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Original Research Paper

Studies on Physico-Chemical Characteristics of Freshwater Bodies in Khatav Tahsil, Maharashtra

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ABSTRACT

The paper highlights the physico-chemical characteristics of eight freshwater bodies of Khatav Tahsil in Satara district of Maharashtra during winter and summer seasons. Investigations are based on different parameters, pH, EC, TDS, TSS, DO, BOD, COD, total alkalinity, total acidity, chlorides, free CO_2, hardness, nitrates, phosphates, sulphates, etc. for which no earlier reports are available on these waterbodies. The study revealed significant changes in water quality during the two seasons. pH of water was alkaline; EC, hardness and alkalinity tend to increase during summer and decrease in winter. DO was maximum during winter, and minimum during summer. The seasonal variations of various factors were studied and interrelationships existing between them discussed.

INTRODUCTION

The availability of water on earth surface has made existence of life, which is major natural gift for life. An indisputable and inseparable bond exists between freshwater bodies and human beings. They are the prime source of water for drinking, irrigation, other domestic purposes and aid in groundwater recharge. Increase in population, industrialization and modern agriculture has put tremendous pressure on the freshwater bodies, causing threat to the healthy existence of mankind. The quality of water is getting vastly deteriorated due to unscientific waste disposal, improper water management and carelessness towards environment. This has led to scarcity of potable water affecting the human health (Agarkar 2003). Therefore, the continuous and periodical monitoring of waterbodies for water quality is necessary.

Several water pollution studies have been carried out in past on waterbodies by Kamat (1965), Goel et al. (1992), Kulkarni et al. (1988) and Bhosale et al. (1994). Majority of the studies are carried out in urban areas. The reports on waterbodies from rural areas are meagre. Thus, there is lack of baseline data on the water pollution studies of Khatav Tahsil, which is being used for domestic, agriculture and drinking purposes. Therefore, the present study was undertaken to evaluate various physico-chemical parameters of eight important freshwater bodies, viz., Ner dam (Site-1), Daruj dam (Site-2), Satewadi dam (Site-3), Aundh pond (Site-4), Yeliv tank (Site-5), Yeralwadi dam (Site-6), Mayani dam (Site-7) and Kankatrewadi dam (Site-8). These waterbodies are man-made, rain-fed, and are 15-25 km away from each other and lie under rain shadow area which is drought and famine prone. The waterbodies are prime source of drinking water for nearby villages. The study area lies between latitude 17°39'N and longitude 74°22'E with average altitude between 600-900 m above sea level.

MATERIALS AND METHODS

Water samples were collected with all necessary precautions during winter (January 2008) and

summer season (April 2008). The samples were collected in pre-cleaned two-litre plastic bottles. The physico-chemical analysis of water samples was performed as per the procedures described by APHA (1995) and Trivedy & Goel (1986) for various parameters.

RESULTS AND DISCUSSION

The values of each parameter recorded during the study period are presented in Tables 1 and 2. Environmental temperature fluctuate both daily and seasonally which is an important physical parameter directly related to chemical reactions in aquatic ecosystems (Goel et al. 1986). In present investigation air temperature varied from 24°C to 26°C during winter, and 32°C to 36°C during summer. Measurement of ambient temperature of surface water is of vital importance to understand solubility of oxygen and carbon dioxide equilibrium. Water temperature varied from 19.5°C to 21°C during winter, and 24°C to 29°C during summer. The values of pH varied from sample to sample in range of 8.08 to 9.82 and 8.05 to 9.44, the EC values ranged from 0.26 to 0.42 and 0.47-0.68 mS/cm during winter and summer respectively. Turbidity is caused by particulate matter in suspension. Suspended matter as clay, silt, and organic matter contribute to turbidity. Turbidity values observed during winter were low and ranged between 1.2 and 4.5 NTU, and higher during summer as 9.92 to 12.68 NTU. Hujare (2008) has reported similar seasonal trend which supports our findings.

Total dissolved solids (TDS) and Total suspended solids (TSS) were maximum during summer and minimum during winter. Tripathy & Pandey (1990) reported maximum concentration of TDS and TSS during summer. It may be due to low water flow into the waterbodies and high evaporation rate. Total acidity ranged from 10 to 38 mg/L and 12.5 to 45 mg/L, the total alkalinity from 134 to 299 mg/L and 160 to 260 mg/L during winter and summer seasons respectively. Kaur et al. (1997) observed higher values of these parameters in summer and lower during winter. Hardness values ranged from 56 to 112 mg/L during winter and 88 to 140 mg/L during summer. Kannan (1991) has classified water with hardness values ranging from 60 to 180 mg/L as moderately hard to hard. By this criteria these waterbodies are moderately hard. The hardness showed seasonal variation, being maximum in summer and minimum in winter.

Dissolved oxygen (DO) was maximum (4.9 to 12.1 mg/L) during winter, and minimum (4.6 to 7.3 mg/L) during summer. It showed an inverse relationship with temperature which might be due to oxidation of oxygen as reported by Patil & Dongare (2006). BOD is a measure of the degradable organic matter present in water. COD is a measure of organic matter which estimates the carbonaceous factors of organic matter. Values of BOD and COD are the main index for the water quality standards. In the present study, the values of BOD and COD were found to be within the permissible limits in all the samples. These values were highest during summer and minimum during winter. BOD values ranged from 1.24 to 2.48 mg/L and 2.10 to 3.62 mg/L, and COD values from 3.1 to 5.4 mg/L and 3.8 to 8.4 mg/L during winter and summer seasons respectively. Similar results were obtained by Khatavkar et al. (1989) and Bhosale et al. (1994).

Chlorides were minimum during winter (41.3 to 90.12 mg/L) and maximum during summer (52.54 to 110.76 mg/L). Decrease in the water level of these water bodies during summer may be the reason for increase of chloride concentration. The results obtained are in accordance with the findings of Tripathy & Pandey (1990) and Khabade et al. (2002). Low values of free carbon dioxide were recorded during winter (6.6 to 21.1 mg/L), and highest during summer (11 to 39.6 mg/L). Increase in free carbon dioxide may be attributed to the higher rate of decomposition during summer.

Table 1: Physico-chemical parameters of freshwater bodies during winter season 2008.

Parameters	Freshwater bodies							
	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
Air Temperature	25	26	24.5	26	24	25	26	25
Water Temperature	19.5	20	19.7	21	21	19.8	20.2	20.1
pH	8.08	8.24	8.88	8.43	8.61	9.82	9.14	8.51
Turbidity	4.1	1.4	2.7	3.7	3.8	1.2	4.5	1.6
Electrical Conductivity	0.29	0.31	0.29	0.35	0.38	0.26	0.42	0.40
Total Solids	398	240	260	238	284	292	379	224
Total Dissolved Solids	356	192	198	140	232	248	319	186
Total Suspended Solids	42	48	62	98	52	44	60	38
Total Alkalinity	183	196	229	209	168	134	207	186
Total Acidity	25	38	10	15	26.3	14.3	21.3	10.1
Dissolved Oxygen	9.2	7.8	7.6	5.6	7.3	12.1	4.9	6.4
Free Carbon Dioxide	12.2	15.4	9.6	13.3	21.1	8.8	6.6	8.4
Total Hardness	72	56	71	112	82	70	74	103
Calcium Hardness	29.71	23.08	14.12	47.20	22.62	18.42	28.12	23.41
Magnesium Hardness	12.42	10.71	18.48	18.46	12.82	22.12	12.81	22.42
BOD	1.42	1.56	1.48	2.48	1.46	1.24	1.96	1.64
COD	3.2	3.8	3.6	5.2	4.4	3.1	5.4	5.8
Chlorides	50.80	41.30	70.20	50.10	62.28	70.14	80.91	90.12
Nitrates (NO_3-N)	0.07	0.05	0.07	0.14	0.08	0.04	0.12	0.09
Sulphates (SO_4)	0.81	0.92	0.54	1.41	1.28	0.48	0.97	0.86
Phosphates (PO_4-P)	0.06	0.09	0.05	0.09	0.07	0.04	0.09	0.08

Note: All parameters are expressed in mg/L except pH, EC (mS/cm), Temperature (°C) and Turbidity (NTU).

Table 2: Physico-chemical parameters of freshwater bodies during summer season 2008.

Parameters	Freshwater bodies							
	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
Air Temperature	35	36	36	36	32	34	36	36
Water Temperature	27	28	28	29	24	28	29	28
pH	8.05	8.13	8.62	8.22	8.40	9.44	8.95	8.30
Turbidity	11.52	4.52	4.04	4.26	6.32	1.92	12.68	2.88
Electrical Conductivity	0.47	0.52	0.58	0.52	0.51	0.53	0.68	0.66
Total Solids	501	348	353	356	454	339	541	438
Total Dissolved Solids	467	264	306	234	394	248	449	376
Total Suspended Solids	34	84	47	122	60	91	92	62
Total Alkalinity	215	230	260	240	200	160	235	255
Total Acidity	35	45	15	20	37.5	25	25	12.5
Dissolved Oxygen	6.6	5.2	4.8	4.9	6.2	8.4	6	5.8
Free Carbon Dioxide	30.8	39.6	13.2	17.6	33	19.8	15.4	11
Total Hardness	104	88	112	126	98	114	102	140
Calcium Hardness	49.69	41.68	32.08	65.75	42.48	32.06	33.66	35.27
Magnesium Hardness	4.87	3.89	7.30	9.25	1.94	8.28	4.38	12.66
BOD	2.54	2.48	2.44	3.62	2.58	2.10	2.84	2.76
COD	3.8	4.2	4.2	8.4	4.8	3.9	7.5	6.2
Chlorides	62.48	52.54	97.98	55.38	76.68	96.56	88.24	110.76
Nitrates (NO_3-N)	0.04	0.03	0.03	0.07	0.04	0.02	0.07	0.05
Sulphates (SO_4)	4.76	5.54	3.68	6.81	6.78	2.21	4.54	3.42
Phosphates (PO_4-P)	0.04	0.02	0.03	0.03	0.02	0.03	0.04	0.04

Note: All parameters are expressed in mg/L except pH, EC (mS/cm), Temperature (°C) and Turbidity (NTU).

Non-polluted waters are generally deficient in nitrate, sulphate and phosphate content (Ganapati, 1960). The values were reported in lower concentration. Sulphates ranged from 0.48 to 1.41 mg/L during winter, and 2.21 to 6.78 mg/L during summer. Sulphate may be present in waterbodies due to bathing and washing of clothes (Jain et al. 1996). Nitrates ranged from 0.04 to 0.14 mg/L during winter and 0.02 to 0.07 mg/L during summer; lower concentration of nitrates may be due to biological destruction and self-purification properties of water bodies. Main cause of nutrients inflow is due to variety of human activities, run-off from catchment areas, mixing of sewage, bathing and washing activities by human beings which pollute the water bodies (Goel & Trivedy 1984). The phosphate content varied from 0.04 to 0.09 mg/L during winter being higher and lower in summer which varied from 0.02 to 0.04 mg/L. Phosphates may be present due to high rate of decomposition of waste materials or due to surface run off from the surrounding crop fields, evaporating of water and low water level during summer. Hujare (2008) obtained similar seasonal trend in phosphate concentration in a water tank.

Increased macrophytic growth, unhygienic conditions, weed coverage (slush and weeds) and silting of dam at site-7 (Mayani dam) have created nuisance. Water storage seems to be decreasing, thus, flood control value is quite low and cattle grazing, cattle washing, siltation and weed chocking is serious problem. Site-1 (Ner dam) also shows activities like vehicle washing, cloth washing, potato and zinger harvest washing, cattle grazing and siltation which pollutes the waterbody. Site-4 (Aundh Pond) is constantly posed to the threat of pollution due to religious rituals (temple pond) and anthropogenic activities like bathing and washing, which result in uploading of nutrients like nitrates and phosphates causing eutrophication with abundant algal blooms. Site-2 (Daruj dam) is also polluted by cloth washing, cattle grazing, cattle washing and bathing. Scum and foam formation was noticed during summer. Site-5 (Yeliv tank) is also affected by vehicle servicing, bathing, cloth washing, cattle grazing and solid waste dumping. Site-6 (Yeralwadi dam) has less anthropogenic activities but cattle grazing and washing of clothes are common. This waterbody is less polluted as it has self purification properties, good wave action and growth of many aquatic plants like *Ottelia alismoides*, *Najas indica*, *Potamogeton nodosus*, *Potamogeton pectinatus* and *Vallisneria spiralis*.

Deterioration of water quality and eutrophication are due to casual attitude of people. Human activities include cattle watering, bathing, washing of clothes, vehicles, household utensils and cattle grazing; pollution load is due to domestic sewage, agricultural run-off and faecal contamination. Even though nature has got its own mechanisms to take care of the wastes when they are in limited quantities, all physico-chemical parameters showed higher values in summer. Thus, it can be concluded that these characteristics of waterbodies are influenced by seasonal variations. The overall level of various parameters suggests that the waterbodies are not much polluted. It is recommended that the proper maintenance of the waterbodies is necessary. Proper sanitation measures and environmental education to public are essential to keep these waterbodies clean and safe. The water quality is suitable for drinking, domestic use and for irrigation purposes except at site-4, site-7.

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