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Assessment of Ground Water Suitability for Different Purpose in Some Wells Diyala

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ABSTRACT

Ground water suitability for consumption in the Diyala region is assess by analyzing ground water samples of 14 wells distributed in the area. Results shown that the ground water of low alkaline. While most of these samples are fresh water and slightly brackish water. The values ion concentrations indicates that some ions are highly than water quality standards for drinking purpose depending on Iraq standard (IQS) and World Health Organization (WHO) except for NO_3^- ion. After comparing these concentrations with water quality standards for humans beings drinking purposes. We found that the most ground water in the region is suitable for human drinking. But it is suitable for livestock, building and for growing many types of crops. It is suitable for irrigation purposes according to (SAR), (Na%) and (RSC).

Keyword: ground water quality. SAR. Diyala.

Introduction

Water is very necessary for humans being in many aspects the life including irrigation of agriculture. There is decrease in the natural water resources of world particularly in arid and semi-arid region, However increase in humans and rapid urbanization have quickened the consumption of ground water recourse and cause environmental problems in the decades ago (1). This water rivers crisis is obvious in Iraq degradation of the Tigris and Euphrates rivers. The deficiencies in fresh water have essential problem in the world. Now days, these has been worldwide conviction that ground water is important natural water resources. Additionally, ground water is providing water to urban and rural communities in some countries of the world. In recent time, the contamination of ground water is problem that had posed serious threated for environment and human health. The determination of the ground water suitability for irrigation and humans use is achieved through chemical and physical properties. Any

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changes can occurred due to microbial activities and human activity in soil (2,3). World Health Organization (WHO) and some countries have determined the guide line for drinking water. It is necessary to compare the measurement of water quality parameter with the declared water quality stands to protect health. The classification for evaluating of water for drinking and irrigation purposes must be established by analyzing several chemical elements including ions (Ca^{2+}, Mg^{2+}, K^{+} Na^{+}, SO_4^{2-}, HCO_3^{-} and NO_3^{-}) and evaluation several physical properties (pH, EC, TDS, and T.H). The quality water of irrigation the water should be evaluated to at least or avoid the negative impact on the agriculture (4). And there for classification to published the suitability of the water for irrigation. The Richard classification depend on the electrical conductivity (Ec) and the sodium absorption ratio (SAR) (5). Wilcox (1955) present another classification with is depend on sodium percentage concentration (Na%) in state the (SAR) in it is relationship (Ec). Therefore, the aim of this study is to valuate the physical and chemical properties for ground water and discuss it is suitability for consumption (drinking, building, irrigation and agriculture) based on hydro chemical analysis.

Material and method

The ground water samples were 14 wells in the study region. Depths and location of the wells used in this study region are shown in Table (1). Electrical conductivity (Ec), Total dissolved solids (TDS) and Potential of Hydrogen (pH) were determined by TRANS (BC3020) in situ the field. Sodium and potassium have been determined by flame photometer. And calcium, magnesium, chloride, bicarbonate and carbonate have been determined by titration. For sulphates were determined by ultraviolet spectra photometer. While nitrate was determined by optical spectra photometer.(9)

Total Hardness (T.H) was calculated using the equation (10)

$$T.H = [Ca^{2+}]\times 2.497+[Mg^{2+}]\times 4.117 \ldots\ldots\ldots (1)$$

Can calculate Sodium Adsorption Ratio (SAR) by using the following formula(11).

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

Evaluate Sodium percentage (Na%) by use the equate(12)

$$Na = \frac{Na+K}{Ca+Mg+Na+K} \times 100 \ldots\ldots\ldots (3)$$

It calculated depending Residual Sodium Carbonate (RSC) by to the follow equate(13).

$$RSC = ([CO_3^{2+}]+[HCO_3^{-}]) +([Ca^{2+}]+[Mg^{2+}]) \ldots\ldots (4).$$

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Results and Discussion

Concentration of chemical and physical parameters with standards of IQS(14) and WHO(15) are shown in the Table (2). Results reveal the values of pH values are ranging from 7.20 to 7.80. And that Ec values are ranges from 550 to 3520 □ $S.cm^{-1}$. while that TDS values are ranges from 372 to 2628 ppm table (1). We observe this is increase because of dissolve the salts of soil, addition to the remains pesticides and fertilizers. All ground water samples are fall within fresh water except water cells (8,9,10,12,13) Classified as slightly brackish water cells according to (11) comparing on TDS values (3)

Cations

Calcium ion concentrations varies from 37 to 261 ppm and magnesium ion concentration is ranging between 17 – 162 ppm. Sodium ion concentration varies from 52 to 339 ppm. While potassium ion concentration is from 0.10 to 7.5 ppm. Table (1) for determining to concentrations of cations (calcium, magnesium and sodium) with standards IQS(14) and WHO(15) table (2). Results reveal that the water cells (8,9,10,12.13 and 14) shown highly concentration of calcium. That is due to it is parts of the study region cover with gypsiferous sediment of Altahrir and Buhriz diyala, where water working to wash the soil and add fertilizers that contain calcium. Results of magnesium ion concentration shown that it is concentration are above in wells (12 and 13) due to presence some dolomite and calcite in components Diyala formation of sandstone and when water is highly in sulfate at pH close to the equalization. It will some part dissolve CO_3, precipitate $CaCO_3$ and release $MgCO_3$ to water (16). Sodium ion concentrations been high that standards, in the wells (8,9,12,13 and 14) because of dissolve rocks that contain as Halite and release sodium into water. While potassium ion concentration is low due to potassium enter the crystal of structure the Illite mineral. Which makes difficult to remove and it is dsroption on clay will make difficult attrition them into water (17).

Anions

Sulfate ion concentration is ranging between 51 – 1019 ppm. While bicarbonate ion concentration is varies between 62 – 449 ppm. And chloride ion concentration are ranges between 99-520 ppm. Table (1). Comparing these concentrations with standards of IQS(14) and WHO (15) table(2). Results reveal that the (sulfate, chloride and bicarbonate) ionic concentrations are highly in wells(8,9,10,12,13 and 14) because of higher concentration ion of sodium because of the dissolve gypsum rocks within of Diyala formation and used agriculture fertilizer contain sulfur. high concentration of chloride because of dissolve rocks as . while highly concentration of bicarbonate because of when pH value in water cells is less that 8.3 all carbonate transforms bicarbonate .

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Nitrate

Nitrate ion concentration is ranging from o.1 to 5.0 ppm Table (1). Compared these values of nitrate with standards IQS(14)and WHO(15) table(2). We observe all the water cells wife limits.

Total Hardness T.H.

T.H value varies between 180 – 1318 ppm Table (1). Competitive of T.H values within IQS(14)and WHO(15), Found all the ground water samples falls within safe limits, except water cells samples (9,10,12,13, and 14) unsuited for drinking. T.H values are high in the ground water to the melting of magnesium and calcium salts. and all ground water samples in study region seeded very hard water depending on classification of (10) Table (4) .

Table (1) Concentration of physical and chemical parameters by unit (ppm)

Sample No.	Location			Wells Depth, m	pH	EC µS m^{-1}	TDS mg l^{-1}	Cations ppm				Anions ppm			NO_3^- ppm	T.H ppm	SAR Meq l^{-1}	Na% Meq l^{-1}	RSC Meq l^{-1}
	Place Name	Longitude, East	Altitude, North					Ca^{2+}	Mg^{2+}	Na^+	K^+	SO_4^{-2}	Cl^-	HCO_3^-					
1	Canan 1	44^0 46' 39''	33^0 45' 33.2'	25	7.62	980	730	60	35	180	2	249	191	68	0.1	294	4.6	57	-4.8
2	Canan 2	44^0 45' 14''	33^0 44' 35''	22	7.76	550	372	38	17	55	1.9	51	113	86	0.4	165	1.9	43	-1.9
3	Canan 3	44^0 48' 08.2''	33^0 41' 14.7''	25	7.63	775	565	38	21	52	1.1	122	120	280	2.0	181	1.7	38	-0.9
4	Canan 4	49^0 50' 55.7''	33^0 37' 31''	25	7.20	910	680	52	36	78	7.5	93	137	173	2.0	278	2.0	39	-2.8
5	Aleabara 1	44^0 39' 18''	33^0 48' 31''	18	7.80	723	497	50	24	60	0.3	115	102	122	1.0	225	1.7	37	-2.5
6	Aleabara 2	44^0 40' 18.8''	33^0 44' 20''	16	7.41	660	493	37	19	55	0.1	82	99	92	0.9	171	1.8	41	-1.9
7	Aleabara 3	44^0 40' 21''	33^0 39' 25''	24	7.80	900	590	49	40	75	6.0	95	135	175	1.9	287	1.9	37	-2.9
8	Altahrir1	44^0 39' 39.1''	33^0 43 29.2	18	7.77	1900	1280	104	58	212	0.4	274	362	219	0.5	449	4.1	48	-6.5
9	Altahrir2	44^0 39' 25''	33^0 40' 11''	21	7.65	1980	1367	125	74	230	0.5	298	380	290	1.1	617	4.0	45	-7.7
10	Altahrir3	44^0 37' 51''	33^0 40' 15''	21	7.70	1750	1206	100	69	199	0.3	270	350	260	1.0	534	3.7	45	-6.5
11	Buhriz1	44^0 41' 26.4''	33^0 30' 24.3''	31	7.20	1200	830	55	33	150	3.8	248	190	62	1.4	273	3.9	55	-4.4
12	Buhriz2	44^0 41' 09''	33^0 36' 22''	36	7.77	3505	2628	261	162	245	5.0	1019	440	260	4.0	1318	2.9	29	-22.3
13	Buhriz3	44^0 39' 53.1''	33^0 36' 14.5''	32	7.42	3520	2470	204	106	572	2.5	572	520	449	5.0	946	4.8	43	-11.7
14	Buhriz4	44^0 38' 44''	33^0 32' 13.2''	32	7.32	1800	1204	115	90	259	5.0	559	330	320	0.9	658	4.1	48	-8.0

Table (2) Comparison ion concentration with the standard of water quality by unit (ppm).

parameter	standards	
	WHO 2007	IQS 2009
pH	6.5 – 8.5	6.5 – 8.5
TDS	1000	1000
Ec	1530	1500
Ca^{2+}	75	150

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Mg^{2+}	120	100
Na^{+}	200	200
K^{+}	12	12
SO_4^{2-}	250	400
Cl^{-}	250	350
HCO_3	200	200
NO_3^{-}	50	50
T.H	500	500

Table (3). Classification of water salinity depending on TDS (11).

Water class.	ppm
Fresh water	0 – 1000
Slightly Brackish Water	1000 -10000
Brackish Water	10000 - 100000
Brine water	> 100000

Table (4). Classification of water according the total hardness (ppm) (10)

Water quality	T.H
Soft	T.H ≤ 9
Slightly hard	9 - 60
Moderately hard	60 - 120
Hard	120 - 180
Very hard	T.H > 180

Ground water suitability

The use of ground water for the different purpose is established (Agriculture, industrial and livestock) by according to it is chemical elements and the quality of water.

Ground water suitability for humans drinking purposes.

The use of water for drink purpose must be within the hydrochemical parameter according to the guidelines prescribed by IQS(14) and WHO(15) table (2) for determining suitability the ground water for humans drinking. Found the all ground water samples with safe limits except water cells (8,9,10,12,13and14) because of high concentration ionic (Ca^{2+},Mg^{2+},Na^{+},K^{+}, Cl^{-},HCO^{-} and SO_4^{-}) Table (1). Generally, that the most water cells in the study region is suitable for humans drinking purposes table(2).

Ground water suitability for livestock purposes.

All ground water samples are suitability **for livestock** purpose according to (18) in table (5)

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Ground water suitability for building purposes

Comparison of ion concentration of ground water samples depending on the classification proposed by (18) reveal that the all samples suitable for building purposes. Table (6)

Table (5). Water specification for livestock purpose of by unit(ppm)

Suitability / Parameter	Excellent type	Good type	Permissible type	Able use	Maximum limit
Na^{+}	800	1500	2000	2500	4000
Ca^{2+}	350	700	800	900	1000
Mg^{2+}	150	350	500	600	700
Cl^{-}	900	2000	3000	4000	6000
SO_4^{-2}	1000	2500	3000	4000	6000
TDS	3000	5000	7000	10000	15000
T.H	1500	3200	4000	4700	5400

Table (6). Evolution of water for building use depending on (19)

Ion	Permissible limit
HCO_3^{-}	350
$SO4_2^{-}$	1460
Cl^{-}	2187
Ca^{2+}	437
Mg^{2+}	271
Na^{+}	1160

Ground water suitability for agriculture purposes.

Depending on the classification suggestion by (11) as show in table(7). We observe in table (1). The most ground water samples of the study region seeds as low salt tolerance except the wells (12 and 13) medium salt tolerance according to classification (11). These types water suitable for grow most of crops.

Ground water suitability for irrigation purposes.

Increasing of electrical conductivity in the irrigation water cause of deteriorate in plant growth and low yield. In addition increase of chloride cause burns of plant leafs mostly the garage and citrus. While increment of sodium lead to increase of SAR, Which effect plant growth (20) values Influencing facts in suitability of ground water for irrigation purposes show in the table(1).

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Salinity

Increase of Ec and TDS in irrigation water influence soil structure, aeration and permeability. Therefore effect the plant growth. The soil water is pass to plant through the roots due to rise osmotic pressure. The effect is visible in plant by stunted growth cause burns of leaves, discoloration and low yield(21). The ground water samples fall within good (2,5 and 6), the wells (1,3,4,7,8,9,10 and 14) medium and the wells (12 and 13) bad. Therefore, its most safe for irrigation purpose table (8) .while the wells (12) and (13) not safe for irrigation purpose depending on (19).

SAR

Sodium Adsorption Ratio is evaluation the ratio of sodium ions for calcium and magnesium, expressed by meq l^{-1}. If Sodium Adsorption Ratio is more than 9. This know an increase of sodium or decrease of (calcium + magnesium) in the water. This is increase cause destroying soil texture, dispersion of soil colloids and high permeability (20).Sodium Adsorption Ratio of ground water samples in the region less from 9. Table (1). Where reference to that the all water cells samples located within the excellent class depending on (19) table (8).

Soluble Sodium Percentage Na %

Sodium percentage (Na%) values in ground water samples of the study region Table (1). Found all that the ground water samples within the medium class except samples (3,4,5,7 and 12) in the good class depending on classification (19), as show in table(8).

Residual Sodium Carbonate

Residual Sodium Carbonate (RSC) values of all ground water samples in the study region Table (1). As shown all ground water fall within excellent, according to (19). show in table(8).

Table (7). Relative tolerances of crops to salts concentrations for agriculture (EC µs.cm$^{-1)}$

Crop Division	Low Salt Tolerance	Medium Salt Tolerance	High Salt Tolerance
Fruit Crops	0 - 3000	3000 - 4000	4000 -10.000
Vegetable Crops	3000 - 4000	4000 – 10.000	10.000 – 12.000
Field Crops	4000 - 6000	6000 – 10.000	10.000 – 16.000

Table (8). Evolution of water for irrigation water quality (19)

Water class	EC µs.cm^{-1}	SAR (meq.l^{-1})	Na%	RSC (meq.l^{-1})
Excellent	< 250	< 10	< 20	< 1.25

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Good	250 – 750	10 - 18	20 - 40	1.25 – 2.0
Medium	750 - 2250	18 - 26	40 – 60	2.0 – 2.5
Bad	2250 - 4000	> 26	60 - 80	2.5 – 3.0
Very bad	> 4000	> 26	> 80	> 3.0

Conclusion

The value of chemical analysis result for the ground water samples shows that the all ground water low alkaline and has low mineralized and most of its classified as fresh water with some that are Slightly Brackish water. Values of major anions and cations are high little than some ground water a quality standards depending on IQS(14) and WHO (15). High concentration some ionic in some ground water that could because impact formation rocks within diyala. Ground water in the study region is most suitable for humans drinking, livestock, building and growth many types of crops. It is most suitable irrigation purpose by salinity and safe for irrigation purpose according to SAR, Na% and RSC.

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