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Ali Abdulhamza Al-Fanharawi

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RESEARCH ARTICLE

ASSESSMENT OF WATER QUALITY OF AL- RUMAYTHARIVER BY USING THE CANADIAN MODEL (CCME WQI)

Ali Abdulhamza Al-Fanharawi

Department of Environment& Pollution, Science College, University of Al-Muthana, Iraq

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ABSTRACT

The present work describes the application of Canadian Council of Ministers of the Environment Water Quality Index (CCME WQI) for three stations located at the Al- RumaythaRiver in Al-Rumaytha city. Water samples collected a monthly during the period from November 2014 to October 2015, and were analyzed for physical and chemical properties immediately after collection. CCME WQI was applied using nine water quality parameterinclude Air temperatures, Electrical conductivity, Total dissolved solids, pH , Dissolved oxygen , Total hardness , Sodium, Potassium and Turbidity. Based on the results obtained from WQI, the water quality of Al- RumaythaRiver ranged between 27.69 – 33.93 which indicate that the water quality is very bad or Poor and is not fit to be used for drinking purposes in all study sites and that due to the effect of various urban, industrial and agriculture wastes sources. The present paper confirms the need to take a serious action for monitoring the river for good management.

INTRODUCTION

The water of rivers plays a critical role in countries development. The rivers serve as a source of water supply to meet our domestic, agricultural, industrial, fisheries and power generation needs [1]; therefore, Euphrates river and its branches are vital importance to people in domestic water use. Al-Rumaythariver is the main source of drinking water in the province of Muthanna.

The quality of any body of surface or ground water is a function of either or both natural influences and human activities [2], Water quality concept can be defined as a conventional ensemble of physical, chemical and biological parameters, formed in acertain category, which expresses the possibility of its anthropic usage to meet a certain purpose such as potable, agricultural, recreational and industrial water usages [3].

There are a difference between water quality assessment and water quality monitoring, the first term defines as the overall processes of evaluation of the physical, chemical and biological nature of water in relation to natural quality, human effects and intended uses, particularly uses which may affect human health and the health of the aquatic system itself, While the second term defined as the actual collection of information at set locations and at regular intervals in order to provide the data which may be used to define current conditions, establish trends[4]. Water quality is determined by comparing the physical and chemical characteristics of a water sample with water quality guidelines or standards[2].

There are a number of methods to analyze water quality data that vary depending on informational aims, samples type, and the size of the sampling area. Research in this area has been extensive, as indicated by the number of methods proposed or developed for classification, modeling and interpretations of monitoring data[5],one of the most effective ways to communicate information on water quality trends is by use of the suitable indices[6]. Indices are based on the values of various physico-chemical and biological parameters in a water sample. It is a communication tool for transfer of water quality data [7]. The index equation is based on the water quality index (WQI) endorsed by the Canadian Council of Ministers of the Environment (CCME).The index allows measurements of the frequency and extent to which parameters exceed their respective guidelines at each monitoring station; therefore, the index reflects the quality of water for both health and

Corresponding author:* **Ali Abdulhamza Al-Fanharawi
Department of Environment& Pollution, Science College, University of Al-Muthana, Iraq

acceptability, as set by the World Health Organization. The index is determined on an annual basis resulting in an overall rating for each station per year. This will allow both spatial and temporal assessment of global water quality to be undertaken [2].

In Iraq, there are a few studies used the Canadian model to assess local rivers water quality including a study on the Tigris River in Baghdad City [8], and the study on Euphrates River North of HillaCity [9], and at NasiriyaCity [10], as a result of the lack of a previous studies on the Al-Rumaythariver were selected study idea. The current work aims to evaluate the water quality ofAl-Rumaytha river by measuring a set of physical and chemical factors to the riverwater and introducing them into the Canadian model, which should be based on water quality evaluation to certain categories showing their suitability for drinking purposes.

MATERIALS AND METHODS

Study area

Euphrates River is one of two major rivers flowing through Iraq. It originates in Turkey, runs through Syria, entering Iraq from the western side and discharge in Shat Al-Arab. Al-Rumaytha river is a branch of the Euphrates River Which is located in RumaythaCity that situated approximately 25 km North of SamawaCitythat situated approximately 270 km Southeast of Baghdad capital of Iraq. The study area included three stations on Rumaytha river, the first station located before the entrance of the river to Al-Rumaytha cityin the area descript agricultural activity, while the second station S2 is located at Rumaytha city center characterized by presence the waste flow from the markets and shops, sewage directly disposal into river water and absence of grass and trees on both sides of the river, the third station S3 located at south of Rumaytha in an area called JalilFig.(1).

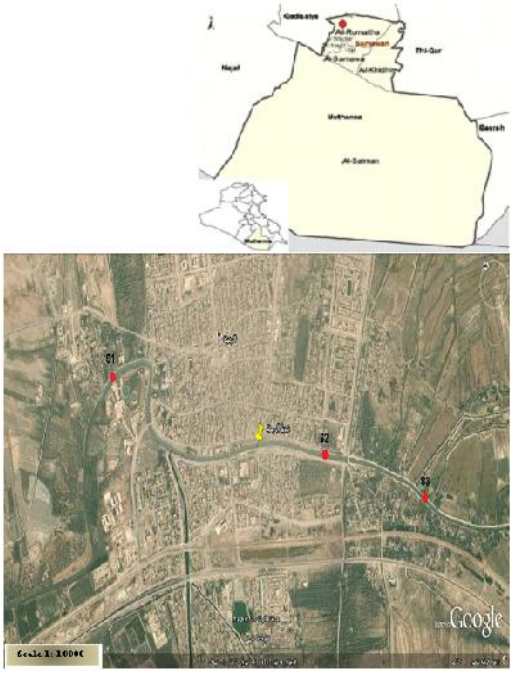

Figure 1 Map Showing Study Sites on Al- Rumaytha River.

Samples Procedures

Subsurface water samples were collected from the study stations on a monthly basis for the period from November 2014 to October 2015, the samples were collected one sample per month from each station by using clean polyethylene bottles 2 liters capacity. Samplingwere analyzed for physical and chemical properties immediately after collection. It was measured several of environmental variables included, Air temperature (°C) and Electrical conductivity (µS/cm) were measured directly at the sampling sites [11]. Total dissolved solids (TDS), pH , Total hardness (mg CaCO3/L), Sodium (mg/l), Potassium (mg/l) and Dissolved oxygen (mg/l)were measured depending on procedures that has been described by [12]while turbidity (NTU) was measured by turbidity meter type Hanna Hi 25557.

CCME Water Quality Index calculation

The index is calculated based on the source CCME (2001) and this indicator is based on three statistical equations are:

$$F_1 = \frac{\text{Number of failed variables}}{\text{Total number of variables}} * 100$$

Where F_1 represents (Scope): The percentage of parameters that exceed the guideline.

$$F_2 = \frac{\text{Number of failed tests}}{\text{Total number of tests}} * 100$$

Where F2 represents (Frequency): The percentage of individual tests within each parameter that exceeded the guideline.

As well as, F3 represents (Amplitude): The extent (excursion) to which the failed test exceeds the guideline. This is calculated in three stages. First, the excursion is calculated:

$$excursion_i = \left(\frac{FailedTestValue_i}{Objective_j} \right) - 1$$

Second, the normalized sum of excursions (nse) is calculated as follows:

$$nse = \frac{\sum_{i=1}^{n} excursion}{Number\ of\ Tests}$$

F_3 is then calculated using a formula that scales the nse to range between 1 and 100:

$$F_3 = \frac{nse}{0.01\ nse + 0.01}$$

The index value is calculated by the following equation final:

$$WQI = 100 - \left[\frac{\sqrt{F_1^2 + F_2^2 + F_3^2}}{1.732} \right]$$

RESULTS AND DISCUSSION

The results of the current study showed variation in the physical and chemical factors of water at different stations

along the Rumaytha River. The descriptive statistics analyses for the collected water quality parameters are shown in **Table 1**

Table 1 Values of the lower and upper limits for factors though the study period.

Characters / Sites	Air Tem. (C°)	pH	E.C. µS/cm	T.D.S. (mg/l)	T.H. (mg/l)	Turb. (NTU)	DO (mg/l)	Na (mg/l)	K (mg/l)
Site 1	*13	6.8	730	360	420	13.14	7	118.7	20.9
	**23	8.8	1254	580	780	33.58	8.3	312	36.1
Site 2	14	7.8	830	410	352	11.05	4.8	117.6	21.77
	24	8.6	1290	560	636	56.86	6.5	287.1	30.4
Site 3	9	6.5	825	410	384	6.1	5.9	120.2	20
	23	8.9	1357	605	624	46.08	7.1	345	40.1

* Lower limits.
** Upper limits.

These values have been introduced in three statistical equations to calculate water quality index. The result values of $\mathbf{F_1}$, $\mathbf{F_2}$ and $\mathbf{F_3}$for each study siteas shown in **Table2**

Table 2 Values of F1, F2 and F3 in sites during the study period.

Values / Sites	F1	F2	F3
Site 1	77.77	58.33	60.34
Site 2	88.88	66.66	57.77
Site 3	77.77	62.03	58.24

Based on values in table 2, it was calculated the value of water quality index (CCME WQI) according to [13]. The results showed that the highest value of this indicator recordedin S1 was33.93 and the lowest value in S2 and amounted to 27.69 either in S3 was equal to 33.44 (Figure 2).

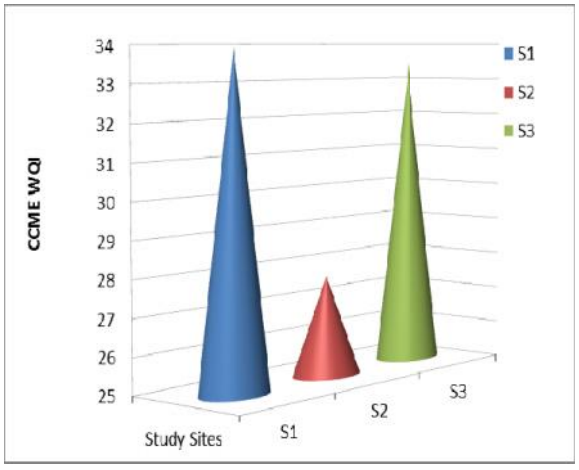

Figure 2 Values of CCME WQI index in the sites during the studyperiod.

By comparing these values with table 3 that classifies water quality into main five categories to show their suitability for drinking purpose found that water quality in all sites of Al-Rumaythariver during the study period within Poor class, and characterized by non-suitability for drinkingpurposes.

The description of the study sites in the Al-Rumaytha river during the current studyas poor may be due to several reasons, includingthe discharge of pollutants to a water resource system from domestic sewage discharges, industrial processpollutants, agricultural runoff and other sources, this is may be untreated, can have significant effects of both short and long term duration on the quality of a river system [14]. The researcher believes that the other reason of poor water qualitythat the Rumaytha river representsdownstream of a branch of the Euphrates River, which branches from the Indian dam andcalled Hilla river which moves during Babil&Diwaniya provinces and during its long distance, received a lot of pollutants that received it.

Table 3 Water quality classification based on WQI values according toCCME(2001).

CCME WQI Categories	CCME WQI Values	Water Quality Status
Excellent	95-100	water quality is protected with a virtual absence of threat or impairment; conditions very close to natural or pristine levels.
Good	80-94	water quality is protected with only a minor degree of threat or impairment; conditions rarely depart from natural or desirable levels.
Fair	65-79	water quality is usually protected but occasionally threatened or impaired; conditions sometimes depart from natural or desirable levels.
Marginal	45-64	water quality is frequently threatened or impaired; conditions often depart from natural or desirable levels.
Poor	0-44	water quality is almost always threatened or impaired; conditions usually depart from natural or desirable levels.

The results of the current study agreed with the study of Al-Janabi *et al*., (2012) on the Tigris River at Baghdad city, which attributed the reason the poor of water quality of study sitestodis charge of different waste into the river, While Jahad (2014) records the highest values of WQI on the Hilla River and classify the water quality within Fair class.

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