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Modules water quality of the Gharraf River in southern Iraq

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Abstract: **Water sources provide quantities of water suitable for drinking or after treatment. We used mathematical indices to know the quality and sweetness of the Gharraf River, which is one of the important branches of the Tigris. The period of the study were one year from (2015-2016) with monthly measurements. The results of the measurements and the evaluating the river water was good for drinking at the first station, and low in stations 4, 3, 2, and in station 5, it is very low, without taking the turbidity. The water indicators of the river as unfit for drinking through the pipes. Overall, the study emphasized the importance of using indicators of freshness and water quality to help the population in the region to take more care of water quality.**

Keywords: **water quality, Gharraf River, chemical, physical, biological, WQI.**

I. INTRODUCTION

Water sources provide quantities of water suitable for drinking or after treatment at the levels. Water sources in Iraq are exposed to large amounts of pollutants that are emitted from near and far unspecified sources and become a point where it is difficult to control, manage and even evaluate, for example agricultural waste and sewage and industrial waste (Ahuja 2003). The chemical, physical and biological properties of water the main factors affect the quality as well as the human activities (Abbasid, 2012). The problems of water pollution of the river it's increased recently due to increasing human activities, which is why we have to collect, analyze and interpret data according to the results of Yahya and Sabah, (2011).The basic method for measuring water quality is (WQI) such as the BOD, TDS, concentration, alkalinity, hydrogen ion, SO, water turbidity, nitrate, phosphate as well as total hardness (Abbasiya, 2012). WQI in races provides important information of the quality rivers. The main source of Al-Gharafa in southern Iraq, it passes through two important areas, the regions of Dhi Qar and Wasit, and branches off from the Tigris to the city of Kut. Its water is used for drinking, animal husbandry, fishing and irrigation (Al-Jezi, 2005). Any type of hazardous pollutant, whether naturally or from human activity, can have a social or economic hard impact (Eweed, 2011).The aims of this study are the measure water quality in the Graf River, and the others parameters that effect on it such as the BOD, TDS, concentration, alkalinity, hydrogen ion, SO, water turbidity, nitrate, phosphate. Relatedly, make a guiding for the people of the area on how to manage water and how to help them meet their needs and consequently protect water in the future.

II. MATERIALS AND WORKING METHODS

Al-Gharraf is the main branch of the Tigris River, located south of the capital, Baghdad, at the Euphrates basin, to the Kut Dam, and passes through Dhi Qar and Wasit governorates until it becomes smaller north of the city of Nasiriyah, located in the south of the Republic of Iraq. It has a length of approximately 230.1 km and a drainage area of 4350,500,000 m^2, and has a flow rate of approximately 620 m^3/sec. It contains 51 canals and 969 trenches that irrigate an area of approximately 70000 hectares (Al-Sahhaf, 1965; US Department of Agriculture, 2009). The atmospheric advantages of the semi-arid valley region, such as temperatures are high in summer, humidity is low, annual rainfall is low by about 150.1 mm, and evaporation is high(Atia, 2015). Among the atmospheric problems are an increase in solar radiation, a lack of water, an increase in the number of plants such as water hyacinth, and an increase in the accumulation of mud (Ewaid 2016). However, the table 1 shows the five stations whose samples were selected. Where Station 1 had the water features of the Tigris River from the beginning. At a distance of 200 square kilometers from the land, specifically on the banks of the river Al-Gharraf in the second station, there were large fields for gardening, from the neighborhood town there was water pollution due to domestic sewage. On the left of the river, were areas of salt, while on the right are large agricultural fields. The canal is affected by the river Garraf with urban wastewater from the municipalities of Al-Rifai and Qalaat Sukkar. On the right bank, before Shatrah, near the Bid'a Gate, there are four stations for the purpose of Karir, which provide the governorates of Basra and Dhi Qar with drinking water. The fifth station is located in the south of the town of Shatrah, affected by sewage water, and the water level in it was low and its width was limited (Figure1).

III. RESULTS AND DISCUSSION

Determine the site for monthly water sampling from the date of December 2015 to the date of January 2016. The techniques were used in the standard protocols in the American Health Association (APHA) of 2012. Where the US techniques given in Table 2 were used to measure (BOD), (TDS), (pH), (DO), Turbidity (Tur.), Phosphates (PO4), (NO3), Chlorides (Cl-), (TH), (EC), and alkalinity for WQI .To examine the acceptable quality of the water of the Graf River for drinking purpose, the water quality index of the River Graf was surveyed using eleven parameters: pH, BOD, TDS, Turbidity, PO4, DO, NO3, TH, chlorides, EC, and alkalinity, for five sites for the purpose of testing. The WQI was done using the arithmetic weighted water quality index method that can be found in Horton (1965), which was developed by Brown et al. (1970) and by Cude (2001), where a weighting coefficient is used and then the average calculation is used. where Qi is the sub-index of the parameter, (Wi) is the unit weight of the parameter, n is the number of applicable parameters, Mi is the observed value for a parameter, I is the ideal value, and Si is the standard value . Tripat and Sahue (2005) found that the approved optimum value for pH is 7, SO is 14.6 mg/L, and all other parameters are zero (Chowdhury, 2012). The unit of weight for each parameter is (Wi) as a number, which is directly inversely proportional to the World Health Standard (Si).The water quality class was determined by the calculated WQI, according to Shweta et al.(2013) and shown in Table 3. The total water quality, plus 11 physical and chemical factors, shows in Table 4 the river quality statistics (range, average, and average during the year). Because the five sites were similar, there was a slight difference in the values obtained for the parameters measured through this study. Despite significant seasonal changes in meteorological conditions, residential and other water supply, and the results were different. The decrease in the Jeddah WQI downstream indicates the presence of several pollutants. Entering the stream led to water pollution as a result of natural and human factors such as untreated sewage and horticultural wastewater (Al-Khatib and Al-Obaidi, 2013), as well as the water level in the rivers was low, as it enhances the drainage. As well as from groundwater where the watercourse is polluted, as in (Al-Khatib and Al-Obaidi, 2013).The dry seasons are (summer and autumn), there are fluctuations in river water levels that occur annually; As the water coming from the tanks is filled with quantities of organic matter, plankton, algae, as well as green plants, which leads to a reduction in pH and oxygen levels, and we notice an increase in turbidity as well as dissolved solids, which affects the freshness and quality of the water as is known (Ministries Iraqi Resources, 2006). The river cannot treat itself due to a decrease in water levels and scarcity due to the lack of rainfall (Al-Obaidi et al., 2015; Issa et al., 2013). The results of the study of the physical and chemical parameter of WQI calculation (Table 3) confirmed the existing poor water quality. The amount of BOD ranged from 0 0.8 to 0 10.1 mg / liter specifically in the Garraf River, as well as an annual average of 0 3.95 mg / liter, were markedly lower in general. The first four stations met the BOD standard but did not at the fifth station. During the research, where the measured level of TDS for river water was from 0.620 mg/L to 0.870 mg/L, with an annual average of 0.686 mg/L, and no differences appeared in the stations, but there was a clear discrepancy between seasons. Whereas TDS levels greater than 0.100 mg/L are not valid as drinking water. (USGS,2015). The pH of the water in the river stations was in the range of 6.8 - 0.8, with an average of 0 7.4; It was slightly alkaline, as in the previous research study on surface waters (Al-Abadi, 2014; Attia, 2015). Nitrate ion causes harm if present in water. The maximum and minimum mean were 0 2.9 and 0 7.5 mg/L, respectively, within an annual mean of 0 4.56 mg/L. The results were much lower than the WHO of 50.0 mg/L. Chloride concentrations in the river range from 0.132 to 0.240 mg/L, for an annual average of 0.195 mg/L, which is also much lower than the World Health Organization limits, at all stations in different seasons, and the total hardness levels were less than 0.500 mg/L, which is the same as the allowed range permitted by the World Health Organization. The annual mean was 0.341 mg/L, with an average concentration from 0.250 mg/L to 0.410 mg/L. The electrical conductivity value ranges from .928 to 0.1270 ms/cm, with an annual average of 0.928 ms/cm, as shown in Table 4. The quality index of river water was calculated by the method of predetermined weighted arithmetic indicators equations (Table 5,) the observed values (Mi) of the eleven water quality standards tested, the standard amounts of potable water (Si) and according to the standards of the World Health Organization (2011) and the units of weight (Wi), sub-water index (Qi), and WQI. Because of the increased levels of turbidity in the river, the indicators for both the station and the whole river were divided into two categories (no turbidity and turbid), as shown in Table 6. When turbidity is taken into account in calculating a river's WQI,

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results vary from 0312.1 to 0387.4, which refers to the water unfit for drinking for humans and animals, according to (Table 3. The WQI values indicate poor quality. This is due to the human and natural events that occur along the course of the river. Moreover, WQI values indicate poor quality of river water and must be treated before use to avoid water diseases. We assessed the quality of the Grave River using seventeen physicochemical parameters in comparison with the Canadian Cabinet's Environmental Water Quality Indicators (CCME-WQI). With annual values ranging from 0.30 to 0.39 with a percentage of 100, the WQI evaluated Garraf water as harmful to aquatic organisms and neutral for irrigation (Ewaid, 2016). Also, the wastewater institution index (NFS WQI) was used for evaluation, and the water was within a range from 0.64 to 0.70, and this indicates that the water crest of the river is medium (Owaid, 2016).

TABLE 1: The coordinates of the water sampling station.

No.	Points	Coordinates	
		N	E
1.	GR-1	32°300 00.3200	45°440 60.0000
2.	GR-2	32°110 16.1000	46° 00 26.3200
3.	GR-3	31°530 13.8700	46° 30 17.6500
4.	GR-4	31°340 32.4800	46° 70 26.5500
5.	GR-5	31°180 9.8200	46°140 17.0600

TABLE 2

NO	Parameter	Unit	Method	Site
1	BOD	mg/l	Azide modification at 20 °C (5 D)	Laboratory
2	TDS	mg/l	Temperature controlled oven	Laboratory
3	pH	Ph units	WTW portable multi-meter 340i	situ
4	DO	mg/l	WTW portable multi-meter	situ
5	Tur.	NTU	WTW portable turbidity meter TURB 355 IR/T	situ
6	PO4	mg/l	Molybdate ascorbic acid method	situ
7	NO3	mg/l	Cadmium reduction method	Laboratory
8	Cl	mg/l	Silver nitrate titrationmethod	Laboratory
9	TH	mg/l	Titration with EDTA-2Na and EBT as an indicator	Laboratory
10	EC	mS/cm	WTW portable multi-meter 340i i	situ
11	Alkalinity	mg/l As	CaCO3 by titration method	Laboratory

TABLE 3: The WQI categories.

Range	Quality
0–25	Excellent
26–50	Good
51–75	Poor
76–100	Very Poor
>100	Unsuitable for drinkin

aggregated using a simple arithmetic mean by these three

equations:

$$Qi = \frac{(Mi - Ii)}{(Si - Ii)} x100 \quad (1)$$

$$Wi = \frac{K}{Si} \quad (2)$$

$$WQI = \sum_{i-1}^{n} \frac{WiQi}{\sum_{i-1}^{n} Wi} \quad (3)$$

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Table 4: Simple statistical analysis of water quality parameters.PH in PH unit, Ec in uS/cm. Tur in NTU and the rest in mg/l.

	1st Station		2nd Station		3rd Station		4th Station		5th Station		Annual Mean
	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	
BOD	0.8–2.6	1.6	1.9–3.4	2.75	2.8–4.4	3.8	2.2–4.7	3.5	2.6-10.1	8.12	3.95
TDS	620–790	691	63–760	700	610–870	727	640–760	710	630–750	700	686
pH	7.1–7.8	7.4	7.3–7.9	7.5	6.8–7.7	7.175	7.2–8.0	7.5	7.1–7.9	7.5	7.4
DO	7–9.6	8.2	6.2–10	7.95	6.8–7.8	7.325	6.2–7.8	6.825	6–8.8	7.125	7.48
Tur.	75–91	81	64–92	75.25	55–84	68	60–78	67	40–70	58.5	50
PO4	0.1–0.21	0.13	0.11-0.27	0.195	0.13–0.65	0.3	0.46–0.66	0.59	0.4–0.7	0.6	0.363
NO3	2.9–5.6	4.1	2.6–7	4.55	3–7.5	4.7	3.4–6.3	4.775	3–6.5	4.68	4.56
Cl	123–225	167	160–240	196	165–265	216	168–235	192	170–220	205	195
TH	250–390	321	320–395	361	300–410	355	290–435	337	300–400	335	341
EC	928–1100	997	980–1200	1075	970–1210	1082	990–1200	1027	1020–1270	1067	1043
Alk.	145–175	165	143–240	189	150–240	200	165–270	196	155–265	195	189

Table 5: Calculation of Water Quality Index (WQI) of the river. pH in pH unit, EC in mS/cm, Tur. in NTU and the rest in mg/l.

	Standard Value (Si)	Ideal value (Ii)	Monitored values (Mi)	Sub-index (Qi)	Weightage unit (Wi)	Wi x Qi
BOD	5	0	1.6	30	0.2	6
TDS	1000	0	691	69.1	0.001	0.07
pH	7.5	7	7.4	80	0.133	10.64
DO	5	14.6	8.2	66.6	0.2	13.32
Tur.	5	0	81	1620	0.2	324
PO4	5	0	0.13	2.6	0.2	0.52
NO3	50	0	4.1	8.2	0.02	0.164
Cl	350	0	167	47.7	0.003	0.143
TH	500	0	321	64.2	0.002	0.128
EC	250	0	997	399	0.004	1.6
Alk.	200	0	165	82.5	0.005	0.41

Table 6: Water Quality Index value of different sampling sites without and with turbidity.

Stations	WQI values without including turbidity		WQI values including turbidity
1	43.0	Good	387.4 Unsuitable for drinking
2	67.2	Poor	364.3
3	64.1		331.6
4	73.5		335.2
5	88.7	Very poor	312.1
The entire river	67.3	Poor	346.1

IV. CONCLUSION

Determine the site for monthly water sampling from the date of December 2015 to the date of January 2016. The amount of BOD ranged from 0 0.8 to 0 10.1 mg / liter specifically in the Garraf River, as well as an annual average of 0 3.95 mg / liter, were markedly lower in general. The first four stations met the BOD standard but did not at the fifth station. The measured level of TDS for river water was from 0.620 mg/L to 0.870 mg/L, with an annual average of 0.686 mg/L, and no differences appeared in the stations, but there was a clear discrepancy between seasons. The pH of the water in the river stations was in the range of 6.8 - 0.8, with an average of 0 7.4; It was slightly alkaline, as in the previous research study on surface waters . The maximum and minimum mean were 0 2.9 and 0 7.5 mg/L, respectively, within an annual mean of 0 4.56 mg/L. The results were much lower than the WHO of 50.0 mg/L. Chloride concentrations in the river range from 0.132

to 0.240 mg/L, for an annual average of 0.195 mg/L. We suggest conducting other intensive studies on the Al-Radada area because of its extensive importance on a major source of Iraqi lands. The study should include more characteristics to cover the largest possible area of land, such as the current situation of the Gharraf River. Organizing awareness for the residents of the region about the pollution that the region contains, and they are largely responsible for it, and how to avoid problems in the environment and at the level of the region. Implementation of an environmental program where stakeholders can participate in ways to prevent pollution as well as mitigate its effects, starting from schools to those with influence.

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