

تقييم صلاحية بعض الآبار في منطقة الرطبة للاستخدام

البشري ضمن صحراء الغربية من العراق

عبد الكريم مخيلف العلواني باسم احمد زيدان احمد فرحان العنزي
جامعة الانبار – مركز دراسات الصحراء

نفذت هذه الدراسة لتقييم صلاحية مياه عشرة آبار في قضاء الرطبة- منطقة الضيعة ضمن المنطقة الغربية من القطر للاستخدام البشري جمعت عينات مائية من كل بئر وبواقع نموذج فصلياً ضمن العام ٢٠١٢-٢٠١٣ ولمدة سنة كاملة لأجراء بعض التحاليل الكيميائية والبكتريولوجية عليها وتقييم نوعيتها حسب الخواص المدروسة للأغراض البشرية اعتماداً على الأسس الموضوعية من قبل جمعية الأرواء الأمريكية, WHO, وحدود مواصفات الخدمات الصحية في الولايات المتحدة (U.S.P.H.S).

أوضحت نتائج التحليل بالنسبة للملوحة وقيم محتواها الكلي من الأملاح ودرجة التفاعل وتراكيز المغنيسيوم والبوتاسيوم والأيونات السالبة والعناصر الصغرى بأنها ضمن الحدود المسموح بها للاستخدام البشري, وأشارت الدراسة البكتريولوجية بانها مياه نظيفة جداً وصحية لعدم تشخيص بكتريا القولون فيها.

Evaluating the suitability of some of the water wells in the Al- Rutba area for human use within the Western Desert of Iraq

Abstract

This study was carried out assessing the suitability of ten water wells in the Ar- rutba - Dabaa area spend within the western region of the country for human use. Water samples from each well were collected and by quarterly model within the year 2012 - 2013 and for a full year to make some chemical analyzes and bacteriological them and assess their quality by properties studied human purposes depending on the foundations laid under by the American Perfusion Society , (WHO, 1984), and the limits of health services specifications in the United States (U.S.P.H.S).



The results of the analysis for salinity and values of the total content of salts and the degree of interaction and the concentrations of magnesium, potassium and negative ions and trace elements as being within the permissible limits for human use, the study pointed bacteriological as very clean and healthy water for not diagnosing coliform them.

Introduction

Water is the finest thing that God created in the nature. From this standpoint water is the basis of life, not for human only, but for other creatures' as well. The importance of water is mentioned in different verses in the Holy Quran such as (وجعلنا من الماء كل شيء حي) (افلا يؤمنون) (we made from water every living thing, will they not then believe?) (Surah AL anbiya ayat 30), Therefore, it's hard to imagine life without water. In urbanized areas the first step in the process of planning and developing agriculture is to glean information regarding the quantity and quality of the water existed in the area (Walton 1970). As for the usage of water (Elkrai et al., 2004) see that the study of groundwater chemistry may enlighten us to understand the geological history of the layers of the earth and from there we can determine whether to use it for domestic, industry or agriculture uses.

Numerous studies have been carried out to address the possibility of taking advantages of the groundwater existed in the western desert of the country. The studies took place due to the shortage of the surface water and lack of rain within this desert environment. As well as the continuous increase in the population growth which led to seeking to employ the available lands for the



purpose of agriculture and establishing residential complexes. As a result the possibility of using groundwater wells became a very important matter for the area (Euphrates center for studies and design irrigation projects, 1988).

Since drinking water is essential to humans, that's why is considered one of the most disease carriers only when polluted (WHO, 1989). Water can be a source of epidemics and diseases caused by microorganisms or chemicals (Lechellier, et al, 1980). Non-appropriate treatment in the drinking water filtering stations may cause pollution (alAzawi, 1997). World Health Organization stipulated standards for drinking water, therefore, surpassing the limitation of the quality is considered to be non-appropriate for drinking which requires re-examination to the filtering stations (WHO, 1973).

Drinking water crisis always occupied the researchers' mind in Iraq in order to obtain a good quality of drinking water; Isamil (1978) studied the microbiological quality in Tigris, Euphrates, Habbaniyah Lake and Piped water of Baghdad. On the other hand Abdul-Ratha (1981) addressed the microbiological pollution in the waters of some Iraqi wells. While Azawi (1997) studied the drinking water in Babil, and Alber undertook the filtering stations in Baghdad and made a comparison between them before and after the economic sanctions on Iraq. Sarhan and his team work (2000) studied the Piped water station in Diwanyah while Alkum and his group (2001) Diwanyah River water pollution and its impact on the quality of drinking water, on (2004) alAzawi focused on the physical and chemical properties



as well as the microbiological in the Piped water of Jurf–alSakhar province in Babil.

Well water in dry areas contain high intensity dissolved ingredients due to continuous contacting with geological rocks during the passage between the permeable rocks (Ismail et al 1986). Therefore, the consumption and usage of groundwater is related to the conformity of the water with the international standards.

In his study (Sahaf 1976) undertook the conformity of eleven wells within Erbil plains and he noticed that 27% of the wells are suitable for human consumption while 91% of them were appropriate for animal consumption. On the other hand (Al Mashhadani et al, 1989) have pointed out in their study of the wells extending between Mosul and Ba'shiqah cities high intensity dissolved ingredients in the water to the upper limits within the permitted frame related to drinking water of Mosul. (Abdul Muzahim et al, 1996) indicated in their study concerning evaluation of the quality of groundwater in north of the island between the cities of Zammar and Rabia that the water existed in the area is not proper for the purposes of consumption and use because of not being subject to international standards, and the results of the study of (Saadia 2002) was corresponding to what he found in the groundwater for the Musayyib district, as well as the results of (Jamil 1990) concerning the study of quality properties related to some water sources in Tamim city focused on suitability of the waters for civil, industrial and irrigation uses. In his study of water



wells in eastern new Tigris within Mosul city (Chet, 2004) noticed increasing rate in the intensity of sulfate values in most of the water wells studied, in most cases the water exceeded the upper limit permitted the purpose of consumption while the quantity of the water was suitable for irrigation. During the study time of (Lavi et al, 2004) concerning the quality of spring water in the district of Qubaisa western Iraq the team showed in their study that the spring contain high intensity of dissolved ions especially sulfate and sodium as well as high numbers of coliform, in conclusion, the team stated that the water is not suitable for drinking and other usage before treatment while it is appropriate to irrigate some resistant to salinity crops. Thus, the aim of this study is to focus on the physical and chemical properties of the groundwater within Dabaa area, later to evaluate the suitability of the groundwater included in the study area in western Iraq. Furthermore, to monitor the status of pollution then giving appropriate instructions to avoid the pollution since those wells are the only water resource for ar-Rutbaa district especially after sabotaging and looting the institutions in 1990 and followed by the occupation of Iraq in 2003. Before these events the existed stations used to transfer water from the Euphrates River whether through the piped network from Abu Tibane station which located on the side of Euphrates River near Mohammadi wadi or transferring water from Al-Qaeem station toward Al-Rutba district and al-Walid military airbase.

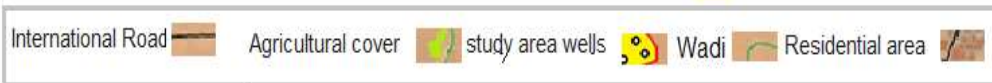
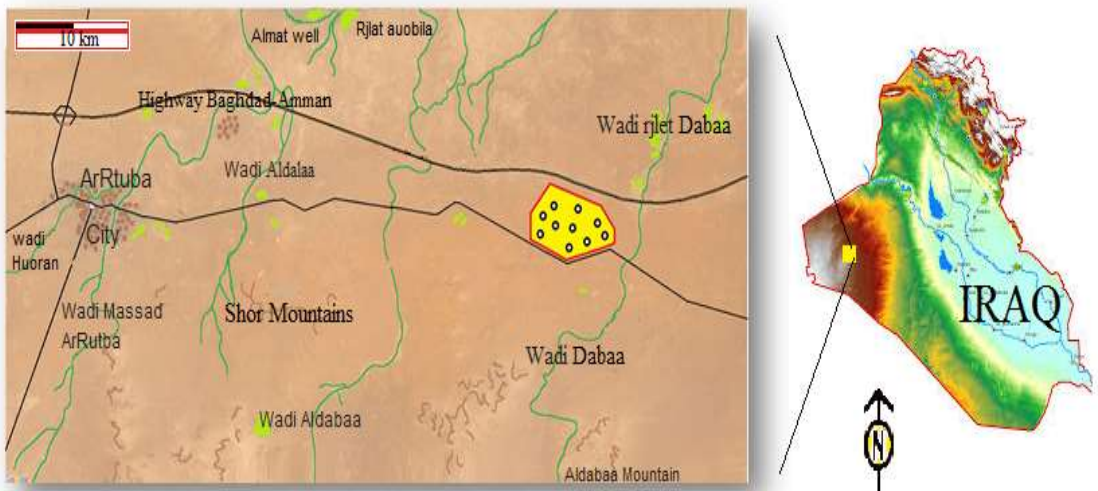
Materials and Methods



- **Study area:**

The study area is located in the Western part of the Physics– Geographical unit between the high valleys and roadways between Ramadi and Rutba cities which they are considered two international roadways between longitudes ($40^{\circ}31'22''$ – $40^{\circ}28'55''$) and latitudes ($33^{\circ}02'20''$ – $33^{\circ}01'27''$) at a height of 600–585 meters above sea level drawing an area of 3600 Acres square (figure 1).

Figure (1):Location of the study area



- **Study of natural features:**

1– Climate: The study area is located within dry desert climate, according to the climatic data of the years between 1994 –

2011 given by Rutba meteorological station, the annual average temperature may range between 10.9 – 27.3 ° C, low temperatures of 16.8 – 7.6 ° C and High temperatures of 23.5 – 46.4 ° C. while the humidity ranged between %26.5 – %71.5 with rainfall rates of 78.5 – 133.9 mm with average of 107.4 mm. The annual rates of evaporation measured by thorn criteria ranged between 2379 – 2778 mm. Figure (1) shows the climatic data for the area.

2- Geomorphological aspect of the area: the figure (1) shows that the study area is located in South East of Hawran wadi Stream which encompasses the area within the range of height of 600 – 640m above sea level. The characters of this area are intensity of low topography with the rate of slope of 1.8 m/km, the top of this area consists of calcareous, dolomite and sandstone rocks and finally the area is interrupt by number of seasonal valleys all together forming a number of plateaus (Al- Kubaisi, 1993).

3- Geological aspect of the area: the history background of the area is related to depositions of the Quaternary which consists of depositions of sand, silts, clay, gravel, rocks and calcite valleys. Its thickness range between 1–2m, which shapes an area with various levels while the stream flows between the valleys and the lowers. Figure (2) (Abdul-Salih et al, 2010) and figure (3) show the Geological cross section of the study area.

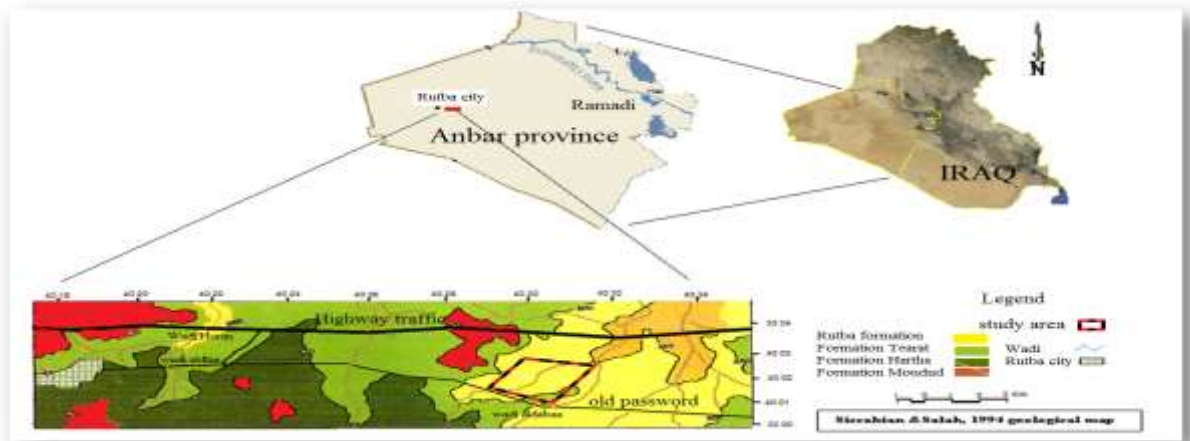


Table (1) Annual rates of rainfall, temperature, relative humidity evaporation in Rutba station for the duration (1941 – 2011)

Measurement years period	annual rate				
	Ranges of temperatures C°	Relative humidity %	Over wind speed M / s	Rain Mm	evapotranspiration (mm) *
1941–1970	26.5–11.0	– 70 24	3.8 – 4 2.00	14 3– 84	1696–1747
average	18.8	45.0	2.9 9	12 1.3	1721.5
1970–1990	28.1–14.7	73 – 29	4.2 – 2.3	12 4–73	1620–1490
average	21.4	46.0	3.2 0	94. 6	1551.0
1990–2011	12.85 – 7.3	72 – 27	4.0 5 – 2.15	13 3.9 – 78.5	1683 –1593
average	20.1	45.5	3.1 0	10 7.9	1636.2

Source: Al Rutba meteorological station

Figure (2): Geological map of Dhab'a district showing the location of the wells of the study



Source: Sissakian&Salah,1994 Geological map.

Figure (3): The cross-section Geological view of the study area

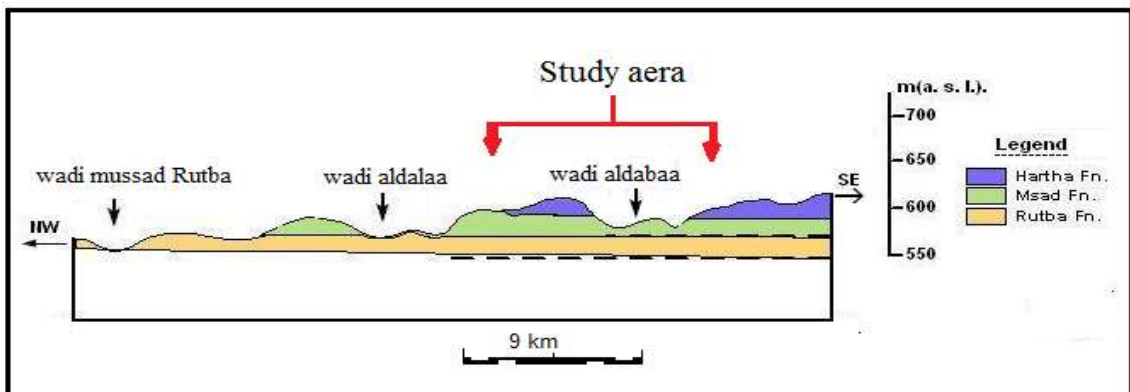




Table:2 limits the Salinity ,concentration of positive ions and negative according to international standard specifications (WHO, 1984).

Measured characteristics	measuring unit	Ranges of values
Na ⁺	Mol.m ⁻³	5.6–11.2
Mg ⁺⁺	Mol.m ⁻³	2.08–6.25
K ⁺	Mol.m ⁻³	0.3
Ca ⁺⁺	Mol.m ⁻³	3.7–10
Cl ⁻	Mol.m ⁻³	5.6–14.0
SO ₄ ⁼	Mol.m ⁻³	2.08–5.2
NO ₃	Mol.m ⁻³	0.016
HCO ₃	Mol.m ⁻³	5.7
Pb ⁺	Mol.m ⁻³	0.0066
B	Mol.m ⁻³	0.046
SAR	–	0.43–8.92
pH <i>value</i>	–	6.5 – 9.0
EC	dS.m ⁻¹	<4

SAR: sodium adsorption ratio; EC: electric conductivity

– The Field Work:

Ten wells have been chosen in the area for the purpose of studying and their coordinates have been identified through a (GBS) device.



Water samples were collected from each well, seasonally and for an entire year and the samples were sealed in sterilized plastic bottles. The electrical conductivity of the water samples and the degree of the water's direct interaction with it was estimated through the field devices. After that, a few drops of Formalin was added to the samples and they were kept in the field refrigerators until transporting them to the laboratories of Desert Studies Center – University of Al- Anbar, for conducting some chemical and biological tests which resulted in the following:

Based on the standard analytical methods (APHA – AWWA – WPCF. 1976), the water samples were chemically analyzed to estimate their overall salt content (Total Dissolved Solids – T.D.S), their electrical conductivity, their acidity (pH), their total hardness (T.H.) and positive ions (K^+ , Na^+ , Mg^{++} , Ca^{++}) and negative ions ($HOC3^-$, $SO4^-$, CL^-). The Boron (B) was measured according to (Chapman, 1961) method, while the ions (Co, Pb, Zn, Cu) were measured through the Atomic Absorption machine, the (Pye – Unicamz 2900 model) for The General Company for Geological Survey and Mineral Investigation.

The Bacteriological Tests: the total probabilistic number of E. coli bacteria (Total Coliforms) has been estimated according to the most probable number method using a nutrient medium and nestling the plates in ($1 \pm 37^\circ C$) for 48 hours, based on the method mentioned in (APHA – AWWA – WPCF. 1976). The quality of the water was evaluated according to the properties studied for human purposes and



depending on the foundations laid down by the American Association of perfusion and most public health departments and as mentioned in the (WHO. 1984),table () . For estimating the total population of coliform, the valuation method through membrane filters has been used with filtering 100 cm³ of water for each sample. After that, the sieve papers are placed on the center of Endo Agar medium and incubated in 1 ±37 C ° for 24 hours. Then the overall estimation of coliform was done according to the (Methods of Laboratory Analysis Guide to Monitor the Quality of Drinking Water.2001) the Bacteriological estimates have been performed in the Technical Medical College laboratories – Technical Education).

Results and Discussion

From the results explained in table (3), it can be observed that there are significant differences between the water of the wells assigned for the study in terms of electrical conductivity, for example, well number (7) showed the lowest rate of 1.16 dS.m⁻¹ compared to well number (2) of which the electrical conductivity reached its highest rate of 1.79 dS.m⁻¹. According to WHO guide (1984), and rang term (1500–100) Micro Siemens / liter based on the water's Total Dissolved Salts (T.D.S.) it is clear that all these wells are of excellent quality and are suitable for human use. The noticeable difference between the electrical conductivity of the water of the wells in these Oases is due to the difference of their locations, besides the



changes in the amount of rainfall and its effect on the amount of water seeping into the groundwater through the earth layers (Ayers, et al 1976). The seasonal change in the electrical conductivity was also significant; the winter season showed the lowest rate of 1.4 dS.m^{-1} , while summer season showed the highest rate of 2.23 dS.m^{-1} on average, and that can be linked to the influences of evaporation and the absence of rainfall in summer.

From table number (1) it can be observed that the value of Total Dissolved Salts (T.D.S.) ranges between 1145.6 mg.l^{-1} and 742.4 mg.l^{-1} and the table points at a significant difference between the wells. While well number (7) showed the lowest number (742.4 mg.l^{-1}) on average, well number (2) showed the highest number (1145.6 mg.l^{-1}). Overall, the observed and measured values of the Total Dissolved Salts (T.S.D.) of the wells were within the standards of suitability for human use (6.5 – 8.5) and the internationally recommended standards. The results of analyzing Calcium ion show that its concentration in the water of the wells ranges between 4.22 and 8.96 Milliliter $^{-1}$, with significant differences between the wells chosen for the study. While the lowest number was recorded in well number (7) with 4.22 meq.l^{-1} (ppm 84.4), the highest concentration of this substance was in well number (1) with 8.96 meq.l^{-1} (ppm179.2), the presence of Calcium in the water of the studied groundwater depends on the geological formations of the area where dolomite, gypsum and Limestone rocks exist. According to the WHO guide, it appears that the concentration of these elements in the



water of the wells was lower than the highest concentration value for drinkable water (10 meq.l^{-1}) (ppm 200). The Magnesium concentration ranged between 4.22 and 9.23 meq.l^{-1} in wells number (7) and (2) respectively. These values were below the value recommended by the WHO for human usage (10.41 meq.l^{-1}) (ppm 125).

The results of the tests conducted for measuring the concentration of Potassium ion in the water of the wells show that it ranges between 0.204 and 0.136 meq.l^{-1} , with significant differences between the wells chosen for the research. Well number (5) recorded the lowest value of (ppm 5.31), while well number (2) recorded the highest concentration of this element with (ppm 7.96). However, the allowed concentration rate of this element is (ppm 20.0).



Table (3) the results of the chemical analysis of the water wells tested and its coordinates in the area

7	40°29' 42"	33° 02' 15"	95.5	w	7.7	1.04	3.79	3.53	4.95	0.122	3.15	1.14	3.60	0.014	0.00	0.16	2.58	0.00	0.00
				s	7.6	1.11	4.05	3.77	5.57	0.130	3.36	1.22	3.84	0.014	0.00	0.17	2.82	0.00	0.00
				m	7.6	1.25	4.56	4.24	6.28	0.147	3.79	1.37	4.33	0.017	0.00	0.22	2.99	0.00	0.00
				A	7.7	1.23	4.48	4.21	6.17	0.144	3.73	1.35	4.26	0.017	0.00	0.20	2.96	0.00	0.00
Well rate					7.7	1.16	4.22	3.94	5.74	0.136	3.51	1.27	4.01	0.016		0.19	2.84		
8	40°28'59"	33° 02' 01"	101.8	w	7.6	1.04	4.39	4.93	4.26	0.127	3.46	0.97	3.47	0.017	0.00	0.15	1.65	0.00	0.00
				s	7.7	1.12	4.73	5.31	4.59	0.137	3.73	1.04	3.74	0.018	0.00	0.16	2.05	0.00	0.00
				m	7.7	1.30	5.49	6.16	5.32	0.159	4.33	1.21	4.34	0.021	0.00	0.19	2.20	0.00	0.00
				A	7.7	1.23	5.19	5.83	5.04	0.150	4.09	1.15	4.10	0.020	0.00	0.17	2.15	0.00	0.00
Well rate					7.7	1.17	4.95	5.56	4.80	0.143	3.90	1.09	3.91	0.019		0.17	2.01		
9	40°29' 21"	33° 01' 45"	91.3	w	7.6	1.09	4.64	5.18	3.87	0.127	2.82	1.56	3.78	0.012	0.00	0.16	1.75	0.00	0.00
				s	7.7	1.16	4.94	5.51	4.11	0.135	3.00	1.66	4.02	0.013	0.00	0.21	1.80	0.00	0.00
				m	7.7	1.28	5.45	6.08	4.54	0.149	3.31	1.83	4.44	0.014	0.00	0.22	1.89	0.00	0.00
				A	7.7	1.22	5.19	5.80	4.33	0.142	3.15	1.75	3.47	0.011	0.00	0.21	1.85	0.00	0.00
Well rate					7.7	1.19	5.06	5.64	4.21	0.138	3.07	1.70	3.93	0.013		0.20	1.82		
10	40°25'32"	33° 02' 13"	71.8	w	7.6	1.17	7.38	6.41	3.91	0.132	2.87	1.41	3.90	0.015	0.00	0.21	1.49	0.00	0.00
				s	7.7	1.21	7.63	6.63	4.04	0.137	2.97	1.46	4.92	0.019	0.00	0.22	1.51	0.00	0.00
				m	7.7	1.35	8.51	7.40	4.51	0.152	3.31	1.63	5.49	0.021	0.00	0.26	1.60	0.00	0.00
				A	7.7	1.24	7.82	6.79	4.14	0.140	3.04	1.49	5.04	0.019	0.00	0.23	1.53	0.00	0.00
Well rate					7.7	1.24	7.84	6.81	4.15	0.140	3.05	1.50	4.84	0.019		0.23	1.53		
WHO standards					6.5-9.0	<4	3.7-10	2.08-6.25	5.6-11.2	0.3	5.6-14.0	2.08-5.2	5.7	0.016	0.0066	0.046	0.43-8.92		
Winter rates					7.7	1.18	5.44	5.74	4.36	0.130	3.59	1.30	3.86	0.015	0.00	0.20	1.84	0.00	
Spring rates					7.7	1.27	5.90	6.21	4.28	0.141	3.88	1.41	4.27	0.017	0.00	0.23	1.96	0.00	
Summer rates					7.7	1.51	7.05	7.37	5.62	0.167	4.60	1.65	4.64	0.020	0.00	0.30	2.12	0.00	
Autumn					7.8	1.42	6.57	6.92	5.30	0.157	4.34	1.55	4.59	0.018	0.00	0.28	2.06	0.00	
LSD 0.05 (W) (1)					0.105	0.296	2.13	0.32	0.124	0.034	0.066	2.444	0.015	0.185	0.00	0.050	0.102	0.00	
LSD 0.05 (S) (2)					0.127	0.124	0.51	0.29	0.091	0.008	0.054	1.244	0.005	0.157	0.00	0.022	0.099	0.00	
LSD 0.05 (W x S) (3)					0.112	0.403	2.11	0.35	0.189	0.031	0.071	3.133	0.18	0.199	0.00	0.79	0.108	0.00	

well: W (1) season : S(2)



No. Well	Well site		Depth well (M)	season	pH	EC _w dS.m ⁻¹	dissolved ions Mol. (+).m ⁻³							B ⁻³ mg.L ⁻¹	SAR Mol. ₂ (+).m ⁻³	M.P.N	T.C		
	Longitude	Latitude					Ca ⁺⁺	Mg ⁺⁺	Na ⁻	K ⁻	Cl ⁻	SO ₄ ⁻	HCO ₃ ⁻					NO ₃ ⁻	Pb ⁺
1	40° 31' 58"	33° 03' 19"	81.7	w	7.9	1.21	6.98	6.17	4.30	0.127	3.44	1.85	4.55	0.014	0.00	0.22	1.67	0.00	0.00
				s	7.7	1.48	8.54	7.55	5.26	0.155	4.21	2.26	5.56	0.017	0.00	0.32	1.85	0.00	0.00
				m	7.7	1.87	10.79	9.54	6.65	0.196	5.32	2.86	7.03	0.022	0.00	0.41	2.09	0.00	0.00
				A	7.8	1.65	9.52	8.41	5.86	0.173	4.69	2.52	6.20	0.019	0.00	0.36	1.96	0.00	0.00
				Well rate	7.8	1.55	8.96	7.92	5.52	0.163	4.42	2.37	5.84	0.018	0.00	0.33	1.89		
2	40°31'22"	33° 01'51"	98.1	w	7.6	1.34	6.48	6.99	5.21	0.153	4.42	0.99	4.65	0.015	0.00	0.25	2.00	0.00	0.00
				s	7.7	1.46	7.06	7.62	5.67	0.167	4.82	1.08	5.07	0.016	0.00	0.30	2.09	0.00	0.00
				m	7.7	2.23	10.78	11.64	8.67	0.255	7.35	1.65	7.74	0.025	0.00	0.52	2.59	0.00	0.00
				A	7.8	2.12	10.25	11.07	8.24	0.242	6.99	1.57	7.35	0.023	0.00	0.50	2.52	0.00	0.00
				Well rate	7.7	1.79	8.64	9.33	6.95	0.204	5.89	1.32	6.20	0.020	0.00	0.39	2.30		
3	40°31'14"	33°01'41"	91.3	w	7.6	1.23	5.58	6.74	4.78	0.127	4.03	1.08	3.78	0.019	0.00	0.23	1.92	0.00	0.00
				s	7.6	1.34	6.08	7.34	5.21	0.138	4.39	1.18	4.12	0.021	0.00	0.24	2.01	0.00	0.00
				m	7.7	1.44	6.53	7.89	5.60	0.149	4.72	1.26	4.43	0.022	0.00	0.31	2.09	0.00	0.00
				A	7.7	1.36	6.17	7.45	5.29	0.140	4.46	1.19	4.18	0.021	0.00	0.25	2.03	0.00	0.00
				Well rate	7.7	1.34	6.09	7.36	5.22	0.139	4.40	1.18	4.13	0.021	0.00	0.26	2.01		
4	40°30'50"	33°01'45"	93.5	w	7.8	1.25	4.59	5.59	4.43	0.127	4.00	1.14	3.58	0.015	0.00	0.24	1.96	0.00	0.00
				s	7.7	1.32	4.85	5.90	4.68	0.134	4.22	1.20	3.78	0.016	0.00	0.26	2.02	0.00	0.00
				m	7.7	1.53	5.62	6.84	5.42	0.155	4.90	1.39	4.38	0.018	0.00	0.33	2.17	0.00	0.00
				A	7.8	1.45	5.32	6.48	5.14	0.147	4.64	1.32	4.15	0.017	0.00	0.31	2.11	0.00	0.00
				Well rate	7.8	1.39	5.09	6.20	4.92	0.141	4.44	1.26	3.97	0.017	0.00	0.29	2.07		
5	40°30'07"	33°01'7"	98.2	w	7.8	1.24	5.58	6.41	3.87	0.125	4.23	1.44	3.60	0.017	0.00	0.23	1.58	0.00	0.00
				s	7.7	1.32	5.94	6.82	4.12	0.133	4.50	1.53	3.83	0.018	0.00	0.25	1.63	0.00	0.00
				m	7.7	1.46	6.99	7.54	4.56	0.147	4.98	1.69	4.24	0.020	0.00	0.32	1.69	0.00	0.00
				A	7.8	1.37	6.17	7.08	4.28	0.138	4.67	1.59	3.98	0.019	0.00	0.27	1.66	0.00	0.00
				Well rate	7.8	1.35	6.17	6.96	4.21	0.136	4.60	1.56	3.91	0.019	0.00	0.27	1.64		
6	40°30'14"	33°01'27"	115.2	w	7.8	1.17	4.94	5.43	4.00	0.135	3.46	1.41	3.65	0.015	0.00	0.18	1.76	0.00	0.00
				s	7.7	1.22	5.15	5.66	4.17	0.141	3.61	1.47	3.81	0.016	0.00	0.19	1.79	0.00	0.00
				m	7.7	1.36	5.74	6.31	4.65	0.157	4.02	1.64	4.24	0.017	0.00	0.26	1.89	0.00	0.00
				A	7.8	1.32	5.57	6.12	4.51	0.152	3.90	1.59	4.11	0.017	0.00	0.25	1.87	0.00	0.00
				Well rate	7.8	1.27	5.35	5.88	4.33	0.146	3.75	1.53	3.95	0.016	0.00	0.22	1.83		

- (1) w: winter (December - January-February) S: spring (April-May, March) m: Summer (June-July-August) A: Autumn (September-October-November)
 (2) T.D.S Total Dissolved Solids :
 (3) M.P.N.: (APHA -AWWA - WPCF.1976)(in mL of water) According to the method of counting bacteria greatest Possibility
 (4) T.C : (E. coli)Total Coliform :

Continued Table (3)



From the results of the tests conducted for measuring Sodium ion in the water of the wells, it can be observed that the concentration of this element ranges between 6.94 and 4.15 meq.l⁻¹ in wells number (2) and (10) respectively. While a low concentration of Potassium ion was observed in the water of the tested wells, due to the resistance the minerals of this element show towards weathering, compared to other positive ions. The tests conducted on the negative ions of the water of the tested wells show that the concentration of Chlorine ion ranges between 4.60 and 3.05 meq.l⁻¹ for wells number (5) and (10) respectively. According to the international standards for drinking water, it can be observed that there are no restrictions on using the water of these wells for drinking as the concentration of this element is lower than the allowed value (7.04 meq.l⁻¹) (ppm 250) and the low concentration of this element makes the water more favorable for humans due to the water's low saltiness.

The concentration of sulfate in the water of these wells ranges between 2.37 and 1.90 meq.l⁻¹ for wells number (1) and (8) respectively, with significant differences between the studied wells, which is due to the nature of the rocks and the geological strata within the geological structure of the area through which groundwater passes. The results show that the concentration of this element in the wells is within the international standards for drinking water which is (5.20 meq.l⁻¹).

The test on the concentration of bicarbonate show that it ranges between 6.20 and 3.91 meq.l⁻¹, and this is within the international standards since it is less than (10 meq.l⁻¹)

Nitrate levels in the water of the wells range between 0.021 and 0.013 meq.l⁻¹, for wells number (3) and (9) respectively, and these



values are lower than the internationally allowed levels which is (50 ppm).

The concentration of the small elements in table number (1) show that Boron concentration levels range between 0.17 and 0.39 meq.l⁻¹, for the wells (2) and (6) respectively, with significant differences between the studied wells concerning this point. The recorded values are lower than the internationally allowed concentration of this element which is (2.00–0.75) meq.l⁻¹ which indicates its drinkability.

The test for the concentration of lead has shown the absence of this heavy element; according to the international standards, the concentration of lead should be less than 0.01 meq.l⁻¹.

When analyzing the water of these wells in terms of its content of bacteria, it is observed that these wells are totally clean since the total number of bacteria in a single milliliter was less than 10. Pathologically, the water of these wells has proven to be healthy as no E. coli bacteria has been detected, according to (Altoviski, 1962) rating.

Conclusions and recommendations

The chemical and bacteriological measurements of groundwater in the district of Dabaa resulted that the water is suitable for human use.

The water resources in the study area are limited in terms of quantity and not clear whether to be supplied with water in the future. Usually when there is drought risk somewhere, the common solution is to give instructions in order not to waste water. The depletion of water resources in the drought areas absolutely lead to economic and social crisis. From this standpoint the citizens and decision makers of those areas must start suggesting emergency plans in order to conserve the water of the wells.



In addition water conservation is a part and parcel of conservation of natural resources programs. Lately new terms and concepts have emerged to express the current phase such as demand for water management and water use efficiency; those are the main concepts for water conservation. Implementing conserving and educating methods appropriately will lead to reduce production costs although applying such plans will increase the cost a little bit, in other words implementing conserving and educating methods require some costs at the beginning but in the long term it is a great achievement. Thus, the consumer must be aware of the importance of water in his life for being basis of life in one hand and part of water resources development on the other hand. Due to the development of the fields of agriculture, industry and tourism water conservation became mandatory requirement. Therefore, the consumer may have to change some of his life styles of his daily consumption of water and by that we mean to use water rationally and participate in educating others not to waste it since it is a gift from God.

This study recommends servicing the water network of (alQaam and Abu Tiban stations) which located on the sides of Euphrates River which used to transfer water from Euphrates River to Rutba district. We recommend not to draw water in huge quantities of those groundwater existed in the area, in other words to save the water as strategic stocks for the future in order not to forbid the coming generations to benefit from those ground resources.



References:

- The Holy Quran, Al-Anbiya surah, ayat (30).
- Albert, Simma Ibrahim 1989, a comparative study of pollution of the river and drinking water of three areas of the Piped water in Baghdad before and after the economic sanctions against Iraq, Master Thesis, College of Science, Mustansiriyah University.
- Ayers, R.S. and D.W. West for Westcott, 1976, water quality for agriculture, Irrigation drainage paper (29), FAO, Rome, Italy.
- Abdul Radtha, Abdul Radtha Kadim (1981), Bacterial contamination for water of some wells in Iraq – Master Thesis, faculty of Sciences/ Baghdad Univ.
- Abdul Muzahim M. and Abdullah A. Shexo 1996, groundwater evaluation in North of Gezira for human and irrigation uses, Tech, vol./ Technical research, 59: 71–82.
- Altoviski, M.E. 1962, Quality of water for drink in CCCP. (C.F) Hassan, A.H., (1962) Estimation of water quantity and quality of the Miocene aquifer and its economic value Hydrological, Hydrological and hydro geochemical investigations of Bahr–El–Najaf area, Sci. Res. Foundation. Baghdad. Iraq. Tech. Bul.85.
- Al–Sahaf, Mahdi, 1976, Water resources in Iraq and protection from pollution, leaflets published by The Ministry of Information, Republic of Iraq.
- Al–Azawi, Ibtisam Habeeb, 1997, a study of bacterial contamination of drinking water in the Babylon city.
- Al–Azawi, Atheer Saib Naji, 2003, a study of some physical and chemical properties for Piped water of Jurf–alSakhar district in Babylon – Iraq, Master Thesis, College of Science/ University of Babylon.
- Al– Mashhadani, Yahya David, Taya'a and Abdulaziz Saad Eddin Majid, 1989, groundwater between Mosul city and Bashiqa district and its scope of validity for civil and agricultural uses, Education and Science, Vol, 11:9–22.
- Al–Kubaisi, Manal Sukur, 1993, Geomorphological of Rutba district, Master Thesis – Baghdad University – College of Science – PP: 107.
- Abuld–Salih Fayath, Bayan Muhi and Husam Naji, 2010, Hydrogeological evaluation and properties of groundwater in Thaba'a district (East of Rutba) – unpublished report.
- APHA–AWWA–WPCF.1976, Standard methods for the examination of water and waste water, Washington, D.C. U.S.A.



Chapman, H.D., and P.F. Pratt. 1961, methods of analysis for soils, plants, and water. Univ. Calif. Davis, Agric. Sci.

Chet, Basil Mohammed, 2004, a study of chemical contrast for some wells in East of the New Tigris and evaluation its validity for human and irrigation uses.

Elkrail, O. Kheir, L. shu, and H. Zhenchum, 2004, "Hydrogeology of the northern Gezira area, central Sudan" Journal of Spatial hydrology, Vol. 4, No. 2, PP. 11.

Furat Center for irrigation projects studying and planning, 1988, strategic plan for the Development of Western Desert. – Ministry of Agriculture and Irrigation – Republic of Iraq, Appendix II, PP. 1–6.

Guideline for Lab examination for monitoring drinking water, 2001, Syrian Ministry of Housing in cooperation with the United Nations Organization.

Ismail, Akram Osman 1986, Determine the validity of some of the groundwater in the plain of Erbil for different uses, Master Thesis, faculty of Agriculture, Salahaddin University.

Jamil Abdul Satar Aziz and Luay Mohammed, 1990, a study of some water resources quality in Tamim city and its scope of validity for civil and agricultural uses, second Scientific Conference of Saddam Dam Research Center/ Mosul University.

Lafi, S. Ahmed, Taha N. Al-Hiti and Hussain J. Al-Hadithi, 2004, a quality study for water of some springs within Kubaisa district (Iraq), Anbar Magazine for Agricultural Sciences, 2nd Vol: 30–38.

Lechellier, M.W. Seider, R.J. and Evans, T.M, 1980, Enumeration and characterization of standard Plate Count Bacteria in Chlorinated and Raw water Supplies: 40, 922–930.

Sa'dia, Mohammed Hassan, 2002, The chemical change in quality for Musayab water and its validity for domestic and irrigation uses, Tech, vol./ Technical research, 102, 30–39.

Sissakian&Salah,1994, Geological map of Iraq .geoserf . Baghdad.

Walton, W.C., 1970, Groundwater resources evaluation, New York, Mc Graw Hill Book.

World Health Organization, 1973, International Standard for drinking water 3rd edition, Geneva.



WHO, 1984, Guideline for drinking water quality – recommendation, vol. 1.

World Health Organization, 1989, Guideline for drinking water quality, Volume 2,
Geneva.

World Health Organization, 1999, Guideline for drinking water quality, 2nd ed. Vol.
2:940–949.