9.65					
	100-150	4.00	7.45	9.62					
S22	0—30	3.80	7.51	9.69	0.47	0.82	31.2	0.84	89.7
	30—100	3.86	7.59	9.77					
	100—150	3.60	7.20	9.36					
S18	0—50	3.88	8.19	10.38	0.46	0.81	66.9	4.92	269.4
	50—100	3.57	9.24	11.47					
	100-150	3.03	8.52	10.73					
S19	0—30	2.79	9.58	11.82	0.59	1.03	53.5	0.18	34.5
	30—100	4.26	8.42	10.62					
	100-150	6.36	7.75	9.94					
S17	0—30	3.39	7.36	9.53	0.52	0.91	51.7	0.5	82.8
	30—100	3.60	10.65	12.92					
	100-150	3.57	8.96	11.17					
S7	0—30	6.56	7.84	10.02	0.16	0.27	88.1	5.6	313
	30—100	5.60	10.18	12.44					
	100-150	3.57	8.15	10.34					
S8	0—50	3.80	7.67	9.85	0.47	0.82	80.2	4.6	324
	50-100	6.34	7.72	9.90					
	100-150	3.60	7.32	9.49					
S11	0—40	18.90	7.87	10.05	1.26	2.19	96.91	6.16	344.3
	40—100	29.30	7.92	10.11					
	100-150	31.20	7.95	10.14					
S10	0—35	19.00	9.12	11.34	1.27	2.21	88.805	5.64	315.5
	35—90	29.60	9.07	11.29					
	90-150	27.60	9.25	11.48					

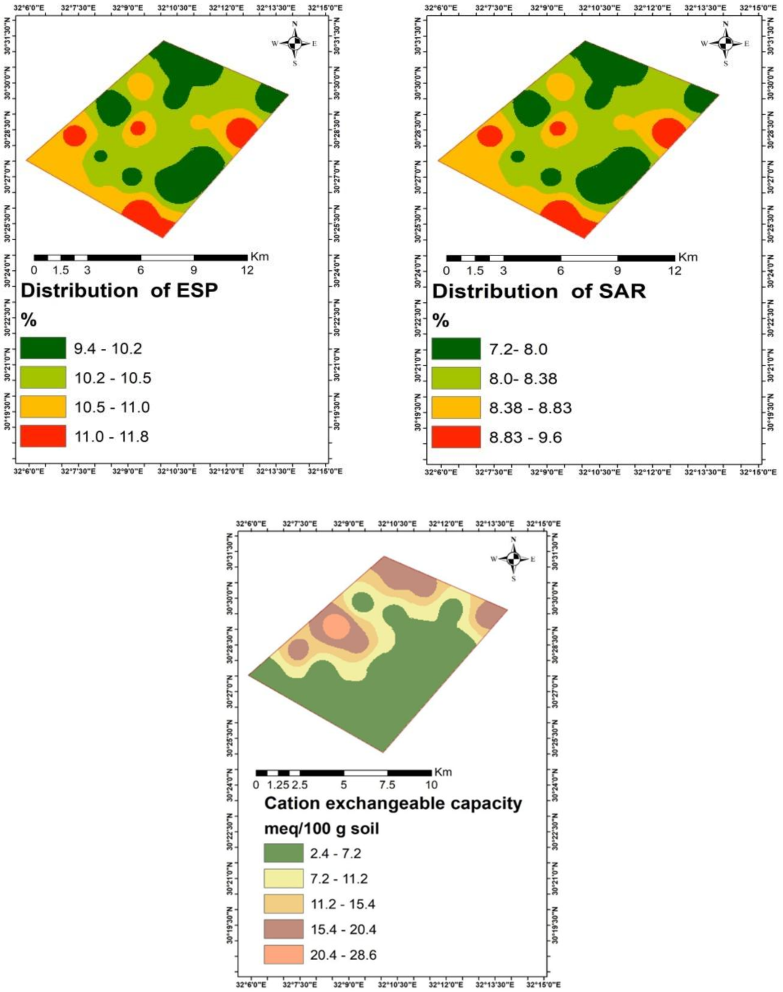

Fig. 9: maps showed CEC & ESP and SAR for soil specification

3.11. Suitability of agriculture crops according soil and water quality

The Salinity hazard can happen when salts accumulate in the zone of the crop to reduce the root sum of water existing at the roots. The available amount of the reduced water occasionally hits such levels that are adversely affecting the crop yield. Plant's growth gets slow rate and drought-like symptoms begins to build up when this water pressure is extended (Ayers and West 1985). A high osmotic potential is caused by high salinity in the water (or soil solution). Plant roots can be burnt and/or flagged by some salts with a toxic effect. The elevated rates of some metals may intervene with proportional availability and plant absorption of other micronutrients (Porter *et al.,* 2005). It is closely related to Total Dissolved Solids (TDS) due to the function of the ionic solute concentrations were classified the groundwater based on salinity hazard into these categories; (Todd, and Mays, 2005)

Excellent groundwater (EC < 250µs/cm)/Good groundwater (EC ranges from 250 – 750µs/cm)/Allowed groundwater (EC ranges from 750 – 2250µs/cm)/Unsuitable groundwater (EC > 2250µs/cm). The total dissolved solids (TDS) are a measure of the total mass of ions dissolved in water. Different methods are used for water classification corresponding to its salinity value. According to Chebotarev, (1955)**,** the natural water is classified into three main categories of total salinity, fresh water (TDS up to 1500mg/L), brackish water (1500 – 5000mg/L) and saline water (TDS more than 5000mg/L). According to this classification, the surface water samples in the study area are related to the fresh water type. Table.12 showed the different values of salinity in watery extract soil at different depths in different farms and showed the different salinity of water types (irrigation water & drainage water and water table). The low salinity is attributed to the contribution Al Salam canal to the water table sub-surface at different parts in the study area, i.e., there is a recharge from these canals to the groundwater in the study area. While, in the other parts of the study area, the high salinity in the groundwater is due to the leaching and dissolution processes of marine soil during the fresh water flow from up-surface to down surface at different depths. The vital aiming of paper was the best crops could give the highest productivity of crops and what crop types agriculture. Figure.10 showed different crops could use with different outcome results. The increasing of soil & water salinity in some areas and also poorly organic matters & nutrients led to decreasing of plant productivity. So that, some recommendations need to use as alternatives new technological fertilizers that achieving good management results.

There some limitations natural or localize that hinder agriculture:

- In some area we need to soil washing by fresh water that had low salinity values.
- Addition of agriculture fertilizers (organic fertilizers).
- Depending on foliar fertilizers to avoid alkalinity & high soil salinity and hardness texture of soil.
- Excellent agriculture managements for all process.

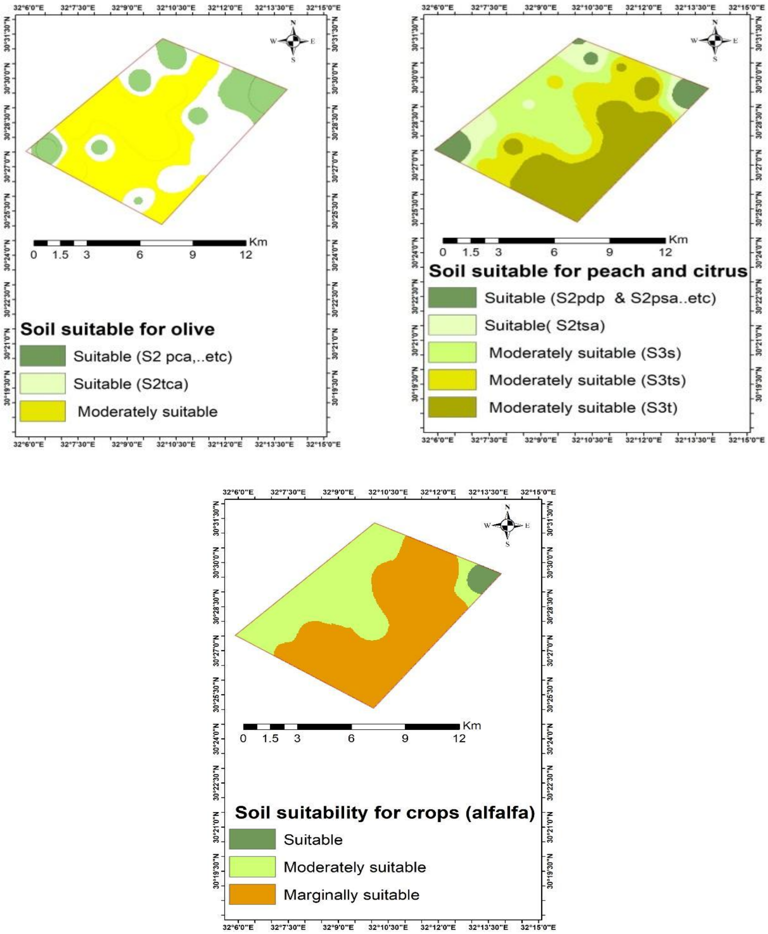

Fig. 10: Showed some crops (Alfalfa 1 & Groundnuts 2 & Pepper 3 & Mango 4 & Olive 5 and Wheat 6)

4. Conclusion and Recommendation

In the present study, an attempt has been made to evaluation the groundwaters of the unconfined aquifer around target area and relationship with soil profiles and suitability of agriculture plants. It is found that the shallow depth to groundwater around target area causing that area more weakness to bedrocks chemical composition and seepage of Suez Canal. Especially with heavily use random fertilization. Meanwhile, the eastern surrounding areas near from the main source of Ismailia canal have a water low salinity and groundwater quality is suitable for all agriculture crops. it can be concluded that the seepage from Ismailia canal to the surrounding areas with losing stream conditions but at some local parts it acts as gaining stream. In general, Ismailia canal could be considered as recharge source for the unconfined aquifer of the study area. The lower values of precipitation in the study area lead to less opportunity to leaching the contaminants in the study area. From chemical analysis showed that the salinity value in an allowed range for fresh water. Samples gave higher values of SO_4/Cl and Ca/Mg ratios might indicate a long residence time of the groundwater in the aquifer which enables the dissolution of small gypsiferous fractions that are dispersed throughout the aquifer. The presence of shale and marl intercalation within the fissured and cavernous limestone aquifer promotes the exchange reactions and dissolution processes which can potentially influence the hydro-geochemical characteristic of the groundwater. The hydro chemical categories of surface water were Bicarbonates > Sulphate > Chloride. The salinity of surface water ranged from 250 to 302 ppm and pH ranges from 7.8 to 8.2 that indicate to high alkalinity content (high bi-carbonate content). The salinity content of groundwater of target area varies from 1870 and 5240 ppm. This indicates to a high difference in salinity values from sites near to Ismailia canal (fresh water) in east and samples was far from canal. The chemical nature of bedrocks in our target area contains limestone with intercalated with salty clay with different earthy minerals. The dissolution and leaching process occurred with time, so it is a big problems in future view for the western sites of target area (recommended points). The main focusing of an article was study of movement salinity in soil depth and relation between fresh water (Ismailia canal) and sea water intrusion from Suez Canal. The formation of $MgCl_2$ in hypothetical salts combination indicated to sea water intrusion and old sea water formed in ground water in this area. The presence of $MgCl_2$ in sites W8/W12/W15 indicated that the presence of sea water intrusion in groundwater in these areas. $MgCl_2$ was the dominant hypothetical salts. Hypothetical salts of irrigation water had the same hypothetical salts symbol IV. The appearance of $CaCl_2$ formed in W12 because the high soil salinity. In brief, the most groundwater sites were suitable for specified crops with limitation and water management program. The total suspended substance concentration was in a permissible limit for agriculture. The major analysis that effect on groundwater quality from Esmalia canal were pollution chemical or microbial that affect directly on the productivity on crops. Chemical oxygen dissolved concentration varied and this data in permissible limit for good agriculture irrigation. The biochemical oxygen dissolved was a pollution guide in water, but the low value in surface water in Ismailia canal not much and less risk effect on plant. It is possible seepage of municipal or anaerobic bacteria pollution. The total nitrogen and total phosphorous were in a permissible limit. The heavy metals content in all samples of surface water in a limited standard ranges. In groundwater samples some sites have moderate values of iron content but in standard range, in general, there no any harmful effect on the productivity of different crops. The increasing of soil & water salinity in some areas and also poorly organic matters & nutrients led to decreasing of plant productivity. So that, some recommendations need to use as alternatives new technological fertilizers that achieving good management results. Such as some area we need to soil washing by fresh water that had low salinity values. Addition of agriculture fertilizers (organic fertilizers) & Depending on foliar fertilizers to avoid alkalinity & high soil salinity and hardness texture of soil and Excellent agriculture managements for all process. Sandy soils rely heavily on the high CEC of organic matter for the retention of nutrients in the topsoil. Organic matter has a very high CEC as in profiles (S10 & S11). All SAR values were less than 10 and this indicated more suitability for agriculture. There are slightly differences in ESP values from site to another. The western sites far from Ismailia canal had slightly sodic. But the nearest sites to fresh water boundary had non-sodic rate. This is because the seepage of fresh water from Ismailia canal. Most Profiles showed slightly difference of the exchangeable sodium percentage (ESP) values from up to down and this may be indicated to the homogeny of soil particles and acceptable water quality irrigation. Profile S28 may be affected by sodic rate in first soil sector and low ESP values different sectors to reach 150 cm. This may be excessive use of pesticides by farmers.

5. Reference

Advanced Purification Engineering Corp, 2016.Water Quality, Total Dissolved Solids in Water, http://www.freedrinkingwater.com/water-education2/72-tds-water.htm

Amadi P.A., C.O. Ofoegbu and T. Morrison 1989. Hydrogeochemical Assessment of Groundwater Quality in parts of the Niger Delta, Nigeria, Environmental Geol. Water Science, 14(3): 195-202.

Amajor L.C., 1986. Geochemical Characteristics of Groundwater in Port Harcourt and its Environs. Proc. Int'l Symp. On Groundwater Resources of Nigeria, Lagos, 358 – 375.

American Society for Testing and Materials (A.S.T.M)., 2002. Water and Environmental technology. Annual book of ASTM. Standards, U.S.A. Sec. 11, Vol. 11.01, and 11.02.

Apodaca L.E., B.B. Jeffrey, and C.S. Michelle, 2002. Water quality in shallow alluvial aquifers, Upper Colorado River Basin, Colorado, Journal of American Water Research Association, 38(1):133-143.

Appelo C.A.J., and D. Postma, 1993. Geochemistry groundwater and Pollution. Balkema, Rottadam,NL, 530 -536.

Ayers, R.S. and D.W. West cot, 1985. Water quality for agriculture. FAO Irrigation and Drainage, Paper 29, Food and Agriculture Organization, Rome.

Barer S., S. Mhli, A. Singh, , C. Arora, , and K. Gil, 2000. Sewer water irrigation effects on some potentially toxic trace elements in soil and potato plants in north western India. Cand. J. Soil, Sci., 80 (3): 465-471.

Baron, T., 1907. The topography and geology of the district between Cairo and Suez. Surv Dept., Cairo.

Chebotarev, I., 1955. Metamorphism of Natural Waters in the Crust of Weathering. Geochimica et Cosmochimica Acta, 8, 22-32.https://doi.org/10.1016/0016-7037 (55)90015-6.

Dehayer, R., N. Diatloff, and I. Gordon, 1997. Irrigation water quality salinity and Department of Agriculture, Technical Bulletin, 19.

Deng, L., Z.P. Shangguan, and S. Sweeney, 2013. Changes in soil carbon and nitrogen following land abandonment of farmland on the Loess Plateau, China. PLOS One, 8(8):e71923.

Edet A.E., 1993. Groundwater quality assessment in parts of eastern Niger Delta, Nigeria, Environmental Geology, Springer Verlag, 22: 41 – 46.

El Ibiary, M.G., 1981. Shallow subsurface geological and geophysical studies in Lake Timsah, Suez Canal Area. M.Sc. Thesis, Tanta Univ., Egypt.

El Shazly, E.M., M.A. Abd El Hady, , M.M. El Shazly, , I.A. El Kassas, , M.A. El Ghawaby, , A.B. Salman, and M.A. Morsi, 1975. Geology and groundwater potential studies of El Ismailia master plan study area. Remote Sensing Research project, Academy of Scientific Res. and Techno., Cairo, Egypt.

ElFawal, F.M. and E.H. Shendi, 1991. Sedimentology and groundwater of the Quaternary sandy layer north of Wadi El Tumilat, Ismailia, Egypt. Annals of the Geol. Surv.of Egypt, v. xvii, 305-314.

EL-Fawal, F.M., 1992. Sedimentology of the quaternary southwest of Ismailia and its chronostratigraphy west of the Suez Canal; pro.3rd conf. Geol. Sinai develop. Ismailia, 141.

Etu- Effeotor, J.O., 1981. Preliminary hydrogeochemical investigations of subsurface waters in parts of the Niger Delta, Journ. Min. Geol., 18(1): 103 – 107.

Etu-Efeotor, J.O and M.I. Odigi, 1983. Water supply problems in the Eastern Niger Delta, Journ. Min. Geol., 20 (1and 2), 183 -193.

Fishman J. and C. Friedman, 1985. Methods for Determination of Inorganic Substances in Water and Fluvial Sediments. U.S. Geol. Surv. Book 5, Chapter A1. Open File Report 85-495, Denver, USA. 84.

Foley, J.A., R. DeFries, G.P. Asner, *et al.,* 2005. Global consequences of land use. Science, 309 (5734):570-574.

Foster, S.S.D and P.J. Chitlon, 2003. Groundwater: the processes and global significance of aquifer degradation. phil trans: R. soc. Land .B 358, 1957- 1972 doi: 1098/rstb2003.

Gee, G.W. and J.W. Bauder, 1986. Particle-Size Analysis. In: Klute, A., Ed., Methods of Soil Analysis, Part 1. Physical and Mineralogical Methods, Agronomy Monograph No. 9, 2nd Edition, American Society of Agronomy/Soil Science Society of America, Madison, WI, 383-411.

Geriesh, M.H., 1989. Hydrogeological investigations of West Ismailia Area, Egypt. M.Sc. Thesis, Fac. Of Sci., Suez Canal Univ., Egypt.

Geriesh, M.H., 1994. Hydrogeological and hydrogeochemical evaluation of groundwater resources in Suez Canal region. ph.D. Thesis, Fas. Sci., Suez canaluniv., Ismailia, Egypt.

Hem, J.D., 1985. Study and interpretation of the chemical characteristics of natural water. U.S. Geol. Survey Water Supply, paper 2254, 3rdedition, third printing, 24.

Hem, J.D., 1991. Study and interpretation of the chemical characteristics of natural Jalali M. Salinization of groundwater in arid and semi-arid zones: an example from Jodhpu.

Howard, K.W.F. and J.W. Lloyd, 1983. Major ion characterization of coastal saline ground waters, Groundwater, 21(4): 429-437.

Ikeda K., 1989. Chemical evolution of groundwater quality in the southern foot of Mount Fuji, Bull. Geol. Surv. Japan, 40 (7): 331- 404.

Lakshmanen E., R. Kannan and M.S. Kumar, 2003. Major ion chemistry and identification of hydrochemical processes of groundwater in a part of Kancheepuram District, Tamil Nadu, India. Environmental Geosciences, 10(4): 157 – 166.

Lipiec, J., J. Kuś, A. Słowińska-Jurkiewicz, *et al.,* 2006. Soil porosity and water infiltration as influenced by tillage methods. Soil and Tillage Research, 89(2):210-220.

Lloyd J.W. and J.H. Tellam, 1988. Caraterizacion hidroquimica de las agues subterraneas en areas costeras (Hydro chemical characterization of groundwater in coastal areas), Proceedings of International Symposium TIAC’88 (Tecnologia de la Intrusion marina en Acuiferos Costeros), Vol 1, Almunnecar, Granada, Spain, June 1-8.

Martinez D.E. and E.M. Bocanegra, 2002. Hydro geochemistry and Cation Exchange Processes in the Coastal Aquifers of Mar Del Plata, Argentina, Hydrogeology Journal, 10: 393 -408.

Matheis G., W.O. Emofurieta., and S.F. Ohiwerei, 1982.Trace element distribution in tin-bearing pegmatites of southwestern Nigeria. In: Evans AM (ed) Metallization associated with acid magmatism. Wiley & Sons, New York London, 205–220.

McKenzie, N.J., D.J. Jacquier, R.F. Isbell, and K.L. Brown, 2004.Australian Soils and Landscapes: An Illustrated Compendium. CSIRO Publishing: Collingwood, Victoria.

McLauchlan K., 2006. The nature and longevity of agricultural impacts on soil carbon and nutrients: a review.Ecosystems. 9 (8):1364- 1382.

Meng, Q.H., B.J. Fu, X.P. Tang, *et al.,* 2008. Effects of land use on phosphorus loss in the hilly area of the Loess Plateau, China. Environmental Monitoring and Assessment, 139 (1-3):195-204.

Michiel C.L., and P.N. Gerhardus, 2019. In Advances in Agronomy.

Murray, W.G. 1951. The Egyptian Climate: An historical outline. Geog. Jour., 117(4).

Nwankwoala H.O., E.V. Okeke and S.C. Okereke 2007. Groundwater quality in parts of Port Harcourt, Nigeria: An overview, trends and concerns, International Journal of Biotechnology and Allied Sciences, 2(3), 282 – 289.

Onken A., and H. Sunderman, 1977. Colorimetric determinations of exchangeable ammonium, urea, nitrate, and nitrite in a single soil extract. Agronomy, J. 69.

Page, A.L., R.H. Miller, and D.R. Keeney, 1982. Methods of Soil Analysis. Part 2. Chemical and Microbiological Properties. American Society of Agronomy. In Soil Science Society of America, 1159.

Panteleit, B., W. Kessels, W. Kantor, and H.D. Schulz, 2001. Geochemical characteristics of salinization-zones in the Coastal Aquifer Test Field (CAT-Field) in north Germany. Proceedings of 5th International Conference on Saltwater Intrusion and Coastal Aquifers—Monitoring, Modeling, and Management (Essaouira, Morocco), 1–11.

PHA, 2005. Standard Methods for the Examination of Water and Wastewater. 21st Edition, American Public Health Association/American Water Works Association/Water Environment Federation, Washington DC.

Porter, D., T. Marek, T. Howell, and L. New, 2005.The Texas High Plains Evapotranspiration Network (TXHPET) User Manual. AREC Publication, 05-37.

Rayment, G.E., and F.R. Higginson, 1992. Electrical Conductivity. In ‘Australian Laboratory Handbook of Soil and Water Chemical Methods’ Inkata Press: Melbourne.

Richards, L.A., 1954. Diagnosis and improvement of saline and alkali soils. Soil structure stability, Water facts, ISSN, 1327–5364.

Said, R., 1981. The geological evolution of the River Nile.Springer-verlag, 151.

Sami, K., 1992. Recharge Mechanisms and Geochemical Processes in a Semi-Arid Sedimentary Basin, Eastern Cape, South Africa. Journal of Hydrology, 139: 27-48. http://dx.doi.org/10.1016/0022-1694(92)90193-Y.

Sandford, K.S. and W.J. Arkell, 1939. Palaeolithic Man and the Nile Valley in Lower Egypt. The Univ. of Chicago press, Chicago, Illinois, 105.

Schoeneberger, P.J., D.A. Wysocki, E.C. Benham, and W.D. Broderson, 2002. Field Book for Describing and Sampling Soils. Version 2.0. Natural Resources Conservation Service, National Soil Survey Center, Lincoln, 228.

Shrestha, B.B., M. Kokh and J.B. Karki, 2016. Mapping of invasive alien plant species in Tarai Arc Landscape (TAL) and ChitwanAnnapurna Landscape (CHAL), Nepal. Unpublished research report submitted to National Trust for Nature Conservation (NTNC), Kathmandu, Nepa.

Tellam J.H. and J.W. Lloyd, 1986. Problems in the recognition of seawater intrusion by chemical means: an example of apparent chemical equivalence, Q. J. Eng. Geol., 19: 389-398.

Todd D.K. and L.W. Mays, 2005. Groundwater Hydrology, John Wiley & Sons, New York, 535.

Todd, D. and L. Mays, 2005. Groundwater Hydrology. 3rd Edition, John Wiley and Sons, Inc., Hoboken, 652.

Toth, J., 1999. Groundwater as a geologic agent: an overview of courses, processes, and manifestation.

Udom G.J., J.O. Etu- Efeotor and E.O. Esu, 1999. Hydrochemical evaluation of groundwater in parts of Port Harcourt and Tai-Eleme Local Government Area, Rivers State., Global Journal of Pure and Applied Sciences, (5), 546 – 552.

USSL., 1954. Diagnosis and improvement of saline and alkali soils, USDA Hand waters, 3rd edition US Geol. Survey, water supply paper 2254, scientific pub.

Yang, L., F.S. Zhang, R.Z. Mao *et al.,* 2008. Conversion of natural ecosystems to cropland increases the soil net nitrogen mineralization and nitrification in Tibet. Pedosphere, 18(6):699-706.

Zoetbrood, J.A., 1984. Water balance study in the western part of Wadi El Tumilat, Egypt Report IWACO. and RIGW. Vol. II.