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Validation evaluation of some wells in Wadi Al-Mohammadi basin for agricultural exploitation[1]

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Abstract

Introduction: Water resources management are the most importante part to organized limited water resources in the agricultural sector in the world especially in arid and semi-arid regions. This situation calls for proper attention to analysis, study and research on all of the issues and aspects that will contribute to the development and maintenance of these resources and to achieve the highest possible levels of quality and efficiency.

Material and methods: The present study examines the chemical properties of the groundwater in the Wadi Al-Mohammadi basin, which is located between the cities of Ramadi and Hit in the Upper Euphrates region. The study is conducted based on the field, geomorphological and geological study of the study area. The water quality of some wells in the region was monitored during 2017, for irrigation according to the FAO Standard and their classification according to Richards.

The aquifers in Wadi AI-Mhammadi basin Western Desert of Iraq were selected to study the geochemical evaluation of groundwater system by a geochemical modeling techniques. There are many geochemical reactions which responsible for the spatial variations. Most of these groundwater is undersaturated with Calcite, Dolomite, Gypsumo Anhydrite, as well as cation exchange process but supersaturated with Calcite and Dolomite in certain places.

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Results: The results of the laboratory analysis showed that all of the well water under study exceeded the criteria for use of irrigation. Therefore, it is not recommended to use it in the Wadi Al-Mohammadi basin because it is saline water, where the values of electrical conductivity, which is a factor affecting agricultural use, ranged between 3.68-7.51dS/m^{-1} for wells 7 and 5, respectively, while the SAR ratio ranged between 7.20- 183.6 for wells 7 and 2, respectively. Wells (5,4,1), according to Richard's chart, 1954, were classified as C4-S2, medium and very high, and wells (2,6,3,7) C4-S4, C3-S3, C4-S3, C3-S1, respectively. With continuous use, salt accumulations are formed which eventually lead to salinization of the soil and increasing the state of the problem of desertification and conversion of agricultural lands from producing to unproductive lands. In the case of its use, the methods for accuracy management intentions and selection of soil types as well as cultivation and selection of plants resistant to salinity and reducing the state of degradation of those soils within the valley should be followed. This causes increasing crop productivity.

Conclusion: Through physical and chemical analysis, it is clear that the climate and the type of rocks is the main influence on the variation of dissolved ions in water. Sulfates dominated the group of anions, and ranged between 561.6 to 1079 mg/L), while the predominance of sodium on the cation group, the values of ions concentrations for chloride (25.2-59.8 meq.l^{-1}) and sodium (71.3-918.3 meq.l^{-1}) were varied because the study area was located in the limestone-dolomite and gypsum-shaped rock deposits, The wells (1,4,5), according to Richard's scheme, 1954, were classified as C4-S2, medium and very high, and wells (7,3,6,2) C4-S4, C3-S3, C4-S3, C3-S1 and respectively. Most wells fall within categories 1, 2, 3, and 4 of the SAR. Based on this scheme, the wells of the study area are located at low limits to suitability for irrigation water. According to the scheme, well water no. 7 in the study area can be considered as the best and suitable for irrigation purposes, provided that appropriate management methods are used when to irrigate the crops.

It is necessary to focus on conducting the periodic studies, monitoring water reservoirs and preparing the hydrological maps in which all sectors contribute to determining the qualities of underground water. To regulate the quantities of pumping from them to maintain its sustainability and conduct scientific practices for future use, conducting chemical analyzes of the well water no. 7 and the investor currently to show their suitability for different uses and approaching the concerned parties in the work of an awareness program for farmers to adopt the modern methods of irrigation such as drip irrigation and others to prevent the waste of large quantities of groundwater and thus cause soil degradation through an increase in accumulations saline and toxic elements, installation of a weather station in the study area for the purpose of accurate data obtained in relation to rain, evaporation, temperature, wind and relative humidity of accurate hydrological budget work for the study area.

Keywords: Crop Productivity, Exploitation, Groundwater, Irrigation, Salinity, Wadi Al-Mohammadi Basin, Well.

1. Introduction

Water resources are of central importance to agriculture in the world especially in light of its scarcity. This situation calls for proper attention to analysis, study and research on all of the issues and aspects that will contribute to the development and maintenance of these resources and to achieve the highest possible levels of quality and efficiency.

Hussain & et al. (2014) used the Irrigation Water Quality Index (IWQI) for groundwater in the GIS program. In assessing the seriousness of groundwater use on the aquifer for the formation of Dammam in the western part of Iraq, 39 sites were chosen and groundwater samples were collected, the characteristics that were tested in each sample included: pH, EC, total hardness Ca^{2+}, Mg^{2+}, Cl^{-}, Na^{+} and SAR and a final water quality map for the aquifer was established, It showed that there are three main regions, the first in the northeastern part of the region while then the second region is limited to the southeastern part, and the third region extends along the western part from the study area, and this map was converted according to the proposed model, it has been shown that the water quality in Dammam formation aquifer is marginal for agricultural use.

Al-Fiqi & Fathi (2016) in his study of water quality in Misurata area, one of the largest Libyan cities located in the northern part of the Libyan coast, where groundwater is the main source of water in this region showed that water is used to meet all of the needs of the population. pH, electrical conductivity of water samples in the field, analysis of the main elements and estimation of total water and total soluble salts. Standard methods were used to estimate the ratio of adsorbed sodium, soluble sodium ratio, magnesium, calcium and sodium ratio. On the results of the analysis, the water was divided according to the prevailing ions into two types: group I, calcium and magnesium ions with chlorides (Ca, Mg, Cl) and group II, sodium ions and calcium (Na, Ca). Salinity, and the results of tests for groundwater showed that its water is considered to be of low quality, unfit for drinking and for agriculture, based on the specifications of the Libyan National Center for Drinking Water (1992). WHO (2006) noted that it may be appropriate to irrigate some crops under certain conditions. The results of the study also showed that the source of salts is due to the intrusion of seawater with the water of the aquifer of the Eocene groundwater of this region.

Bouderbala (2017) assessed the suitability of groundwater for drinking and irrigation purposes carried out in place the Loesser plain in North Algeria, in

the sahel covering region having an area of 533 km^2 located in the humid Mediterranean Sea climate, groundwater is the main source for the household uses agricultural activities, groundwater samples were collected from 15 wells during the dry and wet seasons in 2015. The major cations and anions were analyzed and completed the comparison with drinking and irrigation specifications. The results showed the groundwater in the study area is suitable for irrigation in both seasons according to the sodium adsorption ratio values, sodium percentage, residual sodium bi-carbonate, and permeability index and water type Ca - Mg - Cl.

Alaizari & et al. (2018) studied the quality of groundwater in Wadi al-Mu'awab and Qa'a Aswad in the city of Dhamar (Yemen) and its suitability for agricultural use. The physical and chemical properties of water were identified in Wadi al-Muawab and Aswad. The purpose of this classification was to determine their validity for irrigation use, magnesium (Mg^{+2}), sodium (Na^{+}), potassium (K^{+}), anions of bicarbonate anions (HCO3), chloride (Cl-), sulfate (SO^{-}_{4}), the pH value, electrical conductivity (EC) and sodium adsorption rate (SAR). The results showed that the 50% water samples were in C3-S1, fall 50% of the water samples within the class (C2-S1) according to the US laboratory system salinity (USSL), In the FAO system, samples fall within the category (increase in salinity risk) for salinity risk, and the pH values are within normal limits.

Panel & et al. (2019) studied the appraisal of groundwater suitability for agricultural use in the semi-arid region of Anantapur, Andhra Pradesh, southern India and fifty samples of groundwater were analyzed for traits such as pH, electrical conductivity, sodium absorption ratio, percent sodium, carbonate. The remaining sodium, to assess the quality of irrigation water, groundwater chemistry was also analyzed through statistical analysis, USSL, Wilcox and Piper charts to see their suitability for irrigation. The analysis reveals that most of the groundwater samples in the study area fall under an excellent category suitable for irrigation.

Haile (2019) explained in his study about the extent of soil salinity and the quality of irrigation water in the awash basin area (Ethiopia), where soil and alkaline soil salinity problems are common in these arid and semi-arid regions, due to the insufficient annual rainfall to reduce the accumulated salts from the root zone of plants, where many of the identified soil types to the soil varieties with problems due to various environmental hazards and bad agricultural practices. The process of salinization of land and water resources is considered

one of the main issues that lead to land degradation all over the world, where serious problems related to soil salinity occur and are identified the soil affected by salt in most parts of the Rift Valley region in Ethiopia, and the results showed the diversity of irrigation water quality in these areas along the areas assessed with respect to salinity, the water in the upper surface area was characterized by a very good quality and could not introduce problems on the quality of the soil however, its quality deteriorates in the central water areas due to the mixing of different water sources (lakes, hot springs and wastewater) of a low quality for irrigation purposes. Therefore, the factors that increase soil salinity and soil permanence must be correctly identified to manage these catalysts. In addition to this, the implementation of crop cultivation system and appropriate management practices according to soil type, salinity and sodium level and the quality of irrigation water is very important.

As mentioned before, purpose of the present paper is to analyze the water of some wells in the Wadi Al-Mohammadi basin, Iraq and to indicate the extent of the validity of these wells for agricultural use according to international standards. Also it must be said that, this unique and innovation studies with overall statistics have set the urgency and great importance for carrying out the bias estimation and correction in CORDEX data before applying it to the hydrological analysis.

2. Material and methods

2-1. Location of Study Area

The study area is located in the western part of Iraq within boundaries of the district of Hit - Anbar province, between the latitudes of (33°22' 8.40"-33°17' 43.4"N), and the Longitude (42°17' 13.76" - 42°39' 55.8" E). The wadi is located to the west of the Euphrates river and limited by the north is Wadi al-Marg, the north-west is the Horan Wadi, the west is the Amj Wadi and the south and south-west is Wadi al-Ghadaf. Figure 1 shows the map of the study area, and the area of the basin about 2309.1 km^2.

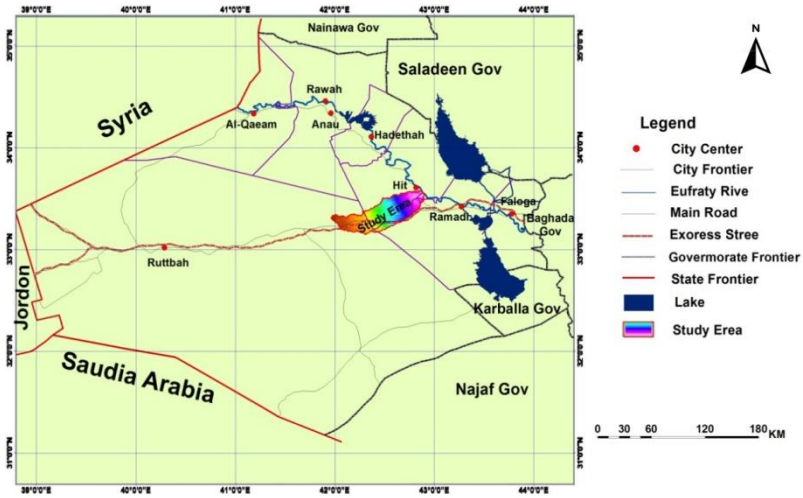

Fig. 1- Location of the search area for Anbar province, Iraq

Source: Ministry of Water Resources, General Directorate of Survey, Anbar Governorate Administrative Map, scale 1: 500000, for the year 2007

2-2. Climate Study Area

The study area is affected by the dry desert climate and to a lesser extent the effects of the climate of the Mediterranean Sea and the Persian Gulf. Based on the climatic information issued by the Iraqi Aeronautical Meteorological and Seismic Research Organization, the temperature is for the study area, annual rates of the minimum and maximum air temperature in thestations for the research area (Haditha - Ramadi) and for the period (1981-2015) ranged between 8°C- 33.1°C at a general rate of 21.4°C, 9.2°C - 34.2°C and a general rate of 22.4°C, respectively concerning the rain falling, the average annual rainfall rates recorded in the Haditha-Ramadi stations for the period 1981-2015 were 129.7 mm and 110.7 mm, respectively. Annual values of evaporation rates recorded in the stations (Haditha - Ramadi) for the same period were about 116.7 mm and 102.2 mm, respectively.

As far as relative humidity is concerned, the relative annual values of relative humidity recorded in the stations in Haditha - Ramadi for the period 1981-2015 were: 44.9% and 51.9%, respectively, wind blowing rates of wind speed recorded in the Haditha - Ramadi stations were about 3.6 m/s, 2.3 m/s, respectively, and the prevailing winds in the research area are mainly western winds and north - west winds.

2-3. Geology of the Area

The map shows in Figure 2, the geological formations on the surface extending from Miocene to Holocene (Sissakian & Buthaina, 2007) and distribution of these sediments and other geological formations. The following geological formations are present in the study area:

● **Formation of Euphrates:** The sedimentation environment (shallow active) consists of basal conglomerates, dolomite, chalky limestone, and limestone, limestone with granular limestone, marl and limestone dolomite limestone and dolomite.

● **Formation of Al-ftha:** The sedimentation environment is a closed coastal marine environment and the layers of the formation of the hole are higher than the four-gravel deposits in the sections near the Euphrates River. It s consists of the periodic rock sequences of clay rocks (Marl), limestone, gypsum, gypsum, and limestone and clay rocks.

● **Formation of Anjana:** The composition of this composition is near the Euphrates river and the middle of the Mohammedi basin, and its rock components (Buday, 1980) are limestone, limestone, sandstone, limestone and slate in the lower part. The layers of quarantine are between 1-5m and the total thickness of the formation is 18 m.

● **Quaternary Deposits:** It consists of the followings:

- Deposits of the river tresses of the Pleistocene era.
- Deposits of the slopes of the Pleistocene-Holocene era.
- Deposition of residual soils from the Pleistocene-Holocene era.
- Deposits of wadi from the Pleistocene-Holocene era.
- Deposits of the plains flood of the Pleistocene-Holocene era.
- Deposits of depressions from the Pleistocene-Holocene era.
- Deposits of organic soils, which are sand-clay deposits on secondary gypsum and tar.
- Deposition of the sabkha, a deposition of saline clay from the Holocene era.

2-4. Hydrochemical Study Area

The study of water hydrochemistry is the chemical relationship between water and its interaction with the bearing rocks, investigating the chemical properties of natural water, its quality and its chemical composition in evaluating it and determining its suitability for agricultural use, based on the results of chemical

analysis of the water models of the research area. The groundwater reservoir is characterized by the reservoir in the Quaternary Deposits with bank storage characteristics. The groundwater reservoir in the formation of the hole is characterized by the characteristics of the perched-unconfined aquifers. The groundwater reservoir for the formation of the Euphrates is characterized by the characteristics of the open aquifer in the recharge areas of the surface and characterized by the characteristics of the underground reservoir trapped in the drainage areas, which are topped by the formation rocks of formation of Alftha.

The general hydraulic regression coefficient for Wadi Al-Mohammadi area is about 0.0033 and the movement velocity of groundwater (V= KI) is 0.0033 × 5.2 = 0.017 m/day (Hussein & Mushtaq, 2010).

The general trend of the groundwater movement is from the west to southwest (ENW) and the water level ranges from 60 to 125 meters above sea level.

2-5. Fieldwork and laboratory

The field work included surveying the Wadi Al-Mohammadi Basin area, selecting seven sites for wells, determining their location and ownership, and specifying their locations geographically using GPS. Table 1 shows the names and locations of the study area.

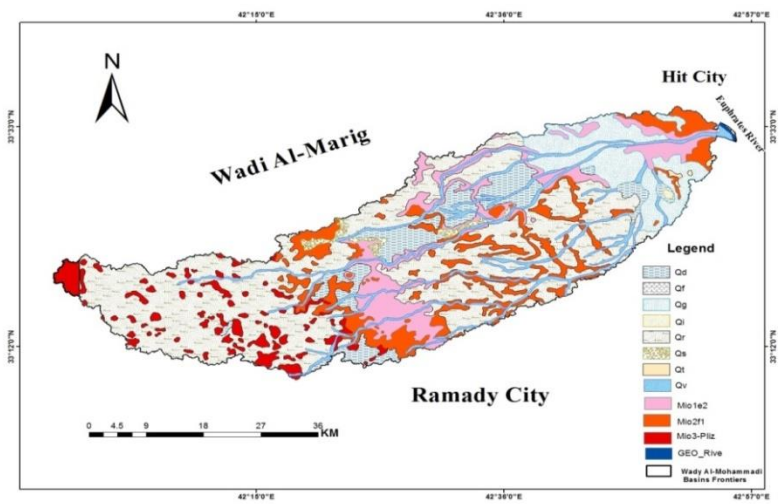

Fig. 2- Geological map of the Wadi Al-Mohammadi basin
Source: Developed by the General Company for Geological Survey and Mining, Ramadi plate, scale 1/250000, 1994

Table 1- lLocations of wells of the study area

Well number	Owner's name	Well elevation above sea level (m)	Geographical location	
			N	E
1	Mohammed Amahs Saleh	63	8.40" 22' 33°	13.76" 17' 42°
2	Mujbil Jabbar Houran	120	3.00" 24' 33°	16.40" 48' 42°
3	Saleh Abdul	97	52.50" 23' 33°	47.80" 47' 42°
4	Hatem Jayad	89	26.20" 25' 33°	32.2" 48' 42°
5	Issa Abdul Jassim	86	40.20" 25' 33°	17.1" 48' 42°
6	Mahdi Abdel Farhan	86	40.80" 19' 33°	17.3" 39' 42°
7	Forest 70 km	140	43.40" 17' 33°	55.8" 39' 42°

2-6. Laboratory Work

The sample collected consists of 28 samples for the seven wells of the research area. One sample for each of the four seasons of 2020 was collected in one liter sealed plastic bottles after washing several times with the well water and then filled to the nozzle to expel the air for the concentration of hydrogen ion (pH). The carbon and carbonate ions were deposited directly in EC_W and pH, and were stored in a refrigerated case with pieces of ice. They were transferred to the laboratory of the Center for Desert Studies at the University of Anbar. Their content was estimated as the negative and positive ions according to the following methods:

1. Calcium and Magnesium by correction with E.D.T.A (0.01 standard).
2. Sodium and potassium using optical flame.
3. Carbons and bicarbonates by correction with sulfuric acid (0.01 standard) and by using phenolphate as carbonate and carbonate as a bicarbonate reagent.
4. Chloride in a correct manner with silver nitrate (0.005 standard).
5. Nitrates in the phenol Dai sulfonic acid method as the ions were sorted above according to the method in (Richards, 1954).
6. Sulphate in the manner of tricylase with barium chloride as stated in (Page & et al., 1982).
7. Calculations of normal sodium adsorption ratio (SAR) were calculated according to the method in (ALZubaidi & et al.1980).
8. The quality and use of water for irrigation purposes has been classified according to the FAO Standards (1989), and the quality of the well water has been classified according to the criteria of Richards (1954), to determine its suitability for agricultural use, See Tables 2 and 3.

Table 2- The main criteria for evaluating water wells for agricultural use

Water quality calibration	Code	Equation / unit	Measurement type
Sodium adsorption ratio	SAR	$SAR=Na/((Ca+Mg)/2)^{0.5}$	Concentrate of sodium to total calcium and magnesium
Electrical conductivity	ECW	dS/m	Measurement of salinity in water
Soluble solids	TDS	mg/L	Measurement of solid salinity in water
pH	pH	$pH = {}^{-}Log(H^{+})$	Hydrogen concentration of hydrogen protons
Basic	Ca-CO3	mg/ L	Concentration of bicarbonates in water

Table 3- Criteria for the assessment of well water according to FAO standards (FAO, 1989)

No.	Nature of the problem	The value of the minimum use		
		No	Low - Medium	Severe
1	Salinity value (EC) $dS.m^{-1}$	> 0.7	3 – 0.7	< 3
2	Total dissolved salts ppm	450	2000 - 450	< 2000
3	Sodium adsorption ratio	Electrical conductivity ($dS.m^{-1}$)		
	3 -0	< 0.7	0.2 – 0.7	> 0.2
	6 - 4	> 1.2	0.3 – 1.2	> 0.3
	12 - 6	< 1.9	0.5 – 1.9	> 0.5
	20 - 12	< 2.9	1.3 – 2.9	> 1.3
	40 - 20	< 5	2.9 - 5	> 2.9
4	Side effect of ions			
	Sodium (meq. L^{-1}) natural irrigation	3 >	9 - 3	< 9
	Chloride (meq. L^{-1}) surface irrigation	4 >	10 - 4	< 10
5	Other incidental effects			
	Nitrate (meq. L^{-1}) No3-N	0.5 >	5 – 30	< 30
	Bicarbonate (meq. L^{-1})	1.5 >	1.5 – 8.5	< 8.5
	pH		8.4 – 6.5	

3. Results

To evaluate the suitability of groundwater for wells in agricultural use and then to conduct the various tests of the characteristics of these water as

recorded in Table 4 and Figure 3 and the distribution of these characteristics depending on the standard methods or testing of this water. The results were evaluated according to the limits allowed in accordance with the specifications and standards. The results showed that there were differences in the values of the studied characteristics and the difference between the results of those wells. The characteristics of the water in general were characterized as water that is difficult to use for agricultural use because it contains high salinity and large percentages of water. These two criteria are considered to be the main criteria in the assessment process. These results are presented below:

3-1. Total Dissolved Salts (TDS) and Electrical Conductivity (EC)

The ionized or non-ionized solids shown in Table 4 and Figure 4 represent the water values of the studied wells ranged between 1840-4800 mg/L. According to the Richards classification (1954), water was classified as severe and very severe (C6-S3 and C6-S1). The water of the wells has a high saline concentration, which indicates the seriousness of the soil and plant and is not recommended for irrigation under normal conditions. It can be used in soils with very high permeability as in the soils with efficient sanding and using the salt resistant crops.

Table 4- Results of chemical analysis of water wells of the study area*

Well no.	owner's name	pH	E.C dS/m	TDS mg/L	K^+ meq/l	Na^+ meq/l	Mg^{2+} meq/l	Ca^{2+} meq/l	Cl^- meq/l	SO_4 mg/L	HCO_3^- meq/ l	CO_3^- mg/L	NO_3^- mg/L	SAR Mole(+) L_{-3}
1	Mohammed Ammash Saleh	6.9	6.28	3140	1.9	94.6	17.6	19.6	33	1079	2.6	nill	0.1117	22
2	Mujbil Jabbar Houran	6.9	5.8	2900	1.9	918.3	14.8	36.4	34.2	890.1	3.4	nill	0.0089	183.6
3	Saleh Abdul	7.1	7.34	3620	2.1	106.2	15.6	20.4	54.2	561.6	3.8	nill	0.0002	25.2
4	Hatem Jayad	6.7	9.6	4800	19.1	113.2	23.2	38	59.8	733.1	3.8	nill	0.0132	20.2
5	Issa Abdul Jassim	6.8	7.51	3750	3.5	103.9	18.8	29.6	40.6	762.2	3.2	nill	0.0106	21.2
6	Mahdi Abdel Farhan	6.9	3.99	1990	1.8	76.03	8.4	8.4	28	81.9	3.6	nill	0.0315	26.3
7	Forest 70 km	6.8	3.68	1840	1.7	71.3	12	7.9	25.2	805.8	3.8	nill	0.0068	7.20

Source: The results of laboratory tests conducted at University of Anbar - Labs of the Center for Desert Studies

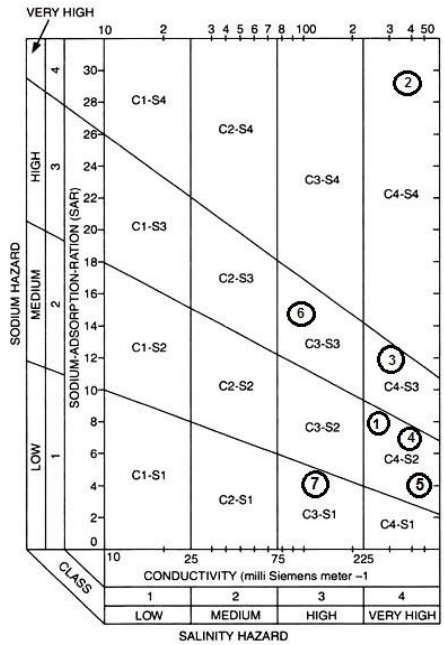

Fig. 3- Richard's chart for irrigation water salinity and basically severity (Richards, 1954)

The electrical conductivity ranged between 3.68 - 9.6 dS .m^{-1}. These values are high and dangerous when using for agriculture. Most of the international water classifications indicate that if irrigation water is more salinized than 3 dS. m^{-1}, its use is economically feasible only after some administrative methods have been adopted in the soils of these areas. The results of the study indicate that there is a change in the saline concentration of the water wells but not significant in terms of the effect on the possibility of use for irrigation, as it means the conservation of class C5 and class C6. This level of salt is greater than the limits allowed under normal circumstances, according to all international classifications.

3-2. The Ratio of Sodium Adsorption (SAR)

The SAR ratio is an important criterion in determining the water viability of these wells for agricultural uses. According to Table 4 and Figure 5 in the language of the value of well (7) the lowest value of 7.2 and the highest value recorded in well (2) is 183.6, considering the large quantity of the element of sodium which has a content in this well 918.3 Mg , a high value. The criteria for this in the Richards scheme, 1954, ranged from S4 to well (2) and S1 (7).

3-2-1. pH

The pH of the wells ranged between 6.7-7.1 (Fig. 6). This criterion has an important role in determining the acidity and the pH of the reaction.

3-2-2. Basic ($HCO_3 + CO_3$)

The basic source of the base is the calcareous rocks and dolomite rocks, which generate the carbonates and bicarbonates for sodium, calcium and magnesium. bicarbonates form the general form of basal compounds, which were the highest results of bicarbonate for well water wells in well (3), (7.4) and the lowest results were in well 1. It is noted that the water wells exceeded the maximum allowed for its suitability of irrigation water.

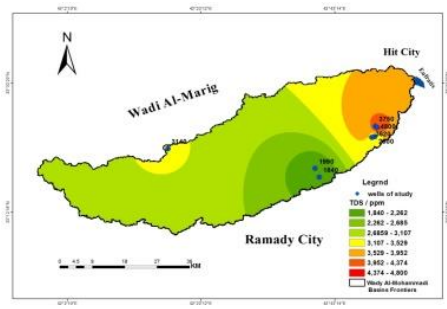

Fig. 4- Total dissolved salt map of the study area (ppm)
(**Source:** Table 4 using GIS 10.4)

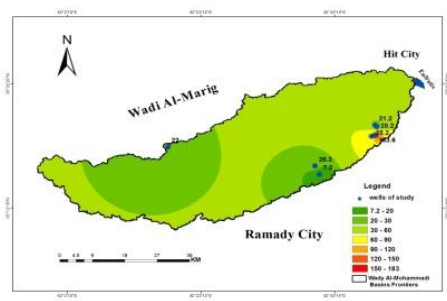

Fig. 5- Map of sodium adsorption ratio, Cmol $^{(+)}.m^{-3}$
(**Source:** Table 4 using GIS 10.4)

3-2-3. SulpHates (SO_4^{-2})

The study revealed that the concentrations of sulphates for the water wells of the study is ranged between (1079- 56106) mg/L. The minimum value is in well (3) whereas the highest value is in well (1). It is also noted from the

comparison of water concentrations of wells with the approved validity specifications that water is not suitable for agricultural use for its effect on soil and plant (Figure 7).

3-2-4. Chloride (CL)

As well as the toxic effect of sulphates, the effect of chloride coincides with that can reduce or increase this effect. The value of this element ranged from (25.2-59.8) mg/L Figure 8 with the lowest values of well 7 and highest value of well 4 and compared with the specifications of the agriculture organization (FAO, 1989) to determine the validity of irrigation. The values of all of the chloride elements are above the allowable and the cultivar (severe) is greater than (10 meq/L).

4. Conclusions

The study concludes that: Through physical and chemical analysis, it is clear that the climate and the type of rocks is the main influence on the variation of dissolved ions in water. Sulfates dominated the group of anions, and ranged between 561.6 to 1079 mg/L), while the predominance of sodium on the cation group, the values of ions concentrations for chloride (25.2-59.8 meq.l^{-1}) and sodium (71.3-918.3 meq.l^{-1}) were varied because the study area was located in the limestone-dolomite and gypsum-shaped rock deposits, The wells (1,4,5), according to Richard's scheme, 1954, were classified as C4-S2, medium and very high, and wells (7,3,6,2) C4-S4, C3-S3, C4-S3, C3-S1 and respectively.

Most wells fall within categories 1, 2, 3, and 4 of the SAR. Based on this scheme, the wells of the study area are located at low limits to suitability for irrigation water. According to the scheme, well water no. 7 in the study area can be considered as the best and suitable for irrigation purposes,

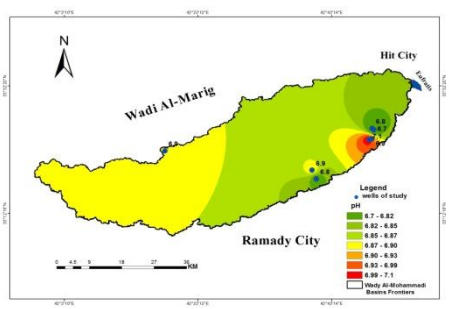

Fig. 6- Map of the distribution of acid function values for the wells of the study area
(**Source:** Table 4 using GIS 10.4)

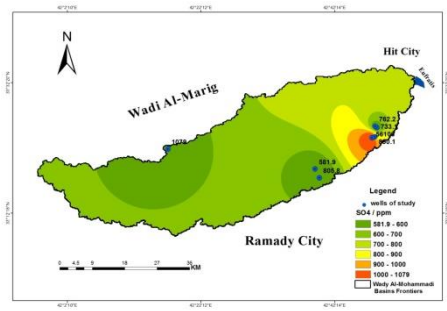

Fig. 7- Distribution Map of Sulfate Concentrations for Wells Study Area (ppm)
(**Source:** Table 4 using GIS 10.4)

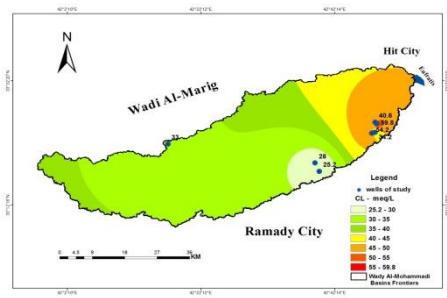

Fig. 8- Distribution map of chloride concentrations for wells Study area (mg/l)
(**Source:** Table 4 using GIS 10.4)

provided that appropriate management methods are used when to irrigate the crops.

It is necessary to focus on conducting the periodic studies, monitoring water reservoirs and preparing the hydrological maps in which all sectors contribute to determining the qualities of underground water. To regulate the quantities of pumping from them to maintain its sustainability and conduct scientific practices for future use, conducting chemical analyzes of the well water no. 7 and the investor currently to show their suitability for different uses and approaching the concerned parties in the work of an awareness program for farmers to adopt the modern methods of irrigation such as drip irrigation and others to prevent the waste of large quantities of groundwater and thus cause soil degradation through an increase in accumulations saline and toxic elements, installation of a weather station in the study area for the purpose of accurate data obtained in relation to rain, evaporation, temperature, wind

and relative humidity of accurate hydrological budget work for the study area.

Possibility of establishing a research terminal affiliated with Anbar University for the purpose of establishing a model farm and cultivating the saline and sulphate crops, studying the special methods of water to make it more suitable when it is used to irrigate crops and circulating the recommendations to various farms in the region to achieve sustainable agricultural development that supports the economy of farmers and the state.

5. Acknowledgments

None declared.

6. Conflict of interest

None declared.

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