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EVALUATING THE GROUND WATER SUITABILITY FOR A NUMBER OF WELLS IN BAGHDAD PROVINCE FOR IRRIGATION PURPOSE

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ABSTRACT

The quality of the groundwater should be monitored constantly for the purpose of irrigation. So, that the hazard of ground chemical pollutants can be minimized by a suitable treatment method. Therefore, the aim of this research was to find out the suitability of the ground water that has been collected from Baghdad province, Iraq, for the purpose of irrigation based on the different parameters of water quality. In this research, twenty-eight samples that were collecting from different positions of the study region and the parameters were analyzed such as pH, Ec, TDS, HCO_3^-, Ca^{+2}, $mg+^2$, Na^+, k+, Cl^-, So4-2 and $N0^-_3$, based on the above some of parameters like (Ca^{+2}, mg^{+2}, Na) were used for calculations of sodium adsorption ratio. The water quality parameters: EC, Na, Cl, HCO_3 and SAR were calculated in order to determine the WQI of the studied area. The values of these characteristics were found more than the permissible limits in the some of the samples of studying area. The higher values of these parameters would increase WQI value. The WQI is an important classification to stand on the whole water quality in a lone term that is helpful for determining the appropriateness of water fort irrigation purpose, was also appreciated. The present dataset established the application of water quality indicators that may be useful for decision makers for managements, treatments and sustainable development in genera.

Keywords: ground water, irrigation, physical and chemical properties. IWQI, GIS.

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1. INTRODUCTION

Ground water is an important and renewable resource that has manyintrinsic advantages over surface water. It is recognized as a safe source of fresh water worldwide. The order for water has greater than before over time and this has led to water scarceness in many parts of the earth *(Nandini **et. al.,2018**), increased* demand for water is a result of the increase in the world population as well as improving living standards. Agricultural demand for water continues to increase with the adoption of supplementary irrigation in areas where precipitation is insufficient to meet best crop water requirements. Water shortage is a major restraint growth of agricultural production in many countries ***(Mohammed et.al.,2013). The*** reason of increased demand for water is a result of the increase in world population as well as improved living standards.

Many countries are relied on the groundwater for agriculture. The quality of irrigation water has a major impact on the soil salinity, the increase and yield of agricultural crops. In general, water used for irrigation always contain different concentrations of dissolved salts which are generated naturally by (e.g. precipitation rate, weathering of rocks and dissolving of other salt sources) or anthropological (i.e. domestic and industrial sources) ***(Jarvie et. al., 1998 and K.N.Kadhim &Noor, 2018).***

Thus, the study of irrigation water quality has become essential because it shows whether the quality of the water appropriate for irrigation and do not cause formation of saline or alkaline soils in addition to be an indicator of whether this kind of the water cause toxicity to plants and crops.

The most useful tool to monitor and evaluation the water quality is by using the Water Quality Index (WQI) ***(Al-obaidy et. al.,2010),*** it is a compilation parameter calculated on many WQ parameters according to a specific process. consequently, the WQI is measured from 0 (poor water quality) to 100 (best water quality) ***(Kizar. 2017).***

The WQI is provide a single value that show on the whole water quality evaluation in a given position and time based on a number of water quality variables. The indicator aims to transform difficult data related to water quality to clear and usable information from the public. This value cannot show the full truth of water quality; here are other values of water quality not integrated in the index. on the other hand, the water quality is indicator based on a few significant criteria which can give easy indication of water quality ***(Hussain et.al., 2014).***

Several guidelines for water quality have been recommended by many researchers for using water in irrigation under different soil condition ***(Al Obaidy, 2014)***. However, this study was conducted to monitor the ground water quality of wells for irrigation uses.

Shukri et. al.,2007 & K.N.Kadhim, 2018 has studied the biological and chemical properties of water samples collected from six wells distributed within the Faculty of Agriculture - Abu Ghraib and water samples from different water sources (freshwater and drain water) from different sites. The result of study was showed that (15-20%) according to the Agriculture and Food Classification of the United Nations for a period 1985-1992, providing good and deep-water drainage to maintain a saline balance of the soil and the use of potential crops for salinity. Caution from using water wells for Animal consumption due to high salinity, but microbial biologically are free of any microbial contamination

Hill, 2008 has mentioned that wells water was lying in the region surrounding the Musayyib project contains high salts concentrations, making them unsuitable for irrigating sensitive agricultural crops. The results also showed the possibility of using 90% of wells to irrigate normal agricultural crops

Hayani, 2009conducted that the water wells located in the village of Khafajiya in Al-Anbar province were not appropriate for irrigation and drinking purposes as well as it contains high concentrations of sulphates. In order to show the validity of the water of the studied wells, the results of the analysis were compared with the approved standards. The study showed that the physic-chemical characteristics of the ground water of the ten wells in Al-Anbar province were not appropriate for drinking purposes. Instead, Its water can be used for irrigation only and for salinity resistant plants (Obeidiet.al., 2013 and K.N.Kadhim &Ahmed,2018).

The current research aims to evaluating the appropriateness of the well water quality for irrigation uses in Baghdad province using IWQI and ArcGIS software to show the spatial distribution of this index.

2. MATERIAL AND METHODS

2.1. Study area

Baghdad province is a part of a sedimentary plain in Mesopotamia Plain. It belongs to the unstable Shelf and represents unsymmetrical a syncline, filled by quaternary alluvial sediments, which belongs generally to Pleistocene and Holocene sediments. Those sediments composed mainly from clay, mud, silt and a little bit fine gravel, heterogeneous distribution, which cause unordered extent for the ground water aquifers.

Clay and mud represent a confining bed at the upper part of quaternary sediments, its thickness almost between (10 – 20) m, while ground water available in the lower beds among fine sand and pebbles.

Quaternary sediments in the Tigris basin represent a hydraulic connecting aquifer; its thickness exceeded 70m. In some locations, this connection with the Injanaformation (U. Miocene) particularly at west and south of the province while this connection at east direction is far away from the Tigris basin ***(Al–Basrawi, 2015).*** It has been set a number of wells in the Baghdad province as shown in Figure (1)

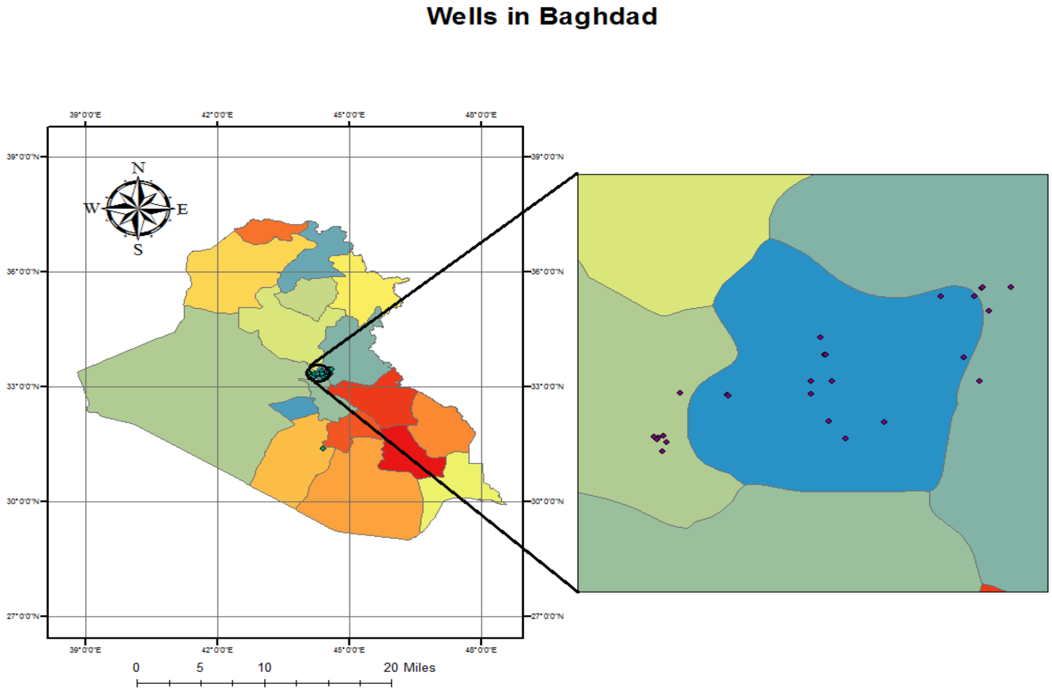

Figure 1A map of Baghdad province describes the study site

3. DATA COLLECTION

Groundwater samples were taken from 30 well. The location of the groundwater samples wells are displayed on a figure (1).

The elements were used the water characteristics of electrical conductivity (EC) and hydrogen ion concentration (PH) and total dissolved solid (TDS) were measuring in the study area while the other characteristics like sulfate (SO_4^{-2}), chlorides (Cl^-), calcium (Ca^{+2}), magnesium (Mg^{+2}), sodium (Na^+), and potassium (K^+) were analyzed in the laboratory according to the standard procedures of APHA (1995). The GIS software, Arc Map (v.10 .5) spatial analyst, are used to perform the analysis for this study. Arc GIS provides a framework for overlying and analyzing spatial relationships among multiple map layers. GIS (version 9.3) was used to generate maps using 3D spatial analysis. Surface interpolation functions create a continuous (or prediction) surface from sampling point values. A continuous surface of a raster dataset represents the concentration of EC, SAR, Na and Cl

4. DATA ANALYSIS

4.1. The appropriateness of Groundwater for Irrigation Uses

The irrigation water quality is varied greatly depending on the kind and the magnitude of salts that dissolved same place. It is generally accepted that the problems caused by the quality of irrigation water are changed in type and severity as a function of many factors, including soil kind and crops, the climate of the region as well as the farmers who uses water ***(Kizar. 2017).*** Irrigation water quality (IWQ) is mainly evaluated as a function of a certain quality parameter level. Different criteria for determining the quality of irrigation water can be classified in the main groups: (a) salinity risk, (b) permeability and infiltration troubles, (c) specific ion hazard; and, (d) miscellaneous problems ***(spandana, 2013).***

4.1.1. A-Salinity risk

The excess of salts content is one of the major concerns with water used for irrigation. The term salinity is used to describe the concentration of salt species ***(Porter and Marek, 2006)***. The salinity risk can occur when salts are accumulated in soil layers between plant roots due to reduction in total water content. The low amount of water that available from time to time is negatively affect crop yield. Plant's growth is getting slow rate and drought-like symptoms begins to increase, but when this water pressure is extended ***(Ayers and Westcot,1985)*** A high osmotic potential due to high salinity in water (or soil solution). Plants roots can be burnt and/ or deformed by some salts with poisonous effects. High rates of some minerals may interfere with the relative availability and plant absorption of other micronutrients ***(Porter and Marek, 2006)***. salinity of irrigation water is expressed of the overall focus of the dissolved salts in water in term of electrical conductivity of water. Electric conductivity is the measure of water's ability to conduct electricity. There is a close relationship between both the electrical conductivity and the dissolved salts amount in water. The EC as is an indicator of

concentration of salt. in water**.** It depends on the total concentration of ionized matter and water temperature ***(Hill, 2003).*** Conductivity is commonly measured by using a specially designed probe and is expressed in units of milli siemens per centimeter (μS/cm). The usual range of EC as mentioned by ***(Mohammed,2015*)** is between 0-3000 (μS/cm)

The total dissolved salt was described in units of milligrams per liter (mg/l) or parts per million (ppm). Their values range between (0-2000 ppm) in water for irrigation uses as mentioned by ***(Mohammed,2015)***.

4.1.2. B- permeability and infiltration problems

The most common water quality factor affecting the normal rate of infiltration of water is the relative concentrations of Na, Mg and Ca ions in water that is also known as the sodium adsorption ratio (SAR). SAR describes the relationship between soluble sodium and soluble divalent cations (calcium and magnesium) ***(Shammi ,2016)*** and is calculated

$$SAR=\frac{Na}{\sqrt{\frac{Mg+Ca}{2}}} \quad (1)$$

where [Na], [Ca] and [Mg] are known as the concentrations of sodium, calcium and magnesium ionsin water, respectively. The common EC-SAR standard is used to evaluate the potential infiltration risk that may develop in a soil. Irrigation water is having high SAR levels can lead to the

build-up of high soil sodium levels over the time, which in turn can adversely affect soil infiltration and percolation rates due to soil dispersion. Additionally, excessive SAR levels can lead to soil crusting, poor seedling emergence, and poor aeration (***Shah and Mistry***; 2013)

4.1.3. C- specific ion toxicity

4.1.3.1. Sodium

Sodium is a highly soluble chemical element with the symbol "Na" so it was found in natural water. The high concentration of sodium in the irrigation water can be affected on soil and plants. The Soil that contains a large amount of sodium is associated with a part of the clay has poor physical for plant growth and water infiltration. At high concentration, Na^+ can also be toxic to many plants. Sodium does not cause problems with the irrigation system. Local water supply is often diluted by replacing calcium with sodium in order to prevent scale formation ***(Boman, 2002)***

4.1.3.2. Chloride (Cl)

Although chloride is necessary for plants in very small quantities, it can cause toxicity to fast-impact crops with high concentrations, such as a sodium. ***(Bauderet, al. 2003.)***

4.1.3.3. PH

It is an indicator of acidity or water basics, but it is rarely a problem in itself. The main use of pH in water analysis is to detect abnormal water. The natural pH of irrigation water is range from 6.5 to 8.4. An abnormal value is a warning that water needs more assessment ***(Ayers et.al., 1994).***

4.1.3.4. Bicarbonate

Bicarbonate (HCO^{-3}) and lower carbonates (CO_3^{-2}) are found in high PH water and are commonly referred to as carbonates. High-carbonated irrigation water complicates Na's excessive management When water is containing carbonates dries on the surface of the soil, calcium carbonate and magnesium (lime) are formed. Since calcium and magnesium are no longer soluble, they do not counteract the negative effects of N, and problems related to high Na may occur. White lime deposit may also appear on grass leaves periods of drought and hot as carbonates are deposited during evaporation ***(Almaliki, 2013).***

4.2. Modeling of Irrigation Water Quality Index (IWQI)

The groundwater quality index for irrigation and its suitability for agricultural crops were analyzed with the following stages: First, the parameters of water quality for irrigation such as EC, Na^+, Ca^{2+}, Mg^{2+}, Cl^-, and HCO_3^- as well as the EC in μS/cm unit and concentration of ions in meq/l units were identified. Then, the adjusting sodium adsorption ratio (SAR) was calculated from eq(1). Also, the IWQI value was calculated based on the equations in the model of Meireles et al. (2010). Limit values of the parameters for calculating the value of the measured water quality for IWQI were determined in agreement with Ayers and Westcot (1994), Al-Mussawi (2014), Khalaf and Hassan (2013), and Omran et al. (2014)). To estimate xamp, of the final category of each parameter, the upper limits was viewed as the maximum value obtained in the physical and chemical examination of water samples. Each weight of a parameter used in the IWQI was gotten by (Meireleset, al., 2010). Furthermore, irrigation water usage restrictions were determined based on the value IWQI and suitability of the use of irrigation water to the soil and plants according to the table of water quality index characteristics proposed by Meireles et al. (2010). In addition, suitability of groundwater quality to types of crops was analyzed based on water use restrictions dan recommendation for plant (Meireles et al., 2010) and relatively salt tolerant agricultural crops (Ayers and Westcot, 1994) considering the types of agricultural crops of high economic value (recommended in the Criteria Development and Management of Groundwater Irrigation) (Haryono et al., 2009) and those with cultural techniques commonly used by farmers , socially, economically acceptable and has been cultivated in the study area (BadanPusatStatistikKabupatenJombang, 2014a, 2014b, 2014c). Finally, the spatial distribution of groundwater quality index in the study area was mapped using ArcGIS software

$$Qi=Qimax-[(xij-xinf)*Qiamp)/xamp] \quad (2)$$

where

Qimax= the maximal value of qi for this category;

xij = the parameter spotted value;

xinf = the value that corresponds to the minimal border of the category to each parameter

Qiamp = category ampleness;

xamp = category ampleness to each parameter.

$$WQI=\sum_{i=1}^{n} Q_i W_i \quad (3)$$

WQI is none dimensional parameter extending from (0 to 100);

Qi is the quality of the parameter (ith)

Wi is the weights for each parameter was shown in table (2)

Table 1 Limiting values of Parameter for quality measurement (Qi) calculation *(Ayers and Westcot,1999)* depend on which guideline

q_i	EC (dS cm^{-1})	SAR° ($mmol_c$ $L^{-1})^{1/2}$	Na^+	Cl^- (mmol$_c$ L^{-1})	HCO_3^-
85-100	$0.20 \le CE < 0.75$	$2 \le SAR° < 3$	$2 \le Na < 3$	$1 \le Cl < 4$	$1 \le HCO_3 < 1.5$
60-85	$0.75 \le CE < 1.50$	$3 \le SAR° < 6$	$3 \le Na < 6$	$4 \le Cl < 7$	$1.5 \le HCO_3 < 4.5$
35-60	$1.50 \le CE < 3.00$	$6 \le SAR° < 12$	$6 \le Na < 9$	$7 \le Cl < 10$	$4.5 \le HCO_3 < 8.5$
0-35	$EC < 0.20$ or $EC \ge 3.00$	$SAR° < 2$ or $SAR° \ge 12$	$Na < 2$ or $Na \ge 9$	$Cl < 1$ or $Cl \ge 10$	$HCO_3 < 1$ or $HCO_3 \ge 8.5$

Table 2 Weights for the WQI parameters

Parameters	Wi
Electrical Condutivity (EC)	0.211
Sodium (Na^+)	0.204
Bicarbonate (HCO_3^-)	0.202
Chloride (Cl^-)	0.194
Sodium Adsorption Ration (SAR°)	0.189
Total	1.000

4.2.1. SAR: Sodium adsorption ratio

Table 3 the restrictions of water use based on irrigation Water Quality Index (*(Meireles et, al., 2010)*

WQI	Water use restrictions	Recomendation	
		Soil	Plant
85 ≤ 100	No restriction (NR)	May be used for the majority of soils with low probability of causing salinity and sodicity problems, being recommended leaching within irrigation practices, except for in soils with extremely low permeability.	No toxicity risk for most plants
70 ≤ 85	Low restriction (LR)	Recommended for use in irrigated soils with light texture or moderate permeability, being recommended salt leaching. Soil sodicity in heavy texture soils may occur, being recommended to avoid its use in soils with high clay levels 2:1.	Avoid salt sensitive plants
55 ≤ 70	Moderate restriction (MR)	May be used in soils with moderate to high permeability values, being suggested moderate leaching of salts.	Plants with moderate tolerance to salts may be grown
40 ≤ 55	High restriction (HR)	May be used in soils with high permeability without compact layers. High frequency irrigation schedule should be adopted for water with EC above 2.000 dS m-1 and SAR above 7.0.	Should be used for irrigation of plants with moderate to high tolerance to salts with special salinity control practices, except water with low Na, Cl and HCO_3 values
0 ≤ 40	Severe restriction (SR)	Should be avoided its use for irrigation under normal conditions. In special cases, may be used occasionally. Water with low salt levels and high SAR require gypsum application. In high saline content water soils must have high permeability, and excess water should be applied to avoid salt accumulation.	Only plants with high salt tolerance, except for waters with extremely low values of Na, Cl and HCO_3.

5. RESULTS AND DISCUSSION

5.1. Spatial distribution of water quality parameters for wells

Statistical measurement for water quality parameters, such as minimum, maximum, mean and standard deviation, are found with help of EXCEL software as shown in tables (4)

Table 4 statistical analysis of ground water quality parameters for wells

Parameter	PH	EC (μs/cm)	TDS (ppm)	K (ppm)	Na (ppm)	Mg (ppm)	Ca (ppm)	Cl (ppm)	SO4 (ppm)	HCO3 (ppm)	NO3 (ppm)
Average	7.38	3917	2764	13.41	363.14	130.07	233.84	574.54	846.97	294.96	4.51
Max. value	7.85	12800	9292	118	895	418	740	2272	2080	903	9
Min. value	7.01	900	621	1	68	20	39	128	46.1	22	0.2
Range	0.84	11900	8671	117	827	398	701	2144	2033.9	881	8.8
Standard deviation	0.24	3264.5	2330.85	26.4	269.98	112.98	198.16	530.24	603.87	250.04	2.847

Electric conduction is the water ability to deliver electricity supply through the water, the EC values varied between 967 and 12800 μScm^{-1}. The EC is the lowest for that collected from well (1) while the highest occurred in a sample from well (17).

Table (5) shows a difference in the values of TDS during the study period. It is noted that the highest value is at well (17), while the lowest value is at well (7)**,** this is mean that the value of EC and TDS throughout the study period was not within the permissible Limits of Water Validity for Irrigation (FAO,1985) for most wells.

Table 5 Concentration of physical and chemical parameters

No	Sub District	PH	EC (µs/cm)	TDS (ppm)	K (ppm)	Na (ppm)	Mg (ppm)	Ca (ppm)	Cl (ppm)	SO4 (ppm)	HCO3 (ppm)	NO3 (ppm)	S.A.R.
1	Center	7.51	967	700	1	147	27	53	188	232	68	1.9	6.33
2	Center	7.51	1232	908	2.4	143	30	57	186	230	64	3.2	4.74
3	Center	7.51	2150	1511	8.5	245	20	39	159	306	193	8.2	5.43
4	Center	7.11	2780	1935	12	308	58	129	239	721	177	7.1	9.67
5	Center	7.12	4710	3310	118	534	160	330	718	1290	504	1.1	15.65
6	Center	7.36	5820	3840	91	511	141	311	681	1179	479	2.5	15.02
7	Center	7.41	900	621	2	74	38	61	181	170	22	1.1	7.03
8	Center	7.13	3870	2800	6.1	247	167	269	442	1030	260	2.9	14.76
9	Center	7.11	985	634	1.2	68	41	53	180	113	84	4	6.85
10	Kasra	7.13	1715	1247	15	339	83	130	463	678	90	2	10.32
11	Kasra	7.41	3160	2322	2.1	376	102	224	530	772	308	5.1	12.77
12	Khan Dhari	7.33	3160	2220	5	370	95	140	464	676	347	9	9.98
13	Khan Dhari	7.71	1248	890	5	88	67	109	181	379	49	8	9.38
14	April9	7.51	7050	4955	11	800	249	455	1057	1739	542	7.8	18.76
15	April9	7.6	3850	2720	7.2	234	106	175	381	671	173	1.3	11.85
16	April9	7.34	9150	6956	1.2	775	320	620	1460	1750	830	6	21.68
17	April9	7.25	12800	9292	15	810	418	740	2272	1354	903	6	24.06
18	April9	7.3	6270	4513	5	465	210	350	646	1433	345	3	16.73
19	April9	7.42	7120	5012	8	800	230	430	1083	1720	530	8.3	18.17
20	April9	7.71	3380	2293	5	382	125	195	485	789	342	2	12.65
21	Krughlia	7.62	1445	1047	11	241	30	115	390	979	190	8.1	8.52
22	Zafaraniyah	7.01	8310	5393	2.9	750	310	499	1295	1872	555	7.5	20.11
23	Jadria	7.11	1092	780	2.88	92	37	66.1	128	46.1	119	6	7.18
24	Zafaraniyah	7.01	10490	7320	18	895	363	601.2	1522	2080	720	0.55	24.11
25	Kadhimiya	7.7	1666	1151	7	110	71	120	269	432	50	1.4	9.77
26	Jadria	7.85	1442	996	5	92	68	110	209	403	48	0.2	9.44
27	Shoala	7.11	1092	780	2.9	92	37	66.1	128	216.1	119	6	7.18
28	Mansour	7.13	1825	1250	4.11	180	39	100.2	150	455	148	6	8.34

5.2. PH

According to results, as shown in table (5) rate in the study area was (7.01-7.85), and this means that the waters of these wells generally tend to (basal), and when the comparison these values with the international standards show that water wells studied did not exceed the allowed amount for irrigation depending on specifications of Agriculture Organization food

5.3. Chloride (Cl)

The results showed that the highest value of chlorides was (2272) ppm in well (17), while the lowest value in well (27) was (128) ppm and most readings within the permissible limits

5.4. Sulfate (So_4)

Sulfate is relatively common in water and has no significant effect on soil other than contributing to total salt content. The rise of sulfur ions in irrigation water reduces the availability of plant phosphorus ***(Bauder et, al, 2003)***.

Sulfate element was available in water samples with range (46.1-2080) ppm most values within the permissible limits of the Organization for Agriculture and food of water for irrigation

5.5. Carbonates and Bicarbonate

Their presence in the ground water increases the concentration of the sodium element and its effect on the plant Based on the data in the table (5), water for most wells is of the same type that does not cause expected problems on plant growth

5.6. Calcium and Magnesium

The groundwater contains quantity of salts which are mostly calcium and magnesium salts, and from the data in table (5) note that the concentration of calcium (39-740) mg / cm and the maximum allowed in irrigation water (FAO, 1985) was 400 ppm. Magnesium ions ranged from (20- 418) mg / cm and the maximum permissible concentration in irrigation was 150ppm, and these high concentrations this makes the water hardness, due to exposure to substances soluble in geological formations as well as salts in which movable ***(AL-Khazali,2016).***

5.7. Sodium adsorption ratio

Sodium adsorption rate (SAR) is important to determine the validity of water for irrigation. SAR describes the relationship between soluble sodium and soluble divalent cations (calcium and magnesium). The higher the sodium in relation to calcium and magnesium, the higher the sodium adsorption rate ***(Shammi,2016).***

Table 6 Classification of irrigation water quality depending on sodium risk

Classification of irrigation water quality depending on sodium risk				
Classification of the US Salinity Laboratory				
Class	electrical conductivity EC (µs/cm)			
	100-250	250-750	750-2250	> 2250
	Sodium adsorption ratio (S.A.R)			
S1Little damage	0-10	0-8	0-6	0-4
S2 medium	10-18	8-15	6-12	4-9
S3Very damaging	18-26	15-22	12-18	9-14
S4very strong	> 26	> 22	>18	>14

5.8. Potassium

Potassium is one of the important elements in plant installation, but little damage except for being included in the increased value of dissolved solids ,and through thoughtful values ranged between (83.5-176.5) mg/L table(5) and are located all values within the permissible limits of the Organization for Agriculture and food of water for irrigation except values of well(5) and well(6)is outside the limits, and the reason for increasing the concentration of potassium due to the presence in the sedimentary rocks ***(AL-Khazali,2016).***

Table 7 Limits of Water Validity for Irrigation *(Khasaf.2015)*

Elements	Symbol	Units	Concentrations
Electric conduction	Ec	µs/cm	3000-0
Total soluble salts	TDS	ppm	0-2000
Calcium	Ca	ppm	400-0
Magnesium	Mg	ppm	150-0
Sodium	Na	ppm	920-0
Potassium	K	ppm	78-0
Bicarbonate	HCO3	ppm	610-0
Sulfate	SO4	ppm	960-0
Chloride	Cl	ppm	1065-0
Carbonates	CO3	ppm	30-0
Nitrates	NO3	ppm	10-0
Boron	B	ppm	2-0
PH	PH	-	8.5-6
Chrome	Cr	ppm	0.1
Cadmium	Cd	ppm	0.01
Cobalt	Co	ppm	0.05
Lead	Pb	ppm	5
Manganese	Mn	ppm	0.2

Water quality parameters is analyzed in the laboratory and transferred to GIS software, and data sets are generated for each parameter within the field of interest using reverse feedback technology. The following forms (2) to (11) showed the dispersal of most elements that affect the quality of groundwater for irrigation in the study area.

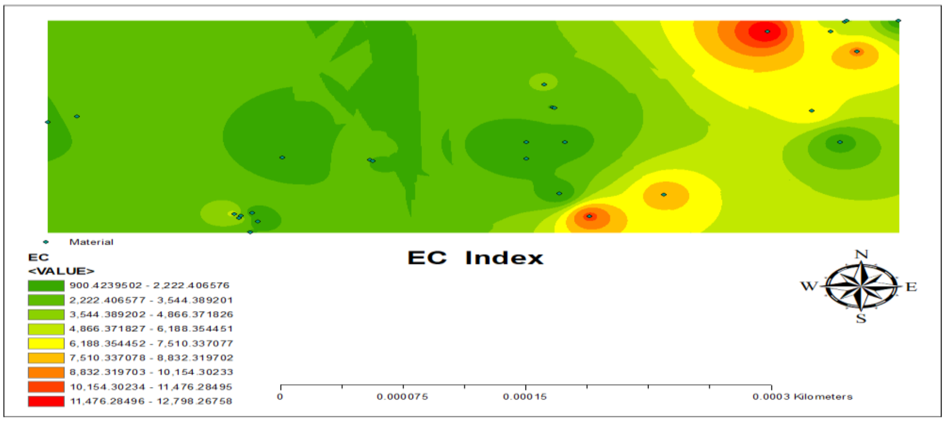

Figure 2 Locative Distribution of EC in the Study Region

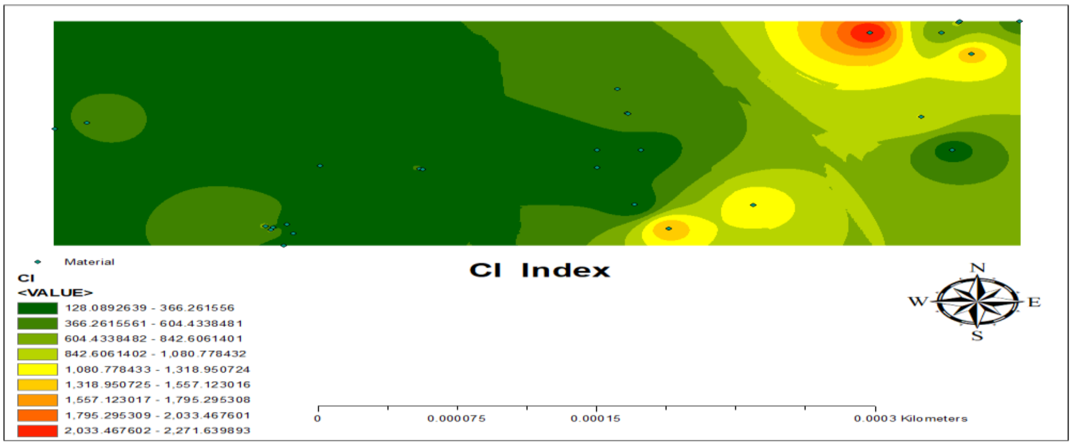

Figure 3 Locative Distribution of Cl Concentration in the Study Region

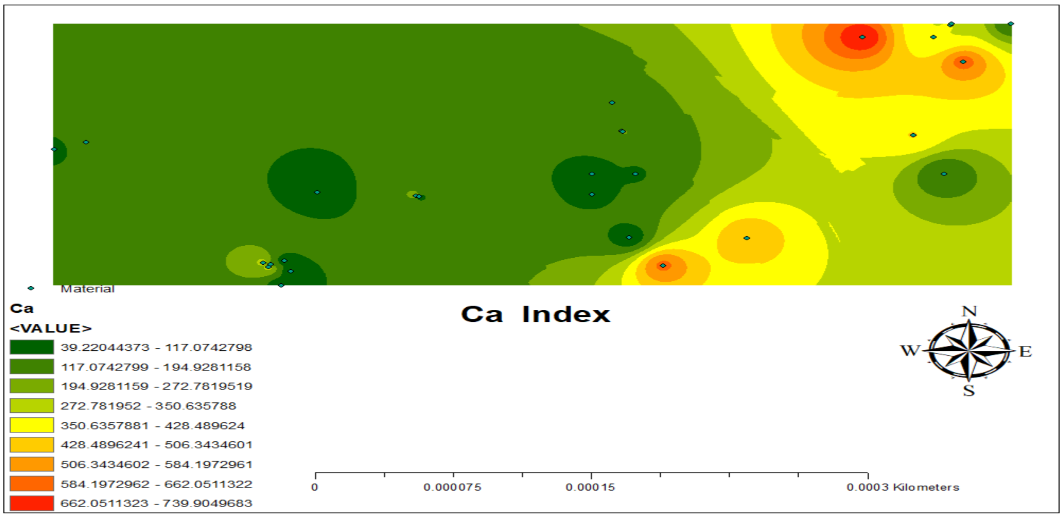

Figure 4 Locative Distribution of Ca Concentration in the Study Region

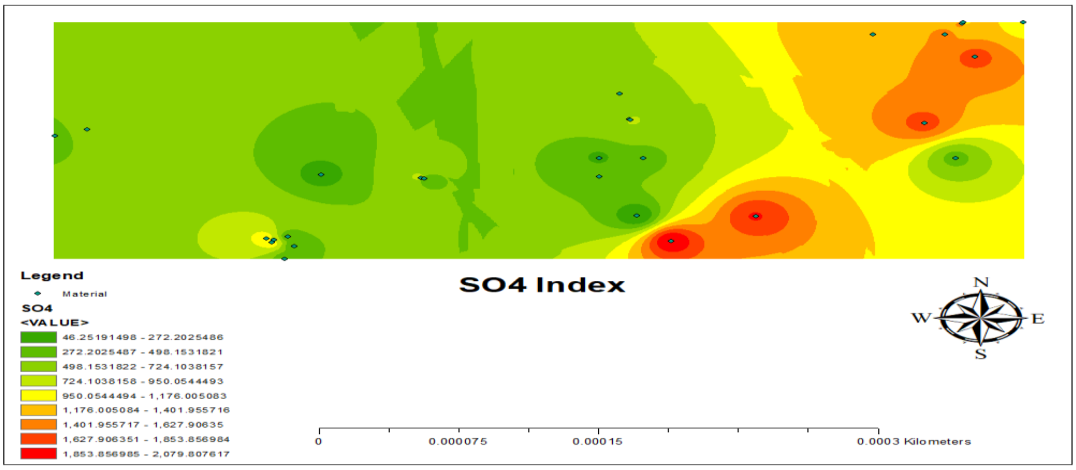

Figure 5 Locative Distribution of So_4 Concentration in the Study Region

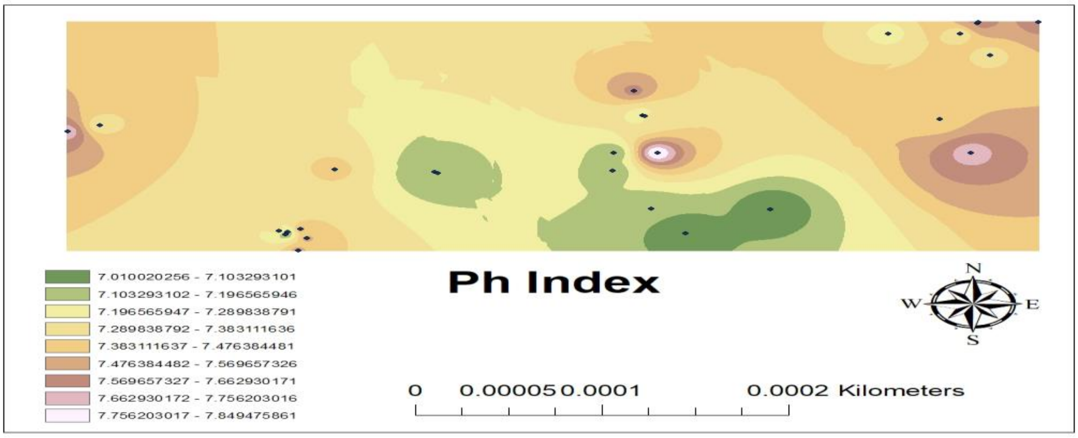

Figure 6 Locative Distribution of pH in the Study Region.

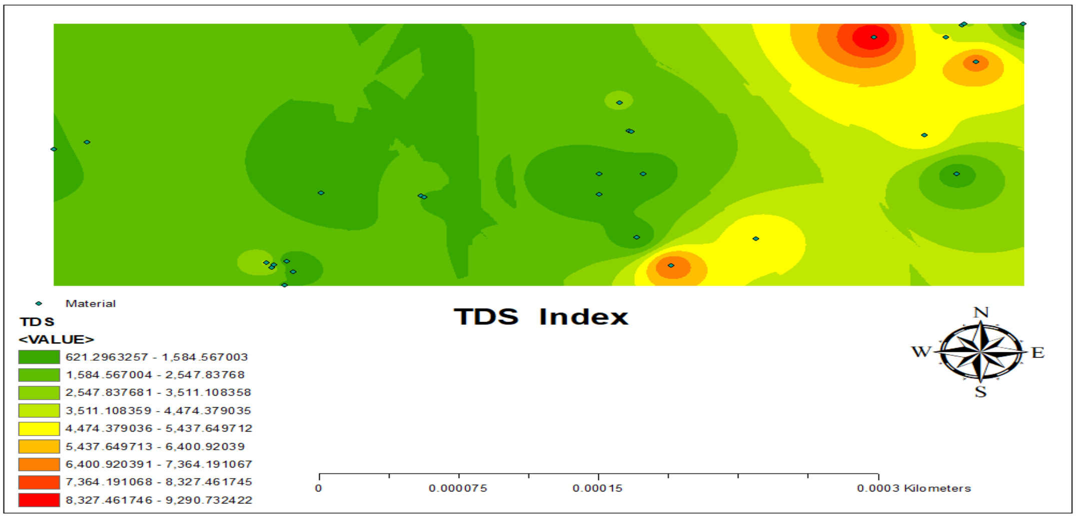

Figure7 Locative Distribution of TDS Concentration in the Study Region

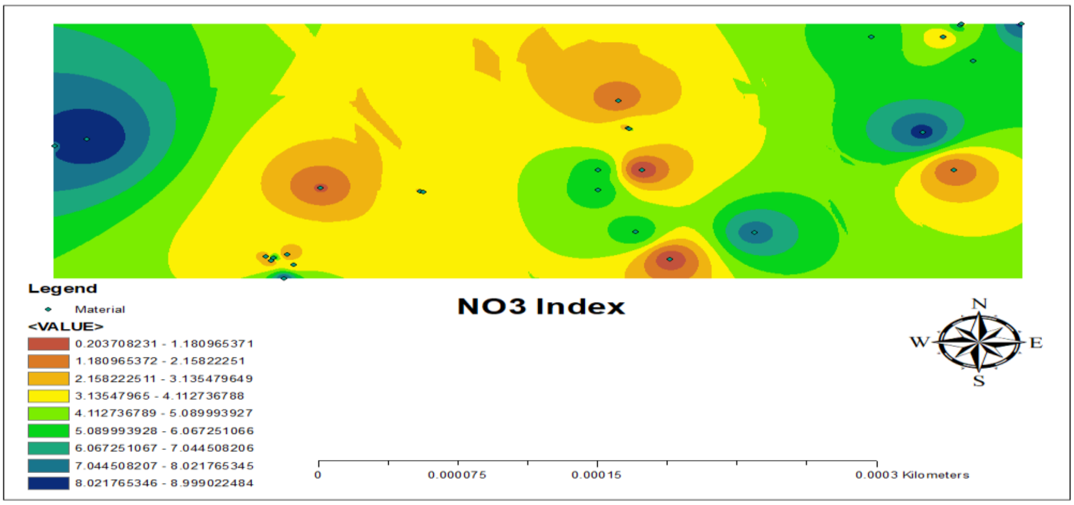

Figure 8 Locative Distribution of No_3 Concentration in the Study Region

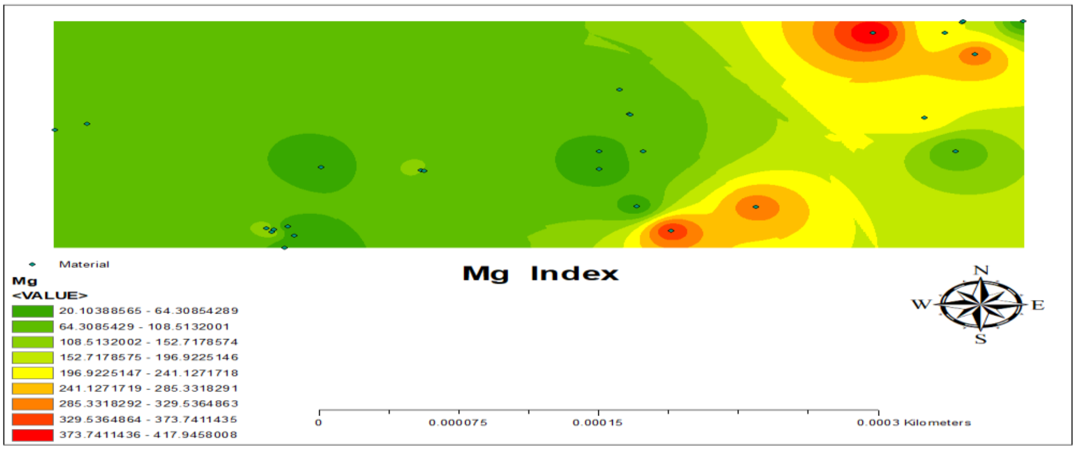

Figure 9 Locative Distribution of Mg Concentration in the Study Region

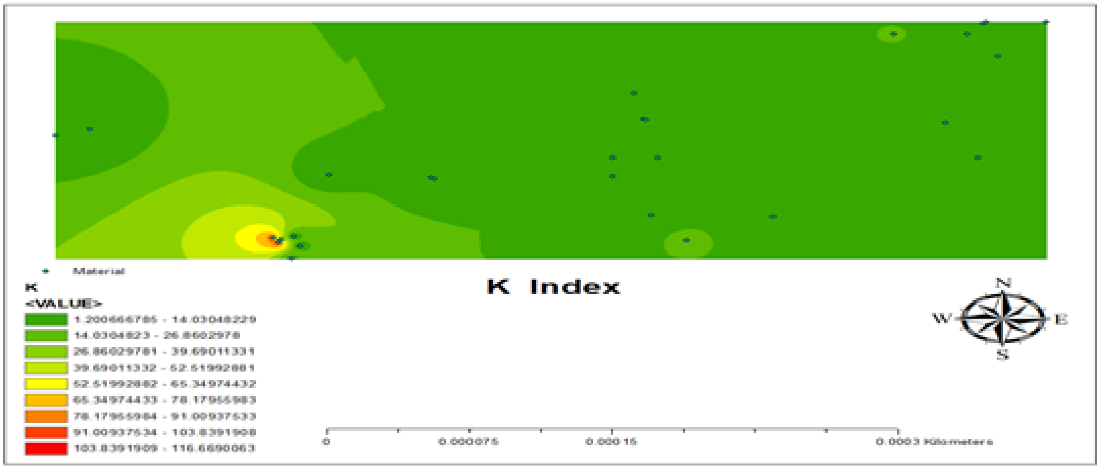

Figure 10 Locative Distribution of K Concentration in the Study Region

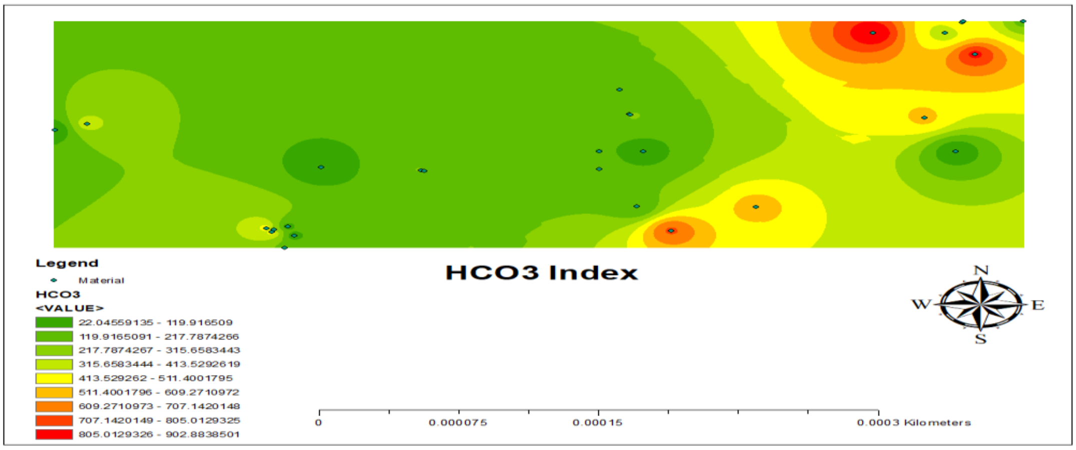

Figure 11 Locative Distribution of HCO_3 Concentration in the Study Region

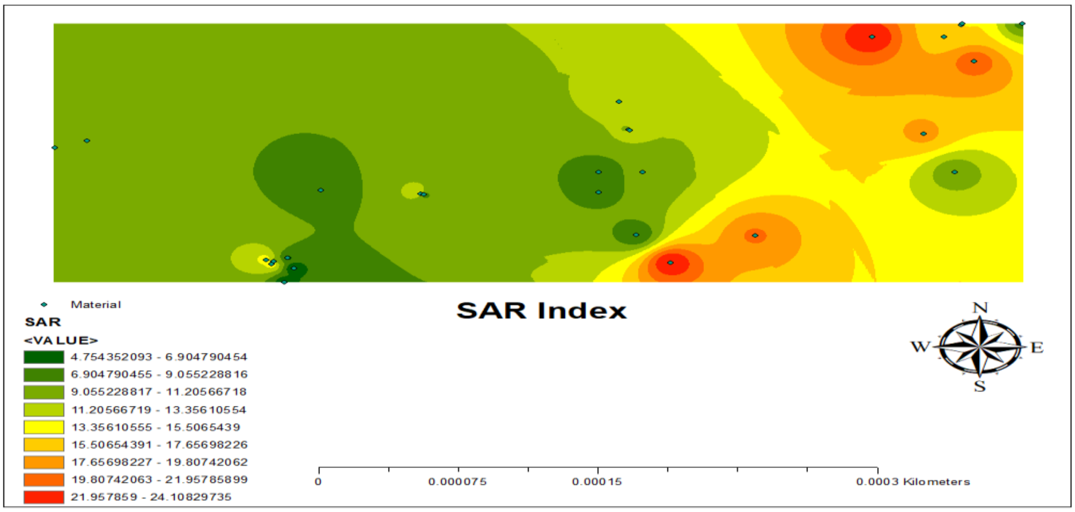

Figure 12 Locative Distribution of SAR in the Study Region

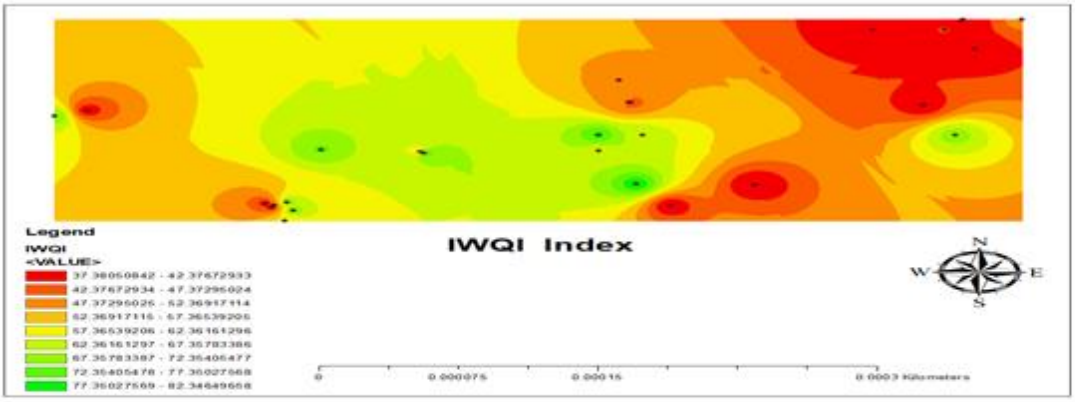

Figure 13 Locative Distribution of IWQI in the Study Region

water quality index for irrigation purposes was calculated by using IWQI values in equation (3). It can be considered as a comprehensive map to provide information and data visually monitoring irrigation water in the study region represented by a spatial distribution of the irrigation water quality indicator. The map also shows the spatial distribution of groundwater quality in the study area as indicator values, so it is now easy for decision makers to assess groundwater quality for irrigation purposes. Figure 13 shows the locative distribution of water quality indexes for irrigation purposes in the study area.

According to table (8) the (IWQI) for 25% of groundwater samples under the second class (low restrictions) for irrigation purposes, so the ground water is suitable to irrigate soil of light texture or moderate permeability and avoided the soil of high clay because the sodic salt may appear which required leaching and reclamation besides this water is not suitable to the sensitive crops for salt.

Small part of study area is classified as Moderate restriction (MR) for using of irrigation water, A moderate filtration of salts was recommended when soil permeability values ranged from medium to large. It is interesting to note that the IWQI in 36% of groundwater samples has Severe restriction irrigation water., it should be taken avoid when it uses for irrigation purposes under natural conditions. In special cases, they can sometimes be used. The water which have a small level of salt and high value of sodium adsorption ratio are necessary for gypsum application. In high saline content, water soils must have high permeability and excess water. Also, Only plants with high salt tolerance, except for waters with extremely low values of sodium, chloride and bicarbonate on the other hand, 25% of groundwater samples. it may be used for the soils with high level of permeability without compacting the layers. High frequency irrigation schedule should be obtained for water with Electrical conductivity (Ec)more than (2000 µS cm-1) and sodium adsorption ratio (SAR) is higher than (7.0)

Table 8 Qi X Wi of individual parameters and Irrigation water Quality Index (IWQI)

NO	Wi*QI of SAR	Wi*QI of HCO3	Wi*QI of Cl	Wi*QI of Na	Wi*QI of EC	IWQI
1	11.70	19.50	14.39	11.57	16.41	73.58
2	12.32	19.90	14.49	11.87	14.54	73.13
3	10.71	14.37	15.72	7.10	10.37	58.27
4	9.79	14.81	12.07	7.12	8.16	51.95
5	8.58	7.37	6.82	7.16	7.39	37.33
6	8.59	7.89	6.76	7.16	7.39	37.78
7	17.25	7.07	14.71	16.97	16.88	72.89
8	14.32	12.52	6.78	7.16	7.39	48.17
9	17.76	17.92	14.76	17.47	16.28	84.19
10	8.23	17.32	6.77	7.16	11.90	51.39
11	9.19	11.43	6.78	7.16	7.39	41.94
12	7.67	10.62	6.78	7.16	7.39	39.62

13	18.04	7.07	16.50	15.94	14.43	71.97
14	10.20	7.05	6.81	7.12	7.39	38.57
15	13.15	14.92	6.72	7.11	7.39	49.28
16	8.88	7.07	6.80	7.24	7.39	37.38
17	9.52	7.07	6.77	7.16	7.39	37.91
18	10.68	10.66	6.81	7.16	7.39	42.70
19	10.48	7.07	6.82	7.12	7.39	38.88
20	7.72	10.72	6.74	7.16	7.39	39.73
21	9.30	14.45	6.81	7.16	13.05	50.78
22	9.10	7.06	6.79	7.16	7.39	37.50
23	15.80	16.41	16.87	15.64	15.53	80.26
24	9.78	7.07	6.76	7.12	7.39	38.12
25	16.71	15.87	10.71	14.31	12.08	69.68
26	17.78	7.07	13.44	15.64	13.07	67.00
27	15.80	14.44	16.87	15.64	15.53	78.28
28	12.21	15.61	16.13	9.14	11.52	64.60

6. CONCLUSIONS

6.1. In over all the research study is indicated that

1. High concentrations of Cl, Ca and K were found in ground water samples
2. The use of Geography Information System (GIS) and Irrigation water quality Index (IWQI) can provide a very effective tool for summarizing and reporting monitoring data to decision makers so that they can understand the state of groundwater quality
3. From the figure above, the WQI total is widely different in study area. Very poor quality of water was located middle of the study area. There is moderately good irrigation water on the western side of the study region.

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