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Original Research Paper

Seasonal Variations in Physico-Chemical Characteristics of Four Aquatic Ecosystems in Gadhinglaj Tahsil of Maharashtra

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ABSTRACT

Water pollution is becoming a severe problem due to various anthropogenic activities in an around the water reservoirs. In the present study four different water reservoirs, Mumewadi, Gijawane, Nool and Mahagaon were studied for their physico-chemical and biological status. This piece of work will remain helpful for proper monitoring and maintenance of these ecosystems. Out of the four studied ecosystems, two show increased pollution level due to various activities taking place in and around the water bodies.

INTRODUCTION

Water is one of the most important natural resources and regular supply of clean water is vary essential for the survival of all living beings. The increased demand for water as a consequence of population growth, agriculture and industrial development has usurped environmentalists to determine the chemical, physical and biological characteristics of natural water resources (Regina & Nabi 2003).

Temporary ponds are found throughout the world. Though there are considerable regional differences in their type and method of formation, many physical, chemical and biological properties are quite similar. The worldwide distribution water body type leads to a large variety of temporary pond type due to climate and geological differences (Solanki et al. 2007).

The quality of drinking water plays an important role in maintaining sound health. Safe water is one which should be free from faecal contamination and conform to the limits of chemical contamination (Murugesan et al. 2004). The quality of water is getting vastly deteriorated due to unscientific waste disposal, improper water management and carelessness towards the environment. This has led to scarcity of potable water affecting human health (Agarkar & Thombre 2005).

Stagnant water bodies have more complex and fragile ecosystem in comparison to running water bodies as they lack self cleaning ability, and hence, readily accumulate greater quantities of pollutants. Increased anthropogenic activities in and around the water bodies damage the aquatic systems and ultimately the physico-chemical properties of water.

Gadhinglaj is an important Tahsil of Kolhapur district of Maharashtra at latitude 16°13'26" N and longitude 74°26'9" E. This region has very rich biodiversity. There is one river named "Hiranykeshi" flowing through the tahsil and does act as lifeline of the people inhabit this area. Most of the people of this Tahsil depend on the river water for their daily needs as well as for agriculture. For their domestic needs, most of the people depend on small ponds, lakes, etc. There are about 40 to 45 different small or larger water reservoirs distributed in the Tahsil, and the local inhabitants depend on these for their daily needs like drinking, cloth washing and water for animals, etc.

STUDY AREA

For the present study four different water reservoirs were selected, namely Mumewadi, Gijawane, Nool and Mahagaon (Fig. 1). All the four water bodies are artificial and constructed in different periods as per the need of villagers. Out of these four, the Mumewadi reservoir is comparatively smaller and is formed due to construction of road at the bottom of hills during 1940s. The water running through the hilly areas is collected at the bottom due to the artificial bund created due to road.

The Mahagaon lake has spiritual value due to a "Ganesh temple" in the centre of the lake. The area under this lake is about 2.5 ha. The area has been reduced to 1.21 ha due to a shopping centre, which is present on the border of the lake. Nool lake is also about 1.23 ha and totally artificial constructed by the villagers of the Nool village in 1972 during the famous famine of 1972 in Maharashtra. Gijawane reservoir was initially about 1.5 acre, but the area is now reduced due to construction of 'Grampanchayat bhavan' on the border.

MATERIALS AND METHODS

Collection of samples: The water samples were collected from different sites in December (2006), April and August (2007) as indicator month of winter, summer and rainy seasons. The sampling was done in the morning hours and the samples were collected in plastic container and brought to the laboratory for further analysis.

Analysis of physico-chemical properties: For the analysis, the standard methods were followed (APHA 1995, Trivedy & Goel 1984)). Some parameters like temperature, pH, transparency, humidity were analysed in the field. The samples for DO and primary productivity were fixed in the BOD bottles at the sites and brought to the laboratory for analysis by Winkler's method.

RESULTS AND DISCUSSION

The results of the study are given in Figs. 2-7 and Tables 1 and 2. The water temperature ranges from 24 to 32°C, while the air temperature from 24 to 36°C in all the studied aquatic ecosystems.

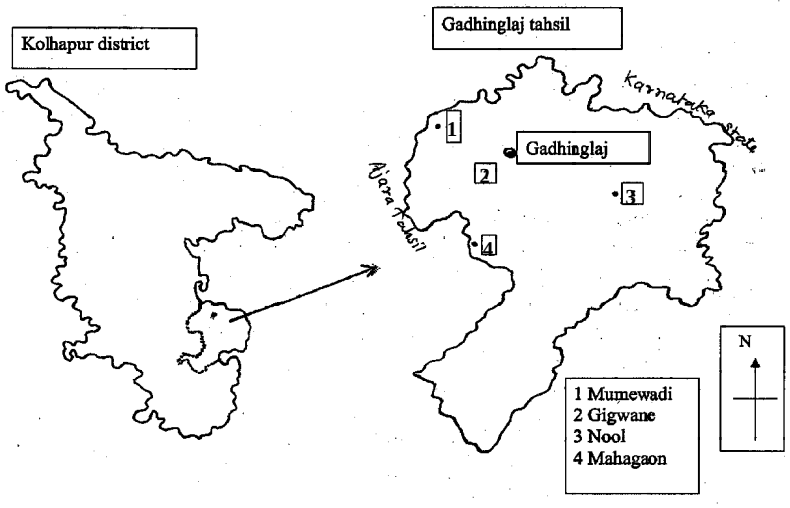

Fig. 1: Location of the study area and water bodies.

The humidity also varies seasonally. The maximum humidity, i.e., 95% was recorded at Gijawane during rainy season, while minimum, i.e., 22% at Mumewadi during summer season. The range of pH of water sample is between 6.30 to 7.65 in the lakes. Maximum pH was recorded at Nool during winter season.

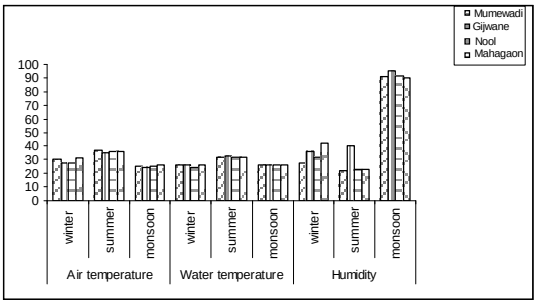

Fig. 2: Seasonal variation in air, water temperature and humidity in different reservoirs.

The electrical conductivity shows seasonal variation and is also site specific. It is maximum at Nool during the summer. The total concentration of soluble salts can be adequately expressed in terms of electrical conductivity for purpose of diagnosis and classification. It highly depends on the amount of dissolved solids in waters. Kumar et al. (2005) shows the range of conductivity from 900 to 1640 µmhos/cm for Jagath tank of Gulbarga.

The transparency ranges between 20 and 68 cm showing seasonal variations. Turbidity also shows seasonal variation. The maximum turbidity was observed in Nool (26 NTU), and minimum at Mahagaon and Mumewadi during summer. The colour of water is mostly colourless except in Nool, which shows a faint greenish colour throughout the year.

Total alkalinity shows variation from season to season in all the sites. The alkalinity was found to be increased during summer months. The hardness of water at Nool is maximum throughout the year as compare to other three sites. It is maximum up to 400 mg/L. Dissolved oxygen was found to be

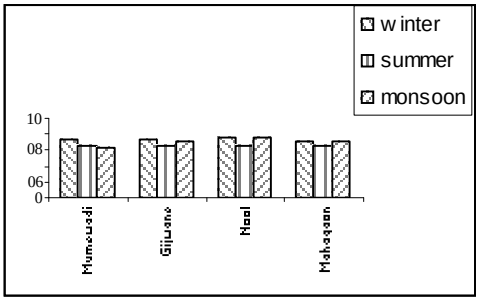

Fig. 3: Seasonal variation in pH in different reservoirs.

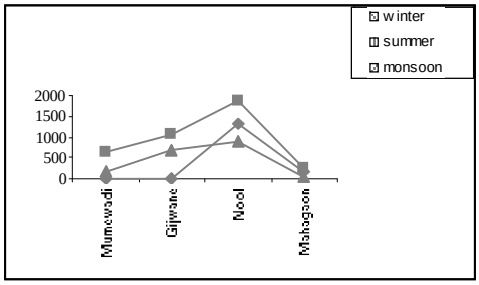

Fig. 4: Seasonal variation in E.C. in different reservoirs.

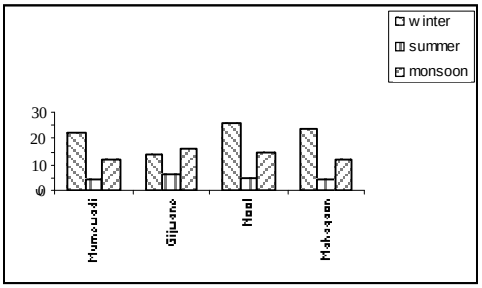

Fig. 5: Seasonal variation in turbidity in different reservoirs.

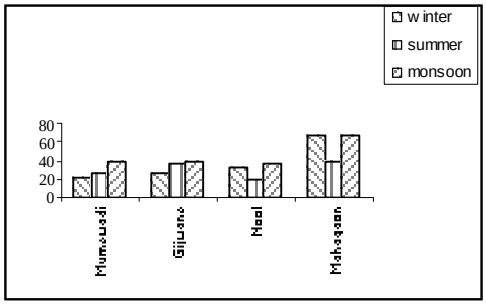

Fig. 6: Seasonal variation in transparency in different reservoirs.

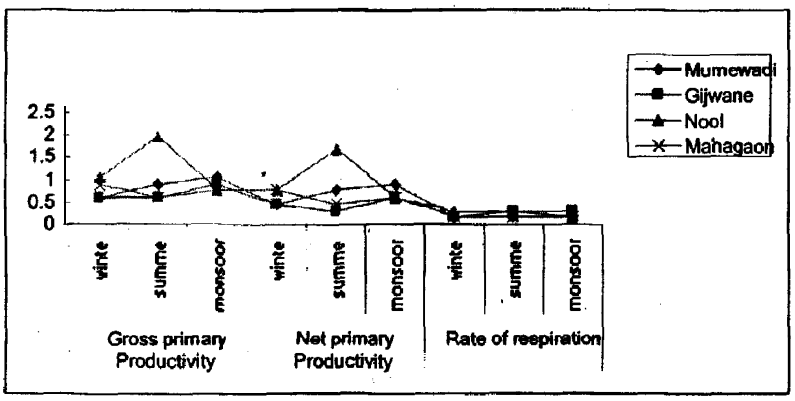

Fig. 7: Seasonal variation in gross/net primary productivity and rate of respiration in different reservoirs.

increased in Nool during summer season, while it is minimum in Mumewadi during winter. Simultaneously the BOD value was also more in Nool in winter.

Productivity of lakes depends on the presence of plankton biomass. Enrichment of nutrients and dissolved matter in the water bodies affects diversity of plankton and also physico-chemical properties of water. In any aquatic body primary productivity gives an information relating to the amount of energy (Vollenweider 1969). The values of gross primary productivity, net primary productivity and respiration rate ranges from 0.60 to 1.97, 0.30 to 1.66 and 0.15 to 30 mg/L/hr respectively in all the water bodies. There is seasonal fluctuation in the productivity values. It has been reported that high and low productivity values of water bodies might be due to high and low nutrient status of the water.

As far as nutrient status is concerned, all the nutrients studied in the present investigation show variations from site to site. The calcium percentage is maximum at Nool, and minimum at Mahagaon during winter season. Magnesium concentration is more in Gijawane during summer and less in Mahagaon during rainy season. The total amount of bicarbonate is maximum in Nool during winter. The ammonia is more in Mumewadi indicating its eutrophic nature. Tiwari & Shukla (2007) also reported 0.5 to 1.8 mg/L of ammonia from some temporary water bodies of Kanpur. The nitrate, phosphate and silicates are important nutrients in freshwater for growth of phytoplankton. The concentration of nitrates in water bodies can rapidly change due to prevailing biological activity making it highly variable seasonally and spatially (Wetzel 1975). The nitrate values show seasonal variation. The nitrate value is very low, i.e. below detectable level, in Mumewadi and Gijawane during winter season. Phosphate is considered amongst the primary limiting nutrients in ponds and lakes (Schindler 1971).

Sulphate level is maximum during summer in Nool, and minimum in Mahagaon during rainy season. Chloride is an important element for plant and animal life. Generally, freshwater bodies show lower values of chlorides (Sathe 2000). But in the present study chloride was detected in higher concentration. It was 282 mg/L in Nool during summer season. Goel et al. (1985) reported higher values of chlorides ranging from 10.65 to 455 mg/L in some freshwater bodies from southern Maharashtra.

The higher concentration of sodium and potassium are generally associated with increased level of pollution (Sathe 2000). Sodium and potassium concentration varies seasonally in all the water

Table 1: Physico-chemical properties of water from the four reservoirs. Values are in mg/L except colour and odour.

Parameter	Mumewadi			Gijwane			Nool			Mahagaon		
	Win-ter	Sum-mer	Mon-soon	Win-ter	Sum-mer	Mon-soon	Win-ter	Sum-mer	Mon-soon	Win-ter	Sum-mer	Mon-soon
Colour	colour less	Faint yello wish	colour less	colour less	colour less	Faint green ish	Faint green ish	Faint green ish	Faint green ish	colour less	colour less	colour less
Odour	odour less	odour less	odour less	odour less	odour less	odour less	odour less	odour less	odour less	odour less	odour less	odour less
Alk.	264	137	118	321	197	209	499	293	361	98	120	85
TH	188	288	112	324	328	256	400	292	332	104	124	57
TH	8	28	20	20	16	40	332	280	280	84	112	44
DO	4.87	6.89	9.32	7.30	9.74	11.35	11.76	25.14	9.73	10.14	6.08	11.35
BOD	20.20	52.70	89.20	36.40	40.50	101.30	113.50	36.50	92.30	81.10	28.40	109.4

Table 2: Chemical properties of water fromthe four reservoirs. Values are in mg/L.

Parameter	Mumewadi			Gijwane			Nool			Mahagaon		
	Win-ter	Sum-mer	Mon-soon	Win-ter	Sum-mer	Mon-soon	Win-ter	Sum-mer	Mon-soon	Win-ter	Sum-mer	Mon-soon
Calcium	52	48	29	63	57.7	43	107	46.50	77	19	32	29
Magnesium	14	26	10	41	45	36	32	43	34	14	11	4
Bicarbonate	322	167	144	392	240	255	609	357	440	120	146	104
Chlorides	30	62	16	164	190	144	164	282	128	30	34	32
Ammonia	4.62	2.52	1.7	1.68	0.672	2.6	3.89	3.36	3.2	1.41	0.92	0.5
Nitrate	BDL	0.024	0.010	BDL	0.009	0.012	0.028	0.049	0.02	0.009	0.008	0.002
Sulphate	40	44.85	20	80	95.06	40	76	125.10	71	22	21.81	8
Sodium	30	40	7	82	65	43	85	92	54	9	25	11
Potassium	4	7.5	2	6	10	2	80	15	90	1	4	26
Iron	0.04	0.21	5.37	0.20	0.08	0.16	0.835	0.18	0.19	1	0.007	0.22
Manganese	0.10	0.00021	BDL	0.005	BDL	BDL	0.61	BDL	BDL	0.58	0.008	BDL
Zinc	0.01	0.18	0.56	0.02	0.021	0.32	1.19	0.01	0.40	1.09	0.020	0.27

BDL = Below detection limit.

bodies. The increased Na and K concentration in Nool indicates the increased level of pollution. Manganese, iron and zinc are also recorded from the studied sites. The Fe and Zn are comparatively low. They also show seasonal variations in all the sites, while very low contribution of copper, lead and chromium is detected in different seasons.

In general, water from all the sites at present can be used for domestic purpose. But in future these are not so useful if not conserved through proper management. The Nool and Mumewadi reservoirs are in danger, and need more attention to pay in recent years. These systems may vanished very soon due to eutrophication.

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