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Applying of Canadian water quality index for evaluation of some water treatment plants in Basrah province

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Abstract. In this study, ten water treatment plants were evaluated for water quality for drinking by using the Canadian Council of Ministers of the Environment Water Quality Index (CCME WQI).The ten main water treatment plants were Jubyla(1), Khor Al Zubair, Al-Shaibah, AlmahkalAljadeed, Hay Al-Hussain, Al Asmaei, Al Garma(1), Al Abass, Al Madena Al Riadia, and Mhaijran. These water treatment plants were in different places in Basrah province and supply most of the needed water for citizens in Basrah city.The samples were collected for the treated water monthly from January to December of 2019. 13 parameters of the treated water were tested, which were the Turbidity (Turb), Total hardness (TH), pH , Total dissolved solids (TDS), Total suspended solids (TSS), Chloride (Cl-), Magnesium (Mg^{+2}), Sodium (Na^{+}), Potassium (K^{+}), Calcium (Ca^{+2}), Alkalinity (Alk.), Sulfate (So_4) and Electrical Conductivity (EC) for all stations.The CCME WQI method classified the treated water of Mhaijran station as poor which means is not suitable for drinking purposes and this is because of several reasons, such as the dischargesof the pollutants into Shatt Al-Arab River from domestic,agricultural drainage, and industrial process pollutants.The water quality for the two water treatment plants, that are Al- Shaibah and Al Madena Al Riadia, were in good condition in the dry season.Whereas in the wet season, Al- Shaibah was marginal and Al Madena Al Riadia was fair.Al Abass was nearly fair in the dry and wet season whereas the others were ranged from marginal to poor condition.
Keywords: Water treatment plant, Canadian water quality index, Drinking water

1. Introduction

A very important issue related to human health is the accessibility to get clean water, which is necessary to ensure a healthy life [1].Water quality deals with the physical and chemical characteristics concerning all other hydrological properties [2]. Usually, the water quality from any water treatment plant (WTP) is determined by comparing the physicochemical properties of water samples from the inlet and outlet of the WTP with the water quality standards [3]. Drinking water quality guidelines have been introduced to ensure clean, healthy, and safe water for human consumption, thus protecting human health. These are usually based on scientifically evaluated acceptable levels of toxicity to either humans or aquatic organisms.There are several ways to analyze water quality data, which change according to informational aims, sample type, and size of the sampling area. Research in this area has been extensive, as evidenced by the number of methods proposed or developed for classification, modeling, and interpretations of monitoring data [4], and one of the most effective ways to communicate information about water quality trends is to use appropriate indicators [5].The indicators are based on the values of many physicochemical and biological parameters in the water sample. It is a communication way for transmitting water quality data [6]. In Basrah province, most of the WTPs were studied by several researchers by assessing the water quality for raw and treated water by using a suitable method for calculating the water quality index (WQI), where Hamdan [7] (2016) studied eleven WTPs in Basrah province center and surrounding areas which were ten of them along Shatt Al Arab River and one was far away from the river, and the water samples were tested for pH, Alkalinity, Calcium (Ca^{+2}), Electrical Conductivity (EC), Magnesium (Mg^{+2}),Chloride (Cl^{-}), Sulfate (SO_4), Total Dissolved Solids (TDS), Sodium (Na^{+}), Potassium (K^{+}), Bicarbonate (HCO_3), and Carbonate (Co_3^{-2}),the study results show that two of these WTPs were good for irrigation which was taken the raw water from Sweet Water Canal(SWC) and the otherswerebad water quality because they depend on Shatt Al- Arab River as a source of raw water.

AL Saad and Hamdan [8] 2017 studied the water quality for nine WTPs in Basrah province during the year 2017 and concluded that the quality of the water was not within the allowable limits of drinking and irrigation usage. Almuktar et al. [9] 2018 studied eight WTPs (seven of them were near to Shatt Al Arab River and were taken the raw water directly from this river and the last one was far away from Shatt Al-Arab River and received the water from another source which is SWC).The study includes the assessment of water quality for raw and treated water based on twelvephysicochemicalparameters (pH, EC, TDS, K^{+}, Na^{+}, Mg^{+2}, Ca^{+2}, alkalinity, TH, Cl^{-}, Turbidity, and SO_4^{-2}).Their study concluded that most of these stations were unsatisfactory for drinking purposes, except the Shuaiba Old (which receivedthe raw water from SWC), which indicates an acceptable water quality for all seasons. Water quality for other WTPs ranged from unsuitable to poor.

Mahdi and Hamdan, 2021[10],studied water quality for eight WTPs by testing twelve parameters which were (pH, Turbidity, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Calcium(Ca^{+2}), Magnesium (Mg^{+2}), Total Hardness (TH), Potassium (K^{+}), Sodium (Na^{+}), SulpHates (SO_4^{-2}), Chloride (Cl^{-}), and Alkalinity(Alk.)).From the Influent of eight WTPs for the period from (2011, 2015, and 2019) and by using the National Sanitation Foundation Water Quality Index (NSFWQI) method, the results of the study detected that the water quality varies as poor, very poor, or unsuitable category for all stations in all the years under study. In Iraq, there are rare researches that used the Canadian model to evaluate water quality.for example, Al-Janabi et al., 2015[11], studied CCME WQI on the Tigris River within Baghdad city they were tested twelve parameters which were Lead, Iron, Zinc, Manganese, Turbidity, pH, Dissolved Oxygen, Water Temperature, Phosphate, Ammonia, Nitrate, and Nitrite, they tested the parameters in 3 stations in Baghdad city and their results show thatstation number 3 which was located in the south of Baghdad was more polluted than others. The calculated WQI values were between marginal in stations 1, and 2 to poor in station 3. Jahad, 2014[12], studied CCME WQI in Babylon, he took four stations on the Euphrates river and Hilla river which were Euphrates River/AL-Musiab, Euphrates River/Kifil, HillaRiver/ Hindia barrage and Hilla river/Hilla.The study results show that the quality of water was fair in Euphrates andHilla river but there are a deterioration of water quality downstream Al-Kifil station that located in Euphrates river. Buhlool et al., 2014[13] studied CCME WQI,where they tested water quality parameters of EC, pH, Bicarbonate, Chloride, Boron, Lead, Iron, Cadmium, and Copper in four stations located along Euphrates river in Al-Nassiryia city. The field study period was extended from summer 2012 up to spring 2013. Based on the results obtained from the WQI, the water quality for irrigation purposes in Euphrates River has Moderate quality. Al-Fanharawi, 2016[14], studied CCME WQI in three stations in Al-Rumaytha River (Muthana governorate). He tested the water samples monthly during the period from November 2014 to October 2015. He tested 9 parameters which include, Air temperatures, EC, TDS, pH , Do, TH , K^{+}, Na^{+}, and Tur.. Based on the results obtained from WQI, the water quality of Al- Rumaytha was very bad or Poor and does not fit for drinking purposes in all study sites. He concluded that the sources of urban, industrial, and agricultural wastes were the main reason forthe deterioration. In this study, WQI has been used based on the method approved by the Canadian Council of Ministers for the Environment (CCME). The method allows measurements of frequency and extent to which parameters exceed the standards for each WTP outlet; therefore, the index reflects water quality for both health and acceptability, as defined by the

World Health Organization (WHO)[15]. The index is calculated on a seasonal (dry and wet season) basis resulting in an overall rating for each station. This will allow a Spatio-temporal evaluation of water quality. This study aims to evaluate some of the main WTP's quality in Basrah city, using the CCME model where rare studies are using this type of WQI for water quality evaluation.

2. Materials and methods

STUDY AREA

Shatt Al-Arab River (which is located between 30º59´ to 30º27´N latitude and 47º26´ to 48º4´E longitude) is considered the main source of raw water with a discharge ranging between 25 and 75 m^3/s in upstream of the river and feeds most of the WTPs that located near to it [9]. SWC was constructed as a temporary source of water in the late 1990s to supply freshwater quality to Basrah province, recently it is considered a very important source of low levels of TDS for the raw water of all the WTPs that are far away from Shatt Al- Arab River and some of the WTPs that located near to it. Ten main WTPs in Basrah province were selected for this study, which was Jubyla(1), Khor Al Zubair, Al- Shaibah, AlmahkalAljadeed, Hay Al-Hussain, Al Asmaei, Al Garma (1), Al Abass, Al Madena Al Riadia, and Mhaijran as shown in Fig. (1), these WTPs have been chosen at different places in Basrah province and feed about 80 % of Basrah city center.

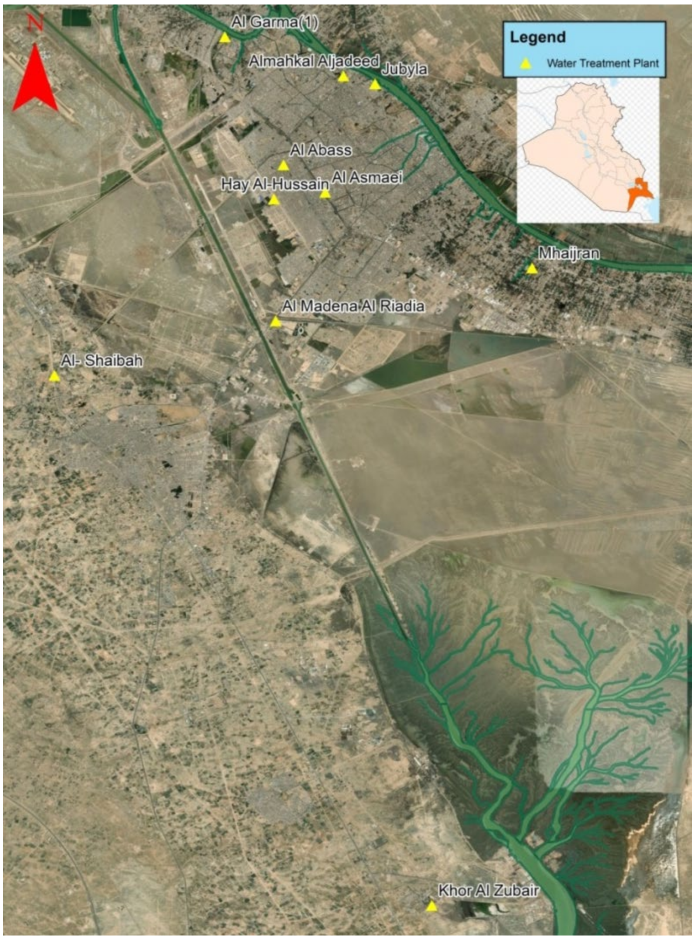

Figure 1 Location of the WTP's on Shatt Al Arab River

Application of CCME WQI

WQI is one of the most effective tools to connect information on water quality to interested residents and policymakers. WQI is a significant parameter to evaluate and manage surface water /groundwater. The objective of the WQI is to transform complicated water quality data into reasonable and applicable information for the public [16]. CCME WQI indicates the water quality in terms of an index number, which represents the overall water quality for any intended use. It is defined as a classification that reflects the combined effect of different water quality parameters [17]. CCME WQI for the ten WTPs was calculated considering thirteen important physicochemicalparameters using IQS standards [18].The thirteen physicochemicalparameters for water samples were collected monthly from the WTPs during the period of 12 months extended from January 2019 up to December 2019 and the measured parameters were divided into two seasons (wet and dry). The physicochemicalparameters were analyzed for the following parameters, Turbidity (Turb.), Total hardness (TH), pH, Total dissolved solids (TDS), Total suspended solids (TSS), Chloride (Cl^-), Magnesium (Mg^{+2}), Sodium (Na^+), Potassium (K^+), Calcium (Ca^{+2}), Alkalinity (Alk.), Sulfate (So_4) and Electrical Conductivity (Ec).

CCME WQI INDEX CALCULATION

CCME WQI has been developed by the Canadian Council of Ministers of the Environment. It is defined by the following equation [19]:

$$CCME\ WQI = 100 - \left(\frac{\sqrt{F1^2+F2^2+F3^2}}{1.732}\right) \quad (1)$$

Where F1 is the scope that evaluates the degree by which the water quality objective is not satisfied, F2 is the percentage of failed tests, and F3 is the amplitude that represents the magnitude by which the failed test values do not satisfy their objectives. These factors are calculated using the following equations [14]:

$$\text{F1} = \left(\frac{\text{Number of faild variables}}{\text{Total number of variables}}\right) \times 100 \quad (2)$$

$$\text{F2} = \left(\frac{\text{Number of faild tests}}{\text{Total number of tests}}\right) \times 100 \quad (3)$$

$$\text{F3} = \frac{\text{NSE}}{0.01\text{NSE}+0.01} (4)$$

In Eq. (2), the variables indicate the water quality parameters considered in CCME WQI determination. In Eq. (3), NSE represents the normalized sum of excursions and it is obtained as;

$$NSE = \frac{\sum_{i=1}^{n} excursion1}{Total\ number\ of\ tests} (5)$$

An excursion is the number of times by which a value of water quality parameter is larger than (or less than, when the objective is a minimum) the objective. When the test value must not exceed the objective:

$$excursion1 = \left(\frac{Failed\ test\ value1}{Objective1}\right) - 1 \quad (6)$$

While, when the test value must not drop below the objective:

$$excursion1 = \left(\frac{Objective1}{Faild\ test\ value1}\right) - 1 \quad (7)$$

The above formulation gives CCME WQI value varies within the range (0-100), i.e., a numerical value to the status of water quality in the water body. The CCME WQI value is then used to find the rank of water quality by adopting the classification scheme shown in Table (1).

Table 1. CCME WQI classification schema [20]

Rank	CCME WQI value	description
Excellent	95-100	Water quality is completely secured with no pollution.
Good	80-94	Water quality is secured with only a slight degree of pollution.
Fair	65-79	Water quality is generally secured, but it is sometimes polluted.
Marginal	45-64	Water quality is commonly polluted.
Poor	0-44	Water quality is polluted all the time

3. Results and Discussion

The summary of average values of physicochemicalparameters during two seasons (wet and dry) and for all WTPs are listed in tables (2), and (3) respectively. Table (4) showed the Iraqi drinking water standards IQS (the guidelines). Fig. (2) show the distribution of water quality parameters in all WTPs during wet and dry seasons, from the figure it can be shown that K^+ was within the IQS standards for all WTPs except Mhaijran in the dry season. Na^+ was within the IQS standards for all WTPs except Jubyla(1), Khor Al Zubair, Al Garma (1), and Mhaijran. Turb. were within the IQS standards for all WTPs except Hay Al-Hussain in the dry season and Al Asmai in the wet and dry season. pH was within the IQS standards for all WTPs. Alk. is greater than the permissible limit during wet and dry for all the treatment plants except Al- Shaibah and Al Madena Al Riadia. Ec was not within the permissible limit for all WTPs except Al- Shaibah, Al Asmaei, and Al Madena Al Riadia in the dry season.Ca^{+2} was within the standards for all except Mhaijran, and TH was over the standards for all WTPs. Cl^- and TDS were within the standards for all WTPs except Jubyla(1), Khor Al Zubair, Al Garma (1), Mhaijran in the wet and dry season, and Hay Al-Hussain in the wet season only.SO_4 is greater than the permissible limit during wet and dry for all WTPs except Al- Shaibah in the wet and dry season and AlmahkalAljadeed, Al Asmaei, Al Abass, and Al Madena Al Riadia in the dry season. From fig. 2 it is clear that the average values of K^+, Na^+, Turb., Ec, TH, Ca^{+2}, and TSSin the dry season were greater than that in the wet season, while Alk., and TDS values were ranged randomly during wet and dry seasons. Also, Fig.(2)shows that the average values of pH in the wet season were always greater than that in the dry season.

Table2. Summary of average values of parameters during wet for the ten WTPs

Station	*K*	*Na*	*T.S.S*	*T.D.S*	*SO_4*	*Cl*	*Mg*	*Ca*	*T.H*	*Alk*	*E.C*	*pH*	*Turb*
Units	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*µs/cm*		*NTU*
Jubyla(1)	*6.4*	*232*	*60.5*	*1432.5*	*513.5*	*358*	*81.05*	*139*	*680*	*141*	*2338.5*	*7.4*	*6.4*
KhorAl Zubair	*6.1*	*209*	*41.2*	*1327*	*474*	*333*	*77.2*	*131.4*	*644*	*128*	*2188*	*7.5*	*4.4*
Al-Shaibah	*3.9*	*83*	*53*	*710.5*	*245*	*151*	*49.25*	*84*	*410.5*	*121.25*	*1180.5*	*7.75*	*5.8*
AlmakalAljadeed	*4.2*	*99*	*45*	*787.5*	*284.5*	*163*	*53.7*	*92*	*450*	*134*	*1295*	*7.7*	*4.8*
Hay Al-Hussain	*5.45*	*169*	*83.05*	*1118*	*397*	*264*	*66.65*	*114.5*	*559.5*	*139*	*1833.5*	*7.54*	*8.8*
Al Asmaei	*4.7*	*101.77*	*146.45*	*806.6*	*285.45*	*165.6*	*53.85*	*92.5*	*451.6*	*138.55*	*1331.1*	*7.65*	*16.55*
Al Garma(1)	*7.75*	*304*	*35.5*	*1780.5*	*642*	*468*	*96*	*165.5*	*810.5*	*136*	*2892*	*7.35*	*3.8*
Al Abbas	*4.18*	*86.5*	*33.25*	*726.5*	*259.5*	*143.5*	*50.5*	*87.625*	*425.5*	*139*	*1183.5*	*7.75*	*3.7*
Al Madena	*3.75*	*89.5*	*41.5*	*746.5*	*263*	*157.5*	*49*	*84*	*411.5*	*106.5*	*1221*	*7.8*	*4.45*
Mhaijran	*11.5*	*891.5*	*62*	*3969.*	*1164*	*1350*	*161.*	*270.5*	*1341*	*152.5*	*6230.*	*7.0*	*7.07*

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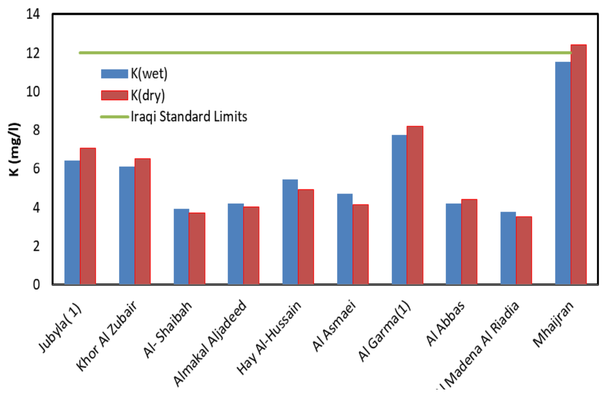
Table3. Summary of average values of parameters during dry for the ten WTPs

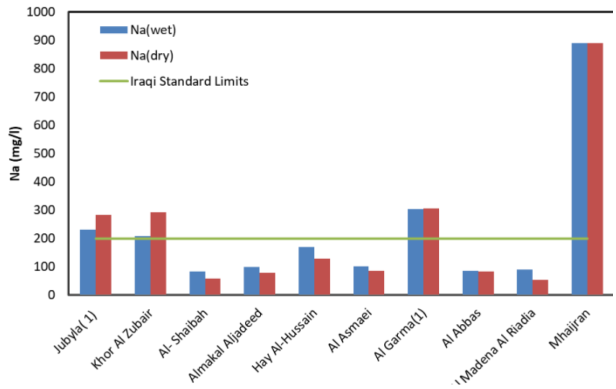
Station	*K*	*Na*	*T.S.S*	*T.D.S*	*SO_4*	*Cl*	*Mg*	*Ca*	*T.H*	*Alk*	*E.C*	*pH*	*Turb.*
Units	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*µs/cm*		*NTU*
Jubyla(1)	*7.05*	*283.5*	*81.5*	*1689*	*607*	*439*	*92.85*	*157.25*	*772.5*	*135.5*	*2726.5*	*7.3*	*8.7*
KhorAl Zubair	*6.5*	*293*	*90*	*1637*	*521.5*	*465.5*	*84*	*142*	*698*	*134*	*2628*	*7.2*	*10*
Al- Shaibah	*3.7*	*58*	*65*	*538*	*165*	*120*	*38.5*	*68*	*328*	*110*	*880.5*	*7.3*	*6.8*
Almakalljadeed	*4*	*78.5*	*89.3*	*614*	*186.15*	*140.65*	*42*	*71.8*	*351.8*	*127.3*	*1014.5*	*7.45*	*9.7*
Hay Al-Hussain	*4.9*	*128*	*112.8*	*843.2*	*264.4*	*206*	*51.7*	*86.8*	*428.4*	*136.6*	*1383*	*7.525*	*12.75*
Al smaei	*4.15*	*85.65*	*138.3*	*634.4*	*191.9*	*137.9*	*42.85*	*70.75*	*352.3*	*142.25*	*1046*	*7.65*	*18.2*
Al Garma(1)	*8.2*	*307.5*	*35*	*1779*	*627.5*	*476.5*	*95.5*	*160*	*795.5*	*135.5*	*2865*	*7.35*	*3.85*
Al Abbas	*4.4*	*84.5*	*60*	*628.5*	*182*	*144*	*41.5*	*71*	*348*	*132*	*1044.5*	*7.6*	*6.7*
Al Madena	*3.5*	*55*	*49*	*517*	*165*	*119*	*38*	*69*	*329*	*105*	*855*	*7.4*	*5*
Mhaijran	*12.4*	*890*	*64.5*	*4021*	*1208.5*	*1345*	*166*	*280.5*	*1383.5*	*158*	*6277.5*	*7.035*	*7.565*

Table4. Iraqi drinking water standards[18]

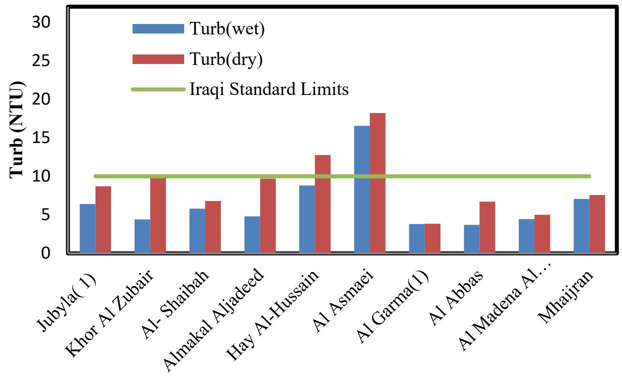
parameter	Measurement unit	Iraqi standards values
Turbidity (Turb.)	NTU	10
Total hardness(T.H.)	Mg/l	300
PH	-----	6.5-8.5
Total dissolved solids (T.D.S.)	Mg/l	1000
Total suspended solids (T.S.S.)	Mg/l	120
Chloride(cl^-)	Mg/l	250
Magnesium(Mg^{+2})	Mg/l	50
Sodium(Na^+)	Mg/l	200
Potassium (K^+)	Mg/l	12
Sulfate(SO_4^{-2})	Mg/l	250
Calcium (Ca^{+2})	Mg/l	200
Alkalinity (Alk.)	Mg/l	120
Electrical Conductivity(E.C.)	µs/cm	1000



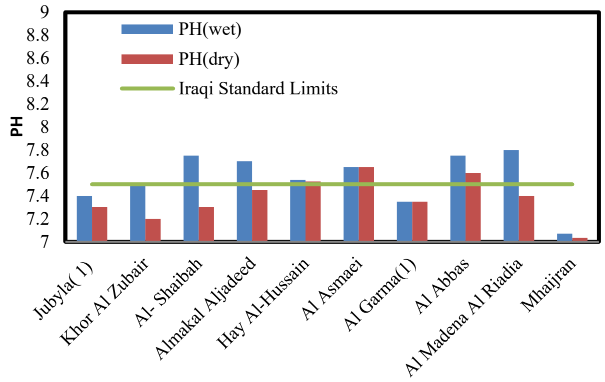
(a)Potassium



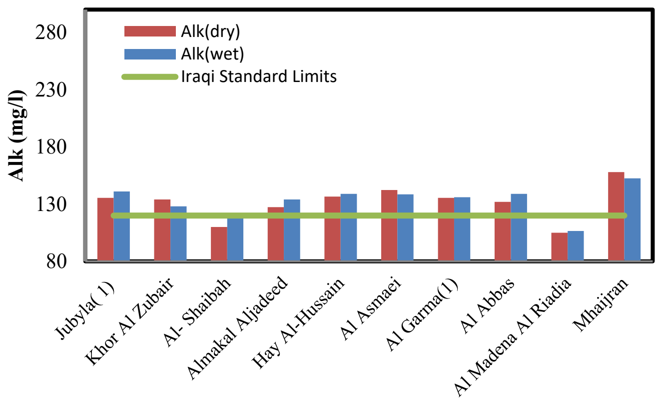
(b) Sodium



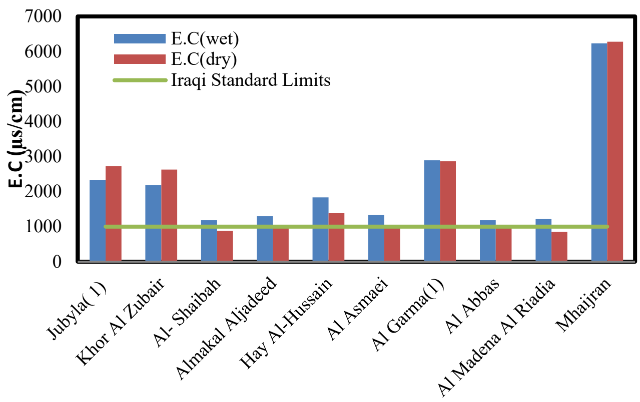
(c) Turbidity



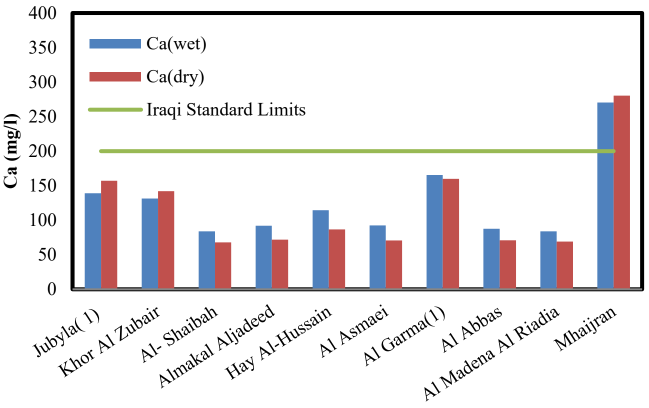
(d) Ph



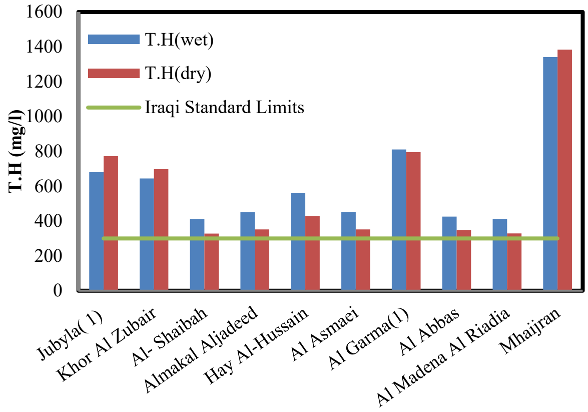
(e)Alkalinity



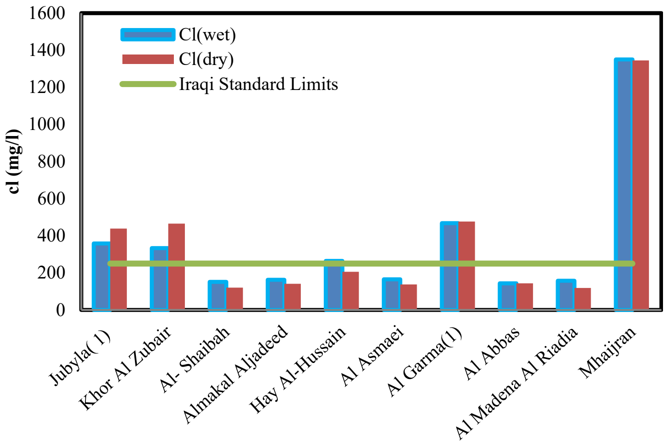
(f) Electrical Conductivity



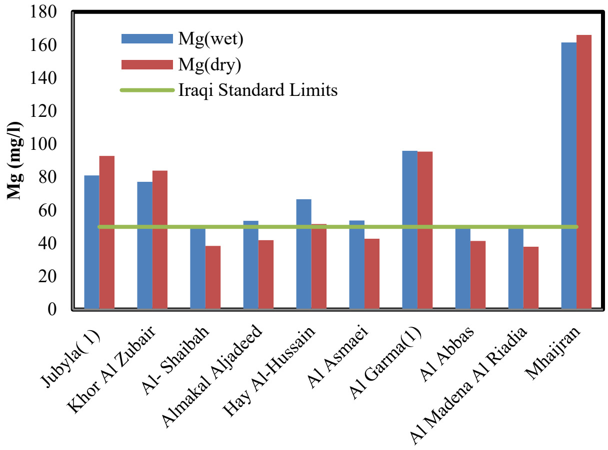
(g) Calcium



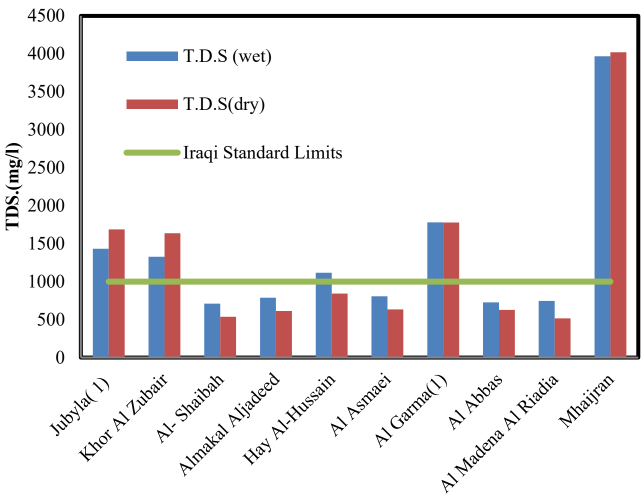
(h) Total hardness



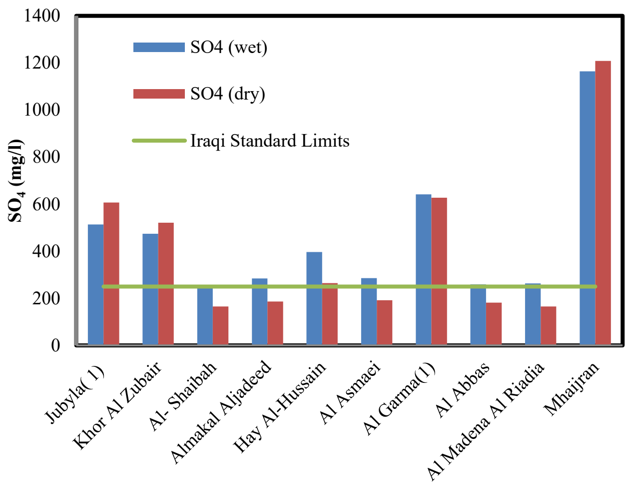
(i) Chloride



(j) Magnesium



(k) Total dissolved solids



(l) Sulfate

***FIGURE 2.** Distribution of the parameters in the WTPs during wet and dry seasons.*

Values in Table (2) and Table (3). have been introduced in the seven equations to calculate the CCME WQI index, table 4 shows the Iraqi drinking water standards used in the formulation. The result values of F1, F2, and F3 for each plant are shown in Table(5) during the wet and dry seasons respectively. Table(6) provides a detailed insight into the water quality situation at the selected sampling stations and summarizes the calculation of WQIs.

Table **5.** Values of F1, F2, and F3 during the wet and dry periods

	Wet period			**Dry period**		
Plant	F1	F2	F3	F1	F2	F3
Jubyla(1)	76.9	43.1	31.4	92.3	63.1	39.2
Khor Al Zubair	61.5	61.5	25.9	61.5	61.5	34.4
Al- Shaibah	61.5	38.5	5.2	15.4	7.7	0.8
AlmahkalAljadeed	46.2	38.5	8.1	61.5	21.8	5
Hay Alhussain	64.6	55.6	20.7	64.6	48.5	11.2
Al Asmaei	61.5	50.9	15.6	46.2	39.9	10
Al Garma(1)	84.6	60.4	41	84.6	59.9	47.4
Al Abass	46.2	34.1	6.7	53.9	28.6	4.1
Al Madena Al Riadia	30.8	26.9	3.5	7.7	7.7	9
Mhaijran	69	69	66.7	76.9	76.9	97.2

Table 6. Summary of CCME WQI calculations used at Jubayla (1) station in wet season.

Stations	Number of failed variables	Number of failed tests	Total number of variable	Total numbe r of tests	F1	F2	NSE	F3	CCME WQI
Jubayla (1) (Wet season)	**10**	**84**	**13**	**195**	**76.9**	**43.1**	**0.457**	**31.4**	**45.98**
Jubayla (1) (Dry season)	**12**	**123**	**13**	**195**	**92.3**	**63.1**	**0.65**	**39.2**	**31.6**

Depend on the values in Table (5), it was calculated the value of WQI using CCME WQI according to [19]. Table (7) and Fig. 3 showed that the highest value of WQI was 76.3 in the Al Madena Al Riadiaplant and the lowest value was 31.76in the Mhaijran plant during the wet season, whereas the highest value of the WQI index was 91.9 in Al Madena Al Riadiaplant and the lowest value was 21.2 in Mhaijranplant in the dry season (See Table (8) and Fig.4).

Table 7. **Values of CCME WQI of WTP during the wet period**

Plant	**CCMEWQI(wet)**	**Assessment Result**
Jubyla(1)	45.98	Poor
Khor Al Zubair	47.6	Marginal
Al- Shaibah	58	Marginal
AlmahkalAljadeed	65	Fair
Hay Al-Hussain	49.4	Marginal
Al Asmaei	53	Marginal
Al Garma(1)	35.5	Poor
Al Abass	66.6	Fair
Al Madena Al Riadia	76.3	Fair
Mhaijran	31.76	Poor

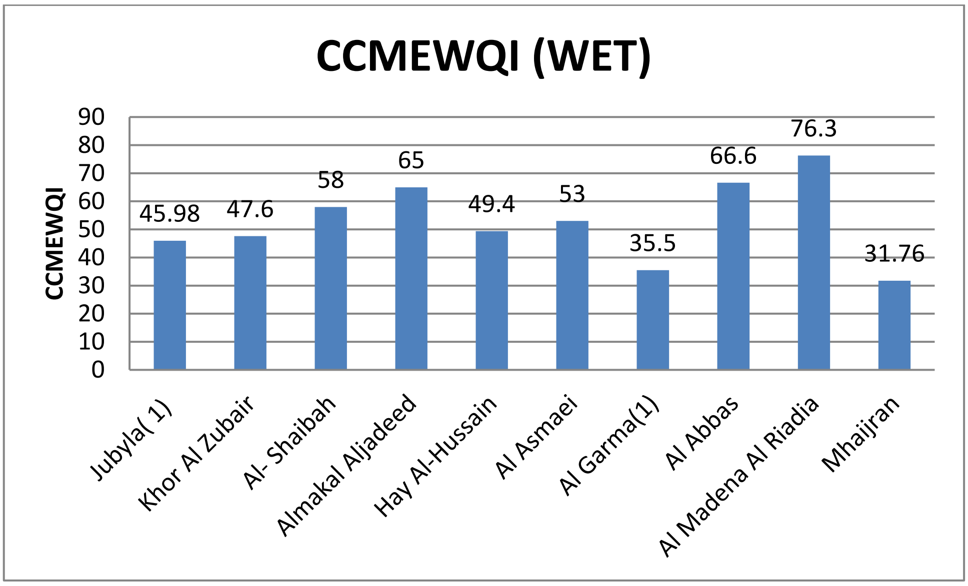


FIGURE 3. Values of CCME WQI index in the plants during the wet period.

TABLE8. Values of CCME WQI of WTP duringthe dry period

Plant	CCMEWQI(dry)	Assessment Result
Jubyla(1)	31.6	Poor
Khor Al Zubair	46	Marginal
Al- Shaibah	90.1	Good
AlmahkalAljadeed	62.2	Marginal
Hay Alhussain	52.9	Marginal
Al Asmaei	64.3	Marginal
Al Garma(1)	34.2	Poor
Al Abass	64.7	Marginal
Al Madena Al Riadia	91.9	Good
Mhaijran	21.2	Poor

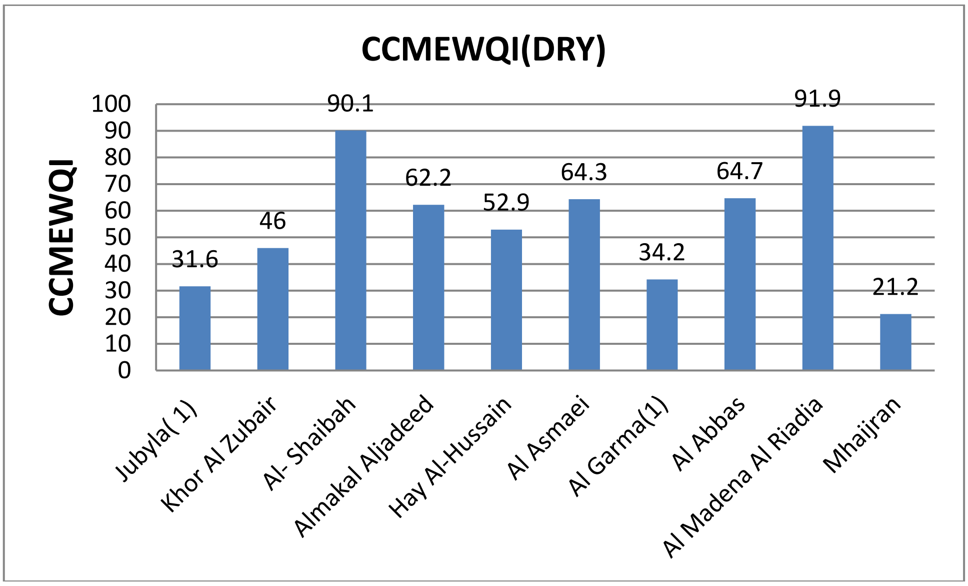


FIGURE 4 . Values of CCME WQI index in the plants during the dry period

By comparing the values in Fig. 5 with Table (1)it's found that the water quality in Mhaijran plant during the wet and dry season was within poor class and considered as non-suitable for drinking usages and this may be due to several reasons, such as dischargedthe pollutants into Shatt Al-Arab River from, agricultural drainages, and industrial process pollutants, whereas the water quality for Al-Shaibah and Al Madena Al Riadia were in good class in the dry season but were marginal for Al-Shaibah and fair in Al Madena Al Riadia in the wet season, Al Abass plant was nearly fair along the year but the others were ranged from marginal to poor rank. Also from the results, it can be shown that the plants that are near to Shatt Al-Arab river and receive the raw water from it such as Jubyla(1), Al Garma(1), and Mhaijran have poor water quality in both wet and dry season whereas others which receive the raw water from SWC have fair to marginal water quality in the dry season and good to marginal in the wet season. Herein it can be concluded that Shatt Al-Arab river does not fit the standards and was unsuitable as a source of raw water and might be replaced by SWC as a reasonable source of raw water.

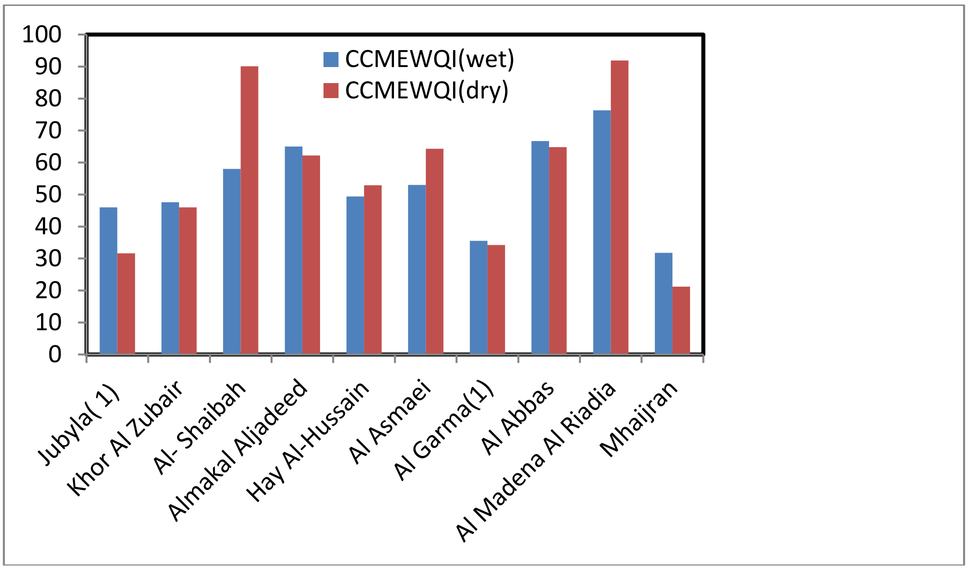


FIGURE 5. Comparison between the values of CCMEWQI in the plants during the wet and dry season

4. Conclusion

The results showed that the average values for K^+, T.S.S during wet and dry were within the permissible limit of IQS for all WTP while the average values for TH and EC were not within the permissible limit of IQS for all WTPs during the wet and dry season. Alk. was greater than the permissible limit during wet and dry for all WTPs except Al- Shaibah and Al Madena Al Riadia.

Also from the distribution of water quality parameters in the WTPs, it is noticed that the average values of K^+, Na^+, Turb., Ec, TH, Ca^{+2}, and TSS in the dry season were greater than that in the wet season, while Alk., and TDS ranges randomly during wet and dry seasons. Also, the average values of pH in the wet season were always greater than that in the dry season.The results of CCMEWQI indicated that the quality of water was poor in Mhaijran and considered non-suitable for drinking purposes and this may be due to several reasons, such as the pour of pollutants into Shatt Al-Arab River from domestic sewage, agricultural runoff, and industrial process pollutants, while water quality for the plants(Al- Shaibah and Al Madena Al Riadia) were in good class in the dry season but Al-Shaibah was marginal and Al Madena Al Riadia was fair in the wet season, Al Abass were nearly fair in the dry and wet season whereas the others were ranged from marginal to poor rank.The results showed also that the plants that are near to Shatt Al-Arab river and receive the raw water from it such as Jubyla(1), Al Garma(1), and Mhaijran have poor water quality in both wet and dry seasons whereas the other which receive the raw water from SWC have a fair to marginal water quality in the dry season and good to marginal in wet season, so it is better to replace the source of raw waterby SWC only as a reasonable source of raw water.

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