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Original Research Paper

Monitoring of Water Quality and Pollution Status of Godavari River in and Around Nashik Region, Maharashtra

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ABSTRACT

Rivers are currently degraded by both natural and anthropogenic activities, which deteriorate the water quality, affecting the ecological balance, pushing them to brink of extinction in the process of unplanned development, giving rise to planning for suitable conservation strategies. On this background to know the present status of sources and degree of pollution of Godavari river, the analysis was carried out in terms of physico-chemical and biological parameters like temperature, turbidity, pH, free carbon dioxide, sulphates, phosphates, chlorides, nitrates, nitrites, total dissolved solids, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, phytoplanktons, zooplanktons and metals like sodium, potassium, zinc, copper, iron and lead at five locations S1 to S5 during the year November 2008-October 2009. Based on the analysis, quality and quantity of pollution, Nashik Municipal Corporation is suggested to device strategies to arrest further pollution of Godavari river and use of river water for drinking purpose after conventional treatment and disinfection.

INTRODUCTION

Water as a natural resource is becoming a scarce commodity due to its indiscriminate use and contamination from various sources such as leaching of agro-chemicals from farms, untreated domestic water from cities, and increasing volume of industrial effluents. Industrialization and urbanization has created serious problems of water pollution of our lakes and rivers. Industrial effluents and domestic sewage are directly discharged into water bodies, which contribute to a significant amount of heavy metals. The Godavari river originates in Nashik district in Sahyadri ranges in Trimbakeshwar and during its course , it meets many small and seasonal streams. At present, Godavari river water is polluted due to unfilthy practices of dumping waste and sewage.

MATERIALS AND METHODS

Study area: Five sampling stations of Godavari river (S1-S5) were selected for the present study. While selecting each sampling station, drainage pattern of the specific area into the river was kept in mind for eventually helping to identify the source and types of contaminants (Manivaskam 1984, Trivedy & Goel 1986).

S1: Someshwar-Point before the discharge of industrial effluents.

S2: Gharpure Ghat-Point before the domestic discharge into Godavari river.

S3: Ramkund-Water is used for washing, bathing, and various rites and rituals are performed here.

S4: Tapowan area-At the confluence of River Godavari and Waghadi and discharge of effluents into the river

S5: Dasak bridge-The exit point of Godavari river from the city.

Water samples were collected from the five sampling stations S1-S5 at an interval of one month from November 2008 to October 2009 seasonwise (Winter, Summer, Monsoon) in clean, rinsed plastic containers. Samples for chemical and biological analysis were collected separately. Methods used for chemical analysis were standardized according to the procedures given by APHA-AWWA-WPCF (1995). Heavy metals were determined by atomic absorption spectrophotometer. Flora and fauna were identified using keys given by Sehgal (1983), Adoni (1985) and APHA (1985).

RESULTS AND DISCUSSION

The seasonwise and annual average analysis of physico-chemical and biological parameters is given in Table 1 and Figs. 1-5 with statistical evaluation in Table 2.

Temperature: Temperature of Godavari water was found to be higher at S4 and S5 at which more of effluents are discharged. On the basis of three seasons, the average water temperature was 21.63°C, 27.92°C and 24.96°C during winter summer and monsoon seasons respectively. The same trend has also been observed by Sumitra (1969) and Kannan & Jog (1980) in tropical impoundments.

Table 1: Seasonwise and annual average analysis of physico-chemical and biological parameters at five stations (S1-S5) of Godavari River during Nov. 2008 to Oct. 2009.

	S1			S2			S3			S4			S5			Average	
Parameters	W	S	M	W	S	M	W	S	M	W	S	M	W	S	M	W	S	M
Temperature	19. 55	28.20.	26.60	19.78	27.78	24.00	21.71	27.55	24.05	23.00	27.55	24.70	24.15	28.53	25.45	21.63	27.92	24.96
pH	8.52	8.22	9.00	8.17	8.25	8.09	8.06	8.21	8.59	7.77	7.53	8.48	8.01	7.56	8.61	8.10	7.95	8.55
Turbidity	6.80	5.40	61.80	10.10	7.00	4.20	4.60	6.20	54.40	3.60	10.60	36.00	3.40	4.00	33.40	5.70	6.64	37.96
Free CO_2	3.64	2.07	2.48	16.54	12.82	11.58	2.73	3.72	6.62	8.77	8.15	6.62	10.01	6.00	4.96	8.33	6.55	6.45
Sulphates	83.87	58.62	81.16	41.43	122.65	57.72	37.88	78.46	27.05	40.58	80.26	54.11	32.47	71.24	46.89	47.24	82.24	53.38
Phosphates	2.47	1.06	0.23	2.19	1.06	0.14	2.02	1.30	0.46	3.07	1.53	0.15	2.36	1.48	0.72	2.42	1.28	0.34
Chlorides	12.61	12.78	20.59	69.02	69.20	54.67	19.17	14.56	23.43	41.18	25.56	41.89	44.02	27.69	46.86	37.2	29.95	37.48
Nitrates	1.99	0.44	0.55	1.45	2.90	0.18	1.33	0.27	0.17	1.18	0.36	0.11	2.11	0.85	0.10	1.61	0.96	0.22
Nitrites	0.01	0.12	0.00	0.01	0.15	0.00	0.00	0.07	0.00	0.01	0.16	0.00	0.00	0.17	0.00	.006	0.13	0.00
TDS	234.76	121.75	154.96	283.90	146.80	363.19	281.94	134.55	158.99	299.41	189.02	269.0	324.20	185.72	281.45	344.84	155.74	245.52
DO	9.16	4.17	7.25	7.57	4.86	3.84	7.36	4.92	5.12	6.41	2.45	3.63	5.55	3.67	5.33	7.21	4.01	5.03
BOD	28.70	22.31	31.53	8.40	6.40	6.25	24.50	17.11	23.94	25.00	53.64	33.62	15.25	20.46	14.26	20.29	23.98	21.92
COD	59.20	57.70	94.58	141.65	124.36	277.17	55.21	54.12	71.83	142.64	155.61	100.87	55.82	48.61	42.79	90.90	88.08	117.48
Phytoplankton	310.60	2150.50	1324.50	326.50	2170.50	1330.30	370.00	2256.00	1360.30	416.50	2360.25	1375.75	430.10	2380.45	1388.10	370.74	2263.54	1355.8
Zooplanktons	210.75	980.00	380.00	215.70	970.80	402.00	230.00	990.20	418.60	235.00	1005.10	410.10	250.00	1050.60	406.40	228.29	999.34	403.42
Sodium	5.75	1.83	3.00	4.93	2.84	3.65	1.95	1.90	3.25	3.58	3.20	3.55	3.75	2.88	3.65	3.99	2.53	3.42
Potassium	1.25	0.30	0.17	0.50	0.31	1.30	0.21	0.10	0.18	0.69	0.47	0.26	0.66	0.35	0.52	0.66	0.30	0.48
Zinc	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.002	0.008	0.002
Lead	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.014	0.00
Iron	0.04	0.01	0.02	0.06	0.01	0.01	0.03	0.01	0.01	0.03	0.01	0.02	0.00	0.01	0.03	0.003	0.001	0.009
Copper	0.001	0.00	0.00	0.001	0.00	0.00	0.001	0.002	0.00	0.001	0.004	0.00	0.001	0.00+4	0.00	0.001	0.00	0.002

All Parameters in mg/L, expect pH, turbidity (NTU), temperature (°C), planktons (Nos/mL).

pH: Water was alkaline during monsoon season (pH 8.55), winter (pH 8.10) and summer (pH 7.95). Kannan & Jog (1980) reported higher pH value during rainy season and lower during summer. Low pH in summer may probably be due to high rate of organic matter decomposing activities by microbes which release weak acids. Higher alkalinity of water may be indicative of intensive leaking from rocks due to runoff water.

Turbidity: Turbidity values varied with seasons. Monsoon season showed highest turbidity of 37.96 NTU as large quantities of suspended matter derived from catchment areas reaches the river, followed by summer (6.64 NTU) due to increased flow of water consequently enriching organic matter and least in winter (5.70NTU) as water is less turbid and relatively clean.

Free CO_2: Winter season showed higher amount of free CO_2 (8.33 mg/L) as compared to monsoon season (6.55 mg/L) followed by summer (6.45 mg/L). Level of free CO_2 varies inversely with level of dissolved O_2 as observed earlier by Ganapati (1943), Gonzalves & Joshi (1946) and Rao (1955).

Sulphate: Seasonwise sulphate showed enhanced values in summer (82.24 mg/L) followed by monsoon (53.38 mg/L) and winter (47.24 mg/L). Its higher concentration at the origin of Godavari in June and subsequent decrease in other months is due to mass visit of pilgrims to the origin for worship, which results into accumulation of voluminous waste from typical pooja articles.

Phosphate: Winter season showed higher phosphate concentration (2.42 mg/L), followed by summer (1.28 mg/L) and monsoon (0.34 mg/L). According to Edmondson (1972), sewage effluents have been regarded as good source of phosphates.

Chloride: Higher values in monsoon (37.48 mg/L), slightly less in winter (37.20 mg/L) and followed by summer (29.95 mg/L) is in accordance with observations of Cristobal (1979), which may be due to different types of industrial wastes, activities of slum dwellers and municipal sewage drained into river water.

Nitrate: Concentration of nitrates was highest in winter (1.61 mg/L) followed by summer (0.96 mg/L) and least in monsoon season (0.22 mg/L). The observed maximum values of nitrates during winter are in agreement with Prasad & Saxsena (1980), whose study indicated that due to flood, nitrates contributing algae from rocks are carried in water, which minimizes fixation of nitrates during monsoon season.

Nitrites: In monsoon and winter season nitrite concentration was barely detectable due to dilution factor. It was maximum in summer (0.13 mg/L) possibly due to accumulation of organic waste in the riverbed, as a result of reduced quantum and rate of flow which helped to increase biodegradation activities .

Total dissolved solids: TDS showed an enhanced value (344.84mg/L) in winter followed by summer (245.52mg/L) and monsoon season (155.74 mg/L). According to drinking water standards, prescribed by USPHS (United States Public Health Services, 1962) TDS should not excess 500 mg/L beyond which they may influence toxicity of heavy metals and organic compounds in fish and other aquatic life (Mckee & Wolf 1963).

Dissolved oxygen: Higher average dissolved oxygen (7.21

Table 2: Statistical evaluation of hysico-chemical and biological parameters at five stations (S1-S5) of Godavari River during Nov. 2008 to Oct. 2009.

Parameters	Winter	Summer	Monsoon	Mean	S.D	S.V	S.E
Temperature, °C	21.63	27.92	24.96	24.83	3.14	9.90	1.57
pH	8.10	7.95	8.55	8.2	.31	.09	.16
Turbidity (NTU)	5.70	6.64	37.96	16.76	18.35	337.08	9.18
Free Carbondioxide, mg/L	8.33	6.55	6.45	7.11	1.05	1.12	.53
Sulphates, mg/L	47.24	82.24	53.38	60.95	18.68	349.26	9.34
Phosphates, mg/L	2.42	1.28	0.34	1.34	1.04	1.08	.52
Chlorides, mg/L	37.2	29.95	37.48	34.87	4.26	18.22	2.13
Nitrates, mg/L	1.61	0.96	0.22	0.93	0.69	0.48	0.35
Nitrites, mg/L	.006	0.13	0.00	0.04	0,07	0,005	0.04
Total dissolved solids, mg/L	344.84	155.74	245.52	248.7	94.59	8947.28	47.30
Dissolved Oxygen, mg/L	7.21	4.01	5.03	5.41	1.63	2.67	0.82
BOD mg/L	20.29	23.98	21.92	22.06	1.84	3.41	0.92
COD mg/L	90.90	88.08	117.48	98.82	16.22	263.13	8.11
Sodium mg/L	3.99	2.53	3.42	3.31	0.73	0.54	0.37
Potassium, mg/L	0.66	0.30	0.48	0.48	0.18	0.032	0.09
Zinc, mg/L	0.002	0.008	0.002	0.004	0.0034	0.00	0.00
Lead, mg/L	0.00	0.014	0.00	0.004	0.008	0.00	0.00
Iron, mg/L	0.003	0.001	0.009	0.004	0.004	0.00	0.00
Copper, mg/L	0.001	0.00	0.002	0.001	0.001	0.00	0.00
Phytoplankton, Nos./mL	370.74	2263.54	1355.79	1330.02	946.66	896170	473.33
Zooplanktons, Nos./mL	228.29	999.34	403.42	543.68	404.20	163384.87	202.10

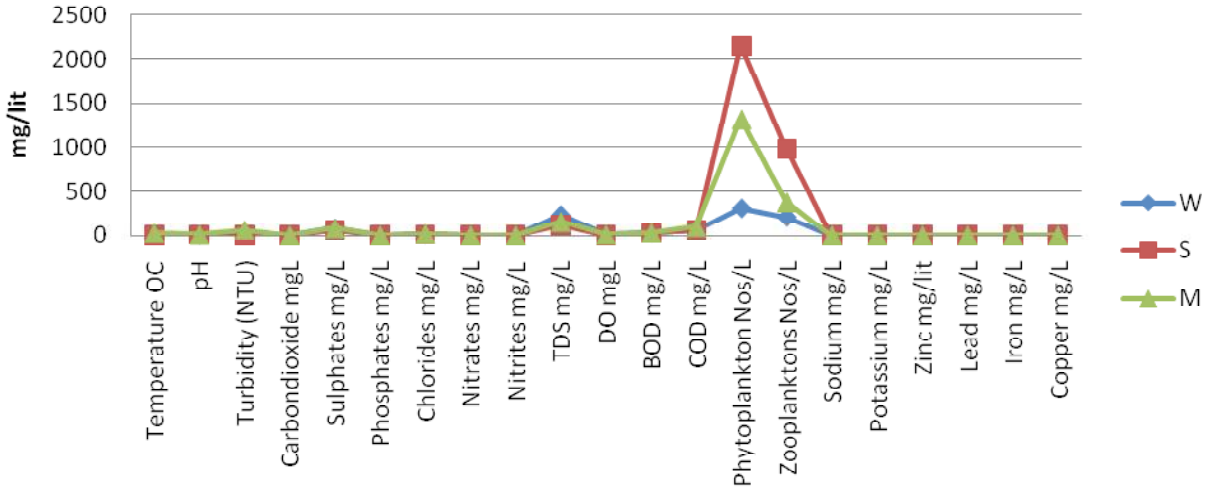

Fig. 1: Sesonwise analysis of physico-chemical and biological parameters at station S1 of Godavari river during Nov. 2008 to Oct. 2009.

mg/L) in winter was followed by monsoon (5.03mg/L) and summer (4.01mg/L) in present study. It is in agreement with the results of earlier workers (Singh 1960, Singh 1965, Gupta & Sharma 1994). The depletion of DO values at various stations indicated that river was polluted and water quality was highly deteriorated during summer months.

Biochemical oxygen demand: Higher BOD value in summer (23.98 mg/L) was followed by monsoon (21.92 mg/L) and winter (20.29 mg/L). Similar trend was observed by Varghese et al. (1992). Variation in BOD was due to variation in quantum of natural flow of river as a function of season as well as variation in the quantum of waste discharged.

Chemical oxygen demand: Higher COD value for winter as compared to summer may be due to waste material brought in during monsoon gets deposited along the banks during summer coupled with low microbial activity. Such patterns of COD values have been reported by Gunale (1997).

Planktons: Phytoplanktons were more dominant than zooplanktons. Presence of more algae and zooplanktons confirmed that the Godavari river is eutrophicated due to do-

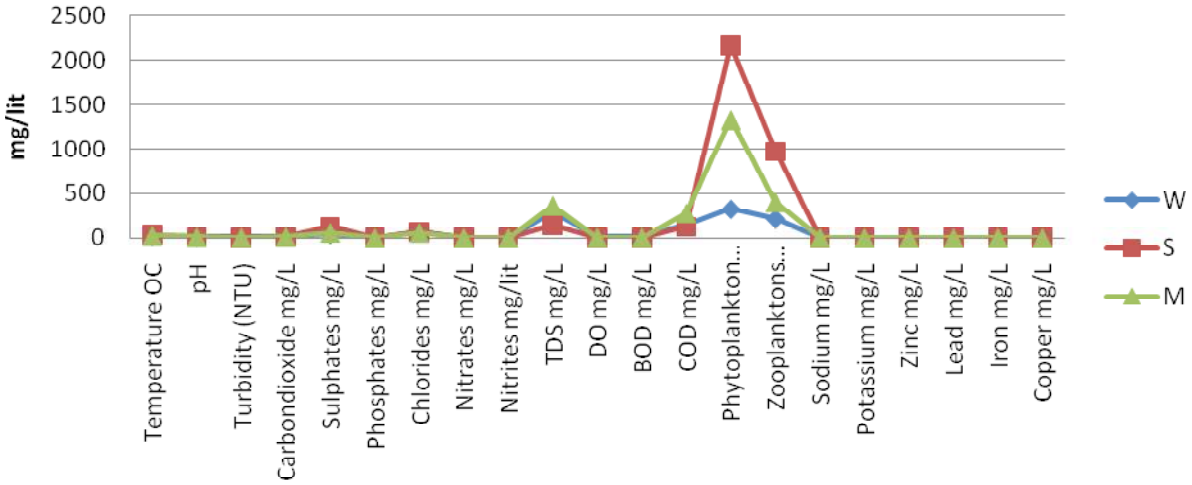

Fig. 2: Sesonwise analysis of physico-chemical and biological parameters at station S2 of Godavari river during Nov. 2008 to Oct. 2009.

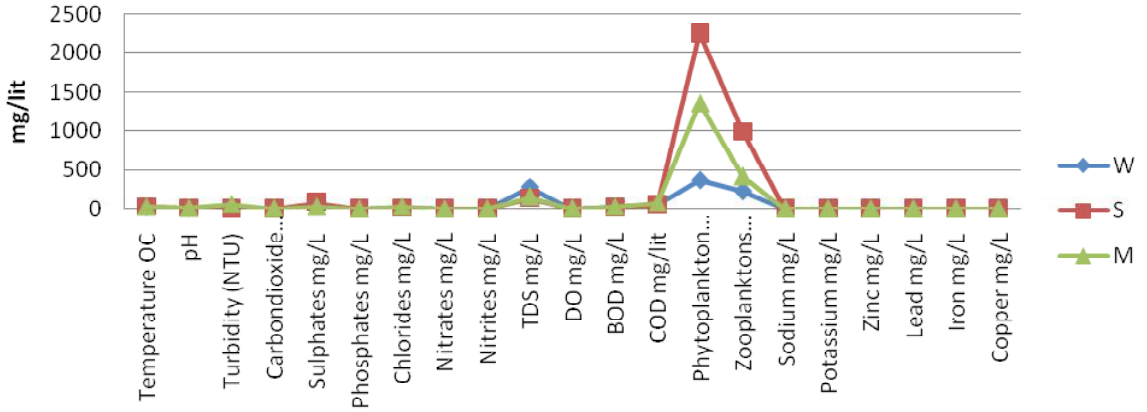

Fig. 3: Sesonwise analysis of physico-chemical and biological parameters at station S3 of Godavari river during Nov. 2008 to Oct. 2009.

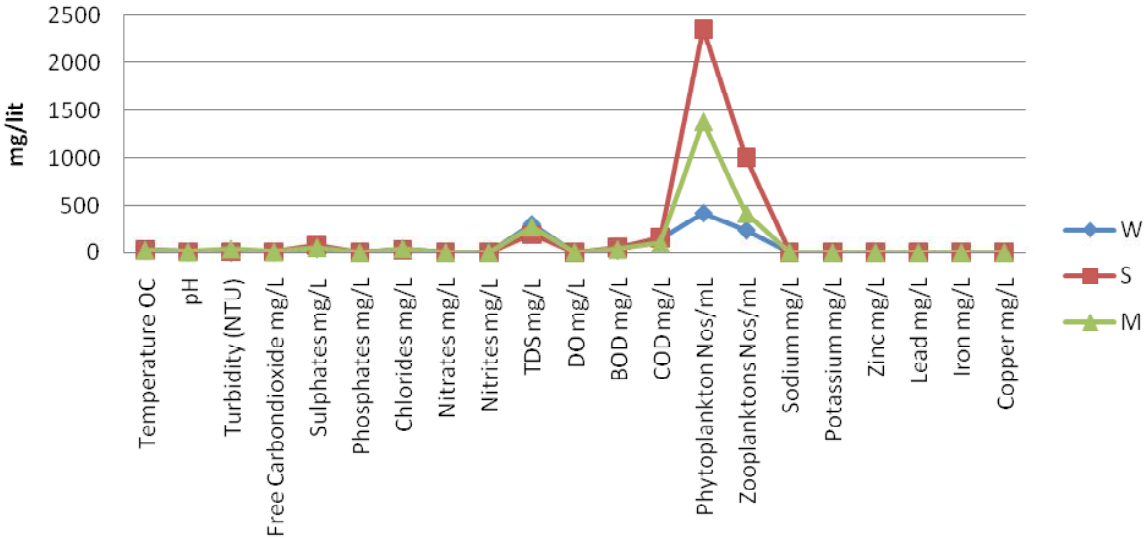

Fig. 4: Sesonwise analysis of physico-chemical and biological parameters at station S4 of Godavari river during Nov. 2008 to Oct. 2009.

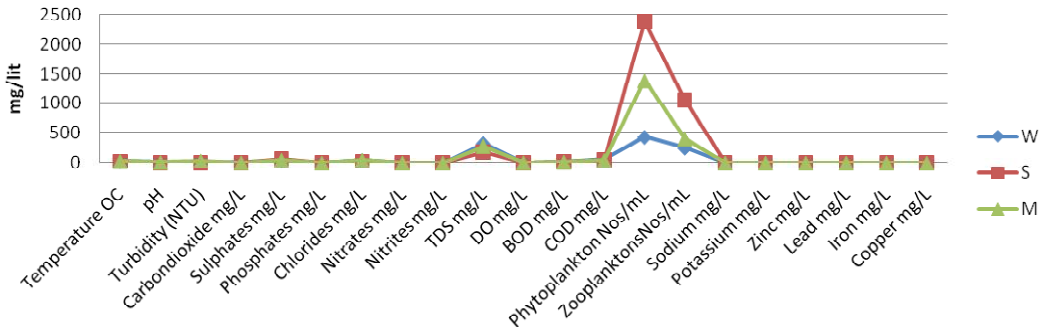

Fig. 5: Sesonwise analysis of physico-chemical and biological parameters at station S5 of Godavari river during Nov. 2008 to Oct.

mestic waste and agricultural runoff.

Sodium and potassium: Higher values observed in waters were due to sodium rich sewage effluents and high values of potassium indicate man-made pollution (Matthess & Harvey 1982). Davis & De Wiest (1967) showed that concentration of potassium goes on increasing with an increase in mineral matter in the river.

Heavy metals (Cu, Pb, Zn, Fe): Heavy metals are one of the most important inorganic pollution parameters. Significant amount of heavy metal content in Godavari river water was observed . The observed concentration of iron was comparatively higher but within limits. Values of Cu, Pb, Zn were found lower in all the samples than the prescribed limits. High pH of river water may result in the reduction of heavy metal toxicity (Dean Ross & Mills 1989).

CONCLUSION

Physico-chemical and biological analysis indicated that Godavari river water does not meet the norms to be potable water, confirming long range impact of pollution on health and ecosystem. Therefore, river water should be subjected to suitable chemical and biological treatment before it can be used for drinking purpose.

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