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Pollution Status of Wetlands in Urban Coimbatore, Tamilnadu, India

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Coimbatore is an important industrial city of India, ranking 11th in terms of population, It is located in the state of Tamilnadu, between 10°55 and 11°10'N, and 77°10 and 76°50'E at an approximate altitude of 470m. There are more than 30,000 small, medium and large industries including textile mills and foundries in the city employing about 40% of the population. The growing industrial sector and ensuing immigration of people pose heavy burden on the city infrastructure that did not grow in proportion. Till date no integrated sewerage system is in operation in the city. The city also does not have facilities for treatment of industrial, municipal, domestic and hospital wastes. The prevailing drainage and sewerage are open type joining the lakes, wetlands and the river Noyyal without appropriate treatment.

In Coimbatore city there are 28 wetlands, mostly fed by the river Noyyal. The river, flowing through the city on it's south, originates in the Vellingiri hills in Western Ghats, located on the south-western side of the city. The river gets flooded only during monsoons. Rest of the days it is almost dry. 15,974 acres of agricultural lands, in and around the city, are irrigated by the Noyyal river system. The river and the river-fed wetlands support a large number of plants (Chandrabose and Nair 1988) and animals including migratory species of birds. Most of these wetlands get dried in summer and serves as a dumping yard for garbage and industrial wastes.

The physico-chemical characteristics of the water in these wetlands with reference to the pollution from various industrial, municipal and domestic sources, and heavy metal contamination are poorly known. Hence the present study on eight major wetlands was undertaken.

MATERIALS AND METHODS

Eight wetlands falling within the city limits selected for the present study are shown in the Figure 1. The water spread area of each wetland and the agricultural lands irrigated by each are given in Table 2. It is found that effluents from industrial units involved in textile dyeing, making jewellery of noble metals and electroplating are directly discharged into Selvachinthamani Lake (S 1).

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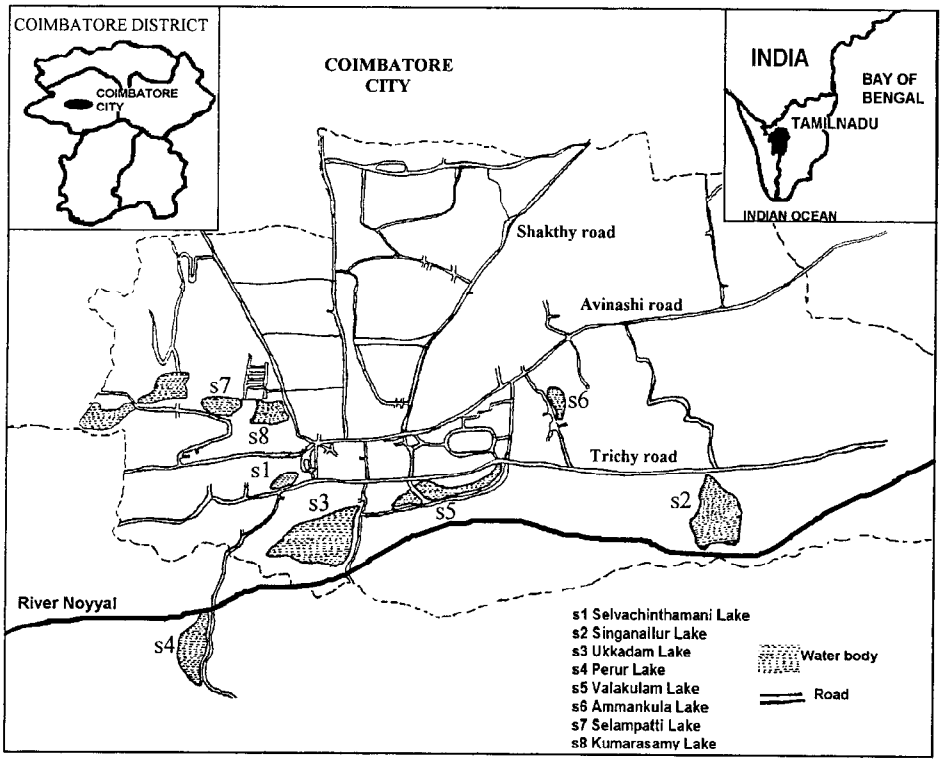

Figure 1. Map showing sampling stations

Singanallur Lake (S2) is highly affected by eutrophication and is almost filled up with *Eichhornia crassipes.* Although *Eichhornia crassipes* is praised for its ability to sequester nutrients and other chemicals from water, it is considered undesirable for wetlands (Mitsch and Gosselink 1993). About 80% of land present in the vicinity of Ukkadam Lake (S3), which has the largest water spread area among the eight wetlands, under the study is urbanised. Hence the land under irrigation from this wetland is low. The lake is surrounded by municipal bus-stand and municipal market. Part of the wetland is regularly used for dumping domestic and municipal wastes. The lake is also used for regular fishing. A number of migratory birds are encountered in the lake in winter. Perur Lake (S4), which lies to the outskirts of the city is more or less far from industrial activity. The lake provides abode to a large number of migratory and resident birds and in recent years is emerging as a bird sanctuary. Slums that occupy a major portion of Valankulam (S5) release their domestic wastes directly into the wetland. On its banks municipal wastes and wastes from the hospitals are also disposed of. A part of the Ammankulam (S6) is converted into housing units by the state government and another part is encroached by slums. This wetland also receives large amount of industrial and domestic wastes. Both Selvampatti Lake (S7) and Kumaraswamy Lake (S8), which do not have any existing connections with river Noyyal, are mostly rain-fed. Water samples were collected from the eight wetlands (Table 1)

Table 1. Wetland characteristics

Sampling stations	Water Spread area (km^2)	Capacity (million m^3)	Registered irrigated area (ha)
Selvachinthamani Lake (S1)	0.149	0.085	2.02
Singanallur Lake (S2)	1.153	1.480	337.1
Ukkadam Lake (S3)	1.295	1.970	5.8
Perur Lake (S4)	1.072	1.469	377.6
Valankulam (S5)	0.648	0.789	356.5
Ammankulam (S6)	0.15	0.1	0
Selvampatti Lake (S7)	0.283	0.281	83.4
Kumaraswamy Lake (S8)	0.380	0.563	76.9

during the pre- monsoon season (Jan to March 1999).The samples were analysed for the physico-chemical parameters namely pH, electrical conductivity (EC), total dissolved solids (TDS), dissolved oxygen (DO), biological oxygen demand (BOD), alkalinity, chloride, magnesium, calcium, total hardness, chemical oxygen demand (COD), phosphate, sulphate, sodium, potassium, ammonia nitrogen, nitrate nitrogen and heavy metals (Cu, Zn, Ni, Pb, Cd, Cr, Fe and Mn) following standard methods (Greenberg et al 1992).

RESULTS AND DISCUSSION

The physico-chemical features of the water samples are shown in Table 2. The pH of the water samples ranged from 6.7 - 7.5. Conductivity, which reflects the mineral / ionic status of water, ranged between 173 and 9633 µmho/cm. The conductivity of water was highest in Selvachinthamani Lake (Sl) and lowest in Perur Lake (S4). Highest alkalinity was found in Sl in March (850.4 mg/L). The Average value for the Lake was 726 mg/L, which was considerably higher than the average for other wetlands. Total dissolved solids were also highest in the samples of Sl (9233 mg/L) which is due to pollution from dyeing and bleaching industries present in its vicinity. The industries involved in textile dyeing and bleaching are known for their effluents with high salt content (Senthilnathan and Azeez 1999). The samples of Kumarasamy Lake (S8) were found to have lowest concentrations of chloride compared to the other lakes. High chloride content in waters of Selvachinthamani Lake, Singanallur Lake and Ukkadam Lake might be due to domestic and other effluents joining them. Principal cations imparting hardness are calcium and magnesium. Both these elements were found highest in Singanallur Lake (S2). Comparatively high concentrations of phosphate, potassium and sodium were found in the samples of Selvachinthamani Lake. In the case of sulphate, samples of Ammankulam (S6) showed highest concentrations. The COD values in the wetlands were in the range of 154 to 673 mg/L, the lowest being in the Singanallur Lake (S2) and highest in the Ukkadam Lake (S3). Nitrogen content of the samples estimated in terms of ammonical and nitrate nitrogen was high in samples of Ammankulam, which may be attributed to

Table 2. Physico-chemical characteristics (average values) of water samples

Parameters		Sampling stations							
		S1	S2	S3	S4	S5	S6	S7	S8
1	PH	6.9	7.27	7.42	7.3	6.7	6.9	7.4	7.5
2	EC (μmhos)	9633	1793	973	173	830	963	276	220
3	TDS (mg/L)	9233	1553	1056	260	506	1176	326	150
4	Alkalinity (mg/L)	726	478	443	210	460	531	347	318
5	Chloride (mg/L)	1470	470	313	78	176	209	84	58
6	Hardness (mg/L)	550	731	342	176	369	350	200	120
7	Calcium (mg/L)	369	484	215	129	227	210	123	88
8	Magnesium (mg/L)	181	246	126	33	142	139	77	31
9	Phosphate (mg/L)	10	7	6.6	5	7.8	7	5.2	6.5
10	Sulphate (mg/L)	216	466	258	183	532	758	291	162
11	Sodium (mg/L)	293	157	164	20	122	174	166	17
12	Potassium (mg/L)	172	20	26	18	64	54	86	6.6
13	DO (mg/L)	4.2	5.7	6.5	6.4	6	4.8	5.2	6.0
14	COD (mg/L)	346	154	673	173	417	312	252	576
15	BOD (mg/L)	13.3	4	4.4	4	5.6	4.6	4.2	1.8
16	Ammonia nitrogen (mg/L)	2	3.3	2.2	2.2	1	64	1.6	-
17	Nitrate Nitrogen (mg/L)	6	4.9	9.8	4.9	5.5	68	7.2	-

domestic wastes and sewage discharges. The heavy metal concentrations (Cu, Zn, Ni, Pb, Cd, Cr, Fe and Mn) in water samples of the wetlands are given in Table 3. Copper in samples ranged between 18 - 177μg/L. Zinc concentrations were in the range of 34 - 493 μg/L, the highest being in the Selvachinthamani Lake (S1). Nickel was in the range of 6.1 - 24.9μg/L and Chromium, 29.8 - 387.5 μg/L. The levels of lead ranged between 4.5 to 375 μg/L with S1 containing highest concentration. The iron content (520 - 8020 μg/L) in all water samples exceeded the prescribed WHO limit (300 μg/L) for drinking water. It was found from the study that S1 had highest concentrations of all the heavy metals, except nickel, and is subject to severe pollution. In general, strong positive correlation (Table 4) among the metals, excluding nickel, was found suggesting common sources of the contamination in Coimbatore wetlands.

Although people do not use the water from these wetlands / lakes for drinking purposes, livestock and other aquatic species consuming these water may get affected on a long term exposure. Moreover the water from these wetlands used for irrigation purposes may lead to bioaccumulation of heavy metals in cultivated plants (Barmen et al 1999) and may have toxic impact on aquatic fauna (Naqvi et al 1998; Rao et al 1998). Many of these wetlands serves to recharge the ground water aquifer. Hence, contamination of the wetlands might lead to the contamination of ground water, which is getting depleted at a fast rate in Coimbatore. Moreover, the qualities of the groundwater in the environs of the city, in recent years, are also known to have become unacceptable by public for consumption. It is widely hinted at that the ecological degradation of the wetlands

Table 3. Heavy metal concentrations (average values in µg/L) of water samples

Heavy metals	Sampling Stations							
	S1	S2	S3	S4	S5	S6	S7	S8
Cu	177	44	18	30.3	24.5	44.1	26	28.2
Zn	493	95	34	53	99.5	101	52.5	69
Ni	6.94	23	6.4	8.6	24.9	11.8	11.5	6.1
Pb	375	26	10.5	4.5	25.5	4.5	15.5	14.5
Cd	10	1	0.5	0.5	2	0.5	0	0
Cr	387	52	29.8	43	48.5	42.4	34.7	61.9
Fe	8020	520	1425	1735	640	3285	3405	1165
Mn	1257	255	55.2	71	346.2	63.6	82.9	54.5

Table 4. Pearson correlation co-efficient among the metals

	Cu	Zn	Ni	Pb	Cd	Cr	Fe	Mn
Cu	1	0.99	-0.24	0.98	0.97	0.99	0.89	0.95
Zn		1	-0.18	0.99	0.99	0.99	0.87	0.98
Ni			1	-0.25	-0.1	-0.28	-0.4	-0.04
Pb				1	0.99	0.98	0.88	0.98
Cd					1	0.98	0.83	0.99
Cr						1	0.88	0.97
Fe							1	0.8
Mn								1

and their filling up are highly responsible for the low quality of the groundwater. Stoppage of dumping industrial effluents, sewage and garbage may help in conserving the wetlands in the city which apparently function as ground water recharge sites, provide habitats for a large number of flora and fauna including migratory birds, and is a major source of freshwater fish in the city.

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