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Water quality evaluation and water quality index of Krishna River near Karad Tahsil, Dist Satara, (M S India)

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Abstract
River water pollution is one of the most important environmental issues faced by the villagers situated on the bank of Krishna River. Krishna River is the largest river in the Satara District of Maharashtra. On the bank of river small scale industries as well as sugar factories are located. The waste from the industries as well as surroundings localities is directly discarded into the river body. To evaluate the water quality of the river, seven sampling stations were selected and the analysis was done for the parameters like pH, DO, BOD, COD, Calcium, Magnesium, hardness, Chloride, Sulphate and Nitrate etc. The pollution status was investigated on the basis of obtained results of physical and chemical parameters of the water. During the analysis it is observed that, the variation in the results is due to human activity, discharge of waste water and agricultural run-off into the water body is the main sources responsible for the river water pollution.

Keywords: Krishna River, water quality index, agricultural run-off, etc.

1. Introduction
Now a day's environmental pollution is one of the undesirable side effect of industrialization, urbanization and population growth. River plays a major role in assimilation or carrying off the municipal and industrial wastewater and run-off from agricultural land. Surface waters are most vulnerable to pollution due to their easy accessibility for disposal of wastewaters. Pollution status of the river is generally analyzed by means of Physico-chemical, bacterial, plank tonic and benthic fauna studies [1]. In India disposal of untreated domestic sewage from cities, towns and villages is the major source of pollution of surface water bodies leading to the outbreak of water borne diseases. Biodegradable organic matter is the contaminant of concern for dissolved oxygen concentration which is the principle indicator of pollution of surface water [2].

There are various water quality indices and calculation of these indices is based on number of physic-chemical and bacteriological parameters. Water quality indices can be classified in four major groups [3] and these are public indices, specific consumption indices, designing and planning indices and statistical indices. Statistical approaches are very much beneficial for finding the significance of parameters used for water quality assessment[4].Several workers has been used WQI for studying the water quality of major Indian rivers[5]. In many parts of the country available water is rendered as non-potable for human beings because of the presence of heavy metals in excess. The situation gets worsened during summers due to water scarcity and rain water discharge. Contamination of water resources available for household and drinking purposes with heavy elements, metal ions and harmful microorganisms is one of the serious major health disorder [6]. The maintenance of healthy aquatic ecosystem is depended on the physico-chemical properties and biological diversity. A regular monitoring of water bodies with required number of parameters with reference to the quality of water not only prevents the outbreak of diseases and occurrence of hazards but checks the water from further deterioration [7].

2. Material and Methods
2.1 Experimental: For this study the water samples were collected from seven sampling stations of Krishna River from the Karad Tahsil including Karad city. Samples were collected in polythene bottles and analyzed for various water quality parameters as per standard procedures given in the table no. I.

The experimental values were compared with standard values recommended by World Health Organization (WHO) [8] and Indian standards for drinking purposes. The calculation of water quality Index (WQI) was done by Weighted Arithmetic Index method. Further statistical analysis was done by using Microsoft office excel 2007.

Table I

Sr. No.	Parameters	Method Adopted	Indian Standard
1	pH	Electrometric Method	6.5-8.5
2	DO (mg/L)	Azide modification	7.6-7.0
3	BOD (mg/L)	Azide modification	< 30
4	COD (mg/L)	Dichromate reflux	< 250
5	Calcium (mg/L)	EDTA Titration Method	75
6	Magnesium (mg/L)	EDTA Titration Method	30
7	Hardness (mg/L)	EDTA Titration Method	300
8	Chlorides (mg/L)	Argentometric Titrimetric method	250
9	Sulphates (mg/L)	Colorimetric Turbidimetric method	200
10	Nitrates (mg/L)	Colorimetric Turbidimetric method	45

2.2 Water Quality Index

Water quality index is one of the important tools used to monitor the surface as well as the ground water pollution. Water quality index provide information on a rating scale from zero to hundred. Higher value of water quality index indicates better quality of water and lower value shows poor water quality. To compute water quality index three steps are required. In the first step, each of the all parameters has been assigned a weight (wx) according to the importance of that parameter for drinking purpose. (Shown in table no. III) Minimum weight 1 is assigned to magnesium as it is not harmful in the water quality for drinking purpose. The maximum weight of 5 is given to the parameter nitrate as per the importance of this parameter in the assessment of water quality. In the second step, the relative weight (Wx) is calculated from the equation given as,

$$W_x = \frac{w_x}{\sum_{x=1}^{n} w_x} \qquad \text{(I)}$$

Where, Wx is the relative weight, wx is the weight of each parameter and n is the number of parameters. Assigned weight (wx) and calculated relative weight (Wx) values for each parameter are tabulated in the table no. III

At the last step, a quality rating scale (qx) for every parameter is assigned by dividing its concentration in each water sample by its respective standard according to the guidelines given by the BIS and the result multiplied by 100

$$qx = \left(\frac{C_x}{S_x}\right) * 100 \qquad \text{(II)}$$

Here,

qx is the quality rating, Cx is the concentration of each water quality parameter in every sample in mg/liter. Sx is the Indian drinking water standard for every parameter in mg/L as per BIS guidelines.

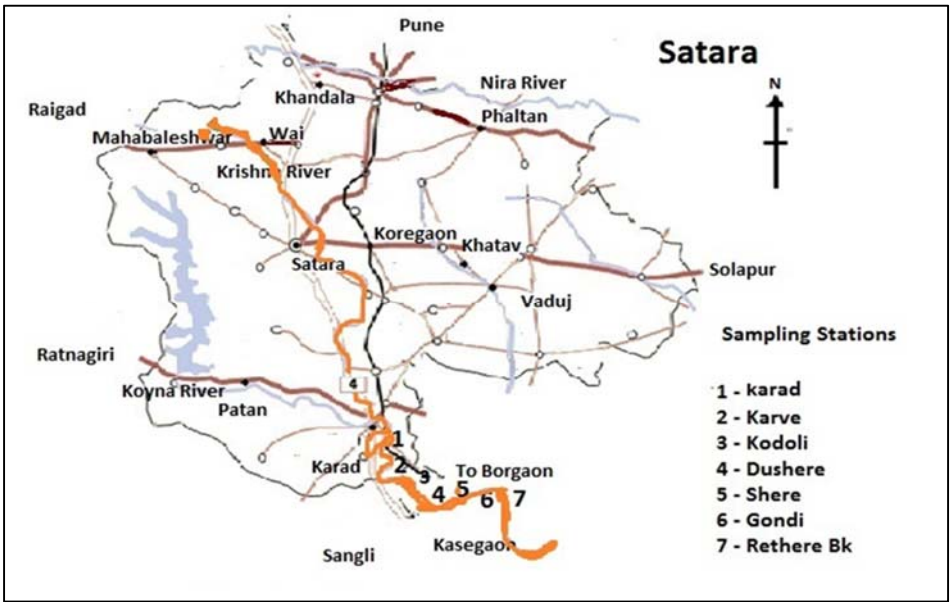
For calculating the Water Quality Index the Sx is first determined for every parameter, which is then used to determine the WQI as per the following equation.

Slx= Wx × qx (III)

WQl= -Slx (IV)

Where, SIx is the subindex of xth parameter, qx is the rating based on concentration of xth parameter, n is the number of parameters.

The calculated water quality index values are classified into respective types whether suitable for drinking or unsuitable.



Map of Krishna River showing various sampling stations: 01 To 07

Table II. Observed values at various sampling stations

Sr. No.	Parameters	S_1 Karad	S_2 Karve	S_3 Kodoli	S_4 Dushere	S_5 Shere	S_6 Gondi	S_7 Rethere Bk
1	pH	8.3	8.1	8.3	8.1	7.8	7.6	7.9
2	DO (mg/L)	4.8	4.3	5.6	5.9	5.4	5.6	5.2
3	BOD (mg/L)	4.1	7.1	7.5	3.3	3.1	3.2	3.4
4	COD (mg/L)	16	20	16.1	12	14	16	17
5	Calcium (mg/L)	17.6	19.1	33.2	29.4	26.6	21.8	22.3
6	Magnesium (mg/L)	16.8	17.5	26.4	26.9	25.6	19.9	21.4
7	Hardness (mg/L)	263	269	259	274	268	266	267
8	Chlorides (mg/L)	58.34	65.30	63.21	73.41	76.32	69.47	71.23
9	Sulphates (mg/L)	21.30	22.33	19.02	23.61	22.14	21.02	21.71
10	Nitrates (mg/L)	17.23	18.69	17.68	19.23	19.87	19.76	19.71

Table III: Relative weight (*Wx*) values of each parameter

Sr. No.	Parameters	Indian Standard	Weight(wx)	Relative weight(*Wx*)
1	pH	6.5-8.5	4	0.1481
2	DO (mg/L)	6	2	0.0740
3	BOD (mg/L)	< 30	2	0.0740
4	COD (mg/L)	< 250	2	0.0740
5	Calcium (mg/L)	75-200	2	0.0740
6	Magnesium (mg/L)	30-100	1	0.0370
7	Hardness (mg/L)	300-600	2	0.0740
8	Chlorides (mg/L)	250-1000	3	0.1111
9	Sulphates (mg/L)	200-400	4	0.1481
10	Nitrates (mg/L)	1-45	5	0.1851
Total			27	0.9994

3. Results and Discussion

3.1 pH: For all the sampling stations pH is in the range of 7.6 to 8.3, It is known that pH of water does not has direct effect on health. But lower value below 5.0 produce sore taste and has higher value above 8.5 and alkaline taste [9]. Throughout all the sampling stations pH was observed which is well within the permissible limit of World Health Organization (WHO).

3.2 Dissolved Oxygen (DO): The presence of aquatic plants in a stream affects the dissolved oxygen concentration. Green plants release oxygen into the water during photosynthesis [10]. Oxygen can be rapidly removed from the waters by discharge of oxygen demanding wastes. The DO values obtained in the present study are within the standards.

3.3 BOD and COD: These are the parameters used to assess the pollution of surface water and ground waters. BOD is the amount of oxygen consumed by bacteria in the decomposition of organic material. It also includes the oxygen required for the oxidation of various chemicals present in the water, such as sulfides, ferrous iron and ammonia [11]. COD is used as a measure of the oxygen equivalent of the organic matter content of a sample that is susceptible to oxidation by a strong chemical oxidant. BOD and COD values obtained in the present study are within permissible limits which is clear from the results in Tables

3.4 Hardness: Hardness is frequently used as an assessment of the quality of water supplies. Water with Hardness above 200 mg/ L. may cause scale deposition in the distribution system and results in excessive soap consumption and subsequent scum formation. Soft water with hardness of less than 100 mg/ L, may have lower buffer capacity and more corrosive to water pipes [12]. The hardness values in the present investigation were found to range between 259 to 274 mg/ L

Calcium is one of the most abundant metals which play an important role in biological system. Magnesium though an essential and beneficial metal is toxic at higher concentrations. Magnesium hardness particularly associated with sulphate ion has laxative effect an persons un accustomed to it [13]. In the present study calcium and magnesium contents are found in the range of 17.6 – 33.2 and 16.8-26.9 mg/ L respectively.

3.5 Chloride: The high concentration of chloride is considered to be an indication of pollution by sewage waste of animal origin. Industries are also important sources of chloride in water [12, 13]. Chloride values obtained in the study are found to be 58.34 mg/ L - 76.32 mg/ L

3.6 Sulphate: Sulphate ion if present in excess amount produce cathartic effect upon human beings [14]. The sulphate ion concentration of the present study varied from 19.02 - 23.61 mg/ L.

3.7 Nitrate: Basically nitrate occurs in trace quantities in surface water. It is the essential nutrient for many photosynthetic autotrophs and has been identified as the growth limit nutrient [15, 17]. The maximum value was observed is in the range of 17.23 – 19.87 mg/ L. Generally water bodies polluted by organic matter exhibit higher values of nitrate [16, 18].

4. Conclusion

River water quality study of the Karad Tahsil region, Satara District, India. Based on water chemistry and suitability for drinking, domestic and irrigation has been carried out. Based on water quality in the study area, the following conclusions were drawn,

- Water quality index (WQI) data stated that near about 85% of river water sampling stations were found potable during all these sampling stations respectively in the study area.

  This study also represents a base for future hydro chemical work for planning, protection and decision making, regarding river water management in the study area.

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