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Research Paper

HYDROLOGY AND SUITABILITY OF GROUND WATER IN SAMAWA FOR THE DIFFERENT PURPOSES

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Study area lies between (44 00- -44 41) longitude (30 18- -30^0 40^0) latitude. It is lies south-west to AL_Muthana. The area is about 140 km^2. Its boundary from the south is Saudi, from North is Euphrates river, from East is Besia, and from West is Shbicha. The geological formations in study area are: Russformation, Dammam formation (Tertiary deposits)-Quaternary deposits, and they are belongs to Eocen_Paleocen. The study area belong to stable shelf of the Nubio-Arabian plat form and the regional bedding strike is trending NW-SE direction and the dip amount is 2-3 toward NE. The study area is considers as a part of western desertof Iraq. Therefore it depends on ground water for many purposes such as: drinking-agriculture and others activities. The ground water movement from recharge area in SW outside the Iraqi border towards the discharge area along Euphrates river and the main sources of recharge is the rain and infiltration of water across the valleys. Climate of study area is arid; monthly average of rainfall (8 mm), temperature (25 °C), Humidity (44%) evaporation (318 mm) and sunshine (8.8 H/D). Therefore the area depends on ground water which consider the main source of waterthat used in the different purposeslike: industrial domestic, drinking and agriculture. According to analysis of parameters (EC, PH, T.D.S), and chemical analysis: (Na, K, Ca, Mg, Cl, SO_4, HCO_3) ground water is unsuitable for drinking and industrial, but suitable-unsuitable for irrigation.

Keywords: Ground water, Chemical analysis, Irrigation

INTRODUCTION

Iraq lies in the contact area between the Asian branches of the Alpine Geosyncline and the African (Nubio - Arabian) platform.

In Southern desered in Iraq, sedimentary beds have agentle slope toward the North and the North east, which is far away from the Arabian shield (Jassim and Goff, 2006).

Water is an essential commodity to mankind and the largest available source of fresh water lies underground, so ground water is amajor natural resources in many fields.The delineation of ground water quality for human use specifically and other uses by using the Water Quality Index methodology make of reduce the cost time necessary to drill the drinking wells in the area of high pollution in ground water so that delineate

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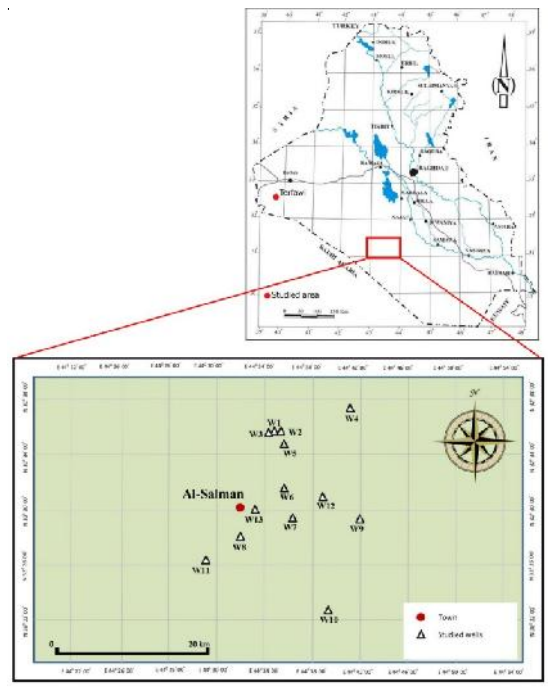
the good areas of ground water drinkable to expand the human populations.

The available quality of ground water is result of all processes and reaction since the condensation of water in atmosphere to the time it is retrieved inform of ground water from itssource. The climatic variable-geological formations and topography are affect on the characteristic of waterso we study the quality of water to understand the ground water sutibility for different purpoces.

STUDY AREA

The study area is apart from western desert of Iraq it is lies south of Al_Muthanabetween (44^0 00^- -44^0 41^-) longitude ($^-30$ 18^- -30^0 40^-)) latitude. Area is about (140 km^2). It is boundary from the south is Saudi, from north is Euphrates river, from east is Besia, and from west is Shbicha (Figure 1).

Figer 1: Well Location Map in Study Area



The rocks in the study area belong to Eocene and Paleocene ages and belong to formations:

Tertiary Deposits

Rus formation – Dammam formation.

Rus (Jil) Formation

The formation Consists of unfossili ferrous limestone, marle, blueshale and anhydrite. The formation in some area has been combined with Umm ErRadhuma formation, forinstanceKifl, shawiya (Safar, 1691, etc).

The Jil formation that equivalent for Rus formation Where the anhydrite has been dissolved and it corres ponds to beds previously assigned to the Dammam Fn (Owen and Nasr, 1958).

At outcrop, the Rus formation divided into two members: The upper member (equivalent to the sharaf, shbicha) and the lower member (equivalent of wagsa), (Jassim and Goff, 2006). The age of formation is early Eocene (Power *et al.*, 1966).

The Dammam Formation

The Dammam formation consist of neritic shoal limestones often re_crystallised or dolomitized, shale and marls. The lower contact with Rus formation may be un conformable. The age of Dammam formation in the supplementary subsurface type section in Iraq is Middle Eocene, Dammam formation also is party of Late Eocene age in south-west of Iraq (Bellen *et al.*, 1959; and AL_Hashimi, 1973).

Quaternary Deposits

The deposits are consist of fine clastics or sandy and silty gravels, also consist of rock fragments which decrease in size and amount down the slopes, and it is belong to stable shelf of the Nubio - Arabian plat form (AL_Mubarak and Amin, 1983).

They says: Western and southern desert divided to:

1. Western Sub Zone.
2. Abu – Jir S.Z.
3. Southern S.Z.

The regional bedding strike is trending NW-SE direction and the dip amount is 2-3 toward NE.

The Salman sub-region represents the control part of the southern sub zone. It is bounded by AL_Rowak fault from SE and AL_Sawafi_Samawa fault from NW.

Salman basin is a SW of Iraqi desert and during the initial assessment of the basin it is show that Salman basin would be one of the promising zones for agriculture and housing projects through the best investment of ground water (AL_Ansari and AL_shamma'a , 1994). All the wells drilled in Dammam formation, so it is the most important aquifer in south-western part in Iraq.

It is recharge by many valleys and depressions with high permeability of water, and the infiltration water affecthe quantity of water exists in the area (Geo and Surv, 1993).

The ground water movement from re charge area towards discharge area and main source of recharge is the rain and infiltration of water seasonal flooding across the valleys (Arim, 1993). The thickness does not exceed one meter and the age considered as Holocene, and even partly still active (Al_Rawi and Al_Sam, 1983).

RESULT

Climate

Study the climate is very important to understand the nature of the study area, and many meteorological variable are controls the climate like: topography, latitude, elevation, amount of water and prevailing atmospheric circulation, study the influence of climate on distribution of vegetation, and degree of weathering of bedrock (Moarn and Morgan, 1994).

Climate elements was taken for AL-Samawa Station (Iraqi meteorological organization for Samawa Station (80-2014) are rainfall, wind speed, Temperature, sunshine and humidity (Table 1 and Figure 2).

1. Rain fall is very important to re charge ground water and when rainfall increase it lead to high humidity, in study area, monthly average is (8 mm).
2. Temperature is also important element, there is relationship between Temp and Evaporation, and temperature has inverse relationship with rainfall, monthly average is (25 °C).
3. Wind speed it's effect to increaseor decrease the evaporation, monthly average is (1.9 M/S).
4. Sunshine is also important element has a effect on the amount of temperature and evaporation, when it increase it lead to increase both of them, monthly average is (8.8 H/D).
5. Humidity is the percentage between the actual vapor pressure to per saturated vapor pressure or it is a measure of percentage saturation of air with water vapor of 100% (Boyd, 2000) in study area monthly aver IS (44%).
6. Evaporation is more important element of climate it is consider as a factor in water balancing, there is a strong relationship between evapor. And the other elements like, rainfall, sunshine, humidity, and temperature. It is about (318 mm).

Table 1: Monthly Average of Climate Parameters Used in Present Study for Period (1980-2014) for Samawa Station (Iraqi Meteorological Organization)

Months	Temperature (°C) Mean	Humidity (%) Mean	Evappration (mm) Mean	Rainfall (mm) Mean	Wind Speed (M/S) Mean	Sun Shine Duration (H/D)
October	26.29	39.2	283.3	5.2	1.4	8.3
November	18.32	57.1	147.6	17.3	1.28	7.3
December	12.65	67.88	95.7	15.25	1.2	6.03
January	10.89	68.9	91.7	16.7	1.29	6.51
February	13.31	58.3	126.8	15.9	1.8	7.36
March	17.66	50.4	209.5	13.13	2.14	7.97
April	24.3	42	300.6	16.5	2.23	8.5
May	30.25	31.4	426.6	5	2.32	9.5
June	34.41	25.3	547.5	0	2.92	11.59
July	36.62	22.2	603.8	0	2.91	11.64
August	36.39	23.3	559.8	0	2.4	11.09
September	32.37	27.9	406.6	0	1.7	10.22
Monthly Average	24.41	42.44	318.54	8.8	1.97	8.8
Yearly Summation	292.87	512.6	3798.5	105.3	23.59	106.01

Figure 2: Monthly Average of Meteorical Variable in Study Area

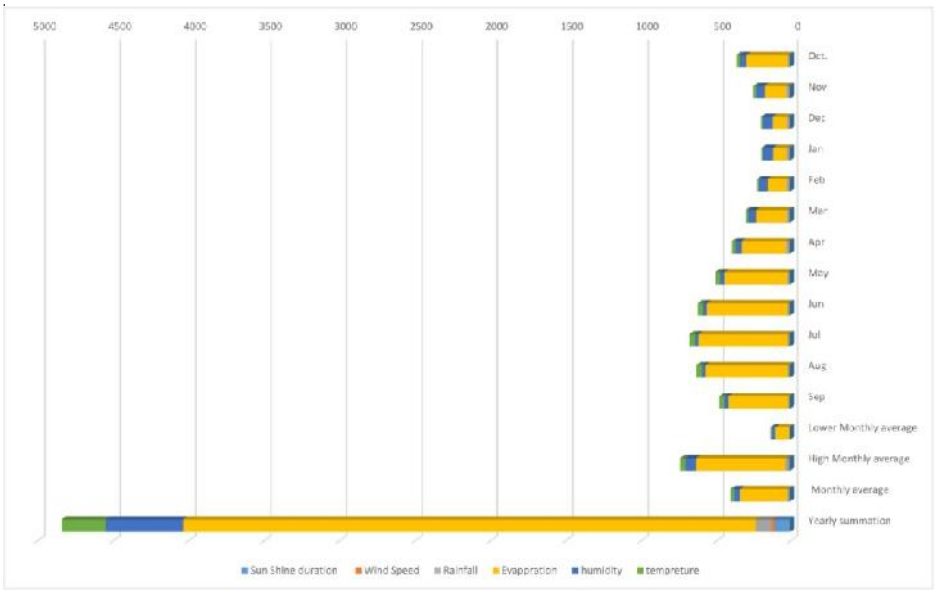


Table 2: Chemical Analysis of Ground Water Samples for Wet Period

Well	Na	K	Ca	Mg	HCO_3	NO_3	SO_4	CI	TDS	EC	PH
W1	9	0	9.6	8.4	3	0.02	11	12	1748	2670	8
W2	8	0	9.5	8.3	3.5	0.02	10	13	1720	2620	7.5
W3	7.3	0	8	8	3.2	0.02	8	11	1500	2300	7.5
W4	8	0.1	8.5	7.5	2	0.03	9	12	1450	2500	8
W5	8.1	0	9	8	3	0.03	10	13.5	1760	2700	7
W6	8	0	7.5	7.5	2	0.03	9	12	1500	2350	8
W7	9	0	9.9	8.8	3	0.03	12	13.5	2000	2070	8.1
W8	8.5	0	7	7	3.5	0.03	7	11	1500	2050	8
W9	8.8	0	9.8	8.7	3	0.03	12	14	1999	2072	8.1
W10	8.5	0	7	6.3	3	0.02	8	11.2	1700	2500	7
W11	8.2	0	7	6	3.5	0.02	7	11	1500	2300	8
W12	10	0.1	7.5	7.3	4	0.03	12	10	1550	2800	8
W13	8	0	7.5	7.3	2	0.03	9	12	1480	2344	8
Total	107.3	0	103.3	95.4	37.3	0	124	155	19922	31276	100
Ave.	8.2	0	7.9	7.3	2.8	0.03	9.5	11.9	1532	2405	7.6

Table 3: Chemical Analysis of Ground Water Samples for Dry Period

Well	Na	K	Ca	Mg	HCO_3	NO_3	SO_4	CI	TDS	EC	PH
W1	9.5	0	10	10	4	0	10.5	11.5	1850	2800	7.9
W2	12	0.1	11	9	3	0	10.5	12	1950	2850	7.8
W3	10	0	8	7	2.5	0	10	12.2	1700	2550	8
W4	13.5	0.1	10	4	3.8	0	11	12	1900	2900	7.5
W5	10.2	0	11	9	3	0	12	14	1900	3000	7.5
W6	10	0.1	9.5	8.7	3.3	0	10.5	13.5	1790	2600	8
W7	10.8	0.1	10.5	77	3	0	14	13.8	2150	3200	8
W8	11	0	8	7	4	0	8	12	1800	3550	8.1
W9	10.5	0	11	9	3.1	0	14	14	2150	3200	8
W10	10	0	9	7.5	3.5	0	10.8	13.5	1800	2700	7.8
W11	11	0	8	7	3.8	0	9	12.5	1700	2700	8
W12	12	0	9	6.9	4	0	11	11	2000	3000	7
W13	10	0.1	9.2	8.5	3.5	0	10.3	13.2	1790	2600	8
Total	139	0	123	99.2	41	0	129	163	24480	37400	98.2
Ave.	10.6	0	9.4	7.6	3.15	0	9.9	12.5	1883	2876.9	7.5

By collect water samples from the wells in study area (13 wells) in tow visits, in (March) and in (Augest) to see the geochemistry changes in ground water during water surplus period and water deficit period, and collect in plastic botteles and washing with dis till water and fill these bottles up to the crater to expel air and closed tightly, after that Calculate chemical analysis for (13 wells) includes: cations (Na^+, K^+, Mg^{++}, Ca^{++}), Anions (Cl^-, CO_3^-, HCO_3^-, SO_4^-) and (PH, TDS, EC) (Labrotary of general commission of ground water).

Ground Water Quality Suitability for Different Purposes

The water quality means that suitability for various uses by man (Turk and Wittles, 1972). To make sure that the analysis is right I calculate the (Accuracy) by use the law of balance, that depends on the salt concentration of total Cations equal to anions, and results accuracy measured proximity to truth value which expressed as the relative differences of cations and Anions (Hem, 1970).

$$TCS = r\Sigma cat. + r\Sigma ani. \quad ...(1)$$

$$R.D = \frac{Abs\ (r\sum aat.+r\sum ani.)}{r\sum cat.+r\sum ani} \quad ...(2)$$

$$A = 100 - R.D \quad ...(3)$$

TCS: Total converted solids

Table 4: Ground Water Suitability for Drinking Purpose of Study Area Compared with Standared (IQS, 2005) (WHOS, 2007)

Parameter	IQS 2005	WHOS 2007	Concentrate of Wet	Concentrate of Dry
Na	200	200	8.2	10.6
k	12	12	0	0
Ca	50	75	7.9	9.4
Mg	50	125	7.3	7.6
HCO3	200	200	2.6	3.15
NO3	50	50	0.03	0
SO4	250	250	9.5	9.9
C1	250	250	11.9	12.5
TDS	1000	1000	1532	1883
EC	1500	1530	2405	2876.9
PH	6.5 - 8.5	6.5 - 8.5	7.6	7.5

Table 5: Ground Water Suitability for Irrigation Purposes of Study Area as Compered with Standared Developed from (Ayers and Westecot, 1989; and CGWB, 2000)

Parameter	Concen. of Wet Period	Concentrate of Dry Period	Median of Two Period	Typical Range	Exceeding Limits
Ca^{++}	6	8	7	0-20	Not Exceed
Mg^{++}	6.8	7	7	0-5	Exceed
Na^+	8.5	10.9	9.5	0-40	Not Exceed
K^+	1.1	1.3	1.1	0-2	Not Exceed
Cl^-	9	11	10	0-30	Not Exceed
$So4^{--}$	8.2	11	10	0-20	Not Exceed
Hco^-_3	2.5	3	2.5	0-10	Not Exceed
PH	7.5	8	7.5	6-8.5	Not Exceed
EC	2225	2500	23625	0-3000	Not Exceed
TDS	1586	1700	1643	0-2000	Not Exceed

Σcat: Sum of cations

Σani: Sum of Anions

r: epm

A: Accuracy

Abs: Absolute value

R.D: Relative differences

Gr. Wa. Suitability for Drinking Purposes

The result of calculation, ground water in study area is unsuitable for human drinking according to (Iraqi Quality standards (IQS, 2005) and (World Health Organization (WHO, 2007) (Table 4).

Gr. Wa. Suit, for Irrigation Purposes

According to classification (Ayers and Westcot, 1985; CPCB, 2000; and CGWB, 2000) the result of the analysis is considers that ground water is suitable for irrigation purposes in study area (Table 5).

Gr. Water Suit. for Animal

According to (CGWB, 2000) classifi., the ground water in study area is suitable for all animals. (Table 6).

Table 6: Threshold Concentration of T.D.S.

Animal	Threshold Concentration TDS mg/l
Poultry	2860
Horses	6433
Cattle dairy	7150
Cattle beef	10,000
Sheep	12,900

CONCLUSION

1. The study area climate is arid, monthly average of rain fall is (8 mm), and monthly average of Temperature is (25 °C), and humidity is about (44%), evaporation (318 mm), windspeed (1.9 M/S), and sunshine (8.8 H/D).
2. The ground water quality a coording to the analysis results of the parameters:

   (Ca^{++}, Mg^{++}, K^{++}, Na^{+}, Cl^{-}, SO_4^{++}, HCO_3^{-}) epm, and (PH, EC, T.D.S.): The ground water is (alkaline) according to amount of PH 7.6-8 for tow periods (wet_dry). The T.D.S. is (1532.4_1790) mg/L. The EC is (2405_2600) umhos/cm, Ca is (7.9-9.2), Mg is (7.3-8.5), K is (o) Na is (8.2-10), Cl is (11.9-13.2), SO_4 is (9.5-10.3), and HCO_3 is (2.8-3), NO_3 is (0), from the results of chemical analysis: Ca and Mg are high concentration is a result from solution limestone by ground water, Na is consider typical with little increasing because nonexistent any source rock of Na, K is consider typical because nonexistent any source rock of K, Cl is high concentration because of the Marine origin of ground water in study area, SO_4 is high concentration because of solution of anhydrite in Dammam Formation, HCO_3 is high concentration because of the dissolution of carbonate minerals, NO_3 its cannot be move from surface to ground water because of its absorption from plant roots through soil.
3. The study area is considers adesertso is depends on ground water for many activities, therefore it is necessary to evaluation the quality of ground water and suitability for different purposes.

When we compare the quality of ground water in study area with standardsit is unsuitable for drinking purposes, and suitable to unsuitable for irrigation purposes, suitable for animal drinking.

RECOMMENDATION

1. It must be drill many wells in the area for drinking water to protect human living and try

to find ground water which is suitable for human drinking and irrigation in the study area.

2. We must tell the people in the area about the dangerous which found in the area like. Mines, bullets, sinkholes that may causes losses in souls and economy.
3. Increase the climate stations in study area to get more informations about the changing in elemants of climat and there affect to ground water.

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