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Assessment of Physico-chemical Properties of Surface Water Quality by using CCME-WQI in Afzalpur Taluk, Karnataka, India

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ABSTRACT

In the current study, the Canadian Council of Ministers of the Environment (CCME) standards were used to evaluate the water quality index (WQI) of surface water from the Afzalpur taluk to determine the influence on drinking reasons. In the study area, surface water samples were taken during the post-monsoon of 2020 and the pre-monsoon of 2021. Standard techniques were used to evaluate the physico-chemical parameters, which included temperature, pH, EC, BOD, turbidity, total hardness (TH), Ca^{2+}, Mg^{2+}, SO^{-}_{4}, Cl^{-}, Pb^{2+}, Cr^{2+}, As^{3+}, Cu^{2+}, Zn^{2+}, and Fe^{2+}. Removing a ranking feature from the CCME WQI index classification scheme resulted in the modification (Frequency). The scope, or the number of variables that do not satisfy water quality standards, and the amplitude, or the degree to which the objectives are not reached, are the two components that make up the Modify Index. The index yields a result between 0 and 100 (best water quality) (worst water quality). Utilizing data gathered from the research region of Afzalpur Taluk, the redesigned index is verified. The original Canadian water quality index and the modified index are contrasted. The results for both indexes during the study period produced a quality class of "Fair," which is equivalent to very good water quality. According to the sensitivity analysis, the modified index model is more accurate than the Canadian index model. The updated index increases the indicator's susceptibility to ecosystem sensitivity because it does not integrate many variables into a single result and can be used to communicate water quality issues to the general public. Created a tiered strategy for the performance of the CCME WQI as a practical means of presenting available physical, organic, and chemical information after successfully testing its application on a few chosen data sets.

Key words: CCME-WQI, Surface water, Physico-chemical parameters, Correlation

Significant quantities of hazardous, difficult to decompose, and persistent pollutants have been produced by industrial, agricultural, and municipal activities as a result of population growth and rapid industrialization. Different water quality indices are employed to clearly represent water quality; these indices aim to assign a single value to the water quality of a source, thereby simplifying expression and making it possible to easily interpret vast amounts of data [1]. The British Columbia Ministry of Environment, Lands and Parks created the formula for the CCME Water Quality Index (1.0), which Alberta Environment updated. The index incorporates three components: scope, frequency, and amplitude [2]. Tested the activity of the CCME WQI in capturing skilled assessments of drinking water quality, with a panel of drinking water quality experts. Hurley *et al*. [3], recommend a modified index calculation procedure to accommodate parameters measured at different frequencies. The advantages are its capability to explain measurements of a variety of variables in a single number, but the loss of interactions among variables, the lack of portability of the index to different ecosystem types and the sensitivity of the results [4]. Select the CCME WQI as the most suitable depending on the possibility of modulating the objectives to be met by each variable for the specific end use as well as its flexibility in selecting parameters. A panel of drinking water quality specialists evaluated the CCME WQI's performance in gathering expert judgments of water quality. A modified index computation process is suggested by Hurley *et al*. [3] to account for parameters recorded at various frequency. Advantages include its capacity to describe measurements of a range of variables in a single number, but disadvantages include the loss of interactions between variables, the index's inability

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to be applied to diverse types of ecosystems, and the results' sensitivity [4]. Depending on the ability to modify the goals that must be attained by each variable for the particular end use, as well as its flexibility in picking parameters, choose the CCME WQI as the most appropriate.

Finally, stratify the CCME WQI to the third simulation dataset design, which includes eutrophication, episodes of urban wastewater discharge, and fish risk [5]. To assess and categorise water quality globally, many different sets of water quality indexes have been created [6-7]. According to Dascalescu *et al*. [8] suggested index, the original Canadian water quality index is contrasted with the weighted index utilizing historical data (Prut River during the months of February through December 2012) gathered by the online monitoring system. for the investigational period. The findings revealed that the weighted index model has a higher accuracy as indicated by the sensitivity analysis. The development of the phased approach for computing water quality indices, the justification for changing the current CCME WQI index categorization plan, and the testing methodology are all described in Khan *et al*. [9] application of the Canadian Council of Ministers of the Environment Water Quality Index (CCME WQI). Talks about the difficulties of using the CCME WQI as well. The benefits and drawbacks of this application were also explored. The goal of this project is to create a modified version of the CCME-WQI that is specifically tailored to monitoring, in order to evaluate and categorize the water as a function of date and station (don't lose information by merging several data to a single index value).

MATERIALS AND METHODS

The study area Afzalpur Taluk is located in Kalaburagi district of Karnataka, India. The area located at N Latitudes 17° 03' 30" – 17° 22' 40" and E Longitudes 76°12'45" – 76°42'35". The Bhima River forms entire southern boundary of the area. 1050 sq.km covering total geographical area, 735 mm (DSO 2021) is average rainfall and the average land elevation is in the range of 400 to 520 m. Main occupation of the people of this area is agriculture and they cultivate Jowar, pulses, cotton, and sugarcane. The climate in this area is arid and semi-arid. The temperature ranges from 30 to 46 °C during summer, during winter 28 to 35 °C monsoon occurs during June to October. In the month of April and May water scarcity is occurred due to over exploitation of groundwater and growth of population. The study area map shows in the (Fig 1).

Suggested model

According to Eq. (1), the original index [10] was proposed after taking into account the index calculation results of the method suggested by the CCME.

$$\text{CCME-WQI} = 100 - \frac{\sqrt{Fms2+Fma2}}{1.414} \quad ...1$$

When the factors Fms - scope, and Fma - amplitude are present, the formulas shown in Table are used to specify both the original and the aforesaid factors (1).

The ratio of the number of failed variables that do not fulfil the quality objectives to the total number of variables is used to determine the factor Fms (scope).

When calculating the normalized sum of excursions, the amplitude factor Fma takes each variable's significance factor into account (nse). In this way, the excursion symbolizes a changeable value to an objective that failed. If a parameter has the potential to significantly affect water quality, it will be more helpful in causing the index value to fall.

Table 1 Formulas for the calculation of the modify quality index compared with CCME-WQI [10]

Original CCME-WQI formula	Modify formula (this study)
$\text{F1} = \frac{Number\ of\ failed\ variable}{Total\ number\ of\ variable} \times 100$	$\text{Fms} = \frac{Number\ of\ failed\ variable}{N\_constant} \times 100$
$\text{F2} = \frac{Number\ of\ failed\ test}{Total\ number\ of\ test} \times 100$	There is no need to calculate the frequency value because we are dealing with the prevention of the collection of interactions between variables for a number of months (to obtain a more accurate result and credibility and the lack of confusion between the data thus the loss of evidence and interactions between them)
$\text{Excrusion} = \frac{failed\ test\ value}{Objective} - 1$	$\text{Excrusion} = \frac{failed\ variable\ value}{Objective} - 1$
$\text{nse} = \frac{\Sigma\ excrusion}{number\ of\ test} - 1$	$\text{nse} = \frac{\Sigma\ excrusion}{N\_constant} - 1$
$\text{F3} = \frac{nse}{0.01\ nse + 0.01}$	$\text{Fma} = \frac{nse}{0.01\ nse + 0.01}$

Where;

N _constant– total number of variables; nse _ normalized sum of excursions; Fms_modify scope; Fma_modify amplitude.

Collection data

Utilizing the data gathered from the study area, the modified model for calculating the water quality index was used. The temperature, Temp, pH, EC, BOD, Turbidity, Total Hardness (TH), Ca^{2+}, Mg^{2+}, SO^{-}_{4}, Cl^{-}, Pb^{2+}, Cr^{2+}, As^{3+}, Cu^{2+}, Zn^{2+}, and Fe^{2} among 16 other physical and chemical characteristics that describe the quality of the water. According to Table, water samples were taken from the study region throughout the two seasons of post-monsoon 2020 and pre-monsoon 2021. (2). These samples (10 sampling locations) were collected at a depth of 20 cm below the water's surface and kept in HDPE bottles for laboratory analysis, but the parameters (TDS, EC, and pH) were assessed on-site using (pH-meter) devices.

Table 2 Shows geo-chemical properties of the surface water sampling sites among post monsoon 2020

S. No.	pH	EC µs/cm	TDS mg/L	Cl^- mg/L	Ca^{++} mg/L	Mg^{++} mg/L	TH mg/L	SO^{-2}_4 mg/L	Pb^{+2} mg/L	Cr^+ mg/L	As^{+3} mg/L	Cu^+ mg/L	Zn^{+2} mg/L	Fe^{+2} mg/L	Temp °C
S_1	7.5	882	**512**	69.6	68.3	137.5	**354**	82.3	0.007	0.011	0.006	0.004	0.004	0.0051	28
S_2	7.4	556	324	37.4	88.7	87.5	**324**	41.5	0.005	0.005	0.006	0.004	0.003	0.0033	27
S_3	8.1	928	**536**	83.5	121.1	124	**374**	85.6	0.004	0.005	0.005	0.004	0.004	0.0007	26
S_4	7.6	971	**548**	94.6	63.02	154.3	**354**	87.4	0.005	0.006	0.004	0.004	0.004	0.0022	27
S_5	7.5	1231	**637**	85.8	69.5	146.2	288	63.7	0.003	0.004	0.005	0.005	0.004	0.0021	28
S_6	7.3	278	182	21.5	41.5	77.4	186	10.4	0.004	0.004	0.007	0.004	0.003	0.011	27
S_7	7.6	964	**539**	92.6	59.7	68.5	234	75.5	0.004	0.006	0.005	0.004	0.003	0.009	28
S_8	8.1	332	185	22.4	65.8	53.5	212	15.4	0.004	0.006	0.005	0.004	0.003	0.0038	26
S_9	8.1	967	**561**	76.5	59.05	155.3	**342**	87.4	0.003	0.004	0.004	0.004	0.004	0.0022	26
S_{10}	7.5	984	**635**	86.3	72.3	158.3	**322**	88.1	0.004	0.005	0.005	0.005	0.004	0.0028	25

Bolded value does not meet the objective

Table 3 Shows geo-chemical properties of the surface water sampling sites among pre monsoon 2021

S. No.	pH	EC µs/cm	TDS mg/L	Cl^- mg/L	Ca^{++} mg/L	Mg^{++} mg/L	TH mg/L	SO^-_4 mg/L	Pb mg/L	Cr mg/L	As mg/L	Cu mg/L	Zn mg/L	Fe mg/L	Temp °C
1	7.4	945.4	**542**	78.6	67.3	64.4	**301**	82.3	0.003	0.004	0.004	0.004	0.002	0.002	38
2	7.3	543.5	345	44.5	86.3	86.6	**328**	37.8	0.003	0.003	0.004	0.003	0.004	0.004	39
3	8.3	954.4	**562**	92.1	61.8	143.4	**311**	76.8	0.006	0.005	0.005	0.004	0.005	0.004	39
4	8.2	164	123	36.2	37.6	23.3	**320**	11.1	0.005	0.003	0.005	0.003	0.003	0.005	38
5	7.5	1231	**652**	111.7	68.6	35.2	202	63.6	0.005	0.003	0.005	0.003	0.005	0.004	39
6	7.2	952.3	**542**	23.3	65.3	33.5	178	93.1	0.005	0.003	0.003	0.003	0.005	0.003	40
7	7.5	1120	**583**	71.5	69.5	41.3	162	42.2	0.005	0.003	0.003	0.003	0.005	0.003	41
8	7.5	872	464	98.5	70.6	32.1	134	78.2	0.005	0.003	0.003	0.004	0.005	0.003	41
9	7.5	921	**523**	92.5	78.3	35.3	**353**	81.2	0.005	0.003	0.004	0.004	0.004	0.002	42
10	7.4	1123	**621**	120.2	77.3	44.3	251	85.5	0.004	0.003	0.005	0.004	0.005	0.004	41

Bolded value does not meet the objective

Water quality classification

Scores between (0-100) are considered to be of the lowest and outstanding quality, respectively, after working on the index generated model. Six quality classes were established to categorize the water, each with a related criterion (Table 3). Classification of water quality took into account the information published in the literature [11].

Table 4 Classification of quality modify index

Classification	Range	Explanation
Excellent	95 – 100	No necessary treatment
Very good water quality	94 – 90	Requires a standard physical treatment
Good water quality	89 – 80	Requires a conventional physical and chemical treatment process:
Fair water quality	79 – 65	Requires an advanced treatment
Poor water quality	65 – 45	Polluted water
Very poor water quality	44 – 0	Not usable for drinking purposes

RESULTS AND DISCUSSION

According to Table, the water quality index was calculated using information gathered from rivers, lakes, and dams in the study area during the post- and pre-monsoon seasons (2). Both the original CCME-WQI model and the modified version that was suggested in this study were used. The solution below for station 10 shows the variation of the CCME-WQI model in relation to changing the variation of the CCME-WQI model as a function of relative variation of measured quality parameters.

$$F_1 = \frac{2}{16} \times 100 = 12.5$$

$$F_2 = \frac{2}{32} \times 100 = 6.25$$

$$\text{Excursion} \frac{354}{300} - 1 = 0.18, etc..$$

$$\text{nse} \frac{0.18+5.02}{32} = 0.067$$

$$F_3 = \frac{0.067}{0.01 \times 0.067 + 0.01} = 6.7$$

$$\text{CCME –WQI} = 100 - \frac{\sqrt{(20 \times 20)+(2.9 \times 2.9)+(2.8 \times 2.8)}}{1.732}$$

$$= 76.32$$

The water quality at various sampling sites would be rated as "Moderate" based on data for two seasons post-monsoon 2020 and pre-monsoon 2021, according to the category ranges suggested by the original index [10], but using the modified index as an example, we choose data for sample number 10.

$$Fms = \frac{0}{7} \times 100 = 0$$

Excursion = 0

nse=0

$$Fma = \frac{0}{0.01 \times 0 + 0.01} = 0$$

$$\text{CCME}-\text{WQI}_m = 100 - \frac{\sqrt{(10\times10)+(0\times0)}}{1.414} = 100$$

The water quality at this river stretch would be regarded as "Excellent" based on the category ranges indicated modify index. Because it can sum together observations of several factors, the original index (CCME-WQI) has a negative trend that, as can be seen from the graph above, is related to a decline in water quality. Secondly, information is lost when many variables are combined with different dates to create a single index value, and variable interactions are also lost. Consequently, the results are sensitive and the index cannot be applied to other ecological types.

Table 5 CCME RESULT Calculated CCME-WQI of analyzed samples in the study area of post-monsoon 2020

Sample	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	S_9	S_{10}
F_1: Scope	26.666	26.666	33.333	20	20	13.333	20	20	20	13.333
F_2: Frequency	26.666	26.666	33.333	20	20	13.333	20	20	20	13.333
F_3: Amplitude	29.566	49.676	52.193	51.187	21.204	54.179	50.022	50.413	55.170	47.527
CCME-WQI	73.95	46.59	45.32	65.04	64.59	67.06	71.08	75.13	76.38	63.22
Ranking	Fair	Marginal	Marginal	Fair	Fair	Fair	Fair	Fair	Fair	Fair

Table 6 Calculated CCME-WQI of analyzed samples in the study area of pre-monsoon 2021

Sample	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	S_9	S_{10}
F_1: Scope	20	26.666	20	6.666	13.333	13.333	20	13.333	0.2666	13.333
F_2: Frequency	20	26.666	20	6.666	13.333	13.333	20	13.333	0.2666	13.333
F_3: Amplitude	39.430	18.174	29.459	4.092	18.032	19.464	35.335	39.271	0.802	41.890
CCME-WQI	66.11	44.18	80.48	85.23	80.49	84.04	80.09	67.08	63.95	71.43
Ranking	Fair	Fair	Fair	Good	Good	Good	Fair	Fair	Excellent	Fair

Table 7 Correlation matrix for different water quality parameters in the study area of post-monsoon 2020

	Temp. (°C)	pH	EC µs/cm	TH mg/L	Turbid NTU	BOD mg/L	Ca^{2+} mg/L	Mg^{2+} mg/L	Cl^- mg/L	SO^{-4} mg/L	As^{3+} mg/L	Cu^+ mg/L	Zn^{2+} mg/L	Fe^{2+} mg/L	Pb^{2+} mg/L	Cr^+ mg/L
T	1															
pH	-0.819	1														
EC	0.172	0.170	1													
TH	-0.159	0.262	0.608	1												
Tu	-0.160	-0.091	-0.025	-0.359	1											
BO	-0.031	0.147	0.162	0.171	-0.615	1										
Ca	-0.259	0.351	0.236	0.605	-0.210	-0.330	1									
Mg	-0.172	0.236	0.750	0.764	-0.041	0.357	0.138	1								
Cl	0.101	0.221	0.944	0.593	-0.015	0.167	0.226	0.685	1							
SO	-0.055	0.337	0.871	0.797	0.246	0.357	0.326	0.775	0.925	1						
As	0.280	-0.590	-0.605	-0.446	-0.097	0.093	-0.135	-0.485	-0.652	-0.625	1					
Cu	-0.153	0.168	0.503	0.047	0.281	0.087	0.744	0.469	0.348	0.210	-0.114	1				
Zn	-0.166	0.350	0.763	0.780	-0.184	0.361	0.282	0.948	0.704	0.792	-0.515	0.408	1			
Fe	0.402	-0.545	-0.493	0.757	0.113	0.179	-0.643	-0.606	0.396	-0.504	0.644	-0.283	-0.667	1		
Pb	0.334	-0.367	-0.139	-0.308	-0.774	0.437	0.069	0.009	-0.075	0.105	0.354	-0.363	0.037	0.111	1	
Cr	0.375	-0.162	0.039	0.255	-0.924	0.615	0.007	0.033	0.077	0.226	0.163	-0.280	0.145	0.081	0.890	1

Table 8 Correlation matrix for different water quality parameters in the study area of post-monsoon 2021

	Temp. (°C)	pH	EC µs/cm	TH mg/L	Turbid NTU	BOD mg/L	Ca^{2+} mg/L	Mg^{2+} mg/L	Cl^- mg/L	SO^{-4} mg/L	As^{3+} mg/L	Cu^+ mg/L	Zn^{2+} mg/L	Fe^{2+} mg/L	Pb^{2+} mg/L	Cr^+ mg/L
T	1															
pH	-0.376	1														
EC	0.450	-0.414	1													
TH	-0.320	0.364	-0.476	1												
Tu	0.714	-0.311	0.307	-0.341	1											
BO	-0.122	-0.314	0.173	0.117	0.385	1										
Ca	0.515	-0.704	0.497	-0.034	0.321	0.026	1									
Mg	-0.314	0.411	0.041	0.403	-0.381	-0.208	0.153	1								
Cl	0.366	0.015	0.643	-0.109	0.511	0.175	0.347	0.083	1							
SO	0.402	-0.403	0.691	-0.217	0.431	0.491	0.435	0.110	0.422	1						
As	-0.435	0.559	-0.143	0.570	-0.405	-0.078	-0.278	0.297	0.348	-0.200	1					
Cu	0.301	0.114	0.270	0.212	0.642	0.522	0.228	0.287	0.627	0.624	0.120	1				
Zn	0.570	-0.097	0.519	-0.590	0.125	-0.634	0.292	0.045	0.298	0.271	-0.155	-0.099	1			
Fe	-0.427	0.525	-0.447	0.090	-0.529	-0.637	-0.439	0.128	-0.132	-0.603	0.604	-0.436	0.195	1		
Pb	0..263	0.569	0.141	-0.264	-0.027	-0.467	-0.441	0.040	0.117	0.051	0.052	0.116	0.564	0.190	1	
Cr	-0.400	0.564	0.108	0.334	-0.257	0.128	-0.176	0.855	0.161	0.252	0.319	0.468	-0.139	-0.340	0.204	1

Table 9 Statistical summary of physico-chemical data for analyzed samples in the study area

Parameter	Min	Max	Mean	SD	BIS (2012) (mg/L)
		Post-monsoon 2020			
Temperature (°C)	29	32	30.5	1.05	
pH	7.2	8.3	7.5	0.3675	6.5-8.5
EC (µS/cm)	164	1231	882.66	313.12	1500-3000
Turbidity (NTU)	5.3	72.3	28.72	23.3590	5
TH (mg/L)	134	353	254	79.19315	300
BOD (mg/L)	2.6	7.2	3.92	1.3323	5
Ca^{2+} (mg/L)	37.6	86.3	68.26	12.9380	75 - 200
Mg^{2+} (mg/L)	23.3	143.4	53.94	36.46018	30 - 100
Cl^- (mg/L)	23.3	120.2	76.91	32.72469	250 - 1000
SO_4^{2-} (mg/L)	11.1	93.1	65.18	26.35568	200 - 400
Pb^{2+} (mg/L)	0.003	0.006	0.0046	0.000966	0.05
Cr^{2+} (mg/L)	0.003	0.005	0.0033	0.00067	0.05
As^{2+} (mg/L)	0.003	0.005	0.0041	0.000876	0.01 – 0.05
Cu^{2+} (mg/L)	0.003	0.004	0.0035	0.000527	0.05 – 1.5
Zn^{2+} (mg/L)	0.002	0.005	0.0043	0.001059	5 – 15
Fe^{2+} (mg/L)	0.002	0.005	0.0034	0.00096	0.1 - 0.3
		Pre-monsoon 2021			
Temperature (°C)	38	41	39.5	1.0801	
pH	7.3	8.2	7.7	0.34383	6.5-8.5
EC (µS/cm)	278	1231	809.3	312.14	1500-3000
Turbidity (NTU)	8.7	81.2	57.96	19.70844	5
TH (mg/L)	186	374	299	66.13286	300
BOD (mg/L)	2.67	7.2	4.27	1.4131	5
Ca^{2+} (mg/L)	41.5	121.1	70.89	21.25477	75 – 200
Mg^{2+} (mg/L)	53.5	158.3	116.25	40.4187	30 – 100
Cl^- (mg/L)	21.5	94.6	67.02	28.76703	250 – 1000
SO_4^{2-} (mg/L)	10.4	88.1	63.73	30.4597	200 – 400
Pb^{2+} (mg/L)	0.003	0.007	0.0043	0.00116	0.05
Cr^{2+} (mg/L)	0.004	0.011	0.0056	0.002066	0.05
As^{2+} (mg/L)	0.004	0.007	0.0052	0.000919	0.01 – 0.05
Cu^{2+} (mg/L)	0.004	0.005	0.0042	0.000422	0.05 – 1.5
Zn^{2+} (mg/L)	0.003	0.004	0.0036	0.000516	5 – 15
Fe^{2+} (mg/L)	0.0007	0.011	0.0042	0.00329	0.1 – 0.3

Seasonal variations of surface water quality in the study area at different locations

Temperature is a crucial factor because it affects how much oxygen dissolves in surface water. Pre- and post-monsoon water temperatures, respectively, ranging from 25 to 28°C and 38 to 42°C the highest temperature ever recorded was 41°C in April. The average value was 26.8 and 39.8°C.

The term "pH" is used worldwide to describe how strongly an acidic or alkaline state exists in a solution. The average pH value is 8.2 and 7.8 in both seasons, indicating an acidic environment during the post-monsoon and pre-monsoon, respectively. The pH value varies from 7.9 to 8.6, 7.5 to 8.3, and when the limit was crossed, alkalinity was indicated. The majority of samples for drinking water quality are within the acceptable range (6.5 to 8.5) at all sampling locations.

Electrical conductivity (EC) is a tool for evaluating water cleanliness and a measurement of how well water conducts electricity. The EC value, which measures the concentration of soluble salts in water, ranges from 235 to 1342 S/cm and 188 to 1128 S/cm. The average value is 1012.7 S/cm and 840.67 S/cm during the post- and pre-monsoon seasons. With the exception of a few samples, all samples meet BIS requirements and are within the allowable range.

Turbidity the amount of suspended matter in water is measured by turbidity. Mud, clay, and silt are frequently included in suspended particles. In both of the two seasons, the value ranged from 6.1 to 10.3 NTU and 4.7 to 76.8 NTU, respectively, with an average of 7.59 mg/L and 28.96 NTU.

Total hardness value ranges from 375.6 to 512.2 and 128 to 347 mg/L in both two seasons and the average value is 440.02 mg/L and 240.2 mg/L respectively.

BOD as more organic matter is aerobically oxidized by microbes, BOD, which stands for Biological Oxygen Demand, rises along with the amount of organic matter in the water. The average value is 5.79 mg/L and 3.6 mg/L, respectively, while the values range from 5.1 to 6.5 and 1.92 to 7.7 mg/L.

Calcium the average calcium concentration in water is 73.36 and 56.65 mg/L, respectively, with the ranges being 24.7 to 99.3 and 24.7 to 92.3 mg/L. Calcium already exists naturally, but the addition of a significant amount of organic waste is also to blame for the elevated calcium levels [12].

Magnesium is a naturally occurring element that can be found in water bodies. Its value ranges from 11.2 to 154.8 and 11.2 to 135.9 mg/L in both the post- and pre-monsoon, while the average value is 62.99 and 45.28 mg/L, respectively (GroCHOW SKA TANDYRAK 2009). Due to runoff from agricultural land, the concentration of magnesium in the study region has increased.

Chloride is present in all naturally occurring waters (APHA) and is what gives water its salty flavour [13]. During the two seasons, the values vary from 28.1 to 234.2 mg/L and 28.1 to 124.2 mg/L, respectively. Both average values are 130.73 and 81.05 mg/L. The research area's chloride concentration was analyzed and found to be within acceptable limits according to BIS guidelines.

Sulphate in both of the two seasons, the sulphate value ranges between 12.5 and 98.3 and 30.9 and 89.5 mg/L. 74.6 and 65.73 mg/L on average, respectively. The sulphate concentration is within the permitted range according to BIS guidelines, according to the analysis's findings.

Heavy metals like, Pb^{2+}, Cr^{2+}, As^{3+}, Cu^{2+}, Zn^{2+}, and Fe^{2+} are within the permissible in the entire study area.

CONCLUSION

It is now possible to identify instances of point pollution, which would previously go undetected when attempting to aggregate data, despite the fact that they may have a major impact on the water body's quality. The requirement to adapt the CCME-WQI to the specificities of physical and chemical features that adequately characterize the water quality of the sources used for multilateral purposes when the necessary treatment level is assessed led to the proposal of a modified version of the instrument. Through the definition of six classes of water quality for various ranges of scores, between 0 and 100, the complex data are transformed into a clear diagnostic. In order to adapt the CCME-WQI to the unique physical and chemical characteristics that accurately describe the water quality of the sources used for multilateral purposes when the necessary treatment level is assessed, a modified version of the instrument was developed. When multiple variables are not combined into a single value, the modified index offers a negative modification as opposed to the original's positive modification. This increases the indicator's susceptibility to the sensitivity of the ecosystems and ensures a higher level of accuracy in the assessment of the water quality.

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