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Assessment of heavy metal pollution in ground water near proximity of south bank canal, Tamil Nadu, India

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ABSTRACT - A study has been carried out on heavy metal contamination of groundwater with respect to cadmium, manganese, zinc, copper and lead in the south bank canal between Karur and Tiruchirappalli districts, Tamil Nadu, India. Heavy metals in groundwater are estimated by using Atomic Absorption Spectrometer, Perkin Elmer AA 200. Univariate statistics along with skewness, kurtosis and 't' test have been employed to test the distribution normality for each metal. The study reveals that the groundwater of the area is highly contaminated with cadmium. A good number of samples are also found to contain manganese at an alert level. The concentrations of copper and zinc in the groundwater of the area are within the guideline values of WHO. Statistical results show that all the metals under study exhibit an asymmetric distribution in the area with a long asymmetric tail on the right of the median. Keeping in view of the high concentrations of cadmium and manganese, it is suggested to test the potability of groundwater of the area before using it for drinking.

Key words - Cadmium, Manganese, Lead, Skewness, Kurtosis, t-Test

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Water plays an essential role in human life. Although statistics, the WHO reports that approximately 36 per cent of urban and 65 per cent of rural Indian were without access to safe drinking water. Fresh water is one of the most important resources crucial for the survival of all the living beings. It is even more important for the human being as they depend upon it for food production, industrial and waste disposal, as well as cultural requirement. Human and ecological use of ground water depends upon ambient water quality. Human alteration of the landscape has an extensive influence on watershed hydrology [1].Heavy metal contamination of groundwater more often not goes unnoticed and remains hidden from the public view. Presently, it has raised wide spread concerns in different parts of the world and results reported by various agencies have been alarming [2,3].There is also evidence of prevailing heavy metal contamination of groundwater in many areas of India [4-6].Trace amounts of heavy metals are always present in fresh waters from terrigenous sources such as weathering of rocks resulting into geo-chemical recycling of heavy metal elements in these ecosystems [7].Contaminants such as bacteria, viruses, heavy metals, nitrates and salt have found their way into water supplies as a result of inadequate treatment and disposal of waste (human and livestock), industrial discharges, and over-use of limited water resources [8]. In this work, concentrations of cadmium, manganese, zinc, copper and lead ions in drinking water samples from water sources in these communities were determined by using standard analytical methods. Correlations between the metal concentrations were investigated. The monitoring of groundwater quality has been universally recognized as the quality of ground water cannot be restored once it is contaminated, by stopping the flow of pollutants from the source[9].Toxic metals have adverse effect on the health of human, when they are penetrated through the human organ and tissue as well as the entire systems. Lead in any concentrated can caused kidney damage and toxicity symptoms include impaired kidney function, poor reproductive capacity, hypertension, tumors, etc. chromium (VI) penetrates cell membranes and causes genotoxic, effect and cancer [10].

Statistical analysis:

Using SPSS/16 statistical software; SPSS Inc., USA, a t-test analysis was performed and differences were considered significant at values of $P < 0.05$. For the statistical analysis, values below the detection limit were set to half that level.

Sampling information:

For the present study, twenty two water samples were collected left side as well as right side five different stations of south bank canal between Karur and Tiruchirappalli districts during June to November, 2010 (Table A).

Table A : Sampling locations

Sample No	Station name	Sample No	Station name
A1		B1	
A2	Towards Left to	B2	Towards Right to
A3	South Bank Canal in	B3	South Bank Canal
A4	Seelapillayarputhur	B4	in Mayanur
A5		B5	
A6	Towards Left to	B6	Towards Right to
A7	South Bank Canal in	B7	South Bank Canal
A8	Mahendramangalam	B8	in Lalapet
A9		B9	
		B10	
		B11	Towards Right to
			South Bank Canal
			in Petavaithalai

EXPERIMENTAL METHODOLOGY

Separate water samples were selected by random selection and compiled together in clean and sterile one liter polythene cans rinsed with dilute HCl to set a representative sample and stored in an ice box. Samples were protected from direct sun light during transportation to the laboratory and metals were analyzed as per the standard procedures [11]. All the metals were estimated by using Atomic Absorption Spectrometer (Perkin Elmer AA 200). The instrument was used in the limit of précised accuracy and chemicals used were of analytical grade. Doubly-distilled water was used for all purposes.

Data analysis:

Univariate statistics were used to test distribution normality for each metal. The confidence interval was calculated at 0.05 levels. *t*- Test is done under null hypothesis (H_0) by taking the assumption that the experimental data are consistent with the mean rating given by (WHO-2004).Simple correlation analysis was used to relate the metal concentrations among themselves. Moment coefficients of skewness and kurtosis were calculated to express how the shapes of sample frequency distribution curves differ from ideal Gaussian (normal). Skewness was calculated as third moment of the population mean. In asymmetrical distributions, skewness can be positive or negative. Kurtosis was calculated as fourth moment of the population to describe the heaviness of the tails for a distribution. Some more statistical estimates derived from the normal distribution in the form of sample variance, 1st, 2nd, 3rd Quartile, Inter Quartile Range (IQR) were also made in the present study to find out the distribution pattern of the data and other related information Details of these may be found in standard books on statistics and software packages [12].

EXPERIMENTAL FINDINGS AND ANALYSIS

The results of analysis of various metals in groundwater samples of the south bank canal between Karur and Tiruchirappalli districts, Tamil Nadu are given in Table 1. To get an idea about the distribution pattern of the metal contents in groundwater left side and right side the canal separately, data are graphically represented in Fig. 1 and 2, respectively. To look into the trend and distribution patterns of cadmium, manganese, zinc, copper and lead in groundwater of the study area, data obtained from 22 sampling stations were exposed to several statistical treatments as discussed briefly in the methodology section. A conventional descriptive statistics based on normal distribution has been shown in Table 2.

In most of the samples under investigation, the cadmium contents were much above the guideline value of 0.003 ppm as set by WHO [13]. Cadmium above the permissible limit can potentially cause nausea, vomiting, diarrhea, muscle cramps, salivation, sensory disturbances, liver injury, convulsions, shock and renal failure along with kidney, liver, bone and blood damage from a lifetime exposure. Differences between mean and median, significant positive skewness and negative kurtosis value indicate that the distribution of cadmium in the study area is highly asymmetric. This is also evident from the width of the third quartile, which is much greater than the first and second quartile. The cadmium contamination of ground water in the area should be accorded maximum attention.

Manganese at concentrations above 0.15 ppm stains plumbing fixtures and laundry and produces undesirable taste in drinks. The WHO limit for manganese in drinking water is 0.05 ppm. It is observed that as many as maximum samples

Table 1 : Metal concentration of groundwater in the left and right side of canal

Sample No.	Heavy metals				
	Cd	Mn	Zn	Cu	Pb
A1	0.02	0.48	0.49	0.20	0.01
A2	0.02	0.39	0.42	0.18	0.01
A3	ND	0.35	0.38	0.12	ND
A4	ND	0.33	0.30	0.08	ND
A5	ND	0.30	0.25	0.03	ND
A6	0.04	0.45	0.05	0.02	0.02
A7	0.03	0.42	0.02	0.01	0.01
A8	0.02	0.46	0.02	0.01	0.01
A9	0.02	0.40	0.02	0.01	0.01
B1	0.05	0.75	0.39	0.15	0.04
B2	0.03	0.69	0.31	0.05	0.03
B3	0.02	0.62	0.28	0.12	0.02
B4	0.02	0.58	0.24	0.10	0.02
B5	0.02	0.52	0.23	0.10	0.02
B6	0.05	0.44	0.18	0.05	0.03
B7	0.04	0.42	0.15	0.05	0.02
B8	0.04	0.40	0.13	0.04	0.01
B9	0.02	0.39	0.11	0.03	0.02
B10	0.02	0.32	0.09	0.02	0.01
B11	0.05	0.11	0.12	0.05	0.02
B12	0.03	0.09	0.03	0.02	0.01
B13	0.01	0.05	0.03	0.01	0.01

*ND=No Detectable

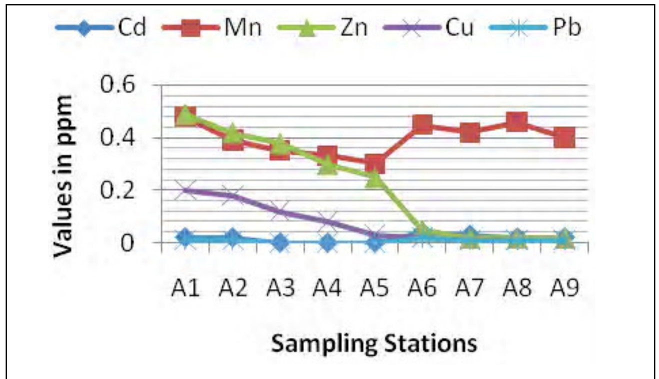

Fig. 1 : Variation of metal contents of groundwater left side the canal

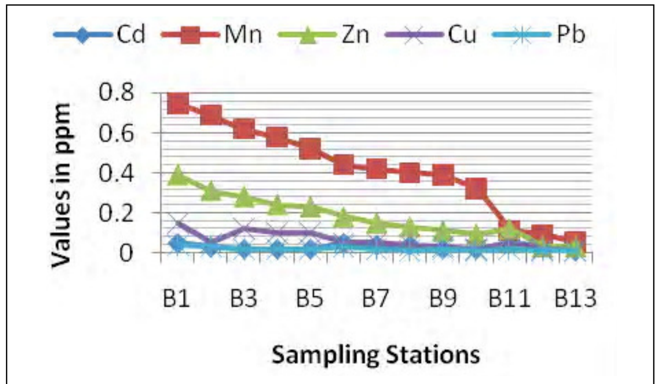

Fig. 2 : Variation of metal contents of groundwater right side the canal

Table 2 : Descriptive statistics of the metal contents of groundwater in the study area

Statistics	Cd	Mn	Zn	Cu	Pb
Mean	0.025	0.407	0.193	0.066	0.015
Standard Error	0.003	0.037	0.031	0.012	0.002
Median	0.02	0.41	0.16	0.05	0.01
Range	0.05	0.70	0.47	0.19	0.04
Standard Deviation	0.01535	0.17488	0.14561	0.05754	0.01012
Variance	0.00	0.031	0.021	0.003	0.000
Skewness	0.087	-0.261	0.454	1.038	0.607
Kurtosis	-0.567	0.437	-0.898	0.099	0.473
1st Quartile	0.02	0.3275	0.0450	0.02	0.01
2nd Quartile	0.02	0.41	0.165	0.05	0.01
3rd Quartile	0.04	0.49	0.3025	0.105	0.02
WHO Rating, in ppm	0.003	0.40	3.0	2.0	0.01
t-test value	-7.638	9.582	4.598	1.297	-16.224
Comment, 0.05 level 95% CL	significant	significant	Non significant	Non significant	significant
No of Samples	22	22	22	22	22

under observation contain manganese either at toxic or alert level. Thus, manganese contamination of groundwater in the area needs proper attention. A broad third quartile and negative kurtosis in case of manganese represents a long asymmetric tail on the right of the median. Heaviness of the tail for manganese distribution in the area is evident from very high positive kurtosis value Pearson's correlation coefficient matrix is presented in Table 3 to measure the linear association among different metals under study. Since the directions of association of the measured variables are unknown in advance, two-tailed test of significance was carried out.

Table 3 : Correlation

	Cd	Mn	Zn	Cu	Pb
Cd	1.0000				
Mn	0.1505	1.0000			
Zn	0.0852	0.5317	1.000		
Cu	0.1375	0.4806	0.9159	1.0000	
Pb	0.1379	0.5305	0.0032	0.0041	1.0000

The ground waters of the study area are by and large safe with regard to zinc as may be seen from Table 1, its distribution is still not uniform in the area. Wide data range and high standard deviation in case of zinc is likely to bias the normal distribution statistic. This observation is supported by positive kurtosis and negative skewness value, which point towards sharp zinc distribution with a long right tail in the study area.

The permissible limit for copper in drinking water is 2.0 mg/L. This was set to ensure the water tastes good and to minimize staining of laundry and plumbing fixtures. The distribution of copper in groundwater of the study area is found to be within the permissible limit of WHO with an average of 0.07 ppm. Asymmetric nature of copper distribution is also apparent from the normal distribution statistics with positive skewness and kurtosis values.

The permissible limit for lead in drinking water is 0.01 mg/L. The distribution of lead in groundwater of the study area is found to be nearly 10 samples above the permissible limit of WHO with an average of 0.015 ppm. Asymmetric nature of lead distribution is also apparent from the normal distribution statistics with positive skewness and kurtosis values.

From the correlation of the studied metals as shown in Table 2, significant correlation was found among cadmium, copper, Zinc, Lead and manganese all are positive correlation. Over all significant correlation was found among zinc shares a clear high positive correlation with copper and low positive correlation with lead content at the 0.05 level in the area.

Conclusions:

Statistical observations on Cd, Mn, Cu, Zn and Pb in groundwater of near south bank canal between Tiruchirappalli and Karur districts, Tamil Nadu show that all these metals exhibit an asymmetric distribution with a long asymmetric tail on the right of the median. It is observed that the groundwater of the area is contaminated with cadmium. A sizeable number of groundwater samples contain manganese and lead at an alert level. The concentrations of copper and zinc in the groundwater of the area are either low or moderate and within the guideline values of WHO. Keeping in view of the unusually high concentrations of the harmful metals, *viz.* cadmium and manganese and lead, it is advisable to test the potability of groundwater of the area before using it for drinking.

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REFERENCES

1. **Kalra, Neerja**, Kumar, Rajesh, Yadav, S.S. and Singh, R.T. (2012). *J. Chemical & Pharmaceutical Res.*, **4**(3) : 1827-1832.
2. **Friberg, L.**, Nordberg, G.F. and Vouk, V.B. (1986). Ed., Handbook of the toxicology of metals,Elsevier, Amsterdam, 1986, 2, 130-184.
3. **WHO/UNEP GEMS** (1989). Global fresh water quality; published on behalf of the World Health Organization/United Nations Environment Programme,Oxford, Blackwell Reference.
4. **Sharma, A.**, Sharma, D.K., Jangir, J.P. and Gupta, C.M. (1989). *Indian J Environ. Protect,* **9**(4) : 294- 296.
5. **Bhattacharjee, S.**, Chakravarty, S., Maity, S., Dureja, V. and Gupta, K.K. (2005). *Chemosphere*,**58** : 1203-1217.
6. **Bhattacharya, P.**, Chatterjee, D. and Jacks, G. (1997). *Water Resources Development,* **13** : 79-92.
7. **Sekabira, K.,** Oryem Origa, H., Basamba, T.A., Mutumba, G., Kakudidi, E. (2010). Assessment of heavy metal pollution in the urban stream sediments and its tributaries. *Internat. J. Environ. Sci. Tech.*, **7**(3) : 435-446.
8. **Singh1, S.** and Mosley, L.M. (2003). Trace metal levels in drinking water on Viti Levu, Fiji Islands. *S. Pac. J. Nat. Sci.*, **21** : 31- 34.
9. **Borah, K.K.**, Bhuyan, B. and Sarma, H.P. (2009). *E J. Chem.,* **6**(S1), S501-S507

10. **Ambursa, M.M.,** Faruk, U.Z., Uba, A., Sahabi, D.M., Atiku, F.A. and Koko, R.A. (2011). *J. Chem. Pharm. Res.,* **3**(6):732-74.

11. **APHA** (American Public Health Association) (1988). Standard method for examination of water and wastewater, NEW YORK, 20th Ed..

12. **Meloun, M.,** Militky, J. and Forina, M. (1992). Chemometrics for Analytical Chemistry, Vol. 1:PC-aided Statistical Data Analysis; Ellis Horwood Ltd: Chichester, ENGLAND.

13. **W.H.O.** (2004). Guidelines for Drinking water Quality, 3rd Ed, World Health Organisation: GENEVA.

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