Water quality assessment in the River Godavari, Near Manthani, Telangana.

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Abstract
The present paper deals with the assessment of water quality in the river Godavari, near Manthani, Telangana. The water samples were collected for a period of 18 months (May 2017- October 2018) to assess the quality of water. The assessment of water quality has been made in the river Godavari on the basis of physico-chemical and phycological characteristics. In the former a number of anions, cations and other parameters have been estimated in the river water samples. Benthic algae were taken into consideration under phycological parameters. The algae were analysed quantitatively and quantitatively for different groups. The percentages of various groups are also been calculated. The results are compared with standards given by WHO and ISI for water quality. In the river Godavari four groups of algae Bacillariophyceae, Cyanophyceae, Chlorophyceae and Euglenophyceae were encountered. Bacillariophyceae were dominant at all the stations followed by Chlorophyceae, Cyanophyceae and Euglenophyceae. The maximum growth of diatoms was recorded during winter, minimum numbers were attained during summer and rainy season. From the data obtained it is concluded that the parameters analysed are within the permissible limits of drinking water standards in the river investigated.

Key words: Physico-chemical parameters, Godavari River, Algae and Water quality

Introduction

A fundamental feature of the earth is an abundance of water which covers 71 per cent of its surface in the ocean depressions. Over 97 percent of water is deposited the relatively small amounts of water that occur in fresh water lakes and rivers belie their basic importance in the maintenance of terrestrial life. Inland waters cover less than 2 percent, of which the water in rivers constitute only 0.0009 per cent. Only fresh water allows human life and communities developed where there was fresh water. value of the land depends upon the presence of water.

Water is a resource present on the earth in great abundance but is becoming a scarce commodity because of the pollution caused by all kinds of human and other activities. With the increase in population, urbanization, industrialization and development of new technology the problem of water pollution is becoming serious day by day. Water in its various states is a major element of all the components of biosphere and is one of the most leading factors in existence of living organisms. Water is used in many ways like direct consumption by human beings, cattle etc., for domestic purposes, agriculture, industry, energy generation etc (Avvannavar and Shrihari, 2008). The diverse uses of freshwater are based on its unique physico-chemical and biological properties which also render it unfit for one or several uses even after a minor change.

The work on the physio-chemical and biological characteristics of Indian rivers was carried out by several scientists in different parts of India. In Andhra Pradesh, Venkateswarlu and his associates have contributed a lot to this discipline (Venkateswarlu 1969 and 1996; Manikya Reddy, 1984; Manikya Reddy and Venkateswarlu; 1987 and 1992; Manikya Reddy and Chandra Shekar, 2008).

Material and Methods

Description of the River

The Godavari River is 1465km long and ranks as the second longest river after the Ganga. It is also known as Dakshina Ganga. It rises at Brahmagiri Mountain, near Triambak in Nasik district of Maharashtra and pours into the Bay of Bengal via two mouths at Antarvedi of East Godavari district, Andhra Pradesh. It has its catchment area in seven states: Maharashtra, Telangana, Chhattisgarh, Madhya Pradesh, Andhra Pradesh, Karnataka and Odisha.Nearly 350 major and medium dams and barrages had been constructed in the river basin by 2012. Manthani is located on the southern banks of River Godavari. In Manthani mandal it enters at Siripuram and exits at Arenda. During its course in Manthani mandal it passes through the villages Kansaipet, Uppatla, Potharam, Vilochavaram, Manthani HQ, Kanapur, Kansaipet and Ammagaripally.

Collection of water samples:
Field work was spread over a period of 18 months to assess the quality of water.2 litres of surface water samples were collected from three different sites, Potharam, Vilochavaram and Manthani of the river.The samples were analyzed on the same day in the laboratory for different physico-chemical parameters following the standard methods. (APHA, 2005). Pebbles from the bottom of the river collected and scrapped to get algal masses from three different locations (Venkateshwarlu, 1969). The pebbles were scraped carefully with scalpel and brush, and then the pebbles were discarded.The scraped sample materials were preserved in 4% formaldehyde solution and the final volume of the sample was reduced to 50ml by sedimentation.This concentrated material was used for frequency measurement and species identification. For determining the frequency of different groups of algae the drop method Pearsall, (1946) and Venkateswarlu, (1969a) was followed.

Results
The average values and ranges of physico-chemical parameters of the river is given in Table:1 and 2.
In the river pH value above 8.0. Carbonates, bicarbonates, Chlorides, Total hardness, organic matter, COD and Phosphates were low in concentrations in the river Godavari. Dissolved oxygen was found above 7.0 mg/L. Nitrate, Calcium and magnesium were high in content. Total dissolved solids were observed in higher proportions in the river.
Algae were studied both qualitatively and quantitatively. The different groups of algae recorded in the river is given in percentages (Table:3). Diatoms were the dominant group of algae followed by Chlorophyceae and Cyanophyceae in the river investigated. Euglenophyceae members were very poorly represented.

Discussion
The physico-chemical parameters analysed in the river has been compared with the standards stipulated by various National and International agencies like Indian Standards Institution (ISI), World Health Organisation (WHO, 2004) (Table: 2). The river exhibited moderate alkalinity showing an average pH value of 8.2-8.6. Chloride concentration was very low in comparison with the stipulated standards. Dissolved oxygen is an important indicator of water quality which also determines the distribution and abundance of algal population. In the river investigated the average value of dissolved oxygen was always above 7.0 mg/L. indicating the satisfactory range. Likewise, the organic matter did not rise beyond 2.0 mg/L in all the cases. Chlorides was always in low pro- portions in the river. Nitrates were recorded with an average range of 0.6-2.9 mg/L. These values are within the permissible limits given by various agencies. Phosphate is one of the essential nutrients for the growth and development of flora in any ecosystem. In general, freshwaters show its presence in less quantity and has no significance in its specific patterns of variations (Usharani et al., 2010). Phosphates were observed in low quantities, traces in the river Godavari recorded an average value of 0.12 mg/L. Mitra (1992) also reported low quantities of phosphates in the rivers Tungabhadra, Godavari and Krishna at selected gauging stations.
Silica has immense significance as a major nutrient for the abundance of diatoms and play an important role in succession and productivity of the group, Silica was recorded in considerable quantities in all the three stations. The concentration of silica depends upon the nature of the substratum. Gurumayum et al., (2002) and Deshmukh (2015) concluded that the relatively high values of silicates are due to sandy nature of the river bed.
The hardness of the water may be temporary or permanent. Temporary hardness is mainly due to the presence of bicarbonates of calcium and magnesium. The permanent hardness is due to sulphates and chlorides of calcium and magnesium (Devajit et al., 2015 and Wetzel, 1983). The works of various investigators (Chavan Ajay et al., 2009) on river eco-colonizers of the river stones Lowe system have revealed that the total hardness of water is variable. In general, freshwaters will always have low hardness. The average values of total hardness in the river are within the prescribed limits of BIS.
Magnesium is a component of chlorophyll and must be present for its proper development (Jindal and Chetan, 2011). Magnesium was observed always to be lower than calcium. Both the ions were observed with in the permissible limits.
In the assessment of raw water quality, the first parameter to be considered is the total solids (dissolved and suspended). The quantity of solids, in general, is proportional to the degree of pollution. The total dissolved solids in the river are within the permissible limits given by the above-mentioned agencies for drinking purposes.

Phycological characteristics
The abundance and periodicity of different varieties of organisms solely depend upon the chemical composition of the water, available nutrients and substrata (Jumle et al., 2015). Rakesh et al., (2005) point out that the productivity of the stream is proportional to the availability of adequate light, nutrients and substratum, according to Manjusha et al., (2013) benthic algae of stream include both species which are perennial and those which markedly seasonal in their development. The above views are in agreement with the present study.
Diatoms are the most important colonizers of the river stones (Smita et al., 2016). In the present river diatoms dominated over the other groups of algae. The nutrients such as nitrates, phosphates, silica and dissolved oxygen are quite favourable and available in the habitats. In the river the highest percentage of diatoms coincided with the high concentrations of silica and dissolved oxygen. Singh and Gupta, (2004) observed that diatoms lend themselves very well to the ecological studies as the associations they form are the result of their environment and thus represent the best indicators of physical and chemical conditions of that environment.

Chlorophyceae occupied the second place in dominance at all the stations. The Chlorophyceae were mainly constituted by desmids and chlorococcales. Desmids are highly sensitive to pollution (Rakesh et al., 2015) in high quantity in the present river shows the unpolluted nature of the water.

Cynophyceae occupied the third place in dominance at all the stations of the river Godavari. Many investigators pointed out the importance of temperature and organic matter in the abundance of blue-greens (Blum, 1957; Venkateswarlu, 1969 c). Most of these authors recorded these algae in summer. In the present investigations also, similar observations have been made.

Euglenophyceae were observed less than 2 percent in the river (Fig:1). Earlier works on this group of algae by different investigators revealed that these flagellates prefer polluted water and require higher concentrations of organic matter, ammonia, moderately high temperature and low pH. Smita et al., (2006) reported that the blue-greens and euglenoid flagellates are mostly associated with organically rich water and low dissolved oxygen.

The species composition in the river revealed that they belong to unpolluted water organisms (Table: 4). Thus, it can be concluded from the physico-chemical and phycological characteristics that the water at all the selected sampling stations is unpolluted and can be utilized for any purpose.

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Table:1 Ranges and Average Values of Physico-Chemical Parameters

All values are expressed in mg/L except pH and Temperature(^{0}C)

Parameters	**STATION - I**		**STATION - II**		**STATION - III**	
	Avg	**Range**	**Avg**	**Range**	**Avg**	**Range**
Temperature	28.2	21.5 - 33	26.9	22.0 – 29.8	26.88	22.0-33.0
pH	8.4	8.2 - 8.7	8.3	8.2 - 8.6	8.30	8.2 - 8.6
CO_3^{2-}	20.2	16- 26	18.3	16 – 24.1	17.39	16 - 24
HCO_3^-	169.1	132 - 210	187.8	142 - 274	190.0	146 - 254
Cl^-	64.4	40.2 - 94	91.5	45 - 160	77.93	65 - 126
DO	8.1	5.8 – 10.5	8.3	8.2 - 12.4	7.60	6.6 - 10.2
BOD	NIL	NIL	NIL	NIL	NIL	NIL
OM	1.5	0.92 – 2.42	1.0	0.12 – 1.6	1.51	0.6 - 1.81
COD	2.5	1 - 6	2.3	1 - 6	2.96	1-4
TH	172.8	145 - 216	169.4	145 - 216	166.0	141 - 210
Ca^{2+}	105.5	27 - 52	29.7	29 - 60	36.83	29 - 46
Mg^{2+}	31.4	27.57 – 37.58	29.7	24.40 – 41.97	31.52	27.33- 36.84
SO_4^{2-}	37.9	22 - 58	37.2	23 - 64	39.83	30 - 68
PO_4^{3-}	0.1	0.11 – 0.14	0.1	0.1 - 0.15	0.12	0.11 - 0.15
SiO_2	2.8	2.4- 3.60	2.6	1.2 - 3.02	2.79	1.4 - 3.4
NO_3^-	1.8	0.8 – 2.9	1.52	0.6- 2.9	1.47	0.6 – 2.9
NO_2^-	0.1	0.01 - 0.08	0.05	0.01 - 0.08	0.04	0.01 - 0.16
TDS	352.5	200 - 500	428.7	330 - 620	450.17	260 - 500

Table: 2 Comparison of the present data with BIS and ISI standards

All values are expressed in mg/L except pH and Temperature(^{0}C)

Parameters	**Station - I**	**Station- II**	**Station - III**	**BIS(2003)**		**ISI 10500:2012**	
	Average	**Average**	**Average**	**P**	**E**	**A**	**P**
Temperature	28.2	26.9	26.88				
pH	8.4	8.3	8.30	5	25	6.5-8.5	No relaxation
CO_3^{2-}	20.2	18.3	17.39				
HCO_3^-	169.1	187.8	190.0				
Cl^-	64.4	91.5	77.93	250	1000	_	_
DO	8.1	8.3	7.60	6			
BOD	NIL	NIL	NIL	3			
OM	1.5	1.0	1.51				
COD	2.5	2.3	2.96	_	10		
TH	172.8	169.4	166.0	300			
Ca^{2+}	105.5	29.7	36.83	75	200	75	200
Mg^{2+}	31.4	29.7	31.52	30	100	30	100
SO_4^{2-}	37.9	37.2	39.83	200	400	200	400
PO_4^{3-}	0.1	0.1	0.12				
SiO_2	2.8	2.6	2.79				
NO_3^-	1.8	1.52	1.47				
NO_2^-	0.1	0.05	0.04				
TDS	352.5	428.7	450.17	500		500	

Table: 3 Percentage of Algae

Groups	**Station-I**	**Station-II**	**Station-III**	**Average percentage**
Bacillariophyceae	51.39	59.33	54.16	54. 96%
Chlorophyceae	32.98	21.65	24.65	26.42 %
Cyanophyceae	21.13	12.6	19.25	17.66 %
Euglenophyceae	1.86	1.9	1.92	1.89 %

Table: 4 Common and dominant species of Algae

Group	Dominant Species
Bacillariophyceae	*Cymbella aspera, C. affinis,* *C.cymbiformis, C.microcephala* *Synedra ulna* (Nitzsch), *S. ulna var. aequalis* (Kutz.) *Gomphonema lancelatum, Navicula rhynchocephala* *N. cryptocephala, Nitzschia denticula* *N. punctata* (W.sm.) Grun and *Amphora ovalis*
Chlorophyceae	*Scenedesmus acutiformis, S. armatus* *S. perforatus, Coelastrum cambricum* *Pediastrum boryanum, P. simplex, P. duplex, P. tetras* *Cosmarium granatum* and *C. leave*
Cyanophyceae	*Chroococcus turgidus, Gomphosphaeria aponia* *Merismopedia glauca, Oscillatoria formosa* and *Osc. princeps*