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Water Quality Index of Tunga River in Shivamogga

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Abstract

River Tunga flowing near Shivamogga City, Karnataka State, India, receives waste water discharges from villages located on the bank of River and industries located along the stretch. The present study involves to determine the water quality index of polluted our selected stretch of River. Water samples were collected from different locations and analyzed for physical- chemical parameters like pH, Alkalinity, total hardness, Electrical Conductivity, Calcium ions, magnesium ions and total dissolved solids. All the physical and chemical parameters were compared with the standard Values of IS. These chemical and physical parameters substituted in the WQI equation. WQI facilitates a single numeric value that defines overall water quality for a definite location. The WQI of Tunga River in Shivamogga city vary from 50.38 to 85.48

Keywords: *Shivamogga, Water Quality Index, assessment*

1. Introduction

According to World Health Organization, about 80% of all diseases in human beings are caused by water. In India, according to Niti Aayog over two lakh people die of water born disease annually. According to report of United Nations the water quality in India is poor and it ranks 120th among 122 nations in terms of quality of water available to its citizens. Karnataka human development report (2005) by Government of Karnataka reported 18.63% people of Shivamogga district lack of safe drinking water.

The Tunga River is one of the major sources of drinking water for peoples of Shivamogga. It is a livelihood to many professions and critical to their survival. In this regard it is essential to put efforts to assess the quality of Tunga River. Many Water Quality studies concentrated on small lakes, ground water and small city stretch of river in Shivamogga region. Present studies aiming at water quality along overall length of river.

Agricultural wastes, Industrial effluents, domestic sewage are released to river. Hence water quality is decreasing and leading to water born diseases. Pollution of Tunga River had affected direct or indirectly more than lakhs of people in the sub-basin as most villages use the river water for drinking, bating, irrigation crops, fishing and livestock.

River water quality can be restored by avoiding pollutants to enter. If not it has even direct impact on flora and fauna. The use of modern pesticides, herbicides and fertilizers is polluting the river, thereby impact the overall productivity of the agricultural land. It causes a severe loss of export revenue also. Water Quality of river can be measured effectively by using WQI.

2. Study Area

Shivamogga is District located in Central Karnataka state between $13^0$27' and $14^0$39' N Latitude and $74^0$38' and $74^0$04' E Longitude covers an area of 8495 sq.km. Figure 1 shows the location of Shivamogga District in Karnataka State.

Figure 1: Location of Study Area

The horticulture, agriculture and animal husbandry is the major sources of employment in Shivamogga, which engage 80% of the workforce. The major industries are iron and steel, paper, foundries and rice mills. Highly weathered Schist and gneiss form the geology of the area.

The Tunga River originates in the Western Ghats, on a hill known as Varaha Parvata, at a place called Ganga Moola of Chikmaglur district in Karnataka state. The Gangamoola hill is surrounded by thick forests called as Bhagavathi forest. From here, the river flows through four districts in Karnataka, Dakshina Kannada, Udupi, Chikmagalur and Shimoga. The River Tunga merges with the Bhadra River at Koodli, a small village near Shimoga. The river is given the compound name Tungabhadra from this point onwards. The Tungabhadra flows eastwards and merges with the Krishna River in Andhra Pradesh.

Tunga river is a river flows 180 km through Shivamogga. Following are the places directly benefited by the Tunga river. Sringeri, Hariharapura, Mulur, Theertahalli, Mandagadde, Sakrebailu, Harakere, Shivamogga, Kudli, Holalur, Saswehalli,Honnali, Ukkadagatri, Sirigere, Harihar. After Kudli the river is considered as Tunga-Bhadra. Figure 2 shows the stretch of the Tunga River.

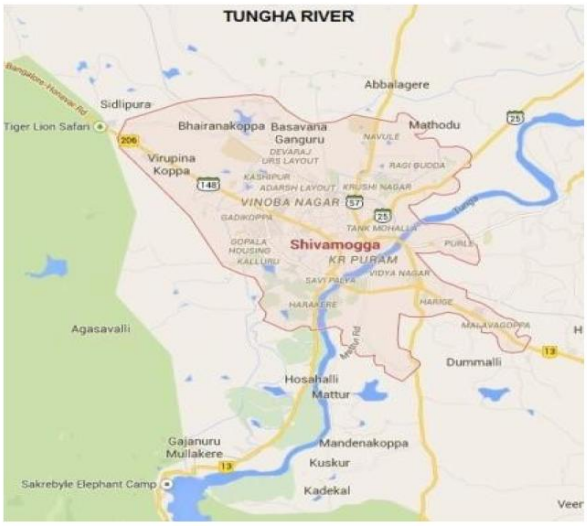

Figure 2: Tunga River Stretch

3. Methodology

During pre monsoon period, water samples were collected from different locations along length of river. Present work is aimed at assessing the Water-Quality Index (WQI) for the surface river water of Shivamogga District. Samples are collected and subjected to physiochemical analysis.

At five locations, samples are collected as per IS code 3025 and subjected to physiochemical analysis. Each of the samples is tested for quality of drinking water as per Indian Standard code 10500 and Water Quality Index is determined. For calculating WQI eight water quality parameters will be considered.

Quality rating scale : qi = (Ci / Si)*100
qi = Quality Rating,
Ci = Concentration of each chemical parameter in each water sample,

Si = Indian Standard
Sub index of i^{th} parameter : SIi = Wi.qi
Water Quality Index = WQI = ΣSIi

Figure 1 shows the flow diagram of the proposed system.

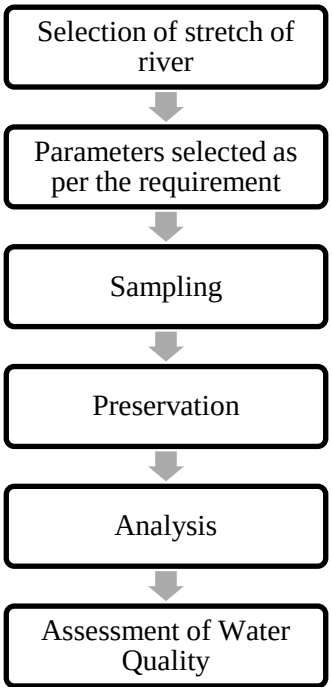

Figure 1: Flow diagram of the proposed system

4. Sampling Stations

Station - S1: details
Mathur is a village in Shivamogga district near the city of Shivamogga, Mathur has a temple of rama, hosahalli is situated across the bank of the tunga river.

Station - S2 details
Station S2 is an upstream station and located near the Shimoga – Thirthahalli new bridge i.e., on the north side of the river. Water is being drawn for supply to the town from this station.

Station - S3 details
The station S3 is located near ayappa Swamy temple (Ramanna Shetty park). A bathing ghat exists near this Station and is the downstream of the sewage disposal point. Station S3 is a most affected station.

Station – S4 details
Station S4 is located on the south side of the river, near the Shimoga – Bhadravathi new bridge. Two number of sewage drains dispose city sewage water in to the river directly.

Station – S5 details
Kodli is a small town near Shivamogga City, Karnataka. It is 147Km long and merges with the Bhadra river at koodli.

5. Assessment of water-quality

The chemical, physical and biological characteristics of water is referred as water quality. It is a measure of the condition of water relative to the requirements of living animals. It is most frequently used by reference to a set of standards against which compliance can be assessed. The most common standards used to assess water quality relate to health of ecosystems, safety of human contact and drinking water.

The overall Water Quality Index was calculated by aggregating the quality rating with the unit weight linearly (Equation 1).

$$\mathbf{WQI} = \frac{\sum \mathbf{q\,n\,W\,n}}{\sum \mathbf{W\,n}} \qquad \mathbf{(1)}$$

Table 1 shows the water quality index and status of water quality.

Table 1: Water Quality Index (WQI) and status of water quality

Water quality Index Level	Water Quality Status
0-25	Excellent water quality
26-50	Good water quality
51-75	Poor water qual-ity
76-100	Very Poor water quality
>100	Unsuitable for drinking

The following are the parameters are

considered for evaluating water quality index of Tunga River.

Determination of:

- Ph
- Electric conductivity (EC)
- Turbidity
- Total hardness
- Calcium
- Magnesium
- Sulphate
- Iron

6. Results and discussion

The quality of water varies from location to location. Table 1 represents status of Water Quality as per Water Quality Index. WHO and ISI standards are represented by Table 2 along with Sample station 01 values. The water quality index of all the five station points are discusses below from table 3 to 7. Sample calculation shown in table 3.

Table 2: Water quality parameters and there WHO and ISI standards

Parameters	**WHO standards**	**ISI stand-ards**	**Sample Station-01**
Ph	7.0-8.0	6.5-8.5	7.03
Electrical conductivity (ms/m)	1.400 d/s/m	300	87.83
Turbidity (NTU)	5	5	2.13
Hardness (mg/l)	100	300	71.3
Calcium (mg/l)	75	75	38
Magnesium (mg/l)	150	30	33.33
Sulphate (mg/l)	400	200	253.82
Iron (mg/l)	0.3	0.3	0

Table 3: Calculation of WQI (Wqn) for Station-01

Parameters	**Values V_n**	**Standard values**	**Unit weight W_n**	**Quality Rating (q_n)**	**Weighted values (W_nq_n)**
Ph	7.03	8.5	0.12	2	0.24
Electrical conductivity ms/m	87.83	300	0.003	28.94	0.09
Turbidity NTU	2.13	5	0.2	287	57.4
Hardness mg/l	71.3	300	0.003	114.35	0.38
Calcium mg/l	38	75	0.013	3700	49.32
Magnesium mg/l	33.33	30	0.03	2.775	0.09
Sulphate mg/l	253.82	200	0.05	26.91	1.34
Iron mg/l	0	30	3.33	30	99.99
		$\sum W_n$ = 3.75		**$\sum W_nq_n$ = 208.87**	

Table 4: Calculation of WQI (Wqn) for stations-02

Parameters	**V_n**	**q_n**	**W_nq_n**
Ph	7.73	48.66	5.72
Electrical conductivity, ms/m	100.44	33.16	0.11
Turbidity, NTU	1.2	380	76
Hardness mg/l	164	68	0.23
Calcium mg/l	36.66	3834	51.11
Magnesium mg/l	127.33	81.10	2.70
Sulphate mg/l	147.06	26.47	1.32
Iron mg/l	0.03	27	89.99
	$\sum W_nq_n$ =227.1956433		
	WQI=60.51601636		

Table 5: Calculation of WQI (Wqn) for stations-03

Parameters	**V_n**	**q_n**	**W_nq_n**
Ph	7.5	33.33	3.92
Electrical conductivity ms/m	273.73	91.06	0.30
Turbidity, NTU	14.9	990	198
Hardness mg/l	160	70	0.23
Calcium mg/l	59	1600	21.33
Magnesium mg/l	101	59.16	1.97
Sulphate mg/l	125.95	37.02	1.85
Iron mg/l	0.02	28	93.33
	$\sum W_nq_n$ =320.94		
	WQI=85.48		

Table 6: Calculation of WQI (Wqn) for stations-04

Parameters	**V_n**	**q_n**	**W_nq_n**
Ph	6.93	4.66	0.55
Electrical conductivity ms/m	175.87	58.43	0.19
Turbidity, NTU	2.5	250	50
Hardness mg/l	86.66	106.67	0.36
Calcium mg/l	47.33	2767	36.88
Magnesium mg/l	39.33	7.77	0.26
Sulphate mg/l	236.15	18.07	0.90
Iron mg/l	0	30	99.99
	$\sum W_nq_n$ =189.1450874		
	WQI=50.38083933		

Table 7: Calculation of WQI (Wqn) for stations-05

Parameters	V_n	q_n	W_nq_n
Ph	8.5	100	11.76
Electrical conductivityms/m	195.3	64.93	0.22
Turbidity NTU	2.5	250	50
Hardness mg/l	106	97	0.32
Calcium mg/l	52	2300	30.66
Magnesium mg/l	54	20	0.67
Sulphate mg/l	213.88	6.94	0.35
Iron mg/l	0	30	99.99
	$\sum W_nq_n$ =193.98		
	WQI=51.67		

7. Conclusions

- The quality of water is poor where it is considered to be least polluted.
- The WQI vary from 50.38 to 85.48 as given in Table 8.

Table 8: WQI values for different stations

Station	WQI values
1	55.64
2	60.52
3	85.48
4	50.38
5	51.67

- Therefore not recommended without treatment

8. Limitation and Scope of Future Studies

- The work is limited to Tunga river within Shivamogga District, however work can be extended for Tunga-Bhadra of 531 km within Karnataka.
- The work is excluding biological characteristics of water like Biological Oxygen Demand (B.O.D) and Chemical Oxygen Demand (C.O.D).

9. Acknowledgement

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