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Short Note

Assessment of Surface Water Quality of Godavari River at Aurangabad

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Abstract: Rivers are under increasing stress due to urbanization and other anthropogenic activities, leading to their over-exploitation and degradation. Godavari originates near Triambak in the Nasik district of Maharashtra, and flows through Madhya Pradesh, Karnataka, Orissa and Andhra Pradesh. Although its point of origin is just 80 km away from the Arabian Sea, it journeys 1465 km to fall into the Bay of Bengal. Like most other rivers, domestic pollution is the biggest polluter of the river Godavari, accounting for 82% of total pollution, whereas industrial pollution accounts for about 18%. The study covers 78 km of the river starting from the Kaigaon Toka to Shahagad. Six locations were selected for collection of water samples from the river and were analysed for water quality parameters in the environmental laboratory of Maharashtra Pollution Control Board (MPCB), Aurangabad. This data as well as the data from the Central Pollution Control Board were used to compute the National Sanitation, Foundation Water Quality Index (NSFWQI), which is generally applicable in USA and India. The results of the NSFWQI of Godavari River indicates its water quality as bad–medium over the stretch. Based on the results, the existing conservation measures have been reviewed and additional measures are suggested. The study concludes that major stress is industrial effluents and domestic pollution.

Key words: Water quality management, assessment of surface water quality, water quality parameters.

Introduction

It is well known that about 2.5% of water resources available on this planet 'Earth' are potable and remaining 97.5% is sea water. If we remove water in the form of icebergs on North and South Poles, hardly 0.26% water is available for human being, irrigation, industry use etc. This is true for past thousands of years and future thousands of years. The quantum of water is fixed but the population /industrial demands are not! Therefore the efficient water resources management and storing/ diverting available water resource are the need of the day. The construction of various structures to storages of water as and when required in and for isolated pockets, without planning, is the most undesirable approach. India is a vast country with varying climatic conditions – snow clad peaks of Himalaya, desert of Rajasthan, place like Cherapunji getting the highest rainfall in the world (1000 cm). The population of India is estimated to reach between 1.5–1.8 billion by the year 2050. The United Nations agencies have put this figure at 1.64 billion. With the present population of around 1000 million, the per capita water availability comes to about 1170 m^3/person/ year. The average annual surface water flows in India has been estimated as 1869 billion cubic metres of which only 690 billion cubic metres can be utilized, if appropriate storages can be treated. The reason for this vast difference between potential (1869 billion cubic metres) and the conditional availability (690 billion cubic metres) has been well recognized due to the monsoonic

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climate, besides topographical and geological limitations (Chavan et al., 2009; Metcalf, 1995; Chapman, 1996).

Godavari River—The Study Area

The Godavari basin extends over an area of 312,812 sq km which is nearly 10% of the total geographical area of the country. The basin lies between latitudes 16° 16′ N and 22° 43′ N and longitudes 73° 26′ E and 83° 07′ E. Over half of the river basin (18.6 million ha) is categorized as cultivable land. Godavari is second largest river in India which attaches considerable significance to the Hindu mythology; Godavari is often referred to as the Vriddh (Old) Ganga or the Dakshin (South) Ganga. The Godavari originates near Triambak in the Nasik district of Maharashtra, and flows through the states of Madhya Pradesh, Karnataka, Orissa and Andhra Pradesh. Although its point of origin is just 380 km away from the Arabian Sea, it journeys 1465 km to fall into the Bay of Bengal. Pollution of Godavari river water from its source of generation, i.e., Trimbakeshwar towards Nanded falls in input due to human activity. The stretch of about 78 km is selected from the Aurangabad city, i.e., from Kaigaon Toka to Shahagad. Samples were taken from the selected six sampling stations. The reconnaissance survey has been carried out before selecting the sampling stations, sampling schedule and frequency of sampling. The following information is collected through the reconnaissance survey [http://envfor.nic.in, 2010].

- The industrial effluents confluence with the Godavari River water.
- The domestic waste water is directly discharged into the river.
- The waste water including urine, sewage, bio-medical waste and solid wastes of Aurangabad are directly discharged into the river.
- River water is being utilized for agricultural purposes at Aurangabad corporation area.

Experimental Study

In the present study, six sampling locations were selected along the Godavari River as shown in Table 1 and Figure 1. The other data from 2005 to 2009 were collected from the records of the Maharashtra Pollution Control Board (MPCB), Aurangabad Head Office and some from the MPCB websites. Table 2 shows the rating scale for NSFWQI (National Sanitation Federation Water Quality Index) used for water quality assessment [www.water-research.net, 2010].

During September 2009 and February 2010, analyses of water quality parameters were carried out in order to detect pollution of the river. Samples were collected from drainage outfall point, river water as well as from the sediments of the river. Average water quality parameters for (post monsoon) September 2009 is shown in Table 3 and average water quality parameters such as physical parameters pH, temperature (ºC), turbidity (NTU), TSS (mg/l), TDS (mg/l), colour, taste and odour, electrical conductivity, etc., for the (pre monsoon) February are shown in Table 4. Chemical parameters like BOD, COD, DO (mg/l), Ca, Mg as $CaCO_3$, oil and grease (mg/l), sulphates were converted to NSFWQI scores which give an idea about the status of the water quality at the given location at the specified time and help the policy and decision makers at the government and public sector to plan for conservation of the river. The numerical scores with water quality descriptions are given in Table 4. The comparison of NSFWQI at the five locations for the years 2005–2009 is given in Table 6 based on data collected from the MPCB.

Table 1: Sampling locations [www.mpcb.mah.nic.in, 2010]

Sampling station	*Sampling station code and name*	*Latitude*	*Longitude*	*Description of station*
1	P_1–Kaigaon Toka	19º37.463’	75º01.490’	U/s of Nat Sager reservoir
2	P_2–Jaikwadi Dam	19º29.263’	75º22.272’	Pollution through agricultural runoff, fertilizers and pesticides
3	P_3–U/s of Paithan town	19º30.887’	75º 22.457’	At Paithan intake pump house
4	P_4–D/s of Paithan town	19º28.835’	75º23.835’	Pollution due to domestic sewage and human activities at Pathegaon bridge
5	P_5–Wadwali village	19º25.675’	75º36.475’	Domestic pollution
6	P_6–Shahaghad	19º21.392’	75º42.870	Industrial and domestic pollution at Jalna intake water house

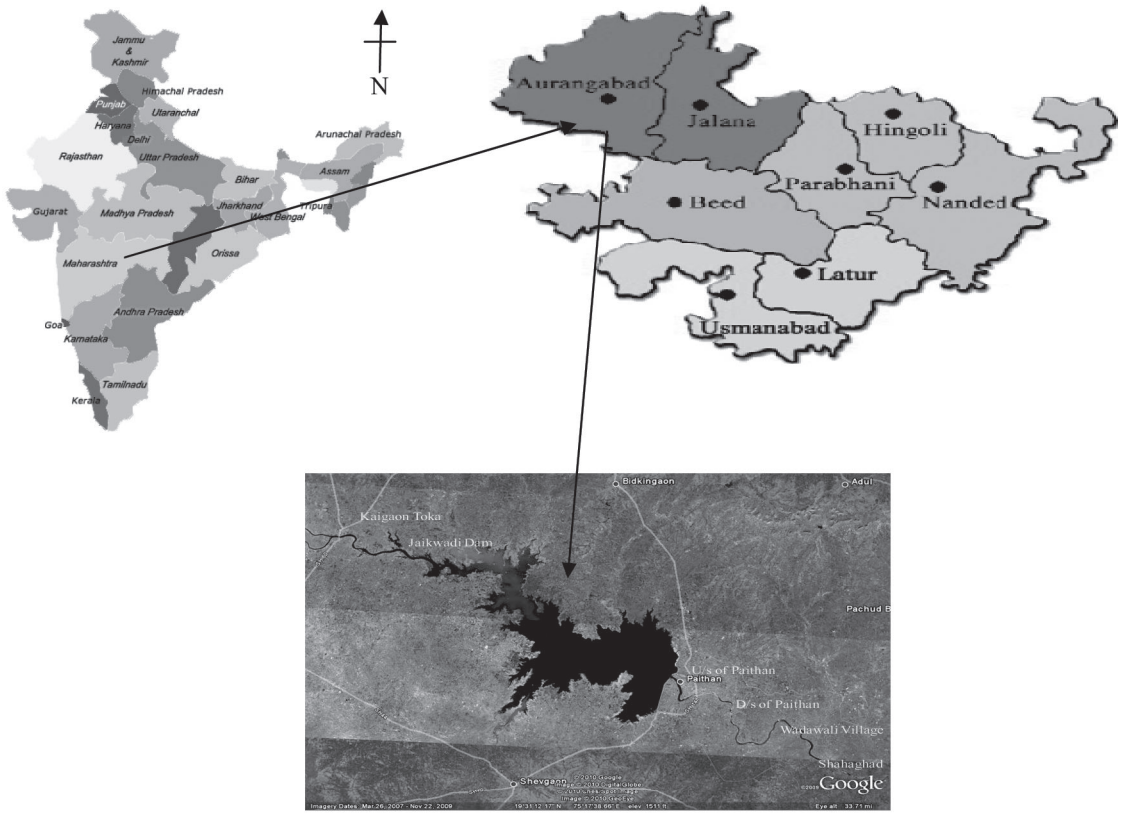

Figure 1: Location of study area on the Godavari River at Aurangabad [http://www.wikimapia.org, 2010].

Table 2: Rating scale for National Sanitation Federation Water Quality Index [www.water-research.net, 2010]

Index value	*Rating*	*Indicating colour*
0 and < 25	Very bad	Red
>25 and < 50	Bad	Orange
>50 and < 70	Medium	Yellow
>70 and < 90	Good	Green
> 90 and < 100	Excellent	Blue

Results and Discussions

The results of Table 5 as shown in Figure 2 Indicate that in September 2009 and February 2010 the water quality at the Shahagad (P_6) is bad while the water quality at other locations was medium, thereby indicating that there is not much change in the river water quality at all the locations during this period. The result shows that the pollution is not high at the P_1, P_2 and P_3 but at P_4 the pollution load is increasing due to the domestic load. Due to the Nath Sager dam (Jaikwadi dam) the water quality at the P_4 (U/s of the Paithan town) is medium. The actual locations are shown in Figure 3.

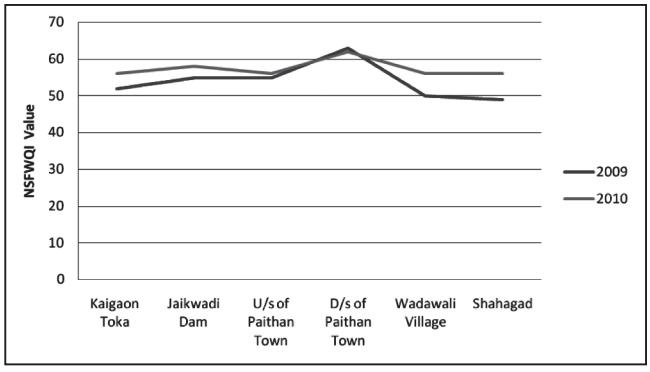

Figure 2: NAFWQI value of Godavari River.

Conservation Measures

Process of conservation may be synonymous of preservation against loss or waste. Technically, conservation of water implies the same meaning in a much wider perspective. Briefly stated it means putting the water resources of the country for the best beneficial use with all the technologies at our command. Water conservation basically aims at matching demand and supply. The strategies for water conservation may be

Table 3: Average water quality parameters (post monsoon 2009 in September) [www.mpcb.mah.nic.in, 2010]

Sampling location	*Temp. (°C)*	*Temp. variation (°C)*	*pH*	*Conductivity (μ mho/cm)*	*DO (mg/l)*	*BOD (mg/l)*	*COD (mg/l)*	*TDS (mg/l)*	*Turbidity (NTU)*	*Nitrate (mg/l)*	*Phosphate (mg/l)*	*Sulphate (mg/l)*	*Magnesium (mg/l)*
P_1	28	0.1	8.45	1091.0	4.48	2.09	16.0	1200.6	0.240	1.279	—	462.56	87.0
P_2	28.4	0.4	7.82	—	4.22	5.0	12.0	—	—	0.76	—		—
P_3	30.0	2.0	8.41	311.4	4.45	2.2	16.0	310.0	0.770	0.8283	—	42.0	120.0
P_4	29.0	1.0	8.21	410.3	5.03	3.92	12.0	258.3	0.915	0.983	0.035	24.9	88.4
P_5	29.5	0.5	8.61	890.79	4.42	2.9	16.0	843.0	1.86	7.6613	0.1222	136.0	197.2
P_6	29.3	0.2	7.96	—	4.60	3.4	8.0	—	—	9.78	—	—	—

Table 4: Average water quality parameters (Pre monsoon 2010 in February) [www.mpcb.mah.nic.in, 2010]

Sampling location	*Temp. (°C)*	*Temp. variation (°C)*	*pH*	*Conductivity (μ mho/cm)*	*DO (mg/l)*	*BOD (mg/l)*	*COD (mg/l)*	*TDS (mg/l)*	*Turbidity (NTU)*	*Nitrate (mg/l)*	*Phosphate (mg/l)*	*Sulphate (mg/l)*	*Magnesium (mg/l)*
P_1	28	0.1	7.72	412.7	4.03	2.59	8.0	415.9	0.894	1.047		24.1	105.4
P_2	28	0.0	7.51		3.37	2.1	12.0			0.70			
P_3	27	1.0	7.39	398.59	4.52	5.09	16.0	307.5	0.497	0.427		17.8	101.3
P_4	29	2.0	7.52	311.9	4.02	3.5	12.0	207.5	0.0981	0.4921	0.1209	27.4	89.8
P_5	29.8	0.8	7.34	541.3	4.87	2.89	12.0	548.3	0.98	4.32	0.09	52.3	151.6
P_6	28	1.8	7.81		4.29	4.17	12.0			0.78			

Table 5: Sub-Index value (Based on Year 2009 Post monsoon and 2010 Pre monsoon) (Water Quality Index)

Post monsoon 2009	*September 2009*					
Parameters	P_1	P_2	P_3	P_4	P_5	P_6
Temperature	28	28.4	30.0	29	29.5	29.3
pH	8.75	7.82	8.41	8.21	8.61	7.96
Conductivity (μ mho/cm)	1091.0	—	311.4	410.3	890.7	—
DO (mg/l)	4.48	4.22	4.45	5.03	4.42	4.60
BOD (mg/l)	2.09	5.0	2.2	3.92	2.9	3.4
COD (mg/l)	16	12	16	12.0	16.0	8.0
TDS (mg/l)	1200.6	—	310.0	258.3	843.0	—
Turbidity (NTU)	0.240	—	0.770	0.915	1.86	—
Nitrate (mg/l)	1.2791	0.76	0.828	0.983	7.661	9.78
Phosphate (mg/l)	—	—		0.035	0.122	—
Sulphate (mg/l)	462.56	—	42.0	24.9	136.0	
Mangesium (mg/l)	87	—	120	88.4	197.2	—
NSFWQI value	52	55	55	63	50	49
Pre monsoon 2010	*February 2010*					
Parameters	P_1	P_2	P_3	P_4	P_5	P_6
Temperature	28	28	27	29	29.8	28
pH	7.72	7.51	7.39	7.52	7.34	7.81
Conductivity (μ mho/cm)	412.7	—	398.59	311.9	541.3	—
DO (mg/l)	4.03	3.37	4.52	4.02	4.87	4.29
BOD (mg/l)	2.59	2.1	5.09	3.5	2.89	4.17
COD (mg/l)	8.0	12.0	16.0	12.0	12.0	12.0
TDS (mg/l)	415.9	—	307.5	207.5	548.3	—
Turbidity (NTU)	0.894	—	0.497	0.0981	0.98	—
Nitrate (mg/l)	10.47	0.70	0.427	0.492	4.32	0.78
Phosphate (mg/l)	—	—	—	0.120	0.09	—
Sulphate (mg/l)	24.1	—	17.8	27.4	52.3	—
Mangesium (mg/l)	105.4	—	101.3	89.8	151.6	—
NSFWQI value	56	58	56	62	56	56

Table 6: Comparison of NSFWQI in different years at five sampling locations

Sampling stations	NSFWQI value				
	2005	2006	2007	2008	2009
Kaigaon Toka (P_1)	45.90–BAD	50.08–Medium	45.9–BAD	48.9–BAD	0.66– Medium
Jaikwadi Dam (P_2)	55.16–Medium	54.55–Medium	54.7–Medium	53.88– Medium	56.88– Medium
U/s of Paithan town (P_3)	43.09–BAD	47.72–BAD	46.67–BAD	49.16–Bad	53.37–Medium
D/s of Paithan town (P_4)	47.16–BAD	45.08–Bad	50.58–Medium	47.09–Bad	56.12–Medium
Wadwali village (P_5)	47.16–Bad	53.91–Medium	49.08–Bad	47.58–Bad	49.55–Bad

demand oriented or supply oriented and/or management oriented. The strategies may vary depending upon the field of water use—domestic, irrigation or industrial, public participation and institutional development, solid waste management, watershed management and development, sewerage and sanitation. Conservation of river includes following measures [MoEF Annual Report, 2004–2005].

- Interception and diversion works to capture the raw sewage flowing into the water through open drains and divert them for treatment
- Sewage treatment plants for treating the diverted sewage
- Low cost sanitation works to prevent open defecation of the riverbank

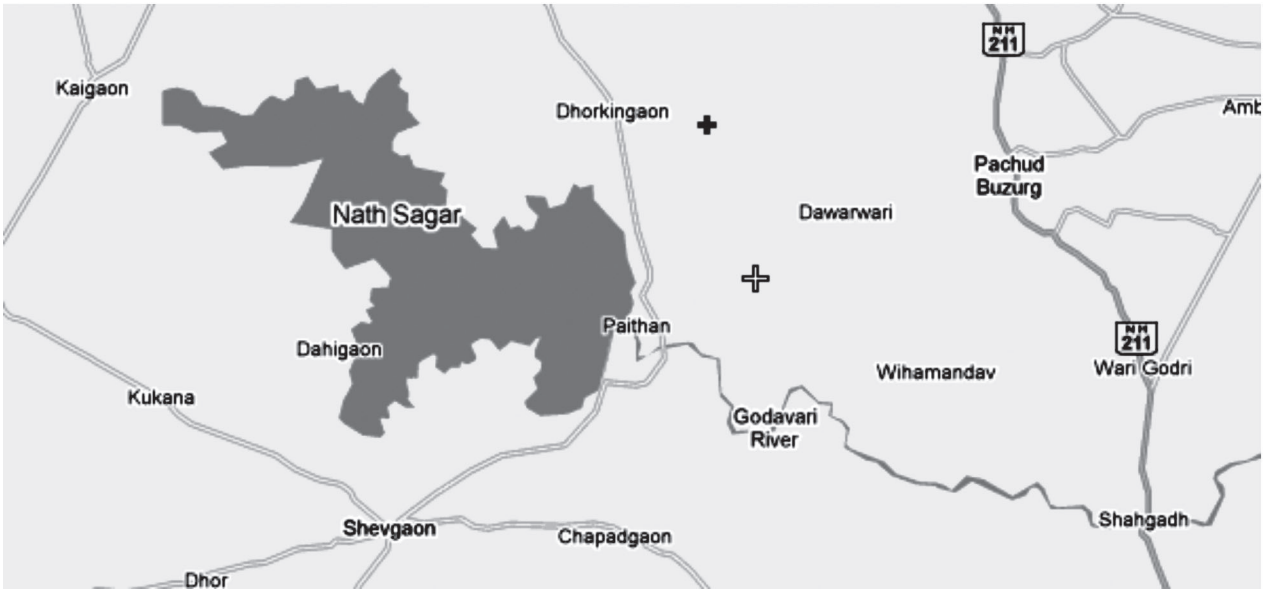

Figure 3: Sampling stations in the study area on the Godavari River.

Conclusion

The water quality assessment of seventy-eight km stretch of Godavari River in Aurangabad district from Kaigaon Toka to Shahagad in Maharashtra indicates that the river is heavily polluted due to the large scale and medium scale units. The water quality at P_1, i.e., Kaigaon Toka is medium. The result shows that the pollution is not high at the P_1, P_2 and P_3 but at P_4 the pollution load is increasing due to the domestic load. Due to the Nath–Sager Dam (Jaikwadi Dam) the water quality at the P_4 (U/s of the Paithan town) is medium. The massive growth of some industries like laundry, restaurants, pathological laboratory, nursing homes, hotels, etc., discharge waste into the river. The National Sanitation Federation Water Quality Index (NSFWQI), computed from September 2009 to February 2010 as well as during 2005–2009 indicates that the study stretch has medium water quality at the starting of the Nath-Sager reservoir (Jaikwadi dam). But at the D/s of the Paithan town the water quality is degraded. The water quality has not improved beyond medium range up to 2009, perhaps due either to the fact that current facilities have become inadequate or are not properly functioning. It is therefore suggested that in the light of present development in the study stretch, there is need to reassess the required facilities and to take effective steps to put them into full operation to achieve the targets.

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