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Evaluation of Quality of Surface Water Resources of Basrah Province for Use in Drinking and Irrigation Purposes

Ahmad Hanon Jasim, Issam Mohammed Ali Alradiny[1*], Iqbal Aoufi Ahmed[2] and Shatha Abd Alhasan

Basrah Environment Directorate, Iraq
[1]Department of Soil Science and Water Resources, College of Agriculture, Basrah University, Iraq
[2]Department of Geology, College of Science, Basrah University, Iraq
**E-mail: issam.abdalkareem@uobasrah.edu.iq*

Abstract: Samples were collected, which were divided: water collected from (Badaa), Tigris - Euphrates river and Shatt Al-Arab, in order to assess the validity of surface water resources received for Basra Governorate in terms of use for drinking and irrigation Total Dissolved Solids (TDS), electrical conductivity (EC), total hardness (TH), pH (pH), sodium (Na), potassium (K), calcium (Ca), nagnesium (Mg), chlorine (Cl), dissolved oxygen (DO) and sodium adsorption ratio (SAR)were estimated. There were significant differences between the three types of water for all parameters except for the dissolved oxygen. The Bada a water was the only one within the limits of the drinking water approved specifications in the study and is suitable for use in irrigation with slight restrictions in use. The two types of Tigris-Euphrates and Shatt Al-Arab water are invalid for use in drinking water, not even for use in irrigation, except in the case of urgency with very strict conditions. The study came out with the need to search for renewable water sources for use in drinking and irrigation, where desalination is used in drinking and irrigation..

Keywords: Water quality, Drinking, Irrigation, Dissolved solids

In Iraq, where it faces challenges in obtaining water resources of good quality and quantity, the majority of which come from outside the country's borders, specifically from Turkey and Iran, by more than 60% (Reza 2017). Therefore, the external factor has contributed mainly to the deterioration of the water quality. Turkey has built several projects on the Euphrates and Tigris rivers, which are called the GAP project, through the construction of 22 dams and 104 major irrigation projects (Almuwaishir 2011), which leads, if all of these projects and dams are completed, to a decrease in water resources coming to Iraq from the Euphrates River by 70% and from the Tigris River by 61% (Abd-Zayed, 2008). Iran has also built numerous projects and dams on the Karun, Karkha and tributaries of the Tigris, which deprived Iraq of good quality water. The Iraqi provinces have been affected by the decrease in water releases from the countries of water resources due to poor management of the water policies in Iraq, where the priority is given to filling the Iraqi dams, such as the Mosul Dam, Haditha Dam, and other natural lakes such as Tharthar, Al-Kazara, Habbaniyah, at the expense of the water needs of the governorates located south of Baghdad (Hamdan 2013, Salman et al 2014, Salman et al 2014), The water evaporates from this collected water which is more than 236 cubic meters per second, which can solve a lot of water deficit. The governorates can be divided according to the abundance and scarcity of water into disadvantaged governorates and underserved governorates. The governorates that are not deprived of water are those governorates that precede others by receiving the Tigris and Euphrates waters by virtue of their proximity to the Turkish and Syrian borders, and have dams and lakes and keep water in excess of needs at most of the times. As for the deprived governorates, they are the provinces that are far from the areas of entering the Tigris and Euphrates waters with the Turkish and Syrian borders, and lack tanks and dams to collect water and most deprived of the Iraqi governorates is Basra Governorate, as it is the last station that the rivers reach, as well as their proximity to the sea. Basrah governorate suffers from a continuous shortage of water supplies, especially the quality of water suitable for different uses, and that what exacerbates the water scarcity is the absence of effective management for those concerned with the water issue in the governorate, in treating water scarcity and exploiting projects established in a proper manner, and this is evident through failure or delay in the work of water projects in the governorate (HRW 2019). There this became imperative for assessment of the water sources reaching to the governorate to determine their suitability. The study aims identify the deterioration in the quality of surface water resources reaching Basrah province and evaluating the suitability of surface water resources for use for drinking purposes as well as irrigation according to the Iraqi specifications,

MATERIAL AND METHODS

Samples were collected in clean and tight plastic containers with three replicates for each sample. The methods described in APHA, et al (2005) were adopted to estimate total dissolved solids (TDS), electrical conductivity (EC), total hardness (TH), pH (Na) sodium (Na), potassium (K), calcium (Ca), magnesium (Mg), chlorine (Cl), dissolved oxygen (DO), and the ratio of sodium absorption was calculated (SAR). The study adopted the Iraqi specifications and the World Health Organization (WHO) specifications when assessing drinking water. As for the water evaluation for the purpose of use in irrigation, the American Salinity index (USDA) and the Food and Agriculture Organization (FAO) were adopted. The study period lasted 12 months, starting from January 2018 until the end of December. The samples were divided into three types according to the destination from which they came, as follows:

Badaa water: It is a water source that reaches Basrah Governorate through open channels from behind the (Al-Kut) Dam across the (Al-Gharaf) River to the center of Basrah. It includes three water channels, as follows:

Unlined channel of (Badaa) RRiver: Section of the unlined channel / north of the site of the storage and sedimentation basins in Basrah water project.b-Lined Channel of (Badaa) River: The Lined Channel ,Section next to Basrah International Airport and Al-Abbas Water Project.c-Badaa River, backup channel: in Basrah Airport.

Tigris - Euphrates water: It is the water sources that feed the Shatt al-Arab and come from the borders of both the governorates of Amarah and Nasiriyah and reach the Qurna district, as well as Karmatt-Ali (the water of the Tigris and Euphrates before entering the Shatt al-Arab) and they are in the following locations: a - Qurna site (Qurna No. 1) before the convergence of the Euphrates River with the Tigris River at a distance of (2.5) km , at tube bridge on the Euphrates River in Qurna.b - Qurna site (Qurna No. 2) / before the convergence of the Tigris River with the Euphrates a distance of (450) m.c- The Euphrates site, before its meeting with Shatt Al-Arab / adjacent to Karmatt-Ali Bridge.

Shatt al-Arab water: The source of this water is a mixture of several sources such as Tigris, Euphrates, Karon, Karkha, and is mixed with sea water and others, and it is distributed on several points which are the following locations:a- Site before the Karmatt-Ali River / water project (25) million unified Basrah.b- A location opposite Khalid Bridge.c- The Abi-Alkhaseeb site in Alsanakar, near the Al-Baraka water desalination plant.d- Alsiba site, near the Cihan water project.e- Alfao site, near the boats anchorage.

Statistical analysis of water samples was performed by GLM Linear Model (Amin 2008).

RESULTS AND DISCUSSION

pH: The mean pH was 7.89, with range of 6.8- 9.1and were within the limits of the approved specifications for drinking and irrigation and was 8.20 , 7.81 and 7.76 was for Badaa (Tigris – Euphrates and Shatt Al-Arab water .

Total Dissolved Solids (TDS): The mean TDS of Badaa water was recorded at 706 mg/L during the study months, the highest was 1740 mg/L, and the lowest recorded concentration was 529 mg/L.In the (igris-Euphrates mean TDS was 2826, the highest recorded \ was 13600 mg/L, and the lowest was 794 mg/L.The mean concentration of Shatt Al-Arab water type was 11187, with the highest of 34400 mg/L, and the lowest was 1150 mg/L.For irrigation purposes with specifications of the Food and Agriculture Organization (FAO) of this parameter, the Badaa water was a little salty, while the Tigris - Euphrates water and Shatt Al-Arab water types, were located within the highly saline water limits (WHO, 1996,Table 1, 2).

Electrical conductivity (EC): The EC of Badaa water was 1412 with range of 1058 to 3480 µs/cm.

Total hardness (TH): The mean concentration of Badaa water was 460.7 at this parameter, with maximum of 784 mg/L and minimum of 360 mg/L. The mean TH of Tigris – Euphrates water was 1072, with maximum of 4400 mg/L minimum of 448 mg/L. The total hardness of Shatt Al-Arabwater 3554, where the highest was 12400 mg/L, and the lowest was 588 mg/L. The results indicated that the Badaa) water type was the only one within the limits of the drinking water specifications for this parameter.

Calcium (Ca): The mean Ca ofBadaa water was 94.14 with highestof 203 mg/L. In Tigris- Euphrates mean concentration was 181.9with range of 88 to518 mg/L. The mean concentration of Shatt Al-Arab) water type was 361.9, varying from to 800 mg/L. The results showed that the mean concentration of Badaa and Tigris-Euphrates water were within the limits of the approved specifications for drinking water at this parameter.

Magnesium (Mg): The mean concentration of Badaawater was 48.5, the maximum was 72 mg/L and the lowest concentration was 33.3 mg/. The mean Mg concentration of Tigris - Euphrates was 148, where the maximum was 768 mg/L and the lowest was 50 mg/L. In Shatt Al-Arab water mean was 632.95, where the highest was 2544 mg/L and the lowest was 66 mg/L.

Sodium (Na): The mean concentration of NA in Badaa water type was 174.8, the highest reading was 410 mg/L during the study months and the lowest was 100 mg/L. In Tigris - Euphrates water type was 1361, with the highest reading recorded of 8800 mg/L and the lowest was 210 mg/L. The mean concentration ofShatt Al-Arab water during the study

Table 1. Concentrations of samples for water types during the study period

Month	Type	Sample	pH	TDS mg/l	EC /cmμs	TH mg/l	Cam g/l	Mg mg/l	Na mg/l	K mg/l	Cl mg/l	DO mg/l	SAR
Jan.			8.5	830	1304	463	97	47.7	122	3	165	10.85	2.53
Mar.			7.9	1250	1800	666	133	72	300	6.8	307	8.65	5.19
Apr.			7.9	970	1462	455	84	52.2	180	4.5	236	8.4	3.79
May.			7.5	960	1457	431	78	50.4	170	4.4	223	9.72	3.67
June.			7.5	915	1370	490	101	50.4	160	3.9	195	8.55	3.23
July.			8.5	830	1194	430	91	43.2	150	3.5	162	6.9	3.23
Aug.			8.3	845	1236	464	96	48.6	170	3.5	138	9.14	3.51
Sep.			8.2	750	1125	408	67	52.2	130	4.8	133	10.3	2.88
Oct.			8.2	706	1106	360	67	41.4	120	3.2	128	6.81	2.83
Nov.			8.8	795	1245	415	92	39.6	140	4.5	190	7.97	3.06
Dec.			9.1	956	1531	560	128	52.2	190	5.3	238	8.9	3.56
Jan.			8.5	848	1309	455	94	47.7	128	3.5	165	9.8	2.67
Feb.			7.8	2040	3480	784	203	59.4	410	6	595	8.74	6.49
Mar.			7.9	1210	1746	588	125	59.4	290	6.6	293	8.6	5.33
Apr.			8	960	1424	431	84	47.7	170	4.1	213	8.36	3.66
May.			8.5	840	1323	376	59	49.5	150	3.9	209	13.28	3.47
June.			7.5	917	1376	470	94	50.4	160	3.9	195	8.82	3.30
July.	Badaa		8.5	821	1191	384	91	33.3	140	3.4	157	7.2	3.18
Aug.			8.1	830	1219	400	64	52.2	160	3	124	7.05	3.58
Sep.			8	915	1317	424	77	50.4	200	5	228	7.91	4.33
Oct.			8	1040	1508	456	86	52.2	250	6.4	280	5.8	5.23
Nov.			8.9	680	1058	415	80	46.8	100	3.7	185	8.13	2.19
Dec.			8.9	838	1368	472	109	43.2	110	4.2	194	10.8	2.25
Jan.			8.5	788	1295	416	87	42.3	108	2.9	160	9.72	2.37
Feb.			7.8	1130	1724	502	103	52.2	220	3.4	278	9.04	4.39
Mar.			8.1	1020	1484	490	101	50.4	200	5.1	245	9.14	4.04
Apr.			8	1080	1546	470	84	55.8	210	4.6	309	8.33	4.34
May.			7.3	997	1465	431	81	49.5	180	4.5	223	6.67	3.87
June.			7.6	895	1364	470	94	50.4	150	3.6	185	9.34	3.09
July.			8.5	838	1196	438	88	46.8	150	3.5	162	6.7	3.20
Aug.			8.1	852	1241	440	96	43.2	180	3.9	143	7.04	3.82
Sep.			8	922	1320	432	77	52.2	220	5.6	238	7.96	4.72
Oct.			8.1	720	1120	376	80	37.8	130	3.4	171	6.1	2.99
Nov.			8.8	730	1138	384	86	36	130	4.3	171	8	2.96
Dec.			9.1	860	1378	480	118	39.6	140	4.5	204	12.1	2.84
Jan.			8	2448	3670	804	148	103	630	6.5	746	7.34	9.689
Feb.			7.6	2412	3640	784	179	80	630	6.4	741	9.78	9.802
Mar.			8.4	1774	2700	627	125	75	450	7.8	470	8.87	7.826
Apr.			7.7	1580	2320	666	117	89	390	4	437	9.03	6.584
May.			7.6	1480	2300	588	125	66	310	4	408	8.59	5.561
June.			7.7	1430	2260	568	117	66	300	3.4	399	7.98	5.475
July.			8.1	1366	2200	557	106	69	300	4	380	6.3	5.549
Aug.			8.5	1291	2030	546	111	66	210	4	333	6.7	3.884
Sep.			7.6	1060	1587	448	96	50	220	5	254	6.52	4.517
Oct.			7.8	1292	1952	540	112	62	240	3.7	356	8.7	4.497
Nov.			8.2	1234	1881	499	108	55	230	3.4	333	7.01	4.476
Dec.			8.1	2060	3060	1133	362	55	390	8.7	428	8.3	5.035
Jan.			8	2533	3750	843	148	113	670	6.5	755	7.05	10.05
Feb.			7.6	2355	3500	725	179	66	610	6	713	9.9	9.867
Mar.			7.9	1960	2970	764	140	99	480	6.1	518	8.94	7.558
Apr.			7.7	1468	2230	627	109	85	370	4.7	389	8.75	6.426
May.			7.5	1580	2330	647	133	75	390	4.5	422	7.5	6.677
June.			7.6	1770	2530	588	109	75	430	4.4	570	7.68	7.73
July.			8.1	1600	2300	576	106	74	400	4.3	485	6.1	7.263
Aug.			8.5	1326	2060	564	126	62	220	4	352	6.4	3.995
Sep.			7.6	1134	1650	460	88	58	210	4.9	264	6.01	4.249
Oct.			7.8	1222	1928	520	104	62	220	3.3	342	9.1	4.201
Nov.			8.3	1490	2190	576	139	55	300	5.1	390	7.13	5.432

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Table 1. Concentrations of samples for water types during the study period

Month	Type	Sample	pH	TDS mg/l	EC /cm µs	TH mg/l	Cam g/l	Mg mg/l	Na mg/l	K mg/l	Cl mg/l	DO mg/l	SAR
Dec.	Shatt Al-Arab	Euphrates- adjacent to the Karmatt-Ali Bridge.	8	1976	2990	1075	347	51	350	8.6	404	8.3	4.631
Jan.			7.5	2844	4490	921	195	103	720	9.8	970	8.11	10.34
Feb.			7.6	3622	5370	1129	203	146	950	15.9	1330	8.89	12.37
Mar.			7.4	3500	5200	960	195	113	940	14.3	1200	8.92	13.2
Apr.			7.7	4182	6230	1137	203	150	1140	16.6	1663	8.35	14.73
May.			7.3	3114	4700	1000	179	132	850	10.6	1230	6.9	11.7
June.			7.6	1770	2530	588	109	75	430	4.4	570	7.68	7.73
July.			7.2	8330	11900	2112	304	322	3200	20	3705	7.3	30.35
Aug.			8.3	15010	19400	3453	518	528	6000	90	6888	5.1	44.13
Sep.			7.3	21416	27200	4400	480	768	8800	200	9840	6.06	57.68
Oct.			7.2	19710	25000	3240	288	605	8000	140	9500	4.7	61.1
Nov.			8	14520	19850	2280	224	413	6200	100	6650	5.43	56.44
Dec.			8.1	8340	11600	1632	216	262	2800	80	3800	8.28	30.14
Jan.		opposite to the water project of (25) million (Unified Basrah)	7.9	3346	5130	980	203	113	910	11.4	1093	6.74	12.65
Feb.			7.7	3806	5510	1156	187	165	1000	13.6	1387	10.22	12.79
Mar.			7.8	4054	5960	1215	211	165	1200	15.1	1546	8.13	14.97
Apr.			7.7	2738	4130	960	179	122	690	8.2	768	9.27	9.704
May.			7.6	1550	2300	588	125	66	350	4	432	9.78	6.278
June.			7.8	2070	2970	755	133	101	580	6.2	665	7.36	9.188
July.			8.2	5680	8200	1267	175	198	1450	21.5	2850	6.1	17.74
Aug.			8.4	10202	16000	2184	252	378	3500	80	4038	6	32.41
Sep.			7.5	9098	13680	1680	192	144	3400	70	3943	7.34	44.98
Oct.			7.7	10898	15300	1920	232	322	4400	100	4750	8.9	43.64
Nov.			8.3	3804	5550	1075	169	156	1320	17.5	1444	7.25	17.52
Dec.			8.4	2482	3660	864	177	101	650	11.1	760	8.7	9.618
Jan.		Opposite to Khalid Bridge	7.5	2610	4240	826	187	94	620	9.6	854	8.55	9.197
Feb.			7.6	3404	5100	990	187	122	610	15.6	1140	9.2	8.49
Mar.			7.4	3478	5190	1000	203	118	940	14.3	1200	8.52	12.93
Apr.			7.7	4066	6190	1058	211	127	1050	16.5	1577	8.42	14.04
May.			7.4	3160	4900	1019	179	136	890	15.5	1315	7.6	12.15
June.			6.8	2992	4840	960	179	122	950	12.5	1197	7.82	13.36
July.			7.4	9470	13300	2112	228	368	3600	50	4275	7.8	34.13
Aug.			8.3	15670	20400	4004	518	660	6200	100	7078	6.8	42.38
Sep.			7.5	16718	21500	3600	480	576	6600	150	7824	7.4	47.83
Oct.			7.1	20840	26700	3280	320	595	8800	200	9738	7.04	66.81
Nov.			8	15246	20200	2400	240	432	6400	130	7030	6.6	56.8
Dec.			8.1	8542	11660	1690	216	276	3000	80	3943	8.6	31.73
Jan.		Abi-Alkhaseeb- Alsankar	7.9	2616	3840	784	179	80	750	9.8	841	7.01	11.67
Feb.			7.6	3164	4550	1030	179	136	900	10.8	1045	9.03	12.29
Mar.			7.4	4438	6640	1156	226	141	1300	19.8	1776	8.34	16.65
Apr.			8.75	4336	6570	1137	203	150	1160	17.9	1511	8.17	14.99
May.			7.2	4834	7600	1313	218	183	1300	18	1824	7.4	15.63
June.			7.36	5480	8430	1372	218	197	2060	20	2280	8.53	24.23
July.			7.4	9470	13300	2112	228	368	3600	50	4275	7.8	34.13
Aug.			8.4	22481	28400	4550	592	748	9200	120	10450	6.6	59
Sep.			7.5	31184	41500	6800	560	1296	12000	240	14725	7.4	63.27
Oct.			7.2	23974	31500	5000	640	816	9400	150	11780	9.71	57.8
Nov.			8	19804	25300	3263	293	607	8200	140	9500	6.48	62.43
Dec.			8.18	7918	11830	1800	256	278	2900	90	3515	9.17	29.73
Jan.		Alsiba near the Cihan water project	7.5	6476	10100	1666	195	282	1960	40	2423	7.42	20.9
Feb.			7.8	9744	13940	1861	296	263	3200	70	4750	8.09	32.47
Mar.			6.8	4752	7000	1333	211	193	1570	21	1920	8	18.71
Apr.			7.3	6474	9570	1411	226	202	2010	22	2592	8.12	23.3
May.			7.1	7387	11350	1627	257	235	2300	50	3840	8.06	24.83
June.			7.1	24580	31300	4508	780	611	9200	170	12825	6.62	59.66
July.			8.2	35488	49000	6144	532	1150	11600	380	19950	6.3	64.46
Aug.			8.4	41938	54000	8000	720	1488	15000	360	21850	5.11	72.92
Sep.			8.2	45152	62500	9400	800	1776	16600	490	22028	4.6	74.44

Table 2. Statistical analysis and the specifications of approved drinking and irrigation water

Parameters / Location			PH	TDS mg/L	EC ds/m	TH mg/L	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	CL mg/L	DO mg/L	SAR
The least significant difference at 0.05	Significant differences between types	The types with each other		0.000 ±759	0.000 ±1518	0.000 ±237	0.000 ±17.27	0.000 ±47.41	0.000 ±426	0.000 ±11.78	0.000 ±609	0.000 ±0.134	0.000 ±2.07
		Badaa-(Tigris – Euphrates)		0.046 ±1053	0.046 2106±	0.073 ±337	0.002 ±27.84	0.144 ±67.69	0.053 ±607	0.291 ±17.54	0.104 ±857	0.001 ±0.281	0.001 ±2.93
		Badaa-Shatt Al-Arab		0.000 ±943	0.000 1887±	0.000 ±302	0.000 ±24.94	0.000 ±60.65	0.000 ±544	0.000 ±15.72	0.000 ±768	0.000 ±0.252	0.000 ±2.62
		(Tigris – Euphrates)- Shatt Al-Arab		0.000 ±935	0.000 1870±	0.000 ±300	0.000 24.73±	0.000 60.12±	0.000 ±539	0.000 ±15.57	0.000 ±761	0.852 ±0.249	0.000 ±2.6
	Between the months with each other			0.000	0.000	0.000	0.007	0.000	0.000	0.001	0.000	0.000	0.000
	Between the samples with each other			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.313	0.000
	Between samples of the same type	Badaa		0.336	0.336	0.233	0.542	0.179	0.535	0.525	0.442	0.688	0.616
		(Tigris – Euphrates)		0.000	0.000	0.001	0.005	0.000	0.001	0.002	0.000	0.074	0.000
		Shatt Al-Arab		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.324	0.000
Iraqi standards and (WHO) for drinking water			(6.5-8.5)[#]	500*-1000[#]	-	500[#]	200[#]	50[#]	200[#]	12[**]	250[#]	(5-8)[*]	-
FAO specifications for use inirrigation			6.5-8.4	<450[*] 450-2000 >2000	<0.7[#] 0.7-3 >3	-	-	-	-	-	<4[**] 4-10 >10	-	<3[##] 3-9 >9
Mean		Badaa	-	706c	1412c	460.7c	94.14c	48.50c	174.8c	4.29c	212.6c	8.59a	3.50c
		Tigris- Euphrates	-	2826b	5653b	1072b	181.9b	148b	1361b	22.91b	1618b	7.60c	13.91b
		Shatt Al- Arab	-	11187a	22374a	3554a	361.9a	632.95a	5910a	144.1a	8135a	7.65a	37.52a

-Symbols for standard water specifications for drinking purposes mean:(*): (USEPA) specifications. (**): Yemeni standards. (#): Iraqi standards and (WHO).

-The symbols of the (FAO) standard for water for irrigation mean: (*): the degree of usage restriction of the dissolved solids parameter (no restrictions -slight to medium restrictions - strict restrictions), respectively. (#): Degree of usage restriction of the electrical conductivity parameter (no restrictions - slight to medium restrictions - strict restrictions), respectively., (**): the degree of usage restriction of the chlorine parameter in surface irrigation conditions (no restrictions - slight to medium restrictions - strict restrictions), in units of mEq/L., (##) degree of usage restriction of SAR in surface irrigation condition (no restrictions - mild to moderate restrictions - strict restrictions), respectively .(Ayers, et al,1985)

- These characters mean: (a, b, c) : Coefficients of variance analysis.

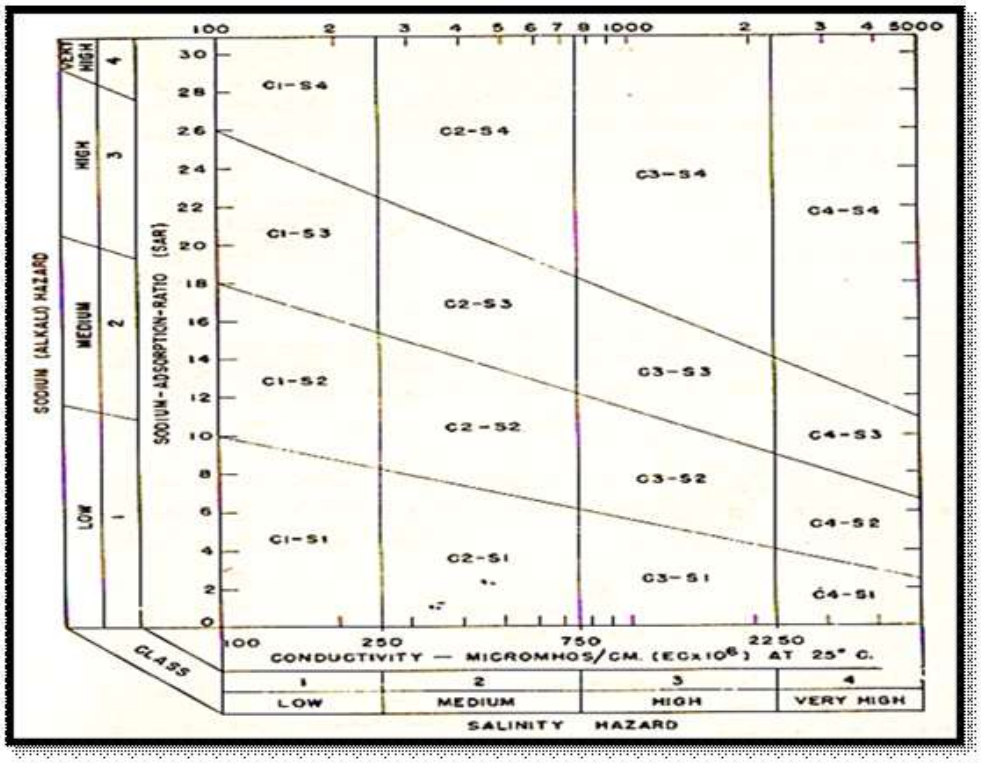

Fig. 1. American salinity laboratory for the classification of irrigation water (Richards 1954)

months was 5910, the highest was 20000 mg/L, and the lowest was 350 mg/L. The results showed that among the three types of water during the study months, only the type of Badaawater within approved specifications for drinking water at this parameter.

Potassium (K): The mean concentration of (Badaa) water type was 4. the highest recorded reading was at 6.8 mg/L and the lowest recorded was 2.9 mg/L. The mean concentration ofTigris - Euphratesater was 22.91wit highest recorded of 200 mg/L and the lowest 3.3 mg/L. The mean concentration of Shatt Al-Arab) water type was 144.1, with the highest of 640 mg/L and the lowest of 4 mg/L. The results showed that among the three types of water, only in Badaa water, concentration was within the limits of the approved specifications for drinking water (YPWRA 1999).

Chloride (Cl): The mean Cl of Badaa water was 212.6, the maximum was 595 mg/L and the lowest was 124 mg/L during the study period. Similarly of Tigris - Euphrates watere was 1618, with maximum and minimum of 9840 254 mg/L. In Shatt Al-Arabwater type was 8135, with range of 432 to 28690 mg/L.

Dissolved oxygen (DO): The mean DO of Badaa water e was 8.59, with maximum of 13.28 mg/L and minimum of 5.8 mg/L. In Tigris - Euphrates water 7.60, with a maximum of 9.9 mg/L concentration, and the lowest of 4.7 mg/L. In Shatt Al-Arab water mean was 7.65, and the highest was 10.22 mg/L, and the lowest was 1.28 mg/L.

Sodium Adsorption Ratio (SAR): In Badaa SAR was 3.50 ,the highest was at 6.36 and the lowest 2.13. The mean SAR of Tigris– Euphrates water was at 13.91 with range of 3.88 and 61.1.The SAR of Shatt Al-Arab water was 37.52, with range of 6.28- 94.56 and the lowest of. To assess the suitability of that water for use in irrigation according to the two indexes used in the study, Badaa water at surface irrigation conditions was within the limits of slight to medium restrictions in the usage.

CONCLUSION

The Badaa water is within the limits of the approved water specifications, which is valid for drinking. Badaa water is valid for use in irrigation with slight restrictions in use, while Tigris- Euphrates water and Shatt al-Arab water, are invalid for use in irrigation except in the case of compulsion, with very strict conditions for use.

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