



Application of CCME WQI in Assessing Water Quality for Fort Lake of Belgaum, Karnataka

KEYWORDS

CCME-WQI, Water quality, Lakes, Karnataka.

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ABSTRACT A water quality index (WQI) developed by the Canadian Council of Ministers of the Environment (CCME) was applied to Fort lake of Belgaum, Karnataka, India to study its impact on aquatic life, livestock and to know whether it is suitable for recreation, irrigation and drinking. The physicochemical parameters used in the index calculation were dissolved oxygen, pH, electrical conductivity, chemical oxygen demand, biochemical oxygen demand, total phosphate, nitrate, sulphate, chloride, calcium, sodium, magnesium, turbidity and total dissolved solids. The index of the lake is rated as poor with respect to drinking, recreation and livestock, marginal with respect to Aquatic life and excellent for irrigation purpose. The overall water quality is rated as poor. The water quality is almost always endangered or deteriorated and the conditions often deviate from natural levels.

Introduction:

Water is a very essential and precious natural resource for sustaining life on this planet. Owing to the increase in population and indiscriminate utilization, this vital resource is now under tremendous pressure. Water is a prime natural resource and a basic human need. Lake ecology and its biodiversity depend on its natural shoreline and connectivity of lakes. Lakes all over the world are drying as they have turned into dumping grounds for sewage, industry effluents and other hazardous wastes. Encroachment of the lakes, pollution of air, agricultural and sewage disposal into the lakes and rapid urbanization has apparently caused undesirable change in the climate and lake structure. Chimnoy and Raziuddin (2002) and Agarkar (1998) have reported that waste water changes the physical and chemical nature of a water body. Interaction of chemicals into water may adversely affect many species of aquatic flora and fauna. Better quality of water is described by its physical, chemical and biological characteristics. The physico-chemical methods are used to detect the effects of pollution on the water quality.

WQI is a widely used tool in different parts of the world to solve the problems of data management and to evaluate success and failures in management strategies for improving water quality. A number of indices have been developed to summarize water quality data for communication to the general public in an effective way. In general water quality indices incorporate data from multiple water quality parameters in to a mathematical equation that rates the health of water body with a single number. That number is placed on a relative scale to justify the water quality in categories ranging from very bad to excellent. This number can be easily interpreted and understood by political decision makers, non-technical water managers and the general public.

The Canadian Council of Ministers of the Environment (CCME) was designed to evaluate surface water quality for the purpose of protecting aquatic life aided with specific guidelines. Water quality guidelines are numerical values that define physical, chemical or biological characteristics of the water that cannot be exceeded without causing harmful effect (CEQG, 1999).

In the present study an attempt has been made to assess the surface water quality of Fort Lake, a major lake of Belgaum.

Materials and Methods:

Study Area: Fort Lake is one of the important water resources, located in the midst of Belgaum city at the latitude of 15° 51' N, longitude 74° 31' E and elevation of 750 m above MSL. It was constructed about 200 years ago as a source of minor irrigation for supply of water to rice fields and has a depth of about 20 feet. The Lake receives the contaminants in the form of sewage from the nearby areas of the city. Presently the lake is used for pisciculture and boating activities by Belgaum zilla panchayat.

Collection of Samples: Water samples were collected from selected habitat for one year. Samples were collected periodically at the first week of every month during morning hours between 9 to 11 am. Samples for BOD analysis were collected in separate 300ml BOD bottles and oxygen was fixed immediately.

Physico-chemical analysis and calculation of CCME WQI: Surface water temperature was recorded on the spot using centigrade thermometer. The pH of the water samples was measured by pH paper on the spot and later confirmed in the lab with the help of pH meter. Physico-chemical analysis (electrical conductivity, alkalinity, calcium hardness, magnesium hardness, total hardness, phosphate, BOD and COD) of the samples was done according to Standard Methods (APHA, 1995)

The water Quality Index (WQI) using the above parameters were calculated by feeding the data to CCME-WQI software -1.0.

Results and Discussion:

The physico-chemical characteristics of the Lake are represented in Table 1. The index involves scope (F1), the number of parameters that are not compliance with water quality guidelines; frequency (F2), number of times that the guidelines are not respected and amplitude (F3), the difference between non compliance measurements and the corresponding guidelines. The index produces values from 0-100 and based on the values the water quality index is characterized as shown in Table 2 and the index values for Fort Lake are shown in Table 3.

Table 1: Physico- chemical characteristics of Fort Lake from August 2010 to July 2011

Parameters	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature	26	27	28	27	25.5	25.5	23	26.5	30.5	29	26.5	25.5
pH	8	7.7	7.5	7.6	7.8	7.8	7.7	7.2	6.3	7.5	7.7	7.5

Conductivity	310	260	240	230	290	290	240	290	500	360	430	360
Turbidity	9.4	1	47	57	35	35	57	9	150	23	8	13
Alkalinity	2.466	2.08	1.81	2.02	1.52	1.52	1.6	1.6	2.08	1.76	2.08	2.058
TSS	40	100	540	140	60	60	80	120	148	180	140	120
TDS	201	640	520	200	220	220	180	188	325	234	279	140
Total Hardness	126.67	101.2	89.33	136	98.66	98.66	86.4	88	86	84	100	100
Calcium Hardness	68	62.4	41.33	61.32	40	40	50.64	44	41.32	48	66.66	69.32
Magnesium Hardness	14.25	9.42	11.66	18.14	14.25	14.25	8.689	10.69	10.85	8.748	8.101	7.455
Sodium	7.687	6.489	6.86	10.88	12.12	12.12	0.869	0.726	9.424	18.12	20.73	0
Potassium	9.064	3.78	3.87	5.568	4.776	4.776	3.608	3.344	9.363	15.39	8.899	10.81
Total Phosphate	2.21	0.24	0.42	0.011	0.074	0.074	0.17	0.19	0.18	0.1	0.09	2.27
Ortho-Phosphate	0.893	0.15	0.22	0.009	0.0002	0.0002	0.04	0.07	0.06	0.05	0.02	0.834
Chloride	46.66	37.2	37.33	58.64	40	40	44	53.2	73.32	57.32	49.32	44
Sulphate	0	19	29.3	6.6	19	19	25	20	62	18	17	26
Nitrate	0	0	0.04	0.09	0.13	0.13	0.35	0.37	0.34	0.16	0.1	0.124
COD	7	1.2	24	38	32	32	8	40	68.25	26	43	58

Table 2: Characterization of the Water Quality Index (CCME-WQI, 1991).

Rating	CCME-WQI	Characterization of the water
Excellent	95.0-100	Water quality intact, conditions close to natural levels
Good	80.0-94.9	Water quality is protected with only a minor degree of threat or impairment, conditions rarely depart from natural desirable levels
Fair	65.0-79.9	Water quality usually intact, but occasionally endangered, conditions often deviate from natural levels
Marginal	45.0-64.9	Water quality frequently endangered, conditions very often deviate from natural levels
Poor	0.0-44.9	Water quality almost always endangered, conditions regularly deviate from normal levels.

The CCME Water quality index for lakes of Mysore has been studied by Hosmani et al., (2011) and Mahesh et al., (2013) and the lakes of Mandya by Deviprasad et al., (2012) The Canadian Water Quality Index of Fort Lake for various purposes indicates that it is poor for overall purpose, drinking, aquatic and recreation with index values ranging between a minimum of 2 for recreation, 26 for aquatic. The value is 100 for irrigation indicating an excellent quality while it is 51 for

livestock rearing and is of marginal quality. The number of variables tested for the overall quality were 10 out of which 4 did not meet the requirements. Similarly 7 were tested for drinking water among which 3 were failures. 3 for aquatic out of which 2 failed. 1 for recreation and there was a failure and no failures among the 2 tested for irrigation and 1 out of 5 failed to meet live stock requirements

Table 3: CCME WQI for Fort Lake of Belgaum.

Data Summary	Overall	Drinking	Aquatic	Recreation	Irrigation	Livestock
CWQI	40	37	26	2	100	51
Rating	Poor	Poor	Poor	Poor	Excellent	Marginal
F1 (Scope)	40	43	67	100	0	20
F2 (Frequency)	39	42	67	100	0	20
F3 (Amplitude)	88	91	86	94	0	80
Number of variables tested	10	7	3	1	2	5
Number of variables failed	4	3	2	1	0	1

Parameters of failing data were TSS for overall, drinking, aquatic and recreation, TSS being very low in all cases. Salinity for overall and aquatic, Turbidity for overall and drinking, Conductivity for overall, drinking and Livestock and total hardness for overall and livestock rearing. Maximum parameters of failing data were TSS, Salinity and Conductivity. Parameters of passing the test were Orthophosphate in almost all cases except for recreation, Total Phosphate in overall, drinking and Irrigation, Potassium in overall, drinking and livestock, Total Hardness in overall and Livestock, Calcium Hardness in overall and drinking and Nitrate in Overall.

The Canadian Water Index for Fort Lake indicated that the water quality for all purposes is poor indicating that the water quality is almost always in endangered condition. It regularly deviates from normal levels. However for certain purposes like live stock rearing the water is marginally good and the quality of water for irrigation appears to be excellent where the water quality is intact and the conditions in it are very close to natural levels.

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