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Sediment Quality of Wetlands in Coimbatore, Tamilnadu, India

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Coimbatore is an important industrial town of South India ranking eleventh in India in terms of population. About 17000 registered small-scale industries operate in Coimbatore. Of these, nearly 450 are foundries, 300 electric motor manufacturing units and 200 wet grinder-manufacturing units (Azeez et al 2000). The city is also known for its textile processing industries. Coimbatore city has a number of wetlands and the major source of water for most of these is river Noyyal (Mohanraj et al 2000). Most of these wetlands receive various types of effluents. Industrial effluents, automobiles, domestic sewage and urban runoff, for the large number of point sources of pollution, carry notable amounts of pollutants including heavy metals such as Lead, Cadmium, Chromium, Zinc, Copper, Manganese and Iron. The physico-chemical characteristics of the sediments in these wetlands with reference to pollution from various sources and heavy metal contamination are poorly known. Hence, the present study on six major wetlands was undertaken.

MATERIALS AND METHODS

The study area includes 6 wetlands of which 5 fall within the urban limits and one outside, the Kovaipudur eri (Perur lake) (Figure 1). The purpose of the present study was to examine physico-chemical characteristics in the sediments of these wetlands and presence of heavy metals. The sediments from these wetlands, collected with pre-cleaned acid washed PVC corer, were placed in pre-cleaned polythene bags and transferred to the laboratory. Grain-size analysis was done using standard sieves. pH, nitrogen and phosphate in the sediments were analysed immediately. For metal analysis the sediments were dried, ground in a mortar and stored in acid washed polythene bags. pH and electrical conductivity were tested using the respective meters. Total Organic Carbon (TOC) was estimated following Walkley and Black method. Exchangeable Ca^{2+} and Mg^{2+} were estimated separately after leaching with ammonium acetate solution by EDTA titrimetric method. Available nitrogen was determined using alkaline $KMnO_4$ and available phosphorus by stannous chloride method. Sulphate was estimated turbidometrically using $BaCl_2$. Total alkalinity was determined by titration using phenolphthalein and methyl orange indicators. Chloride was estimated

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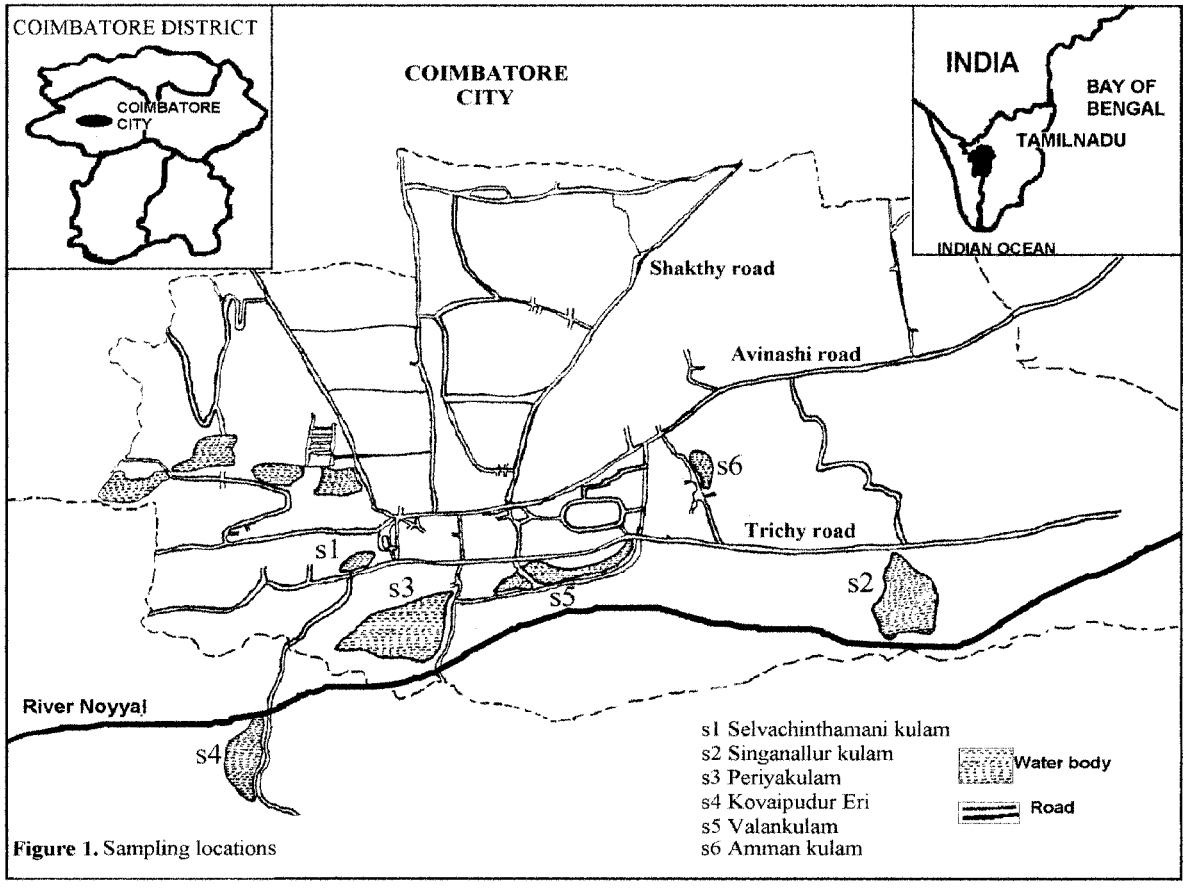

Figure 1. Sampling locations

argentometrically using $AgNO_3$. Sodium and potassium were estimated using flame-photometer, after extracting with neutral ammonium acetate. Heavy metals were extracted by double digestion of the sediment sample with concentrated HNO_3 and HCl (4:1 by volume) and estimated by Pye Unicam Atomic Absorption Spectrophotometer.

RESULTS AND DISCUSSION

In Selvachintamani Kulam (Station 1) medium sized grains were found in highest percentage (Table 1) and mud and clay (BSS >150 um) was the least. Sample from Singanallur Kulam (Station 2) had lowest percentage of very fine sized grain (BS-150). Mud and clay was only 5.4%. In Periya Kulam (Station 3) gravel and granules and granular sized grains were highest (37.3%) and mud and clay was only around 0.2%. In Kovaipudur Eri (Station 4) very fine sized grains were found to be the most (27.8%), followed by medium sized grains (24.5%). In Valan Kulam (Station 5) very coarse sized grains was highest (25.8%), followed by medium sized grains (24.8%). In Amman Kulam (Station 6) very coarse sized was found most (24.6%) and the medium sized fractions the next (20.3%).

Table 1. Grain size composition (percentage) of the sediment in wetlands.

Sample	BSS 7	BSS 16	BSS 30	BSS 60	BSS 150	BSS >150
S1	14.40	12.85	17.30	28.95	19.39	6.71
S2	7.57	15.06	25.41	30.47	15.27	5.44
S3	37.31	41.57	19.60	1.15	0.10	0.20
S4	18.02	10.83	11.60	24.50	27.79	7.0
S5	9.60	25.84	24.82	19.71	2.79	6.73
S6	16.64	24.62	21.44	20.32	5.84	11.50

BSS-7 Gravel and granules (Mean 2.83 mm), BSS–16 Very course (mean 1.9 mm), BSS-30 Coarse (mean 0.59 mm), BSS-60 Medium (mean 0.25 mm), BSS-150 Very fine (mean 0.1 mm) BSS>150 Mud and clay (mean < 0.1 mm)

The mean values of the physico-chemical parameters of samples are given in table 2. The pH of the samples ranged from 7.1 to 9.6. Highest pH was in the sediments from Valan Kulam (9.6). EC was highest in the sample from Selvachinthamani Kulam (1433 millimhos). Alkalinity varied from 1.40 to 4.60 mg/g $CaCO_3$ and the highest was in the sediments of Amman Kulam. Chloride content ranged between 11.2 - 24.8 mg/g. Highest phosphate (0.49 mg/g), sulphate (4.80 mg/g) and sodium (1.9 mg/g) were found in Selvachinthamani Kulam.

Table 2. Physico-chemical characteristics (mean) of sediment samples.

Parameters	Sampling stations					
	1	2	3	4	5	6
PH	7.7	7.7	9	7.5	9.6	7.1
EC (millimhos)	1433	1137	587	490	457	650
Chloride (mg/g)	24.8	12.3	11.6	11.6	11.2	15
Alkalinity (as $CaCO_3$ mg/g)	2.82	1.8	2.5	1.4	2.6	4.6
Calcium (as $CaCO_3$ mg/g)	1.3	0.86	1.4	0.28	0.60	0.98
Magnesium (mg/g)	0.29	0.17	0.23	0.12	0.17	0.35
TOC (mg/g)	4.8	8.7	8.3	9	5.6	10.3
Phosphate (mg/g)	0.49	0.37	0.24	0.23	0.29	0.29
Sulphate (mg/g)	4.8	3.7	2.4	2.4	2.4	2.4
Sodium (mg/g)	1.9	0.41	1.5	0.2	0.82	0.32
Potassium (mg/g)	1.1	1.2	0.70	0.35	0.40	0.47
Available Nitrogen (kg/ha)	405	220	221	166	166	746

The available nitrogen content was maximum (746 kg/ha) in Amman Kulam. TOC concentration with 10.3 mg/g was found highest in Amman Kulam. Heavy metals, Cu, Pb, Zn, Ni, Cd, Cr, Fe and Mn, concentration in the sediment samples are given in table 3. The normal range of these metals as per Alloway (1990) is given in table 4. The highest concentration of Cu in the samples was in Amman Kulam (79.9 mg/kg), falling within the critical range. Concentration of Zn (613.8 mg/kg) in Amman Kulam exceeded the critical concentration range (70-400 mg/kg). Ni was found in the normal range (2-750 mg/kg) in all the samples. Pb also was found in the normal range (2-300 mg/kg).

Table 3. Heavy metal concentrations (mean - µg/g) in sediment samples.

Heavy metals	Sampling stations					
	S1	S2	S3	S4	S5	S6
Cu	16.5	9.3	9.3	28.9	24.8	79.9
Zn	167.8	64.5	72.5	56.3	67.0	613.8
Ni	50.9	28.8	3.7	21.7	46.9	32.5
Pb	8.0	4.0	9.0	16.6	0.5	38.8
Cd	0.00	0.25	0.25	0.25	0.00	0.25
Cr	17.2	15.2	18.9	48.4	10	84.8
Fe	50.0	25.0	32.5	6572.6	1177.5	6425.0
Mn	318.8	292.5	375.0	177.1	377.0	160.2

In Selvachinthamani Kulam and Valan Kulam, Cd was found below detection limits. In other four wetlands the Cd concentration was 0.25 mg/kg. Cr did not exceed the normal range (5-150 mg/kg) in any of the wetlands. The highest concentration of the metal was found in Amman Kulam (84.8 mg/kg), the level

being within the critical concentration range. Mn concentration was also within normal range (20-10,000 mg/kg) with the highest being in Valan Kulam (377 mg/kg). The Fe concentration was found maximum in Kovaipudur Lake (6572 mg/kg). The study shows that Selvachinthamani Kulam is more polluted than other wetlands in Coimbatore, mainly because of effluents from textile dyeing, electroplating and manufacture of jewellery of noble metals.

Table 4. Concentration of heavy metals in soil (Alloway 1990).

Element	Normal range	Critical concentration in soil (mg/kg)
Cu	2-250	60-125
Zn	1-900	70-400
Ni	2-750	100
Pb	2-300	100-400
Cd	0.01-2.0	3-8
Cr	5-150	75-100
Mn	20-10000	1500-3000

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