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Chemical and biological assessment of water quality in the river Godavari, near Basara, Nirmal district, Telangana

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Abstract
The paper deals with the assessment of water quality in the river Godavari, near Basara, Telangana. Water quality assessment in the river has been investigated for a period of two years (March 2017 - February 2019). Three sampling stations, covering a distance of 15 km were selected. Water and algal samples were collected near Basara, Nirmal district at an interval of one month for a period of 2 years. Also collected uniform size pebbles for benthic algae. Both phytoplankton and benthic algae have been studied. In the river Godavari three groups of benthic algae Bacillariophyceae, Cyanophyceae and Chlorophyceae were encountered. Bacillariophyceae were dominant at all the stations followed by Chlorophyceae and Cyanophyceae. All the physico-chemical parameters are well below the permissible limits.

Keywords: assessment, water quality, algae and Godavari river

Introduction
The main uses of water are drinking, industrial and agriculture, hydroelectric power generation, navigation, recreation, fish and wild life conservation. The uses of water depend upon its quality (Dhirendra *et al*., 2009) [6]. Water quality is an important factor for its suitability to various purposes. Severe impairment of water quality has resulted in extensive loss of aquatic life and in the destruction of proper biological balance in streams and rivers (Barinova *et al*., 2004) [2]. The primary cause of deterioration of surface water quality is municipal and domestic waste water, industrial and agricultural wastes, solid and semi-solid refuse (Bawa kalpana and Gaikawad 2013) [3]. The materials which cause pollution are inorganic salts, acids, alkalis, organic matter, suspended solids, floating solids and liquids, heated water, color, toxic chemicals and radioactive materials (Khan *et al*., 2008) [7]. Water is a good medium for the growth of different flora and fauna. The growth of algae is connected with the seasons of the year, availability of nutrients and ionic composition of the medium as well. Those species of algae which can adopt themselves to water currents will develop and form a community in a lotic habitat (Chathain and Harrington 2008) [5]. Various algae can develop in winter season. While in summer green and blue green algae will dominate.

Material and Methods
The river Godavari, the largest of the peninsular rivers rises at Triambak in Nasik district of Maharashtra enters Telangana in Adilabad district and joins the Bay of Bengal near Antarvedi after traversing a distance of 1,465 kms. The Godavari flows at a low level until May. It has a double maxima one in May to June and the other in July to August. After August there is a sharp fall in discharge although the volume of flow in October and November is higher than in any of the months from January to May.

Three sampling stations, covering a distance of 15 km were selected. Water and algal samples were collected near Basara, Nirmal district at an interval of one month for a period of 2 years. Also collected uniform size pebbles for benthic algae.
Collection of surface water samples and their analysis followed by standared procedure (APHA, 2005) [1]. Surface water samples were collected in polythene cans continuously for two years (March 2017 - February 2019) at monthly intervals. All the samples were kept in an ice-box and transported to the laboratory. Separate samples were collected for the estimation of dissolved oxygen.
One liter of surface water sample was collected from the river and was kept in the sedimentation column after adding 2 - 3 ml of 4% formaldehyde solution. The samples were kept undisturbed for about one month for complete settling of the organisms. The samples were concentrated to 100 ml. Finally the concentrated material was used for frequency measurement and identification of species also the planktonic net of 45 µm pore size (Ricco sampler, Tokyo, Japan) was used to collect the planktonic samples. For frequency measurement of different species of algae at each station, the drop method of Pearsal *et al*., (1946) [12] and described by Venkateswarlu (1969a) [13] was followed.

Results and Discussion
Physico-chemical parameters
The average values of physico-chemical parameters are incorporated in table -1.
In the river pH recorded always above 8.0. River water exhibited moderate alkalinity. pH concentration is deemed to be important because of its effect on the chemical and biological properties of water. It is an important means of understanding the chemical conditions, which prevail in natural waters (Khan *et al*, 2008) [7].

Chlorides concentrations were recorded very low compared with stipulated standards. Dissolve oxygen is an important indicator of water quality which also determines the abundance of algal population. In all the three stations the average value of dissolved oxygen was always above 8. 0 mg/L. Organic matter did not raise beyond 2 mg/L at all the stations. The hardness of water appears to be temporary which is mainly due to the carbonates and bicarbonates of calcium and magnesium. In general freshwaters will always have low hardness. Magnesium was observed always to be lower than calcium. Both the ions were observed within the permissible limits. Silica has immense significance as a major nutrient for the abundance of Diatoms and plays an important role in the succession and productivity of the group. Silica was recorded in considerable quantities in the river. Sulphate content was low in the river Godavari. Nitrates and nitrites were recorded less quantity. These values are within the permissible limits given by various agencies. Phosphates are 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. Phosphates were observed less quantity and traces in the river.

Table 1: Average values of Physico-chemical parameters and Comparison with BIS and ISI standards

S. No	Physico - Chemical Parameters	Station-I	Station-II	Station-III	BIS(2003)		ISI 10500:2012	
					P	E	A	P
1	Temperature	26.12	25.24	26.20				
2	pH	8.32	8.46	8.53	5	25	6.5-8.5	No relaxation
3	CO_3^{2-}	18.42	24.48	24.86				
4	HCO_3^-	144.68	124.12	136.48				
5	Cl^-	78.86	96.68	104.32	250	1000	_	_
6	DO	8.46	8.89	9.24	6			
7	OM	1.66	1.46	1.72				
8	TH	72.26	78.84	82.12	300			
9	Ca^{2+}	36.42	42.44	52.48	75	200	75	200
10	Mg^{2+}	26.96	22.14	32.16	30	100	30	100
11	SO_4^{2-}	54.24	52.32	58.74	200	400	200	400
12	PO_4^{3-}	0.024	0.022	0.032				
13	SiO_2	8.54	7.88	7.34				
14	NO_3^-	0.66	0.68	0.54	45	45	45	No relaxation
15	NO_2^-	0.008	0.006	0.008				

(All parameters are expressed in mg/L except pH and Temperature)

Algae

Both phytoplankton and benthic algae have been studied. In the river Godavari three groups of benthic algae Bacillariophyceae, Cyanophyceae and Chlorophyceae were encountered. Bacillariophyceae were dominant at all the stations followed by Chlorophyceae and Cyanophyceae (Table - 3). In all the cases the Diatoms dominated at all the three stations. Diatoms are the most important colonizers of the river stones (Manikya Reddy, 1984) [8]. In the present rivers investigated Diatoms dominated over the other groups of algae. The nutrients such as nitrates, phosphates, silica and dissolved oxygen are quite favorable and available in the habitats (Manikya Reddy and Chandra Shekar, 2008) [11]. Khan *et al*., (2008) [7] observed that Diatoms lend themselves very well to the ecological studies and thus represents the best indicators of physical and chemical conditions of that environment. Similarly the biological parameters indicate that the flora was represented by unpolluted water species (Table – 2). This is in accordance with the list of organisms given by Venkateswarlu (1981) [14] and Manikya Reddy and Venkateswarlu (1992) [10]. In the river Godavari, the dominant diatoms constituted by *Synedra tabulata, Synedra ulna, Cymbella aspera, Cymbella cymbiformis, Cymbella affinis, Gomphonema montanum, Diploneis ovalis, Caloneis silicula, Mastogloia smithii, Navicula bacillum, Navicula cryptocephala, Navicula pupula, Nitzschia amphibian, Nitzschia punctata, Rhopalodia gibba, Amphora ovalis and Surirella robusta.*

In the river Chlorophycaea represented by the species of *Cosmarium granatum, C. subtumidium, C. varioilatum, Scenedesmus armatus, Coelastrum cambricum* and *Pediastrum simplex.* Cyanophyceae group exhibited by the species of *Merismopedia glauca, M. punctata, Spirulina major* and *Oscillatoria formosa.*

Table 2: List of common and dominant species of algae

Group	Algae Species
Bacillariophyceae	*Synedra tabulata, Synedra ulna, Cymbella aspera, Cymbella cymbiformis, Cymbella affinis, Gomphonema montanum, Diploneis ovalis, Caloneis silicula, Mastogloia smithii, Navicula bacillum, Navicula cryptocephala, Navicula pupula, Nitzschia amphibian, Nitzschia punctata, Rhopalodia gibba, Amphora ovalis and Surirella robusta.*
Chlorophyceae	*Cosmarium granatum, C. subtumidium, C. varioilatum, Scenedesmus armatus, Coelastrum cambricum* and *Pediastrum simplex*
Cyanophyceae	*Merismopedia glauca, M. punctata, Spirulina major and Oscillatoria formosa.*

Table 3: Number of Dominant algal species

Algae Species	Number
Synedra tabulata	128
Synedra ulna	122
Cymbella aspera	145
Cymbella cymbiformis,	240
Cymbella affinis	180
Gomphonema montanum	120
Diploneis ovalis	186
Caloneis silicula	116
Mastogloia smithii	112
Navicula bacillum	182
Navicula cryptocephala	190
Navicula pupula	145
Nitzschia amphibian	121
Nitzschia punctata	154
Rhopalodia gibba	114
Amphora ovalis	108
Surirella robusta	146
Cosmarium granatum	72
C. subtumidium	64
C. varioilatum	45
Scenedesmus armatus	72
Coelastrum cambricum	54
Pediastrum simplex	76
Merismopedia glauca	54
M. punctata	58
Spirulina major	42
Oscillatoria formosa.	46

Conclusions

Physico-chemical parameters and the biological factors especially the benthic algae can be used as good indicators in assessing the quality of water. The river waters are alkaline and the pH was present always above 8. The DO always present above 8.0 mg/L. All the physico-chemical parameters are well below the permissible limits. All the three stations Diatoms constituted the major bulk of algal populations. The presence of all these species indicates that the water is clean and unpolluted nature of the river, as they are very sensitive to pollution.

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