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River Water Quality Assessment in Beed District of Maharashtra: Seasonal Parametric Variations.

[1]Sayed R.A. and [2]S.G. Gupta

[1]Shri Bankatswami College, Beed-431122 Maharashtra, India
[2]State Institute for Administrative Careers (SIAC), Mumbai, Maharashtra, India

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Abstract: The water quality of rivers at Beed district was analyzed to assess their suitability for drinking and domestic. The sampling was done seasonally and the study period was divided into three seasons i.e. winter, summer and monsoon. The physico-chemical and bacteriological parameters were compared with standard values, recommended by Indian Council of Medical Research, the Bureau of Indian Standards and the World Health Organization. The water was found moderately hard and unfit for consumption and domestic purposes.

Key word:

INTRODUCTION

Man is heading faster towards both utopia and catastrophe. Urbanization and industrialization are being used to transform the entire earth towards sophistication which usually leads to the destruction of the environment. Water resources have been one of the most exploited in the ecosystem. On one hand, rapid population growth and industrialization have resulted in greater demand of good quality water while on the other, pollution of water resources is increasing steady.

A recent UNESCO Report indicates that a vast chunk of population in India has no access to safe drinking water and that about 66 million people still rely on unsafe ground water for consumption [1]

Beed town is situated on Solapur-Dhule National highway No.211. It is densely populated with some of 39379 inhabitants as of 2001. Like the other cities and town of India, business and trading activities are the mainstay in Beed. Ground and river are main sources of water for drinking and domestic purposes respectively. Due to poor maintenance of supply lines and improper drainage system, the water quality is greatly affected negatively. Pipelines at several places are broken and are exposed directly to sewage and urban effluents, increasing bacterial and organic load. Surface effluents further go deep into sub surface of earth causing ground water pollution. Septic tanks, urinals, latrines and drains are found very close to water bodies and pipelines.

Water supplies contaminated with faecal matter cause number of diseases. The relationship between polluted water and waterborne diseases such as typhoid, dysentery and cholera is well known. Various human activities cause pollution of river water. The discharge of human and animal wastes directly into water bodies, further deteriorate their quality. Thus, there is high potential of environment pollution at Beed because of the human activities. A wide variety of pollutants have been reported to cause deterioration of physico-chemical properties of water, consequent to rapidly increasing population, urbanization, industrialization and new technological development [2]. Bacteriological and physic-chemical studies has been carried out in recent years at different places viz. Nagpur district, Rajasthan, India. [3], Akola, Maharashtra, India [4], Hyderabad andhra Pradesh, India [5], Aurangabad, Maharashtra, India [6].

No initiation has been taken so far to assess the current status of water quality at the suspected points. Systematic study is attempted to investigate the water quality of Bindusara river and Sindhfana river (Hirapur village).

Corresponding Author: R.A. Sayed, Shri Bankatswami College, Beed-431122 Maharashtra, India,
Email: razbansayed@rediffmail.com.

MATERIALS AND METHODS

Based on the rainfall data, sampling was done for three seasons viz. Winter (Nov. 2005 to Feb. 2006), Summer (March to June 2006) and Monsoon (July to Oct. 2006). Grab sampling techniques ware adopted and river water samples were collected fortnightly from 7 sampling stations in three seasons. Samples were collected in morning at 8.00 to 11.00 am. During each sampling, two samples were collected from each station. Samples were collected in polyethylene bottles, for physico-chemical analysis viz. pH, temperature, Electrical Conductivity (EC), TDS, TSS, total alkalinity, total hardness, Ca, Mg, Cl, salinity, nitrate, ammonia, sulphate, phosphate, dissolved oxygen, BOD, COD, heavy metals like copper, zinc, chromium cadmium; and glass bottles for bacteriological analysis, as per standard procedure. Suitable preservatives were used (Mathur, 1985). Analysis was done as per the methods given by APHA (1998) and others (Trivedy and Goel, 1986; NEERI, 1988). Temperature, pH and DO were immediately determined on-site after collection of the samples. Bacteriological analyses were performed immediately after collection of water samples in the laboratory. Multiple tube fermentation technique was followed for coliform and faecal coliform estimation, Trivedy *et al.* [17] where in the results of examination of positive tubes were reported in terms of Most Probable Number (MPN). Heavy metals concentration in water samples were determined on Atomic Absorption Spectra(AAS, Perking Elmer AA4BB).

RESULTS AND DISCUSSION

The data on the physico-chemical and bacteriological analysis of waters at various sites obtained in the present studies are give in Table 1. The pH values were mostly well within permissible limits (6.5 to 8.5) prescribed by WHO except the values which were above 8.5. The pH values of the water samples showed slightly alkaline trend. The higher pH values may be due to the geology of catchment area. The pH value of Mornn river was also in the alkaline range [7]. These findings correlates with present study.

The seasonal effect plays an important role in water temperature. The minimum temperature of 24.0°C and maximum of 36.0°C were recorded during monsoon and winter/summer respectively. Electrical conductivity ranged between 0.208 mmhos/cm (summer) to 1.32 mmhos/cm (winter) in Bindusura river and 0.695 (monsoon) to 0.955 mmhos/cm (monsoon) in Sindhfana river. Changes in conductivity of sample may signal changes in mineral composition of raw water and intrusion of domestic water. EC depends and increase with increase in ionic strength of water. Deshmukh and Ambore [8] recorded EC of 290 to 610 μmhos/cm at Nanded, India, in the year 1999-2000. Rekha Rani *et al.* [9] reported EC for three season in the range of 288 to 395 μmhos/cm in the river water near Satna city Madhya Pradesh, India.

TDS in the river water of Bindusara was 541 mg/L (winter) to 920 mg/L (summer) and 470 mg/L (winter) to 670 mg/L (monsoon) in Sindhfana river. These values were within permissible limit of drinking water standards (500 to 1500 mg/L) suggested by WHO and the Bureau of Indian Standards. Shanta *et al.* (2006) reported TDS in the range of 75-110 mg/L from Varaga river at Theni district Tamil Nadu, India.Total Alkalinity of 168 mg/L (monsoon) to 365 mg/L (summer) in Bindusara river and 160 mg/L (monsoon) to 191 mg/L (winter) in Sindhfana river was observed. Alkalinity affects the amount of chemicals that need to be added to water during chemical coagulation. Up to 400 mg/L of alkalinity is not considered a problem to human health. This high alkalinity may cause incrustation in the distribution pipes, even raises the pH level, which in turn harms or kills fishes and other river organisms.

Water with hardness above 200 mg/L may cause scale deposition in the distribution subsequent scum formation (WHO, 1984). In the present study, total hardness was highest during winter and summer and minimum during monsoon season. Meitei *et al.* [10] noted total hardness in Purna river (Maharashtra, India) as 102 mg/L (monsoon) to 132 mg/L (post monsoon). The highest hardness levels were recorded during monsoon. Mishra and Tripathi [11] reported a higher value of 295 mg/L in Ganga river. According to Kannan [12], water with hardness value more than 180 mg/L is very hard. Hardness below 300 mg/L is considered potable but beyond this limit produces gastrointestinal irritation [13].

Various authorities like Indian Council of Medical Research (ICMR), World Health Organisation (WHO), laid down limits for Ca not for health reasons but to alleviate the adverse tendency of calcium to contribute to hardness of the water. In the present study, Ca level was 20 mg/L (winter) to 48 mg/L (summer) in Bindusara river and 23 mg/L (monsoon) to 60 mg/L (winter) in Sindhfana river. Shrivastava and Patil (2002) reported calcium in Tapi river water at different sites in the range of 25.18-42.74 mg/L. Mishra and Tripathi [11] reported a higher value of 295 mg/L in Ganga river. Mg level from both rivers was below the prescribed limit. Mohanta and Patra [14] observed the levels of magnesium maximum during summer and minimum in winter in the river Sanamahhakandana at Keonjhar Garth. (Orissa), India.

Table 1: Physico-chemical and bacteriological qualities of river water during different seasons.

Parameter	Season	S1	S2	S3	S4	S5	S6	S7
pH	Winter	8.81	8.41	7.43	7.4	8.06	7.8	7.92
	Summer	7.47	7.45	7.4	7.5	Dried	Dried	Dried
	Monsoon	8.6	8.82	8.45	7.94	8.12	8.04	8.22
	Winter	26.5	26.7	24.2	24	24.1	23.5	23.7
Temperature (°C)	Summer	36	31.8	31.2	31.8	Dried	Dried	Dried
	Monsoon	28.9	29.5	30.4	29.8	30	29.7	30.2
	Winter	0.6	0.64	1.11	1.32	0.76	0.86	0.81
EC (mmhos/cm)	Summer	0.208	0.291	0.778	0.914	Dried	Dried	Dried
	Monsoon	0.591	0.797	0.835	0.985	0.695	0.866	0.955
	Winter	541	864	868	872	470	560	660
TDS (mg/L)	Summer	860	790	880	920	Dried	Dried	Dried
	Monsoon	880	810	900	910	720	590	670
	Winter	149	256	160	262	82	90	92
TSS (mg/L)	Summer	65	48	70	88	Dried	Dried	Dried
	Monsoon	74	56	82	90	110	75	96
Parameter	Season	S1	S2	S3	S4	S5	S6	S7
Total	Winter	199	193	188	185	190	191	184
Alkalinity	Summer	306	310	365	280	Dried	Dried	Dried
(mg/L)	Monsoon	168	178	170	175	160	168	172
	Winter	353.8	229.4	549	695.5	390.4	402.6	396.5
TH (mg/L)	Summer	70	100	90	90	Dried	Dried	Dried
	Monsoon	78	98	87	88	104	102	109
	Winter	80	20	80	40	28	52	60
Ca (mg/L)	Summer	32	36	48	48	Dried	Dried	Dried
	Monsoon	23	31	25	27	23	42	31
	Winter	12	64.8	74.4	117.6	81.6	60	50.4
Mg (mg/L)	Summer	28.6	47.66	47.66	45.28	Dried	Dried	Dried
	Monsoon	12.6	14.7	11.8	16.3	9.3	20.6	13.3
	Winter	355	319.5	497	355	639	355	497
Cl (mg/L)	Summer	454.4	482.8	397.6	298.2	Dried	Dried	Dried
	Monsoon	283.6	269	354	275	478	272	283
	Winter	640	576.73	897.12	640.81	1153.43	640.81	897.12
Salinity (mg/L)	Summer	820.22	871.48	717.7	538.28	Dried	Dried	Dried
	Monsoon	511.93	485.58	639	862.82	862.82	490.99	510.85
	Winter	0.92	0.97	0.99	0.96	0.64	0.55	0.5
NO3	Summer	1.1	1.5	2.5	1.9	Dried	Dried	Dried
	Monsoon	1.3	1.8	2.8	2.2	1.6	1.9	1.8
	Winter	0.9	2.15	2.11	1.92	0.9	1.1	1
NH4 (mg/L)	Summer	1.2	0.9	1.1	1.5	Dried	Dried	Dried
	Monsoon	0.75	0.56	0.82	0.87	0.4	0.6	0.8
	Winter	742	850	842	482	116	125	140
SO4 (mg/L)	Summer	472	861	862	750	Dried	Dried	Dried
	Monsoon	801	861	862	865	470	472	475

Level of chloride in river Bindusara was found to be 269 mg/L (monsoon) to 497 mg/L (winter); in river Sindhfana 272 mg/L (monsoon) to 497 mg/L (winter). Chloride concentration indicates the presence of organic waste, primarily, of animal origin, Munawar [15].

Level of nitrate and ammonia in the river Bindusara was found in the range of 0.92 mg/L (winter) to 2.8 mg/L (monsoon) and 0.56 mg/L (monsoon) to 2.15 mg/L (winter) respectively. The same was found in Sindhfana river as 0.5 mg/L (winter) to 1.9 mg/L (mansoon) and 0.4 mg/L (mansoon) to 1.1 mg/L (winter) respectively. These values were within the prescribed limits.

It was reported that ammonia is the most reliable single parameter for measuring the quality of river water [4]. The presence of large amount of ammonia in surface water indicates pollution.

Sulphate ion is one of the major anions occurring in natural waters. The ICMR and WHO standards, however, suggest an upper limit of 400 mg/L of sulphate in potable waters. In Bindusara river, sulphate concentration was occurred as 472 mg/L (summer) to 865 mg/L (monsoon) in Sindhfana river,. It was 116 mg/L (winter) and 475 mg/L (monsoon). Shanti [16] noted sulphate 1-3 mg/L in Varaga river at Theni district, Tamilnadu, India.

Enrichment of phosphate in water results in eutrophication of water bodies. Domestic sewage, detergent and agricultural runoff are the main sources of phosphate in water. Therefore, its high concentration is indicative of organic pollution. In present study levels of phosphate in Bindusara river was 0.5 mg/L (summer) and 1.9 mg/L (winter) and in Sindhfana river, it was 0.5 mg/L (winter) to 1.1 mg/L (monsoon).

In Bindusara river, DO was 0.5 mg/L (summer) and 14.3mg/L (winter); BOD was 12.8 mg/L (summer) and 18.9 mg/L (winter); and COD was 15.5 mg/L (summer) to 48.5 mg/L (winter). In Sindhfana river, DO was found to be 6.0 mg/L (winter) and 7.6 mg/L (monson); BOD as 10.5 mg/L (winter), to 20.1 mg/L (monsoon); and COD as 20.6 mg/L (monsoon) to 50.1 mg/L (winter). Dissolved oxygen (DO) is essential to maintain higher forms of biological COD is used as a measure of the oxygen equivalent of the organic content of a sample. [17].

The major source of heavy metal pollution in urban area includes coal combustion, underground rock structure, industrial effluents, solid waste disposal, metal processing, etc. The metallic waste invariably discharged into water results in pollution. Concentrations of metals in the two rivers are in Table 1. These heavy metals are biologically non-degradable and through the food chain there may pass on to humans and can cause significant health concern [18] Whom also reported Zn value in river Ganga as highest 0.031 mg/L (summer) while lowest value 0.019 mg/L (rainy). Khan *et al.* [19] observed level of Cu from Godhavari river near Aurangabad (M.S.), India, as in the range of 1.755 to 3.640 ppm, the highest concentration of Cu in water was recorded in May, 2005, while the minimum was in October, 2005; Cr level from river Godavari as 0.473 ppm (June, 2005) to 1.630 ppm (Sept. 2005), this value exceeds maximum limit which may be due to the waste discharge into the river water from the variety of sources.

Municipal sewage contains a variety of pathogenic becteria and viruses including coliform bacteria, faecal coliform, *Escherichia coli* sp. *Salmonella* sp.etc. These agents are known to cause several diseases. In the present work, water samples of Bindusara river showed MPM for total coliforms 250/100 mL (summer) to > 2400/100 mL (winter) and faecal coliforms 240/100 mL (monsoon) to 1600/100 mL (winter). In Sindhfana river total coliforms were 120/100 mL (winter) to 2400/100 mL (monsoon) and faecal coliforms 75/100 mL (winter) to 950/100 mL (winter). Fokmare [4] found average TC and FC as 1039.8 and 407.44/100 mL from Morna river and 464.74 and 157.84/100mL from Purna river at Akola, India. The rise in the count may be due to the rapid growth of population in the catchment area and also due to the open defecation along the river bank.

CONCLUSION

The forgoing analysis reveals that increased urbanization and Industrialization have resulted in deterioration of water quality of Beed city. The results of present study concluded that the physico-chemical parameters showed undesirable variation than that of the normal. Further bacteriological parameters are also above the prescribed limits throughout the study period. Hence Bindusara river and Sindhfana river are already in a polluted state. The water is having greenish tinge bad odour and unpleasant taste. Therefore it is concluded that most of the water samples were found unsuitable for both domestic and drinking purposes. In order to save these river water from further deterioration or pollution, effective pollution control measures must be taken in the future.

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