Assessment Of Water Quality For Al-Gharraf Stream Southeast Of –Iraq Using Canadian Council Of Ministers Of The Environment (CCME) Index

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***Abstract*— The presence of contaminants in natural water continues to be one of the most significant environmental issues in many areas of the world, where there has been a tremendous increase in demand for freshwater and water shortage in dry and semi-dry regions due to population increase, urbanization, agricultural activities, and industrialization.in this study was used CCME Index for assessment Quality of irrigation water to AL-Gharraf stream, where this index aims at giving a single value to reducing a lot of information into a simpler expression. The samples were taken from seventeen fixed points along a stream for two seasons 4/FEB/2017 and 11/MAY/2017. They were analyzed depend on the standard methods for the following parameters: acidity (PH), Total Dissolved Solid (T.D.S), Alkalinity(ALK), Electrical Conductivity (E.C), Calcium(Ca), Chloride (CL), Sodium (Na), Sulfate (SO4), Potassium (k), Total suspended solids (T.S.S), Total Hardness (TH). Given the category ranges suggested in the results, the water quality at this stream reach would be rated as "good" for all stations except Loc_7,11,12 and 15 was Fair based on 2017 data.**

Keywords—Irrigation Water Quality, Physical and Chemical Parameters, Water Quality Index, CCME Index, Al-Gharraf River, WQI, Water pollution

ملخص: الملوثات الحاضرة في المياه الطبيعية مستمرة لتكون واحده من اهم القضايا البيئية في العديد من بلدان العالم، حيث كانت هناك زيادة هائلة في الطلب على المياه العذبة ونقص المياه في المناطق الجافة وشبه الجافة بسبب الزيادة السكانية والتحضر والنشاطات الزراعية والتصنيع. في هذه الدراسة تم استخدام مؤشر(CCME) للتقييم جودة مياه الري لجدول الغراف، حيث يهدف هذا المؤشر إلى إعطاء قيمة واحدة لتقليل الكثير من المعلومات إلى تعبير أبسط. العينات كانت تأخذ من سبعه عشرة نقطة ثابتة على طول الجدول لموسمين **4 / فبراير / 2017 و 11 / مايو / 2017**. تم تحليلها اعتمادا على الأساليب القياسية للمعلمات التالية: الاس الهيدروجيني مجموع المواد الذائبة ، القلوية ، الموصلية الكهربائية ، الكالسيوم ، كلوريد، الصوديوم ،كبريتات، البوتاسيوم، مجموع المواد العالقة ،الصلابة الكلية. وبالنظر إلى مدى الفئات المقترحة في النتائج، فإن نوعية المياه في الجدول ستصنف على أنها "جيدة" لجميع المحطات باستثناء **15, LOC_7،11،12** كانت عادلة استنادا إلى بيانات عام **2017**.

[1]INTRODUCTION:

in general, the water is seen as the main input to human production and an effective tool for economic development, social prosperity and the well-being of all people [1,2,3]. Water is found on forms static water (lakes and marshes), running water (Tigris River, Euphrates and the Arabian Sea), where water bodies in Iraq are estimated at more than (5%)[4].Observed in recent years, the quality of the Tigris and Euphrates rivers, which are considered the two main sources in Iraq, started to deteriorate at a rising rate and rapid[5].A group of studies dealt with a stream or parts of it, specialized for a seasonal study of some physical and chemical properties of water and sediments of the Gharraf stream and study the monthly variables in concentrations of trace elements in the channel of water Gharraf, which is one of the branches of the River Tigris[6,7].The current study dealt with assessment water quality of the Gharraf stream, which is one of the most important irrigation projects using Council of Ministers of the Environment (CCME) index. This index is an advantage for the ability to represent measurements of a variety of parameters in a single number and the capacity to combine various measurements with different dates[8].The CCME index was not given details parameters analysis,

where include the loss of information by combining several parameters to a single value. then the loss of interactions among parameters, but the single value was represented as a tool to help decision management and policymaker to communicate the overall quality of water[9].

[2] MATERIALS AND METHODS

[2.1]STUDY AREA

Several dams were established along the Tigris River (Mosul dam, Samarra Dam and Al Kut Dam) for energy generation and agriculture. Al Kut Dam was established between (1934-1939) with the aim of feeding the Gharraf stream, that branches before Al Kut dam[10]. The stream continues to flow, where it passing through AL Hay and Muwafaqiya district, before entering the Nasiriya city. Nasiriya is located between latitude (30˚36´00˝ _ 32˚00´00˝ N) and longitude (45˚36´00˝ _ 47˚12´00˝ E) as shown Figure (1). This location gave different climatic characteristics represented by the proportion of solar radiation higher, less moisture and rain [11]. Enter Nasiriya and passes ALfagr, Qalat Sikar, Al Rifai and Al Nasr. Then, Two branches in Shatt Al bdai, the first section is which ends in the marsh leading to Hammar, while the second section is which passes in Shatrah, Gharraf and ends in the marshes leading to Hammar also. Its length of 230 km from the beginning to the downstream in the marshes of Nasiriya, that was established four systems separate on the Gharraf stream for the purpose of maintaining the high level of water at the start of the stream (17.4 m) and Al bdai (10 m)[12].

[2.2]FIELD WORK AND LABORATORY WORK

To complete the study within the current Gharraf stream, 17 stations were chosen from the middle of the stream, where the first station is located in Al-Fagr and the last station is Al-Gharraf District. These stations were important for assessing the quality of water, its properties and the extent of its pollution by examining the physical and chemical parameters, which are 11 parameter including: acidity(PH), Total Dissolved Solid (T.D.S), Alkalinity (ALK), Electrical Conductivity (E.C), Calcium(Ca), Chloride (CL), Sodium (Na), Sulfate (SO4), Potassium (k), Total suspended solids (T.S.S), Total Hardness (TH). The water samples collected from the study stations were for two seasons 4/FEB,11/MAY ,as shown Table (1) and Table (2). These samples were taken from depth 20 cm the surface of the water and keep in plastic bottles for examination in the laboratory, but the parameters (T.D.S,E.C and PH) were examined in situ by (ph-meter &oakton pcs testr 35) devices .

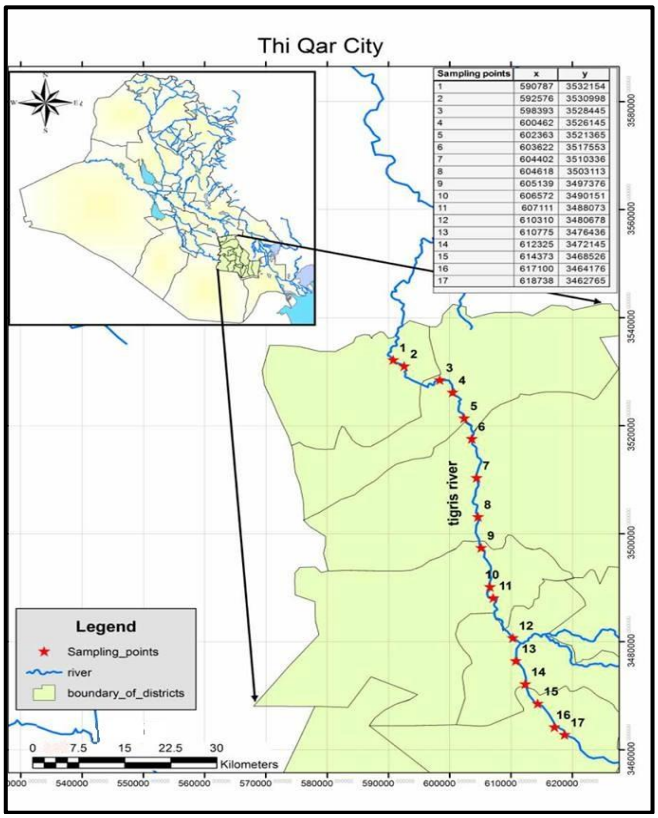

Figure (1): Location of the study area (Al- Gharraf stre

	Name	Location		Physical Properties				Cation (mg/l)				Anion (mg/l)		
		E	N	Ph	EC(µs/cm)	TSS	TDS	Ca	TH	Na	K	Cl	So4	ALK
Loc_01	ALfagr	590787	3532154	7.85	1494	60	1016	121	486	142.8	4.0	153	413	128
Loc_02	ALfagr	592576	3530998	8.01	1568	44	1022	127	508	146.0	4.4	148	281	136
Loc_03	ALfagr	598393	3528445	8.18	1471	30	1018	120	482	143.2	4.0	146	405	128
Loc_04	Gala sgar	600462	3526145	8.24	1477	58	1020	120	482	142.4	4.0	148	408	128
Loc_05	Gala sgar	602363	3521365	8.25	1476	60	1026	120	482	143.2	4.0	140	386	128
Loc_06	Gala sgar	603622	3517553	8.31	1474	36	1030	120	482	146.4	4.0	143	395	128
Loc_07	Al-Rifai	604402	3510336	8.31	1472	70	1032	120	482	144.8	4.0	144	392	126
Loc_08	Al-Rifai	604618	3503113	8.39	1467	42	1036	120	482	145.2	4.0	146	497	126
Loc_09	Al-Rifai	605139	3497376	8.43	1497	22	1026	121	486	142.0	4.0	144	397	128
Loc_10	Alnsar	606572	3490151	8.40	1480	56	1030	121	486	145.2	4.0	140	374	128
Loc_11	Alnsar	607111	3488073	8.42	1480	72	1028	121	486	143.2	4.0	143	404	128
Loc_12	Albdai	610310	3480678	8.42	1478	66	1024	120	482	144.4	4.0	144	408	128
Loc_13	Alshatra	610775	3476436	8.43	1481	28	1022	120	482	145.2	4.0	153	408	128
Loc_14	Alshatra	612325	3472145	8.58	1485	36	1018	120	482	144.8	4.0	149	413	128
Loc_15	Alshatra	614373	3468526	8.80	1484	28	1022	120	482	145.6	4.0	144	394	128
Loc_16	Algarraf	617100	3464176	8.67	1502	40	1036	121	486	145.2	4.0	149	398	130
Loc_17	Algarraf	618738	3462765	8.34	1532	56	1040	122	490	146.8	4.4	137	402	132
Max.				8.8	1568	72	1040	127	508	146.8	4.4	153	497	136
Min.				7.85	1467	22	1016	120	482	142	4	137	281	126
Mean				8.355	1489.294	47.294	1026.2353	120.8	485.2	144.6	4.047	145.4	398.5	128.6
SD				0.224	25.45772	15.999	6.9957971	1.704	6.366	1.408	0.133	4.358	39.62	2.32
permissible				4-8.6	2250	60	2500	450	300	250	100	250	200	200

Table1: Test results conducted in the Department of the Environment Water / Najaf Governorate (date: 4/FEB/2017).

*The values in yellow color do not meet the permissible.

	Name	Location		Physical Properties				Cation (mg/l)				Anion (mg/l)		
		E	N	Ph	EC(µs/cm)	TSS	TDS	Ca	TH	Na	K	Cl	So4	ALK
Loc_01	ALfagr	590787	3532154	8.4	828	34	564	73	294	74.7	2.4	90	181	74
Loc_02	ALfagr	592576	3530998	8.4	790	58	446	72	290	73.5	2.1	88	186	72
Loc_03	ALfagr	598393	3528445	8.3	808	34	482	73	294	75.6	1.8	89	171	72
Loc_04	Gala sgar	600462	3526145	8.3	808	24	598	73	294	74.7	2.4	89	181	72
Loc_05	Gala sgar	602363	3521365	8.3	818	48	560	73	294	75.6	2.4	88	171	74
Loc_06	Gala sgar	603622	3517553	8.4	816	56	486	73	294	76.2	2.4	88	176	74
Loc_07	Al-Rifai	604402	3510336	8.5	836	52	598	76	304	77.7	2.4	98	217	76
Loc_08	Al-Rifai	604618	3503113	8.4	816	60	562	73	294	77.4	2.4	89	202	74
Loc_09	Al-Rifai	605139	3497376	8.4	816	38	556	73	294	76.8	2.4	89	204	74
Loc_10	Alnsar	606572	3490151	8.4	827	42	494	73	294	76.5	2.1	90	182	76
Loc_11	Alnsar	607111	3488073	8.3	851	68	488	76	304	78.0	2.1	94	208	76
Loc_12	Albdai	610310	3480678	8.6	848	38	680	76	304	79.5	2.4	92	246	76
Loc_13	Alshatra	610775	3476436	8.4	846	36	450	76	304	75.9	2.4	93	205	76
Loc_14	Alshatra	612325	3472145	8.4	855	40	646	76	304	76.5	2.4	94	214	76
Loc_15	Alshatra	614373	3468526	8.6	881	36	602	77	308	89.7	3.9	98	208	78
Loc_16	Algarraf	617100	3464176	8.5	866	54	526	77	308	79.2	2.4	100	214	78
Loc_17	Algarraf	618738	3462765	8.5	872	16	628	77	308	76.5	2.4	102	220	78
Max.				8.6	881	68	680	77	308	89.7	3.9	102	246	78
Min.				8.3	790	16	446	72	290	73.5	1.8	88	171	72
Mean				8.418	834.2353	43.176	550.94118	74.53	299.2	77.29	2.4	92.41	199.2	75.06
SD				0.095	25.43504	13.566	69.401432	1.841	6.366	3.553	0.424	4.57	20.7	2.015
permissible				4-8.6	2250	60	2500	450	300	250	100	250	200	200

Table2: Test results conducted in the Department of the Environment Water / Najaf Governorate (date: 11/MAY/2017).

*The values in yellow color do not meet the permissible.

[2.3]CALCULATIONS OF THE WQI

CCME WQI was used to provides convey the water quality information for both decision management and policymaker. This index can be applied by many water agencies in various countries with slight modification [13]. The calculation of index outcome in CCME WQI method can be acquired by using the following equation[14]:

$$CCME-WQI = 100 - \left(\frac{\sqrt{F_1^2 + F_2^2 + F_3^2}}{1.732} \right) \quad (1)$$

The CCME WQI model include three measures of variance (scope F1, frequency F2, and amplitude F3) [15].

$$F_1 = \frac{Number\ of\ failed\ variables}{Total\ number\ of\ variables} x100 \quad (2)$$

$$F_2 = \frac{Number\ of\ failed\ tests}{Total\ number\ of\ tests} x100 \quad (3)$$

F3 (Amplitude) is determined in three steps. The first step is called “excursion", where the test value must not exceed the permissible expressed as follows:

$$Excursion_i = \left(\frac{Failed\ test\ value_i}{Objective_j} \right) - 1 \quad (4)$$

The second step is referred to as the normalized sum of excursions, or nse (sum the excursions of individual tests, then dividing by the total number of tests) expressed as follows:

$$nse = \frac{\sum_{i=1}^{n} excursion_i}{\sum of\ tests} \quad (5)$$

:

Then, F3 is calculated and expressed as follows:

$$F_3 = \left(\frac{nse}{0.01\ nse + 0.01} \right) \quad (6)$$

These are combined to produce a single value (between 0 and 100) .Therefore, five class have been proposed to categorize the water qualities, as shown Table (3) [16].

Table 3: CCME WQI index categorization .

Rank	WQI value
Excellent	95-100
Very Good	89-94
Good	80-88
Fair	65-79
Marginal	45-64
Poor	0-44

The following physical and chemical parameters were determined according to Iraqi standard , as shown in Table (4).

Table 4: Irrigation water Iraqi standards

Water quality parameters	Unit	Standards
PH		4-8.6
Total Dissolved Solid (T.D.S)	mg/l	2500
Alkalinity (ALK)	mg/l	200
Electrical Conductivity (E.C)	s/cmμ	2250
Calcium(Ca)	mg/l	450
Chloride (Cl)	mg/l	250
Sulfate (SO4)	mg/l	200
Potassium (k)	mg/l	100
Total Suspend Solid (T.S.S)	mg/l	60
Total hardness (TH)	mg/l	300
Sodium (Na)	mg/l	250

[2.4] Results and Discussion

The pH measurement reflects a change in the quality of the source. in addition, higher values of pH reduce the germicidal potential of chlorine [17]. In this study, the average values for pH are the basicity of the interaction. They are within the permissible range of 4-8.6 for irrigation water.

The Sulfate was found to be in the range of 171 to 413 mg/l and exceeds the permissible in FEB and MAY for some stations. The exceeded values probably are due to Some metals, such as calcium sulfate or carbon dioxide, are dissolved in the air and mixed with rainwater during their fall.

Higher Total Hardness values increase turbidity in stream. In this study, the average values for Total Hardness from 308 to 508 mg/l. They are within the permissible range of 300 mg/l for irrigation water.

T.S.S was found to be in the range of 22 to 72 mg/l and exceeds the permissible in FEB and MAY for some stations. The exceeded values probably are due to Suspended solids consist of two parts, a non-precipitated part and a grainy part, and the difference between them is determined by the size and shape of the minutes, which increases or decreases the number of contaminants.

According to the total values of parameters examined, Table (1) and Table (2) calculates water quality CCME WQI for all station separately. The total numbers of parameters examined are 11, and the total numbers of individual tests are 22. The number of parameters not meeting permissible is 2 (Total Hardness and sulfate for Loc_01,02,03,04,05,06,08,09,10,13,14,16 and 17), while the number of parameters not meeting permissible is 3 (Total Hardness, sulfate, and T.s.s for

Loc_07,11,12) except Loc_15 the number of parameters not meeting permissible is 3 (Total Hardness, sulfate, and PH). The calculated values and ratings of WQI are presented in Table (5).

No.	Date	Scope – F1	Frequency – F2	nse	Amplitude – F3	WQI	Rating of water quality
1	04/FEB/2017 11/MAY/2017	18.18	9.09	0.076	7.063	82.605	Good
2	04/FEB/2017 11/MAY/2017	18.18	9.09	0.049	4.671	87.950	Good
3	04/FEB/2017 11/MAY/2017	18.18	9.09	0.074	6.890	87.608	Good
4	04/FEB/2017 11/MAY/2017	18.18	9.09	0.074	6.890	87.608	Good
5	04/FEB/2017 11/MAY/2017	18.18	9.09	0.069	6.450	87.680	Good
6	04/FEB/2017 11/MAY/2017	18.18	9.09	0.071	6.629	87.656	Good
7	04/FEB/2017 11/MAY/2017	27.27	22.72	0.083	7.660	79.034	Fair
8	04/FEB/2017 11/MAY/2017	18.18	13.63	0.095	8.675	85.955	Good
9	04/FEB/2017 11/MAY/2017	18.18	13.63	0.073	6.803	86.305	Good
10	04/FEB/2017 11/MAY/2017	18.18	9.09	0.067	6.279	87.710	Good
11	04/FEB/2017 11/MAY/2017	27.27	27.27	0.092	8.424	77.208	Fair
12	04/FEB/2017 11/MAY/2017	27.27	22.72	0.090	8.250	78.960	Fair
13	04/FEB/2017 11/MAY/2017	18.18	18.18	0.076	7.063	84.605	Good
14	04/FEB/2017 11/MAY/2017	18.18	18.18	0.079	7.321	84.56	Good
15	04/FEB/2017 11/MAY/2017	27.27	22.72	0.075	6.976	79.114	Fair
16	04/FEB/2017 11/MAY/2017	18.18	18.18	0.077	7.149	84.592	Good
17	04/FEB/2017 11/MAY/2017	18.18	18.18	0.080	7.400	84.55	Good

Table 5. Calculated values of WQI in Gharraf irrigation water

[2.5] Conclusion

choosing a number of parameters necessary for providing a different picture to most adequately summarize water quality in a particular region.

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