

## WATER QUALITY OF DUDHSAGAR RIVER AT DUDHSAGAR (GOA), INDIA

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**Key Words** : Pollution, Phytoplankton, Zooplankton, Nitrates

### ABSTRACT

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Dudhsagar river of Goa originates in Karnataka State and flows through rapids in Goa, covering a distance of about 60 km. before joining the Arabian Sea. The physico-chemical characters of the river water were analysed. The river water showed high concentrations of sulphates and nitrates. In all ten genera of phytoplanktons were observed while the zooplanktons were represented by *Notholoca* sp., *Nauplius* sp., *Micronauplius*, sp., *Karatella* sp., *Keretella* sp. The river water was found polluted in specific periods of a year.

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### INTRODUCTION

It has been now established that the water quality of the rivers and their tributaries get vastly deteriorated due to the disposal of wastes in them. Due to the rapid industrialisation, urbanisation, poor sanitation and unscientific waste disposal procedures as well as carelessness towards environment, the environmental degradation has gained momentum. Recently some investigators like Ghose and Sharma (1988), Mahajan (1988), Mishra and Saksena (1991), Palharya and Malviya (1988), Rana and Palria (1988), Sengupta *et al* (1988), Shah (1988), Shyamsunder (1988), Sinha (1988), Somshekhar (1988), Shukla

*et al* (1988) Trivedy (1989), Rao *et al* (1990), Singh and Singh (1992), Kapoor (1993), Saxena and Chauhan (1993), Trivedy and Dodia (1993) have reported pollution in Indian rivers. As there is hardly any information available on Dudhsagar river of Goa which originates in Karnataka state and flows through rapids in Goa covering a distance of about 60 km. before joining the Arabian sea. During its course in Goa, it flows through different villages and subsequently gets polluted. In the present study an attempt is made to evaluate the quality of the river water right at the place where it enters Goa in the form of Dudhsagar falls which eventually is recognised as Dudhsagar river.

## MATERIAL AND METHODS

The surface water samples were collected fortnightly in polysterene bottles (500 ml) at two stations from Dudhsagar river (15°18' N Lat. and 74°17' Long) in the year July 1988 through June 1989. The samples were collected in the early hours of the day i.e. between 7.0 a.m. to 9.0 a.m.

Analytical techniques as described in Standard methods for examination of water and waste water (APHA, 1980) and chemical and Biological methods for water pollution studies (Trivedy and Goel, 1986) were adopted for physico-chemical analysis of river water. Water temperature, Oxygen, Carbon dioxide, Acidity, Alkalinity, Hardness were determined on the site while pH, Chlorides, Phosphates, sulphates and Nitrate contents were analysed in the laboratory. The phytoplanktons were collected from the river and preserved in 4% Lugols solution. The zooplanktons were collected with the help of a plankton net (mesh 25, diameter of the pore 60  $\mu$ m). The zooplanktons were preserved in 5% formalin.

## OBSERVATIONS

Physico-chemical characteristics of water temperature varied from 23°C to 31°C. The temperature was minimum in September and January and maximum in May 1989. The humidity around Dudhsagar river at the sampling sites varied between 45 to 91. It was maximum (91%) in June 89 while minimum (45%) in March 89.

The river water was acidic throughout the study period except Nov. -

Dec. 88 when it was slightly alkaline. The low pH value (6.0) was observed in Jan. 89 and the high pH (7.6) was noted in Dec. 88. The dissolved oxygen ranged from 4.8 mg/l to 17.9 mg/l. The water was rich in oxygen in July 88, Sept. 88, Jan.-Feb.-Mar. 89. The free CO<sub>2</sub> in water varied between 6.0 mg/L to 28 mg/L. Almost for nine months the CO<sub>2</sub> level was above 10 mg/L.

The range of total acidity was between 20.0 mg/L to 140 mg/L, especially the summer values of acidity were significantly high. Only in Oct.-Nov. 88 the acidity was comparatively low. The alkalinity fluctuated between 40.0 mg/L to 220 mg/L. The river showed high alkalinity in Nov.-Dec. 1988 and through Jan. 89 to Mar. 89. The hardness ranged between 12.0 mg/L to 47.0 mg/L. The water was hard in summer and soft in rest of the months. The chloride concentrations varied between 1.24 mg/L to 11.28 mg/L. Only in Jan.-Feb. 89 the chloride concentration went above 10.0 mg/L. The PO<sub>4</sub> values fluctuated between 0.8 mg/L to 10.27 mg/L. The river had high PO<sub>4</sub> contents in Nov. 88 and Feb.-March 1989. The monsoon values for PO<sub>4</sub> were quite low. The range of sulphate was between 0.62 mg/L to 30.5 mg/L. Only in Feb.-Mar. 89 the SO<sub>4</sub> content were every high. Nitrates ranged between 0.4 mg/L to 21.7 mg/L. Only in Feb. 89 the nitrate concentration in the water was high. The total suspended solids showed varying levels but still they were quite low.

The total suspended solids amounted to 4.0 mg/L and increased in summer (Mar. Aprl. May 89) to 14

**Table 1.** Physico-chemical characteristics of Dudhsagar river at Dudhsagar, Goa (All values except humidity & Temperature are expressed as mg/L)

Month	Humi.	pH.	Temp.	D.O.	CO <sub>2</sub>	T.Acid.	T.Sol.	Alk.	Hard.	Cl.	PO <sub>4</sub>	SO <sub>4</sub>	Nit.
July 88	82	6.6	24.2	10.12	6.34	41	12	40	22	1.24	1.2	1.42	1.0
Aug. 88	85	6.7	23.4	9.74	8.0	50	13	60	20	4.26	1.12	1.55	1.32
Sep. 88	73	6.5	23.0	17.9	16	35	10	40	12	8.52	1.1	0.81	0.62
Oct. 88	65	6.8	24.6	8.1	10	20	8	40	12	3.12	0.8	0.62	1.3
Nov. 88	63	7.4	25.0	5.5	16.	28	6	220	36	4.7	9.9	3.8	1.15
Dec. 88	60	7.6	24.4	4.8	28	51	4	150	26	6.39	0.18	4.73	1.55
Jan. 89	58	6.0	23.0	14.0	20	40	7	117	36	11.28	4.38	16	2.57
Feb. 89	50	6.7	25.1	12.0	6.0	140	7	140	28	10.65	10.27	30.5	21.7
Mar. 89	45	6.8	27.6	10.4	16.1	110	14	100	47	7.1	9.5	31	0.8
Apr. 89	77	6.8	29.2	9.2	14.2	80	14	60	45	5.2	3.6	20	0.6
May 89	73	6.7	31.0	10.3	12.2	45	14	55	40	4.3	2.12	10	0.4
June 89	91	6.65	28.7	8.6	10.3	33	12	45	30.4	3.16	1.8	5.2	0.56

**Abbreviation :** Humi = Humidity, Temp = Temperature, D.O. = Dissolved oxygen, T. Acid = Total acidity, T. sol. = Total suspended solids, Alk = Alkalinity, Hard = Hardness, Cl = chlorides, Nit = Nitrates.

mg/L. Phytoplanktons : In all ten genera of phytoplanktons were observed in the water. They are : Bacillariophyceae : *Melosira granulata*, *Synedra ulna*, *Amphora ovalis* *Cymbella* sp. Chlorophyceae : *Pediastrum simplex*, *Scenedesmus obliquus*, *Oocystis crassa*, *Tetraedron minimum*, *Characium* sp. *Cladophora-glomerata*. On the basis of species available it appeared the chloro-phyceae were dominant for most period but Bacillariophyceae were dominant in February 1989.

**Zooplankton :** The maximum population of zooplankton was noticed in September, 1988 to Jan. 1989. (231 to 508 organisms/M<sup>3</sup>). In the remaining period it was very low. Protozoans were insignificant contributors but the dominant other species were *Notholoca* sp., *Nauplius* sp., *Karetiella* sp., *Karetiella* sp. and *Microcyclops* sp., Occasionally *Daphnia* were also seen.

## DISCUSSION

The pH of the water body indicates the degree of deterioration of water quality (Verma *et al.*, 1984). The water pH was acidic and it could be due to the iron present in the water (Fergusson 1982). The rise of pH towards alkaline range in November and December indicates mixing of sewage and other effluents as these lead to pollution (Mishra and Sexena, 1991).

The precipitous drop in O<sub>2</sub> contents in November and December 88 could be due to the release of wastes demanding more oxygen (Mishra and Sexena, 1991). Sinha (1988) reported D.O. between 6.7 and 7.5 mg/L in Damodar river of Bihar

while Sharma (1988) reported a range of 5.3 to 10.0 mg/L of oxygen in Ganga river at Patna where the water quality has deteriorated. Therefore low D.O. for almost 3/4th year is in conformity with these reports. In the rainy season in an unpolluted river the D.O. values are usually high and in the present study the low D.O. could be considered as an indication of deterioration of water quality.

The high CO<sub>2</sub> level indicates pollution (Mishra and Sexena, 1991). Sexena and Chauhan (1993) reported inverse relation between D.O. and CO<sub>2</sub>. In the present study such a relationship was observed only for six months. Increase in CO<sub>2</sub> indicates increase in pollution load. High acidity also indicates increase in pollution. Ajamal and Razi-Ud-Din (1988), Chandra Prakesh *et al.* (1988), Ghose and Sharma (1988), Shah (1988) have observed high alkalinity in river water indicating high pollution load. Similarly high alkalinity in the present study also indicates high pollutions load which may be due the effluents and sewage added in to the river during its course through villages of Karnataka state before it entered Goa. The alkalinity fluctuates in accordance with the fluctuations in the pollution load.

Increase in hardness in summer could be due to the increase in Ca<sup>++</sup>, Mg<sup>++</sup> and Mn<sup>++</sup> ions (Mishra and Saksena, 1991). Domestic sewage, agricultural effluents containing fertilizers and industrial wastes contribute to the increase in PO<sub>4</sub> concentrations. Shamsunder (1988), Sharma and Pathak (1981) observed comparatively low PO<sub>4</sub> concentrations in

polluted river but in the present study comparatively high concentrations of  $PO_4$  have been found indicating higher degree of pollution load. Similarly Rana and Palria (1988) have reported high  $PO_4$  concentration (7.6 mg/L) for Bandi river. The phosphate concentrations usually above 2.0 mg/L can be considered as an indication of pollution.

The high  $SO_4$  concentration indicates pollution of the river water. In summer the evaporation of water and rise in temperature could result in rise in  $SO_4$  level.

The presence of specific phytoplanktons and low population of zooplanktons clearly indicates the deterioration of the river water quality.

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