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DEPOSITION OF MACRO AND MICRO NUTRIENTS IN SOIL AND SEDIMENTS OF RIVER TAPTI BECAUSE OF INDUSTRIAL DEVELOPMENT

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ABSTRACT

In the present study, soil and sediment samples were collected from the bank of Tapti river from Taloda to Kukurmunda for their physico–chemical and metallic characteristics. These samples showed two fold increased level of studied parameters in comparison with relatively non polluted values. The statistical evaluations were made by following standard methods. Also, metal analysis by ICP–AES were included in the statistics. Further, the results of correlation coefficient and t–test values indicate positive correlation in deposition and significant at 5% level of confidence. The higher contents of concentration of parameters of physico–chemical characteristics and metals in soil and sediments is attributed to surrounding industrial activity.

Key word : Macro nutrients, Micro nutrients, Soil, Sediments, Tapti river

INTRODUCTION

The present communication deals with physico–chemical characteristics of soil and sediments and their statistical evaluations. Sampling was be done from Taloda taluka of Nandurbar district (M.S.) The sediment of river generally preserves a very good historical record changes in the flux of trace elements[1]. These workers have studied the deposition of trace elements in sediments of ponds around Lakamanahalli industrial area, near Dharwad city. With the growth of increased industrial activity as a result of rapid urbanization and the release among many environmental parameters, sediments have a more significant importance in the assessment of pollution and management. Many works have been reported on soil and sediments as indicators of pollution[2–5].

The main objective of the present study was to assess the impact of surrounding increased industirlization on inland water bodies by analyzing the soil and sediment and their correlation studies. The protection of river Tapti is an important aspect to keep ecosystem in balance and to provide the base line information to the pollution control authorities.

MATERIALS AND METHODS

The physico–chemical parameters of soil and sediment sample were analyzed by following the standard methods[6]. pH was measured by electronic pen type pH meter and metals were analysed by atomic absorption spectrophotometer.

The statistical evaluations SDQ, SE and 95% CL were computed using the following formulae[7].

$$S.D. = \sqrt{\frac{(X - \bar{X})^2}{n - 1}} \quad ...(1)$$

$$S.E. = \frac{S.D.}{\sqrt{n}} \quad ...(2)$$

$$95\%\ CL = X \pm t \times S.E. \quad ...(3)$$

where the value of t was obtained from the t– distribution table[7]. The following abbreviations were used throughout the text.

SD = Standard deviation, SE = Standard error and CL = Confidence limit

RESULTS AND DISCUSSION

The results achieved during the course of present study are tabulated in Tables 1–7. The physico–chemical characteristics of soil and sediment samples are being described in Tables 1 and 2. The results are demonstrated by the minimum and maximum values, average values and statistical evaluations (SD, SE, CL) of the parameters of soil and sediment are presented in Tables 3 and 4. There is a desription of correlation coefficient (r) of soil and sediment samples in Tables 5 and 6. Table 7 shows statistics of heavy meals of soil and sediment samples.

Table 1. Physico–chemical parameters of soil samples of Tapti river

Sr. no	Site of sample collection	pH	EC	Cl^-	HCO_3–	TA	WES	T–n	No3–n	Po4–p	OM	COD
1	Cultivated by chilli crop	7.8	2500	55.0	60.0	180.0	1200	243.0	26.00	1.610	2327.4	225.0
2	Cultivated by cohon crop	8.0	2800	77.0	86.2	280.0	7200	550.0	33.10	0.300	363.764	215.0
3	Cultivated by jowar crop	7.5	2500	43.14	75.2	260.0	3500	102.8	32.00	0.220	813.24528	276.0
4	Cultivated by sugar cane	8.0	1800	55.5	75.2	300.0	4500	250.0	14.70	0.210	2292.92	234.0
5	Cultivated by banana crop	8.6	4300	67.44	70.0	245.0	2400	445.0	38.29	0.260	4422.06	230.0

Table 2. Physico–chemical parameters of sediment of Tapti river

Sr. No	Site of sediment sample collection	pH	EC	Cl^-	HCO_3–	TA	WES	T–n	No3–n	Po4–p	OM	COD
1	Taloda Station No. 1	8.9	3600	326	120.0	230.0	2100	730.0	32.00	1.210	2327.4	38.0
2	Budhawai Station No. 2	8.6	5900	500	926.1	145.0	2200	650.0	43.10	0.230	1637.8	52.100
3	Kukurmund Station No. 3	8.1	7200	200	111.0	173.0	2450	550.0	50.00	0.170	1379.2	53.0
4	Hatoda Station No.4	7.9	7000	140.40	101.0	145.0	2650	110.0	22.0	0.185	1982.6	20.0
5	Modalpada Station No.5	7.9	5100	375	110	200.6	2650	880.0	48.4	0.255	1293.0	52.4

pH, EC and chloride

The pH of soil and sediment samples was found to be in the range 7.5 to 8.6 and 7.9–8.9 alongwith concentration of average value with 95% CL was found to be 7.98 ± 0.49 and 8.28 ± 0.55, respectively.

The conductivity values of soil and sediment was found to be in the ranges of 1800–4300 and 3600–7200 μ mho/cm, respectively. This conductivity of average value with 95% CL was found to be 2780 ± 1149.27 and 5760 ± 1834.26, respectively. The concentration of chloride was found to be in the range of 43.14 – 77.0 μg/g in soil sample alongwith 95% CL average value was obtained 59–61 ± 6.10 whereas in sediment, it is in the range of 140.40 – 500 μg/g. The average value of chloride with 95% CL in sediment was calculated 308.28 ± 177.13 μg/g.

Bicarbonate, total alkalinity and WES

The concentration of bicarbonate, TA and WES (Table 3) in soil was found to be in the range of 60.6 – 86.2, 180.0 – 300.0 and 1200 – 7200, respectively and the average value with 95% CL were found to be in the range 73.32 ± 11.30, 253 ± 56.82 and 3760 ± 2834.5 μg/g, respectively.

The concentration of HCO_3–, TA and WES in sediment sample ranges form 101.1 – 926.1, 135.0 – 230.0 and 2100 – 2650 μg/g, respectively, whereas the concentration of average value with 95% CL was found to be 273.64 ± 452.88, 176.6 ± 48.64 and 2410 ± 314.68 μg/g for the parameter HCO_3–, TA and WES.

Organic matter

The concentration of organic matter in soil samples ranges from 363.764 – 4422.06 μg/g. The concentration of average value with 95% CL was found to be 2043.877 ± 1976.17 μg/g for soil sample, whereas it concentration in sediment ranges from 1293.0 – 2327.4 μg/g alongwith the concentration of average value with 95% CL was found to be 1724 ± 535.07 μg/g (Table 3 and 4).

Table 3. Statistical evaluation for physico–chemical parameters of soil sample

Parameter	Min.	Max.	$\overline{X}$	SD	SE	AV ± 95% CL
pH	7.5	8.6	7.98	0.40	0.18	7.98 ± 0.49968
EC	1800	4300	2780	925.49	414.00	2780 ± 1149.27741
Cl^-	43.14	77.0	59.616	12.97	5.80	59.616 ± 16.10469933
HCO_3–	60.0	86.2	73.32	9.10	4.07	73.32 ± 11.30019552
TA	180.0	300.0	253	45.77	20.46	253 ± 56.82330282
WES	1200	7200	3760	2283.19	1021.07	37603760 ± 2834.512142
TON	102.8	550.0	236	23.46	10.49	236 ± 29.12816468
NO_3–N	14.70	38.29	318.16	177.84	79.53	318.16 ± 220.7861823
PO_4–P	0.21	1.61	28.818	9.01	4.03	28.818 ± 11.19796009
OM	363.76	4422.06	2043.87	1591.80	711.87	2043.877856 ± 1976.172399
COD	215.0	276.0	0.52	0.61036 8741	0.27296 5199	0.52 ± 0.757751392.

Table 4. Statistical evaluation for physico chemical parameters of sediment sample

Parameter	Min.	Max.	$\overline{X}$	SD	SE	AV + 95% CL
pH	7.9	8.9	8.28	0.44	0.20	8.28 ± 0.55
EC	3600	7200	5760	1477.49	660.75	5760 ± 1834.26
Cl^-	140.40	500	308.28	42.68	63.80	308.28 ± 177.13
HCO_3–	101.1	926.1	273.64	364.79	163.14	273.64 ± 452.88
TA	135.0	230.0	0.41	0.44	0.20	0.41 ± 0.55
WES	2100	2650	176.6	39.18	17.52	176.6 ± 48.64
T–N	110.10	880.0	2410	253.47	113.35	2410 ± 314.68
NO_3–N	22.0	50.00	584	291.12	130.19	584.02 ± 361.42
PO_4–P	1.170	1.21	1724	431	192.74	1724 ± 535.07
OM	1293.0	2327.4	43.1	14.36	6.42	43.1 ± 17.83
COD	20.0	53.0	39.1	11.87	5.31	39.1 ± 14.74

Chemical oxygen demand (COD)

The concentration of COD in soil and sediment ranges from 215.0 – 276.0 and 20.0 – 53.0 mg/kg, respectively. T concentration of average value with 95% CL was found to be 236 ± 29.12 and 43.1 ± 17.83 mg/kg (Table 3 and 4).

Phosphorous (PO_4–P)

The concentration of phosphorous (PO_4–P) ranges from 0.210 – 1.61, 0.170 – 1.21 in soil and sediment samples, respectively. The concentration of average value of with 95% CL was found to be 0.52 ± 0.75 and 0.41 ± 0.55 µg/g, respectively.

Total nitrogen and nitrate nitrogen

The concentration of T–nitrogen and nitrate nitrogen in soil and sediment was found to be in the range of 243.0 – 102.8, 14.70 – 38.29 and 110.10 – 880.0, 22.0 – 50.00 µg/g, respectively. The concentration of average value with 95% CL are described in Tables 3 and 4.

The correlation coefficient (r) among the physico–chemical parameter of soil and sediment are given in Tables 5 and 6. The statistical evaluation of heavy metals analysed for soil and sediment is presented in Table 7.

Table 5. Correlation coefficient values among the physico–chemical parameter of soil samples

Sr. No	Parameters	pH	EC	Cl^-	HCO_3–	TA	WES	T–N	NO_3–N	PO_4–P	OM	COD
1	pH	1										
2	EC	0.74	1									
3	Cl^-	0.66	0.46	1								
4	HCO_3–	0.01	0.09	0.44	1							
5	TA	0.08	0.23	0.1	0.83	1						
6	WES	0.04	0.22	0.52	1.01	0.77	1					
7	T–N	0.69	0.52	0.99	0.44	0.18	0.52	1				
8	NO_3–N	0.32	0.84	0.35	0.11	0.23	0.02	0.41	1			
9	PO_4–P	0.22	0.14	0.14	0.75	0.89	0.60	0.18	0.13	1		
10	OM	0.77	0.02	0.08	0.58	0.28	0.63	0.12	0.12	0.09	1	
11	COD	0.56	0.18	0.83	0.03	0.10	0.22	0.79	0.04	0.30	0.21	1

Table 6. Correlation coefficient values among the physico–chemical parameter of sediments

Sr. No	Parameters	pH	EC	Cl^-	HCO_3–	TA	WES	T–N	NO_3–N	PO_4–P	OM	COD
1	pH	1										
2	EC	0.66	1									
3	Cl^-	0.50	0.49	1								
4	HCO_3–	0.41	0.63	0.75	1							
5	TA	0.43	0.82	0.17	0.43	1						
6	WES	0.98	0.55	0.51	0.47	0.36	1					
7	T–N	0.35	0.66	0.71	0.14	0.71	0.34	1				
8	NO_3–N	0.09	0.06	0.43	0.19	0.20	0.00	0.70	1			
9	PO_4–P	0.77	0.85	0.12	0.15	0.78	0.68	0.33	0.31	1		
10	OM	0.61	0.47	0.16	0.10	0.22	0.51	0.31	0.82	0.56	1	
11	COD	0.12	0.09	0.61	0.35	0.26	0.22	0.78	0.96	0.16	0.69	1

Table 7. Statistical evaluation for heavy metals of soil and sediment

Sr. No.	Sample	Metals	Min.	Max.	$\overline{X}$	SD	SE	AV ± 95% CL
	Soil							
1		Cu	0.90	1.72	1.15	0.34	0.15	1.15 ± 0.42
2		Zn	0.64	1.32	0.94	0.24	0.11	0.94 ± 0.30
3		Cd	0.21	0.40	0.29	0.07	0.03	0.29 ± 0.09
4		Pb	0.41	1.0	0.69	40.88	18.28	0.69 ± 50.76
5		Fe	150.0	192	177.68	21.34	9.54	177.68 ± 26.50
	Sediments							
1		Cu	1.0	2.10	1.59	0.46	0.20	1.59 ± 0.57
2		Zn	10.0	40.0	19.08	20.92	9.35	19.08 ± 25.97
3		Cd	0.58	1.0	0.88	4.93	2.20	0.88 ± 6.12
4		Pb	0.97	1.72	1.41	0.33	0.14	1.41 ± 0.41
5		As	0.02	0.06	0.03	0.86	0.38	0.03 ± 1.07
6		Hg	1.54	3.0	2.43	0.59	0.26	2.73 ± 0.74
7		Cr	2.86	5.58	3.68	1.15	0.51	3.68 ± 1.43
8		Fe	185	249	210.6	24.86	11.12	210.6 ± 30.86

CONCLUSION

The sediment of river Tapti investigated assume a special significance (in terms of historical record) as indicators of anthropogenic macro and micro nutrient or trace elements pollution. The river bottom sediment and soil sample recorded a low trace elements level (Table 7) and whose presence could be tied only to lithogenic contribution with increase in industrial activity around/nearby areas the banks of river and with rapid urbanization, trace elements started fluxing. The present rates of the trace element level in sediments indicate rapid increase and clustering of industrial activity in the recent times. Therefore, the sediment and soils in and around river Tapti have a bound record of industrial activity and showing about two fold increased level in top layers compared with non polluted samples. This is expected to pose potential danger to the aquatic environment leading to eutrophication of this river. Now a days, land water bodies are used as popular dumping sites for effluents. This has to be avoided and to be protected from extensive industrial activity around river Tapti and its catchment area.

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