Assessment of some groundwater wells in the west of Al Najaf city for by Water Quality Index (WQI)

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Abstract

Najaf an Iraqi city considered an agricultural city. Located southwest of Baghdad .this study was conducted for the purpose of evaluating the quality of well water in the South and West of Najaf through chose 32 a water well distributed in the region and analyzed chemically and physically. The results showed a variation of water quality in different locations. The test for validity of water for agricultural use it found that the electric conductivity EC ranged between (5305-2342) disisimnz-1 in Wells 6, 7, 9, 12, 13, 14, 16, 17, 21, 22, 26, 28, 30, 31, 32, where there is a clear increase in the values of electrical conductivity. Electrical conductivity values depend on the concentration of water and the quality of its salts, the SAR values ranging from (6812-0.92), so that the classification of these wells according to the specifications of the agriculture and food Organization to determine the validity of the irrigation water was as follows: it was a very large TDS values exceeded the limits of risk of irrigation by this specification, the influence of sodium adsorption ratio SAR with EC electrical conductivity with impact (few-average) on agricultural crops , Na sodium values ranging from (51-1000) ppm so there is no impact on agricultural crops, Cl values ranging from (117-1375) ppm and bicarbonate ion HCO3 ranged between (58.507) ppm so it's not any problem when irrigation with this specification. The value of nitrates NO3 ranging from (3-700) ppm where the wells are 13, 15, 17, 30, NO3 ratio greater than 30 and that's very dangerous when irrigation with NO3. Either the wells 2s this range is allowed except wells number 22, 23, 32, were lower than the limits allowed by the specification.

The results shows that the water is not safe for drinking and need to use treatment for animal handlers and agricultural crops

Keywords: WQI, ground water, wells, physicochemical factors

Chemistry Classifiication QE1 -99605

1.1 Introduction

Water resources are of central importance for agriculture and industry in the world as well as their importance to man of drinking and daily uses. Leading to the use of alternatives of fresh water that are poor water and drainage water and industrial sewage and that may be used for agriculture or industry [15]. And for the purpose of drinking water use must have properties and characteristics have been adopted by the World Health Organization WHO as directory standards and parameters for drinking water [16], and followed by the countries of the world and every country has its own guide according to the quality of water in that country [2], The first purification of groundwater begins through the soil, where the soil is a pored media adaptability natural filtration of water, the previous studies has lime and in turn transmitted with irrigation water [11].

1 -materials and methods

The study of examined water quality in many countries are the most important quality standards for irrigation water that must be studied and most agreed [5]. The US Agriculture Department recorded in his USDA of 1954 [14]. The most important specification characteristics of water quality is the value and sodium adsorption ratio electric conductivity and boron concentration and bicarbonate. Both the food and Agriculture Organization of the United Nations FAO [11], have adopted electric conductivity value direct impact on plant growth and sodium adsorption ratio of that impact on soil permeability and concentrations of chlorine, boron and sodium as a harmful ions and adopted other incidental effects such as nitrate and bicarbonate and the degree of interaction of water. Either the last Organization for 1992, [20gillli], has adopted the salt concentration estimated with electric conductivity to determine the type of salt water demonstrated that the maximum depth reached pollutants are within 2 meters from the ground surface [8], The criteria and the validity of drinking water parameters are divided into three criteria physicist and chemist and biological. Physical properties include temperature — suspended solids-color – taste and smell. Either chemical properties are pH – Hardness – Turbidity and unwanted elements. While biological properties divided into two types: viral and bacterial indicators and check for bacteria only in water because the virus needs a living body for reproduction and transmission [1], [16], to assess water quality for irrigation and livestock dependent on several criteria, the most important one is the total content of salts, and ion composition significantly that resulting variation in quality terms depend on the type

and quantity of dissolved salts and from melting or weathering rocks like dissolving gypsum and and came up with six varieties and types of salt water. While [19], classified the water into six classes depending on the sodium adsorption ratio and outreach and boron ion concentration and effectiveness of chloride ion and proposed a guide to rating the quality of irrigation water for Iraqi waters.

The scope of this study is to test the validity of water for human drinking purposes by using WQI the validity for Animals and Agricultural use.

The study adopted to collect samples from 32 a wells have been drilled in the South and southern west of Najaf depths ranged between (15-45) meters, and took water samples from these wells used sterile plastic bottles capacity (100 cm3) for the collection and preservation of samples and conducted by the following tests:

Ionic chemical estimates: measured the degree of interaction PH and electrical conductivity EC assessment and positive and negative ions are

dissolved in accordance with the methods described in [14]. Estimated total materials TDS (TDS) Total Dissolved Solids of uniform drying method [1], [16],[2], Samples were saved during the stages of analysis at 4 ° c for the purpose of keeping them from evaporation and biological processes

1-1 Description of study site

Najaf lies south of Baghdad (163Km). Samples collected from wells distributed in the study area, the wells widespread in different regions in Najaf. (Table 1, and figure 1).

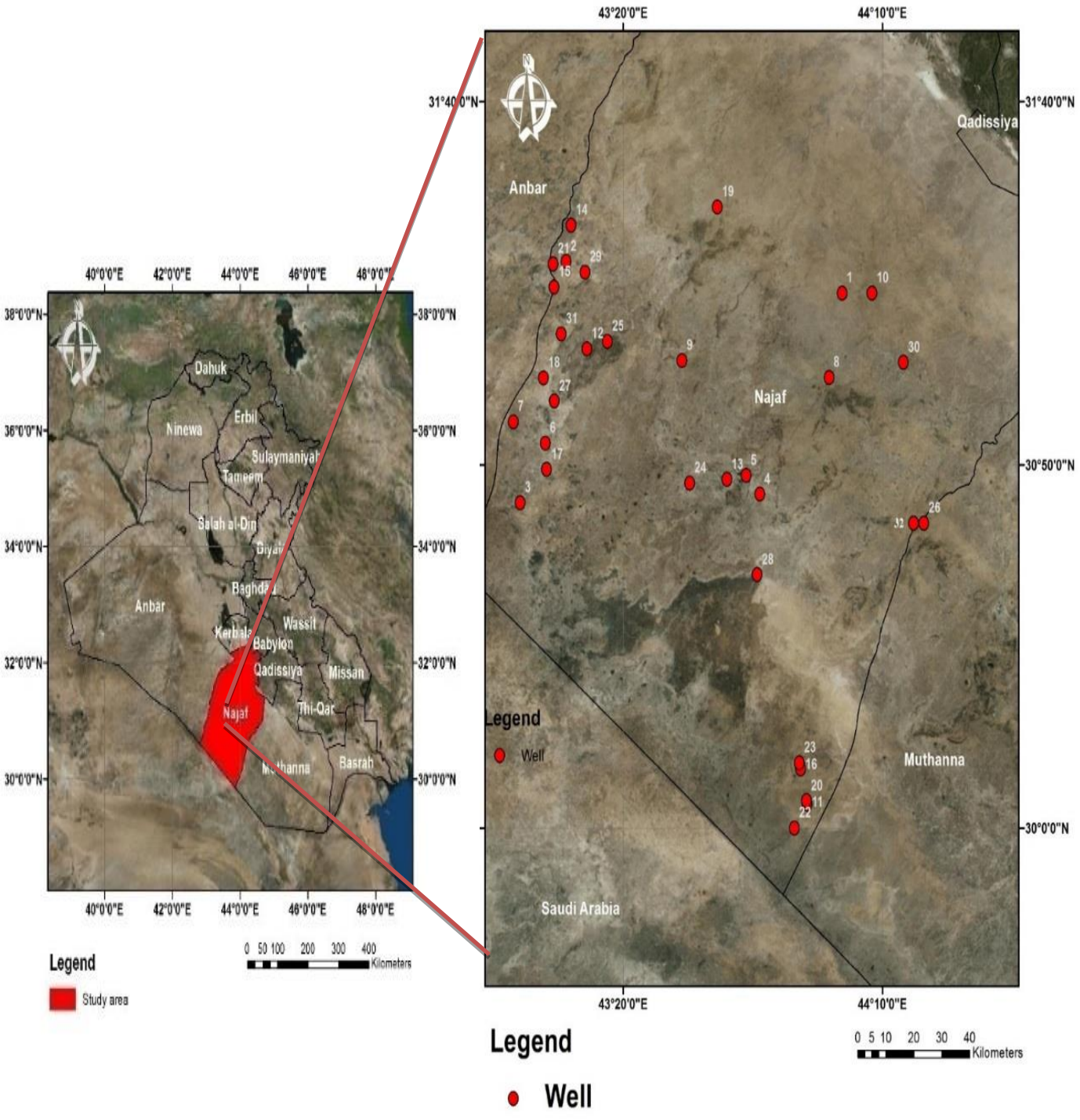

Figure (1) Wells location of the study area

Table (1) **Coordinates** of Wells

No.Well	Locality	LAT_DEC	LONG_DEC	Elevation
1	BAHER NAJAF	31.227778	44.0375	298
2	AL AAZIYA1	31.3	43.15	281
3	AL MAANIYA1	30.746667	43.002778	308
4	AL SEHEL 2	30.783333	43.75	323
5	ALSHABICHA4	30.800833	43.7325	294
6	SAIGALSD3	30.883333	43.083333	319
7	RUM-HAD K385	31.089167	42.925278	281
8	GREENBELTI	31.034167	43.995	254
9	RUM-HADK318	31.073056	43.522778	278
10	AIN MISTRAHA	31.227778	44.133333	386
11	UMM MANAJEF1	30.066667	43.916667	409
12	AMERYNAJAF6	31.1	43.216667	281
13	KAR -NAJRO20	30.8	43.666667	296
14	AL-SAADIYA1	31.383333	43.166667	281
15	UMMASEI	31.279167	43.114167	317
16	KER NAJ.RO58	30.15	43.9	409
17	OIL PUMPST3	30.823056	43.087778	50
18	JDEIDA 1	31.033333	43.076944	277
19	AL RUHIMA 1	31.425278	43.636389	294
20	KHALIJARAD2	30.066667	43.916667	386
21	KAR-NAJRO 24	31.3	43.116667	324
22	JAMILIYA 3	30	43.883333	259
23	KHAN HAAMAD	30.15	43.9	386
24	AL JAMAIYA 1	30.791389	43.547222	316
25	ALJUMILIYA2	31.116667	43.283333	317
26	MADHLODM V.8	30.7	44.3	277
27	SAIGAL2	30.979722	43.112222	281
28	BRAGAHAMAD4	30.581389	43.764167	194
29	SUMMELI 2	31.275833	43.211111	277
30	MAANIYA 4	31.068333	44.233889	291
31	____ ___ _____	31.133889	43.134167	295
32	SONA 2	30.7	44.266667	31

1-2 Geology of the Study Area:

The study area is located within the Inner Platform and the Outer Platform of the Arabian Plate [17], [18]. The contact between the two platforms passes in the apex area of the fan. Consequently, the two cliffs are located within the Outer Platform represented by the Mesopotamia Foredeep, its western margins, whereas, the extreme part of the studied area is located within the Inner Platform [17], no surface faults occur near the two cliffs. However, the Abu Jir-Euphrates Fault Zone passes in the western part of the studied area. The presence of tens of springs is good indication for this active tectonic zone.

The exposed geological formations and present Quaternary sediments are briefly mentioned, hereinafter.

Dammam Formation, Upper Member (Late Eocene)

Only the upper member of the Dammam Formation is exposed in the studied area. The upper member consists of thickly bedded limestone: some beds include small nummulites, with marl intercalations and very rare chert lenses.

Euphrates Formation (Early Miocene)

The formation consists of basal conglomerate and/or breccia, followed upwards by fossiliferous limestone, dolostone with some marl intercalations. The pebbles of the conglomerate are derived from the underlying Dammam Formation, the size of the pebbles ranges from < 0.1~1.5 m.

Nfayil Formation, Lower Member (Middle Miocene)

Only the lower member of the Nfayil Formation is exposed in the studied area. The upper member consists of three sedimentary cycles. Each cycle consists of green marl overlain by limestone. The limestone of the second cycle includes large oyster shells.

Dibdibba Formation (Pliocene-Pleistocene)

The formation consists of coarse and white sandstone and rare conglomerate.

Quaternary Sediments

Different types of Quaternary sediments are eveloped in the studied area, like gypcrete, sabkha, sand dunes, alluvial fan, flood plain, depression fill, and valley fill sediments. However, the gypsum is the most widely developed and covers the majority of the Karbala-Najaf Alluvial Fan. The fan is originated from Al-Khir Valley. Its length is 64 km with SW-NE trend. The size of the gravels of the fan ranges from 1~2 cm,

1-3 results and discussion

Result for completing the laboratory tests of samples taken from wells table (2), it can test the validity of water for human, animal and agriculture consumption and. For testing the validity of human drinking water: WQI is calculated for each well as follows:

$WQI = \Sigma(Ci/Si)/n$

Where:

Ci = Concentration of each component in the form in (mg/L).

Si= Iraqi drinking specification for each element.

n = Number of elements in the sample.

Table (3) shows the WQI results for each well. And have been compared to Iraq's drinking water specifications table (4) found that all of these wells water not suitable for drinking.

1-Test the *validity of water for irrigation crops*: it found that the electric conductivity ranged from EC (5305-2342) disisimnz table (2) in Wells 6, 7, 9, 12, 13, 14, 16, 17, 21, 22, 26, 28, 30, 31, 32, where there is a clear increase in the values of electrical conductivity. Electrical conductivity values depend on the concentration and type of salts that found in water sample. The reason of high salts concentrations of wells is due to the region's geological composition and effect on water salinity underground water seeps through the

layers of Earth and acrid its melting salts by force [3],[6]. Classification of Water is depending on the specifications of the World Health Organization WHO, 1989).

So that the classification of these wells depending on the food and Agriculture Organization specification [13], to determine the validity of irrigation water ;

3-Very large TDS values were exceeded limits, so there is a risk of irrigation depending on this specification.

4 -Sodium adsorption ratio SAR effect with EC electrical connectivity with impact (few-moderate) on agricultural crops.

5 -Na sodium values ranging from ppm (51-1000) so there is no impact on agricultural crops.

6 -Cl ion values ranging from (117-1375) ppm so that there is no risk recorded. -NO3 nitrate values were ranging from (3-700) ppm where the wells are 13, 15, 17, 30, NO3 ratio greater than 30 ppm and this very dangerous when irrigation where NO3 ratio is very high concentration. Either the wells 2, 6, 9, 15, 18, 28, 32, NO3 was between (5-30) ppm and this concentration is medium-low dangerous when irrigating. While the remaining wells, concentrations of NO3 less than 0.5 so no problem when irrigating.

2 -SAR values were ranging from (6812-0.92).

7 -Bicarbonate ion HCO3 worth between ppm (58-507) and all samples were less than 15 ppm so there isn't any danger when irrigating.

8 -pH set by the World Health Organization and the Central Agency for Standardization and Quality Control of drinking water and the U.S. Environmental Protection Agency specifications of 1975, range from 6.5-8.5. And through a table (2) Note that groundwater interaction degree values measured fall within this range except wells number 22, 23, 32, were lower than the limits allowed by these specifications.

Test the validity of water for animal use: TDS values ranging from (4570-658) where the concentration of the total dissolved salts balance for the groundwater in the study area with the classification of [12],[9],. Table (3) is the value of WQI between (2323-387).

Table (2) the Physical and Chemical Analysis of Water Wells of the Study Area

well	SAR	EC	TDS	ph	K	Na	Mg	Ca	Cl	SO4	HCO3	NO3
1	2.367128	0	2687	7.4	0	239	320	245	1085	658	258	0
2	4.819688	0	2715	8	0	414	213	208	767	999	210	11
3	2.743349	0	1943	8.2	0	213	157	198	242	1073	121	0
4	2.592209	0	4200	7.2	0	336	432	561	0	1378	507	0
5	2.42689	0	0	7.7	0	82	27	42	0	296	214	0
6	1.569733	3700	2862	6.9	0	163	253	400	380	1590	180	5
7	6.812003	5305	3385	7.9	0	607	183	300	1349	768	146	0
8	11.28775	0	4570	7.3	0	1000	180	298	1200	1884	140	0
9	2.402624	2342	1827	7.8	0	173	117	200	213	960	147	5
10	4.570305	0	2023	6.8	0	308	102	176	0	605	90	0
11	4.280743	0	2619	7	0	368	165	288	724	854	220	0
12	7.295846	4950	3775	7.8	0	692	200	352	1375	1050	213	0
13	5.812128	4760	3310	8.2	0	518	171	320	994	1090	177	75
14	1.813485	4000	2921	7.4	0	184	216	424	450	1550	75	60
15	4.664394	0	2641	7.5	0	389	145	288	735	970	220	4
16	11.29204	4400	3085	7.5	0	780	98	200	1207	700	201	700
17	4.221064	3500	3205	7.7	0	388	170	360	532	1560	138	5
18	4.210658	0	2465	7.3	0	340	125	288	607	883	210	10
19	3.624346	0	3111	7.9	0	345	169	408	596	1459	130	4
20	2.316202	0	2310	7.1	0	196	132	325	210	1351	197	0
21	4.504621	5732	4479	7.9	0	518	239	608	1065	1985	58	0
22	1.439906	2930	2613	6.4	0	138	165	424	213	1625	92	3
23	1.438901	0	3500	6.2	0	150	195	502	1017	0	145	0
24	1.038104	0	658	8.1	0	51	43	112	117	202	260	0
25	0.920836	0	2314	8	0	86	151	412	211	1416	77	0
26	3.537275	3840	2774	7.5	0	315	134	380	604	1248	73	0
27	1.711372	0	2559	8	0	161	149	425	266	1517	83	0
28	3.814705	3963	3126	6.6	0	368	156	448	675	1200	134	13
29	2.390722	0	3072	8.2	0	241	165	498	466	1670	65	0
30	1.899213	3686	3246	7.2	0	202	156	600	235	1946	134	40

31	4.971565	4100	2655	7.3	0	520	60	730	486	700	129	0
32	1.534614	2937	2330	6	0	144	298	176	213	1437	113	5

Table (3) Results of WQI for Each Wall

well no.	WQI
1	1580.747619
2	1540.345238
3	1104.835714
4	2094.857143
5	387
6	1592.009524
7	1788.285714
8	2323.809524
9	1015.319048
10	869.0261905
11	1433.257143
12	2031.452381
13	1886.47619
14	1662.052381
15	1473.242857
16	3057.333333
17	1655.5
18	1356.964286
19	1645.492857
20	1275.345238
21	2293.62619
22	1388.502381
23	1406.309524
24	538.6095238
25	1267.138095
26	1450.447619
27	1379.769048
28	1631.409524
29	1624.985714
30	1785.1
31	1554.809524

32	1292.654762

CONCLUSION

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To assessment of some groundwater wells in the west of Al Najaf city for by Water Quality Index(WQI)32 samples were collected from selected site, to comprehensive physico-chemical analysis. For calculating the WQI twelve parameters have been considered such as SAR,EC,TDS,PH,K,Na,Mg,Ca,Cl,SO4,HCO3 and NO3. The result shows that 90% of water sample bad water category. Only one site at well 5 limit for drinking water is good. The high value of WQI at this site has been found to be mainly from the higher values of calcium, potassium, nitrate, total dissolved solids, bicarbonate, and chloride in the groundwater

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تقييم نوعية المياه الجوفية لبعض الآبار في غرب محافظة النجف باستخدام WQI

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الخلاصة

تعتبر مدينة النجف من المدن الزراعية مدينة النجف أو النّجف الأشرف إحدى أبرز مدن العراق ومركز محافظة النجف، تقع إلى الجنوب الغربي للعاصمة بغداد، أجريت هذه الدراسة لغرض تقييم نوعية مياه الآبار في منطقة جنوب وجنوب غرب محافظة النجف من خلال أختيار 32 بئر موزعة في المنطقة وتحليل مياهها كيميائياً وفيزيائياً . وقد بينت النتائج وجود تغايرات في نوعية المياه بأختلاف مواقعها تم أعتماد مواصفات منظمة الصحة العالمية WHO ومواصفات عراقية صادرة عن الجهاز المركزي للتقييس والسيطرة النوعية وبإستخدام دليل نوعية المياه WQIوجد بأن مياه هذه الآبار غير صالحة للشرب جميعا. اما من ناحية الاستخدام الحيواني فكانت قيم TDS تتراوح بين (658-4570) هذا يعني ان المياه الجوفية في منطقة الدراسة كانت من نوع brackish water ماء مالح. وبالنسبة للري وجد بأن الأيصالية الكهربائية EC تراوحت بين (2,342-5,305) ديسيسيمنز.م-^{1} في الآبار6، 7، 9، 12، 13، 14، 16، 17، 21، 22، 26، 28، 30، 31، 32 حيث توجد زيادة واضحة في قيم التوصيلية الكهربائية. اذ تعتمد قيم التوصيل الكهربائي للمياه على تركيز ونوعية الأملاح فيها، كانت قيم SAR تتراوح بين (0.92-6.812)، لذلك فان تصنيف هذه الآبار حسب مواصفات منظمة الزراعة والاغذية (FAO,1989) لتحديد صلاحية مياه الري كانت كما يلي: كانت قيم TDS كبيرة جدا تجاوزت الحدود المسموحة فان الري بها خطر حسب المواصفة.، تأثير نسبة امتزاز الصوديوم SAR مع EC التوصيلية الكهربائية ذات تأثير (قليل-متوسط) على ري المحاصيل الزراعية، قيم عنصر الصوديوم Na تتراوح بين ppm(51-1000) لذا فانه لايوجد تأثير له على ري المحاصيل الزراعية، قيم ايون Cl تتراوح بين ppm (117-1375) و ايون البيكاربونات HCO_3 تتراوح قيمته بين ppm (58-507)لذلك فان الري بها لايشكل خطورة حسب هذه المواصفة، كانت قيم النترات NO_3 تتراوح بين ppm (3-700) حيث كانت الآبار رقم 13، 15، 17، 30، فيها نسبة NO3 اكبر من 30 وهذا يشكل خطورة شديدة عند الري بها لان نسبة NO_3 مرتفعة جدا.

اما الآبار 2، 6، 9، 15، 18، 28، 32 فأن نسبة NO_3 فيها كانت بين (5-30) وهذا فيه خطورة متوسطة-قليلة عند السقي بها. أما بقية الآبار فكانت NO_3 فيها أقل من 0.5 لذلك لا توجد مشكلة عند الري بها. pH(الأس الهيدروجيني) تقع ضمن هذا المدى المسموح به عدا الآبار رقم 22، 23، 32، كانت أقل من الحدود المسموح بها حسب المواصفة.

بعد الاطلاع على النتائج نستنتج ان المياه غير صالحة للشرب وتحتاج الى معالجات لاستخدامها للحيوان ولري المحاصيل الزراعية.

الكلمات المفتاحية: WQI، المياة الجوفية ،ابار ،العوامل