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ORIGINAL ARTICLE **OPEN ACCESS**

Evaluation of water quality of Tiptur Lake, Tumkur District, Karnataka by Water Quality Index Method

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ABSTRACT
Water is a "cradle of life" on which all organisms play. Lentic water system is more accessible to pollution than ground water because of increased industrialiazation, anthropogenic activities and disposal of septic effluents, domestic and municipal sewage.The present investigation is an attempt to provide information on certain physico-chemical parameters like P^H, EC, Turbidity, Total hardness, Total alkalinity, DO, Chloride,Calcium and Magnesium of Tiptur lake in order to know suitability for domestic and human consumption based on computed water quality index values.
KEY WORDS: *Lentic water, Water Quality Index, Tiptur Lake, Anthropogenic activities.*

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INTRODUCTION

Water is essential for survival of any form of life. Water is aptly being described as the mother of life, a precious gift of nature to humankind and millions of other living species. It also performs unique and indispensible activities of ecosystem, biosphere and biogeochemical cycle.

The lentic water systems are the most important sources of water for human activities which are under severe environmental stress as a consequence of developmental activities. Freshwater resource is at a faster rate of deterioration day by day is now a global problem, [1].

Water quality is a measure of its suitability for human consumption, irrigation, recreation, pisciculture and other purposes. Water quality of lentic and ground water is affected directly or indirectly by the leachates from farm fields, discharge of domestic waste, washing of animals, cloths and decaying of flora in the water body [2].

World health organization survey has revealed that 1.2 billion people all over the world do not have access to pure and safe drinking water. Unsafe drinking water accounts for mortality and susceptibility to water borne microbial infectious diseases due to improper management and environmental degradation.

Inadequate management of water resources directly or indirectly resulted in the degradation of hydrological environment [7].Any change in hydrological characteristics of water not only alters its quality, but also disturbs aquatic environment and ecological balance. Therefore a periodical monitoring of water quality is necessary to take appropriate steps for water resource management practices.

Water quality index is one of the most effective tools to communicate information on the quality of water to the concerned citizens and policy makers and environmental planners. The water quality index was first developed by Horton in early 1970, [3].Water quality index provides a single number that expresses the overall water quality at a certain locations and time, based on several water quality parameters. The objective of water quality index is to turn complex water quality data into information that is understandable and useable by public and environmental planners.

Water quality index incorporate data from multiple water quality parameters into mathematical equation which rates the health of water body with number. Several methods of water quality index calculations are developed from time to time. They are NSF-WQI, CCME-WQI, Numerous pollution index (NPI) and weighted arithmetic index method. In the present investigation weighted arithmetic index method is followed to evaluate water quality index of Tiptur Lake.

Study area:

Tiptur Lake is situated in a central place of Deccan plateau of western side of Tumkur district, between 76º 21′ east longitude to 76 º 43′ east longitude and 13º5′ north latitude to 13º 26′ north latitude and located at 861m(2628 feet) above the sea level. It spread over an area of 785 sq.km. The average temperature ranges from 11ºc in winter and 38ºc during summer. The average rainfall of Tiptur town is 510mm. Tiptur Lake provide infrastructure for pisciculture and it also provide abode for many aquatic birds. Now town municipal has a proposal to supply water to Tiptur town for domestic and human consumption purposes, hence the present investigation is undertaken.

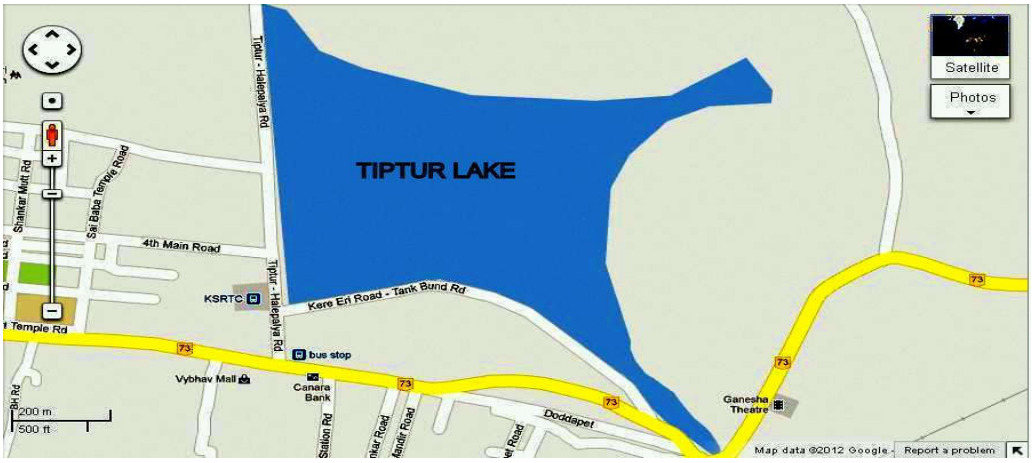

Fig1: Study area

MATERIAL AND METHODS

Water samples from 16 different sampling locations of the lake were collected from 7.00 to 9.00 AM at 25 cm below the surface by using prewashed polythene cans by grab sampling method.

Physical parameters like p^H, EC, Turbidity and TDS were analyzed by using Systronics water analyzer 371 micro controller based instrument at the sampling stations.

Chemical parameters like Total hardness, Total alkalinity, DO, Chloride, Calcium and Magnesium were analysed systematically following procedure suggested [4, 5].

Calculation of Water Quality Index: (WQI)

To calculate water quality index 10 parameters were considered. The WQI has been calculated by using standards of drinking water quality recommended by BIS, WHO and ICMR. The water quality index was calculated by using weighted arithmetic index method.

In the first step, the quality rating scale for each parameter Qi was computed by using the equation:

Quality rating, Qi: [(Vn-Vi) / (Vs-Vi)] X 100 ……1

Where, Qi= Quality rating of n^{th} parameter.

Vn= Actual value of the water quality parameter.

Vi= Ideal value of the parameter, Vi=0 for all parameters, except for P^H=7 and DO=14.6 mg/L.

Vs= Recommended standard value.

In the second step, the relative weight (Wi) was calculated by a value inversely proportional to recommended standard (Si) for the corresponding parameter.

Relative weight, Wi=1/Si ……2

Where, Wi= Relative weight of n^{th} parameter.

Si= Recommended standard value of each parameter.

The overall WQI was calculated by aggregating the Quality rating Qi with the Relative weight (Wi) linearly by using the following equation:

WQI= ∑Qi Wi / ∑ Wi ……3

WQI is discussed for specific and intended use of water. In the present investigation WQI for human consumption is considered and permissible WQI for drinking water is taken 100. Table 1 explains water quality classification based on WQI value.

Table: 1 Water quality classification based on WQI value [6]

WQI Value	Water quality
<50	**Excellent**
50-100	**Good water**
100-200	**Poor water**
200-300	**Very poor water**

Results and Discussion

The average results of physico-chemical parameters of all the 16 different sampling locations stations during summer and winter seasons were tabulated in the Table-2 and 3. Whereas Water Quality Index were presented in Table 4 and 5.

Table 2 Results of Physico-chemical parameters of Tiptur Lake from Nov 2014 to January 2015. (Winter season)

Parameters	November	December	January	Average
P^H	8.4	8.45	8.12	8.32
ECμs/cm	120.5	124.95	134.7	126.72
Turbidity NTU	3.15	3.7	2.83	3.23
TDS	50.95	61.82	66.95	59.91
Total hardness	50.26	51.37	50.07	50.57
Total alkalinity	48.15	47.2	45.97	47.11
DO	5.33	6.44	8.27	6.68
Chloride	22.09	21.22	24.26	22.52
Calcium	10.48	10.82	10.57	10.62
Magnesium	5.67	5.87	5.72	5.75

NOTE: All values expressed in mg/L, except for P^H and otherwise stated

Table 3: Results of Physico-chemical parameters of Tiptur Lake February to April 2015. (Summer season)

Parameters	FEBRUARY	MARCH	APRIL	Average
PH	8.32	8.5	8.7	8.50
ECμs/cm	177.62	175.57	181	178.06
Turbidity NTU	2.35	3.94	4.08	3.45
TDS	88.47	87.51	90.5	88.82
Total hardness	48.45	41.62	42.12	44.06
Total alkalinity	53.15	55.01	56.88	50.01
DO	12.81	12.82	13	12.87
Chloride	24.39	24.27	24.43	24.43
Calcium	8.45	10	10.15	9.53
Magnesium	6.57	4.08	4.97	4.97

NOTE: All values expressed in mg/L, except for P^H and otherwise stated

Table 4: Water Quality Index of Tiptur Lake- Winter season

Parameters	Average	Standard value	Relative weight Wi	Quality rating Qi	Weighted value Wi X Qi
P^H	8.32	6.5 -8.5	0.117	88	10.296
ECµs/cm	126.72	300	0.0033	42.24	0.0139
Turbidity NTU	3.23	5	0.2	64.4	12.88
TDS	50.90	500	0.002	10.18	0.02
Total hardness	50.56	300	0.0033	16.85	0.0556
Total alkalinity	47.11	75	0.0050	23.55	00.177
DO	6.68	5	0.2	82.50	16.500
Chloride	25.52	250	0.004	10.208	0.04
Calcium	10.62	75	0.0133	14.16	0.0188
Magnesium	5.75	30	0.0333	19.16	0.0638
			∑Wi 0.5812		∑Wi Qi 40.873
				WQI=∑Wi Qi / ∑Wi	70.32

Table 5: Water Quality Index of Tiptur Lake- Summer season

Parameters	Average	Standard value	Relative weight Wi	Quality rating Qi	Weighted value Wi X Qi
P^H	8.50	6.5 -8.5	0.1333	100.00	11.70
ECµs/cm	178.06	300	0.0033	59.35	0.190
Turbidity NTU	3.45	5	0.2	69.00	13.800
TDS	88.82	500	0.002	17.76	0.035
Total hardness	44.06	300	0.0030	14.68	0.044
Total alkalinity	50.01	75	0.0050	25.00	0.125
DO	12.87	5	0.2	18.02	3.604
Chloride	24.43	250	0.004	9.77	0.039
Calcium	9.53	75	0.0133	12.70	0.168
Magnesium	4.97	30	0.0333	16.56	0.551
			∑Wi 0.5812		∑Wi Qi 30.256
				WQI=∑Wi Qi / ∑Wi	52.05

Water quality index of Tiptur Lake is established from various Physico-chemical parameters in winter and summer seasons. Water quality index calculations were depicted in the table 4 and 5.In the present investigation the estimated values of WQI an average ranged between a minimum of 52.05 to 70.32 indicating water is good for domestic and human consumption with proper treatment. The above water quality is also supported by the following physico-chemical parameter variations observed during winter and summer seasons of the study.

P^H

The P^H of a solution is the concentration of hydrogen ions, expressed as negative logarithm. It reflects acidity or alkalinity of water. The P^H plays a role in growth of flora and fauna of aquatic ecosystem. Thus measurement of P^H is important because most of the biological process and biochemical reactions are P^H dependent. The P^H value during winter season ranged from minimum of 8.12 to maximum of 8.45. During summer the P^H value ranged from minimum of 8.32 to maximum of 8.7. Somewhat alkaline in nature. The P^H value exceeded the permissible limits set by BIS, WHO and ICMR standards.

EC

Electrical conductivity is a numerical expression of the ability of aqueous solution to carry electric current. EC signifies the amount of total dissolved salts. EC value during winter season ranged from minimum of 120.05 µs/cm to maximum of 134.7 µs/cm. During summer the EC value ranged from minimum of 175 µs/cm to maximum of 181 µs/cm. The EC values were within the permissible limits of 300 µs/cm set by ICMR.

TURBDITY

Suspension of particles in water interfering with passage of light is called turbidity. It is caused by wide variety of suspended matter. Turbid water is undesirable from aesthetic point of view in drinking water supplies. The turbidity of water during winter ranged from minimum of 2.83 NTU to maximum of 3.15

NTU. During summer the turbidity values ranged from minimum of 2.35 NTU to maximum of 4.08NTU. The estimated values were well within the permissible limits of BIS standard of 5 NTU.

TDS

It is the amount of solids that remain as residue upon evaporation and subsequent drying at defined temperature. It gives the measure of ions dissolved in water. The TDS value during winter season ranged from minimum of 50.95 mg/L to maximum of 87.51 mg/L. During winter the TDS value ranged from minimum of 87.51mg/L to maximum of 90.5mg/L. The estimated values were within the permissible limits of BIS standard of 500mg/L.

TOTAL HARDNESS

The hardness is the property of water which prevents the lather formation with soap and increases the boiling point of water. Hardness of water mainly depends upon the amount of calcium or magnesium or both. The hardness value during winter season ranged from minimum of 50.07mg/L to maximum of 51.37mg/L. During summer the hardness value ranged from minimum of 41.62mg/L to maximum of 48.45 mg/L.

TOTAL ALKALINITY

It is the capacity to neutralize a strong acid and it is normally due to the presence of bicarbonate, carbonate and hydroxide compounds of calcium, sodium and potassium. The alkalinity value during winter season ranged from minimum of 45.97 mg/L. During summer the alkalinity value ranged from minimum of 53.15 mg/L to maximum of 56.88 mg/L. The estimated values were within the permissible limits of BIS standard of 75 mg/L.

DISSOLVED OXYGEN

DO is one of the important chemical parameter to assess the quality of water. Temperature plays an important role in determination of DO in aquatic ecosystem. DO is an index of physical and biological process occurring in water. The unpolluted water is normally saturate with DO, while presence of oxygen demanding pollutants causes rapid depletion of DO. The DO value during winter season ranged from minimum of 5.33mg/L to maximum of 8.27 mg/L. During summer the DO value ranged from minimum of 12.81 mg/L to maximum of 13 mg/L. In the present investigation higher DO values observed during summer and DO values exceeded WHO and BIS standards of 5 mg/L.

CHLORIDE

It plays an important role in the water quality determination. The chloride concentration serves as an indicator of pollution by sewage. The chloride content during winter ranged from minimum of 21.22 mg/L to maximum of 24.6 mg/L. During summer the chloride content ranged from minimum of 24.27 to maximum of 24.63 mg/L. The estimated values were within the permissible limits of BIS standard of 250 mg/L.

CALCIUM AND MAGNESIUM

They are directly related to hardness. Calcium and magnesium are both essential minerals for living organism. Both the minerals are found in all kinds of natural water with magnesium concentration generally lower than calcium. The calcium content during winter ranged from minimum of 10.48 mg/L to maximum of 10.82 mg/L. During summer the values ranged from minimum of 8.45mg/L to maximum of 10.15 mg/L. The estimated values were within the permissible limits of BIS standard of 75mg/L.

The magnesium content during winter ranged from minimum of 5.67 mg/L to maximum of 5.87 mg/L. During summer the magnesium content ranged from 4.08 to 6.57 mg/L. The estimated values were within the permissible limits of BIS standard of 30mg/L.

CONCLUSIONS

- Water Quality Index study revealed that the Tiptur Lake water is Good, suitable for domestic and human consumption but with proper treatment.
- Application of WQI in this study has been useful in assessing the overall quality of water. This method appears to be more systematic and gives comparative evaluation of the water quality in different seasons of the year. It is also helpful for public to understand the quality of water as well as being useful tool in many ways in the field of water quality management.
- WQI in the present investigation ranged between a minimum of 52.05 to 70.32 indicating water is good for domestic and human consumption.
- The Physico-chemical parameters were found within the permissible limits of BIS, WHO and ICMR standards except for P^H.
- Lake water is slightly alkaline in nature.
- Bathing, washing and defecation, washing of motar vehicles, immersion of idols, domestic and septic tank effluent discharge must be strictly prohibited, since these activates alter water quality and affect adversely aquatic organism.

- Unplanned growth of human habitation in the vicinity of the lake has to be checked.

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