

## Application of Canadian Council of Ministers of the Environment Water Quality Index (CCME WQI) to Evaluate Tap Water Quality in Babylon Governorate

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**Abstract:** This study conducted to assess water quality by using Canadian Council of Ministers of the Environment Water Quality Index (CCME WQI). Study area involves four districts (Almusayab, Almahaweel, Almuharibeen and Aljamiyaa) located in Babylon governorate. Samples collected during three months starting from January 2016 until March 2016 and analyzed for many physical and chemical properties included PH, Calcium (Ca), chloride (Cl), total Hardness (TH), sulfate (SO<sub>4</sub>), total dissolved solid (TDS) and magnesium (Mg). The calculated values of CCME WQI showed that the water quality of study area in four districts (Almusayab, Almahaweel, Almuharibeen and Aljamiyaa) were good according to CCME WQI classification during study period and measured values of chemical and physical properties were within Iraqi standards.

**Keywords:** CCME WQI, water quality index

### INTRODUCTION

The assessment of water quality can be a complex process undertaking many parameters capable of causing various stresses on overall water quality. To evaluate water quality from a large number of samples, each containing concentrations for many parameters is difficult. So, water quality indices are such approaches which minimizes the data volume to a great extent and simplifies the expression of water quality status.

Water quality index can be evaluated on the basis of various physical, chemical and bacteriological parameters. Numerous water quality indices have been formulated all over the world which can easily judge out the overall water quality within a particular area promptly and efficiently. To represent water quality in a lucid way different water quality indices for water quality assessment are used which aim at giving a single value to the water quality of a source reducing great amount of parameters into a simpler expression and enabling easy interpretation of monitoring data [1].

Field work for at 3 stations located along with Tigris River in Baghdad city, Iraq. was conducted during the period from February to December 2010. CCME WQI was applied using eleven water quality parameter (pH value, Total Dissolved Solids, Calcium, Total Alkalinity, Ammonia, Nitrate, Nitrite, Turbidity, Lead, Chromium, and Iron). Based on the results obtained from the index, the water quality of Tigris River ranged between 37-42 which indicate that river has the worst quality due to effect of various urban pollutant sources. This work confirms the need to take a serious action for monitoring the river for proper management [2].

The calculated value of CCME WQI was 87.81 which indicated that the drinking water quality in the city of Pogradec is "good," and that turbidity is the main problem in quality [3].

The values of CCME-WQI at each station of Aboabo River classified the River as poor. The deteriorating nature of the Aboabo River is directly linked to poor sanitary conditions prevalent in the Aboabo Catchment as well as the presence of cottage industries that discharge their effluent into the river [4].

The River water of Chambal comes under the categories of Good quality. This indicates that very little anthropogenic activity has been found and it will solve the problem of drinking water nearby area [5].

Overall the lake water of chikkakere , Periyapatna, Mysore district , Karnataka state which located in India is failed to satisfy the parameters and it's not safe to use for purposes like Drinking, Aquatic, Recreation, irrigation and livestock .The WQI values in the lakes is rated as poor and unable to protect aquatic life [6].

The results of the regression analysis of water quality status of the Hawkesbury-Nepean River in Sydney, Australia, demonstrate that not all the water quality parameters are significant in explaining the CWQI at the stations. The results of this study are expected to provide useful information for water quality management, and to form the basis for further investigation [7].

CCME WQI value of different locations at Goalichara for drinking purposes, agriculture purpose, and aquatic life indicate more or less marginal water quality. Also, NSF WQI (National Sanitation Foundation Water Quality Index) was applied to the same location. The overall NSF WQI value at different sampling points of Goalichara was in indicates more or less bad water quality in the canal [8].

**MATERIAL AND METHOD**

**Sample collection**

The samples of tap water were collected from four districts in Babylon governorate involves (Almusayab, Almahaweel, Aljamiyaa and Almuharibeen) during three months starting from January 2016 until March 2016. The samples analyzed for physical and chemical properties included PH, calcium (Ca), chloride (Cl), total Hardness (TH), sulfate (SO4), total dissolved solid (TDS) and magnesium (Mg). The Iraqi recommended Guidelines for drinking water specifications are stated in Table 1.

**Determination of Water quality index**

In this study Canadian Council of Ministers of the Environment Water Quality Index (CCME WQI) was used. This index can be determined as follows [10]

$$F1 = \left[ \frac{\text{Number of failed variables}}{\text{Total number of variables}} \right] * 100 \dots \dots (1)$$

F1 is called Scope which represents the percentage of variables that do not meet their objectives at least once during the interval under consideration (“failed variables”), relative to the total number of variables measured.

$$F2 = \left[ \frac{\text{Number of failed tests}}{\text{Total number of tests}} \right] * 100 \dots \dots (2)$$

F2 is called Frequency which represents the percentage of failed tests. The term “Excursion”

represents the number of times that certain concentration is different from the objective. When the value of the test is less than the objective, Excursion is given by:

$$\text{Excursion} = \left[ \frac{\text{Failed test value}}{\text{Objective}} \right] - 1 \dots \dots (3)$$

When test value is greater than the objective, Excursion is given by:

$$\text{Excursion} = \left[ \frac{\text{Objective}}{\text{Failed teste value}} \right] - 1 \dots \dots (4)$$

The sum of exertions of individual tests divided by the total number of tests is called normalized sum of excursions (nse) and is computed as follows.

$$nse = \left[ \frac{\sum_{i=1}^n \text{Excursion}}{\text{(Number of tests)}} \right] \dots \dots (5)$$

F3 is a function of nse and is given by:

$$F3 = \left[ \frac{nse}{(0.01 + 0.01nse)} \right] \dots \dots (6)$$

Finally CCME WQI is calculated as follows:

$$CCMEWQI = 100 - \left[ \frac{\sqrt{F1^2 + F2^2 + F3^2}}{1.732} \right] \dots \dots (7)$$

**Table-1: Iraqi Standards (Objectives) for Drinking Water, 2001**

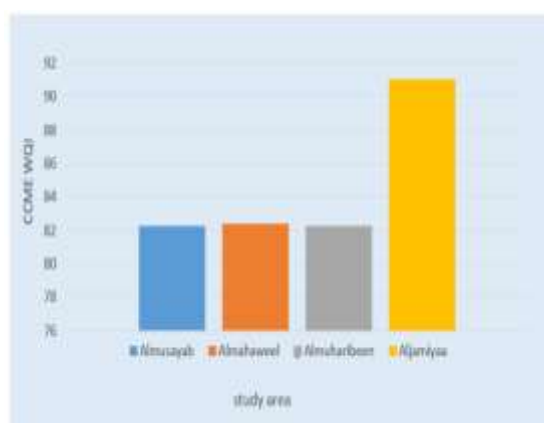
Parameter	Unit	Iraqi standards
pH	-	6.5-8.5
Chloride (Cl)	mg/l	350
Calcium (Ca)	mg/l	150
Alkalinity (Alk.)	mg/l	125-200
Magnesium (Mg) mg/L	mg/l	100
Total dissolved solid (TDS)	mg/l	1000
Sulfate (SO <sub>4</sub> )	mg/l	400

**Table-2: CCME WQI Classification [9]**

Rank	Value of WQI
Poor	0-44
Marginal	45-64
Fair	65-79
Good	80-94
Excellent	95-100

## RESULTS AND DISCUSSION

The calculated values of CCME WQI were (82.254, 82.337, 82.2 and 91.028) of study area (Almusayab, Almahaweel, Almuharibeen and Aljamiyaa) respectively, figure (1), which indicated that the water quality of four districts was good according to CCME WQI classification. The measured values of PH ranged from 7.73 to 8.23, total dissolved solid (TDS) values ranged from 386 to 740 mg/l, Sulfate (SO<sub>4</sub>) values were (121-213.85) mg/l, chloride (Cl) values were (100-179.944) mg/l, calcium values ranged from 114.8 to 216.4 mg/l and total hardness (TH) values were (340-575) mg/l in four districts. The above values of chemical and physical properties demonstrated that the measured values of parameters were within Iraqi standards except total hardness and calcium.

**Fig-1: Water Quality index for study area**

## CONCLUSION

The results showed that the water quality of study area in four districts (Almusayab, Almahaweel, Almuharibeen and Aljamiyaa) was good according to CCME WQI classification during study period. The measured values of chemical and physical properties were within Iraqi standards.

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