Pre and Post Monsoon Variation of Heavy Metals Concentration in Ground Water of Angul-Talcher Region of Orissa, India

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ABSTRACT: *This study was undertaken to assess the portability of ground water with the reference to heavy metals in Angul-Talcher region of Orissa, India. The groundwater samples from 19 different locations from industrial as well as domestic areas were collected in pre and post monsoon season. The Standard methods (APHA, 1998) were adopted for heavy metal analysis of these samples and the results were compared with the Indian Standards (IS: 10500) for potable water. The study reflects the presence of some heavy metals in few groundwater samples but all were within the limits except cadmium. Mercury (Hg) could not be detected in any of the samples in the study area.* [Nature and Science. 2009;7(6):52-56]. (ISSN: 1545-0740).

Key Words: Groundwater quality, heavy metals, drinking water

INTRODUCTION:

In India almost 80% of the rural population depends on untreated ground water for potable water supplies (Sudhkar at el., 2004). It is well known fact that potable safe water is absolutely essential for healthy living. Adequate supply of fresh and safe drinking water is a basic need for all human beings on the earth. Drinking water is a potential source of human exposure to toxic substances. Contamination of drinking water may occur by, percolation of toxics through the soil to ground water that is used as a source of drinking water (Sargaonkar and Deshpande, 2003).

In recent years, because of continuous growing of population, urbanization and rapid industrialization, the rate of discharge of pollutants into the environment is far higher than the rate of purification. Groundwater contamination and its management has become the need of hour because of far reaching impact on human health. Contamination of ground water resources occurs through surface discharge as well as naturally due to geochemical activities (Sudhaker at el., 2004). Open dug wells are generally considered as one of the worst type of drinking water source (Adekunle, 2008). Usually in unaffected environments the concentration of most metals is very low and is mostly determined by the mineralogy and the weathering (Jinwal and Dixit, 2008). The water composition varies in the groundwater reservoir through percolation and the reactions with minerals present in the rock that may modify the water composition. There are a few examples of metal pollution through natural weathering but in most of the cases metals become an environmental and health issue because of anthropogenic activity.

STUDY AREA

Angul-Talcher is situated at an average height of 139 m above mean sea level (MSL) and about 160 km from the Bhubaneswar, the state capital of Orissa, India. The area lies between 20°37’ to 21° 10’ N latitude and 84°53’ to 85° 28’ E longitude. Angul-Talcher region is economically very important and has also been identified as a critically polluted area (CPCB, 2007). Many small, medium and large scale industries such as coal mines, super talcher thermal power plant (Kaniha), Talcher Thermal Power Station, Nalco smelter and its captive power plant and other iron & steel industries are situated in the region. These industries are polluting the surrounding areas including groundwater resources.

The present study on heavy metals concentrations in ground water of Angul-Talcher area is necessitated because of coal mining and coal based heavy industries. Large number of motor vehicles may also contribute in the release of heavy metals into surrounding environment. In this region the heavy rain fall occur during June to September, so there is possibility that heavy metals present in the atmosphere may also contaminate shallow ground water resources. Hence it is extremely important to assess the groundwater quality in respect of heavy metals. Geographical location of study area is shown in the Figure 1.

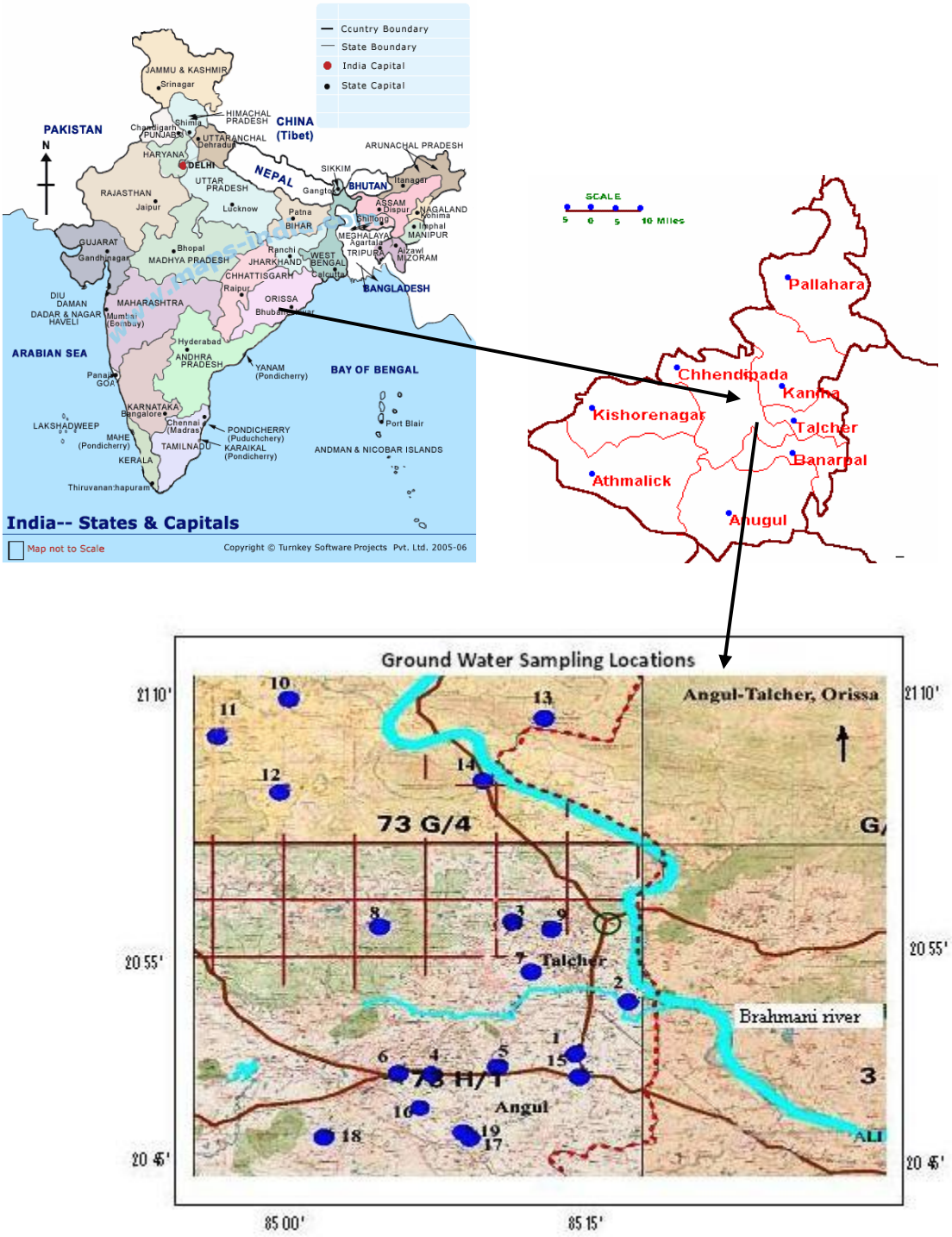

Figure 1: Study Area

SAMPLING

The sampling locations consist of industrial as well residential area. Nineteen no. of ground water samples were collected from tube well and open well during pre and post monsoon period. Details of sampling locations are illustrated in Table 1. Samples were collected in plastic containers to avoid unpredictable changes in characteristic as per standard procedures. (APHA, 1998).

ANALYSIS

The collected water samples were pretreated and preserved by concentrated HNO_3. Metal concentrations in the water samples were determined using the Atomic Absorption Spectrophotometer (Avanta) for major heavy metals such as Cadmium (Cd), Copper (Cu), Lead (Pb), Nickel (Ni), Zinc (Zn), Iron (Fe), Cobalt (Co), Mercury (Hg), Arsenic (As) as per to the standard procedure prescribed by APHA (1998) and the results were compared with the Indian Standards (IS: 10500) for potable water.

Table 1. Ground water Sampling Stations within the study area.

Code	Sampling Locations	Latitude	Longitude
GW1	Gotamara village, tube well water	20º 51’ 21”	85º 12’ 46”
GW2	Dasnala village, open well water	20º 53’ 33”	85º 14’ 33”
GW3	Jagannath village tube well water	$20^0$56’50”	$85^0$10’40”
GW4	Kandasar village, open well water	20º 50’ 33”	85º 07’ 58”
GW5	Girang village, open well water	20º 50’ 52”	85º 10’ 08”
GW6	Hingula- Gopal Prasad village, Tube well water	20º 50’ 30”	85º 06’ 50”
GW7	Sharma Chak, open well water	20º 54’ 44”	85º 11’ 15”
GW8	Donara village, Open well water	20º 56’ 36”	85º 06’ 12”
GW9	Hingula tube well water	20º 56’ 32”	85º 11’ 57”
GW10	Takua village, open well water	21º 06’ 04”	85º 03’ 10”
GW11	BarhaGundari village, open well water	21º 04’ 47”	85º 00’ 02”
GW12	Kamarel village open well water	$21^0$02’10”	$85^0$02’50”
GW13	Blinda village open well water	$21^0$05’20”	$85^0$11’40”
GW14	Ekgharia village, open well water	$21^0$02’38”	$85^0$09’39”
GW15	Near Banarpal junction, tube well water	20º 50’ 28”	85º 12’ 55”
GW16	Nuashahi village, open well water	$20^0$48’10”	$85^0$09’00”
GW17	Tulsipal village,open well water	$20^0$49’00”	$85^0$07’40
GW18	Longibeda village, tube well water	$20^0$47’50”	$85^0$04’20”
GW19	Gadrak khai village, open well water	$20^0$48’20”	$85^0$09’30”

RESULTS AND DISCUSSION

The range of heavy metals concentrations of various groundwater samples are shown in Table 2 along with statistical variations. In most of the cases the concentration of Copper (Cu), Lead (Pb), Nickel (Ni), Zinc (Zn), Iron (Fe), Cobalt (Co), Mercury (Hg), Arsenic (As) from groundwater samples were below detection limit. In other samples such as GW3, GW4, GW5, GW7, GW9 and GW15, the concentrations were found within the prescribed limit for drinking water (IS: 10500) except cadmium. The level of cadmium was found slightly above than permissible limits in sample of Jagannathpur village tube well water (GW3), Sharma Chhak open well water (GW7), Hingula tube well water (GW9), Kandasar village open well water (GW4) and Banarpal junction tube well water (GW15) in pre-monsoon season. In sample GW9 and GW4, Cd levels were above the prescribed limits in post monsoon season as well. Mercury (Hg) could not be detected anywhere in the study area. Distribution of various heavy metals during pre and post monsoon season is shown in figure 2 & 3 respectively.

Cadmium is natural constituent of ground water and it may found with in organic and inorganic forms. Cadmium in ground water may arise from industrial discharge, mining activities, weathering and erosion of bed rock (Stanley, 1993).

Table 2. Statistical analysis of heavy metals at various locations.

Sl. No.	Heavy metals	Pre-Monsoon			Post Monsoon			IS: 10500 (ppm)
		N	Range	Mean ± SD	N	Range	Mean ± SD	
1	Cadmium (Cd)	9	0.005-0.031	0.015 ± 0.010	8	0.001-0.02	0.007 ± 0.006	0.01
2	Copper (Cu)	10	0.001-0.01	0.004 ± 0.003	5	0.001-0.04	0.011 ± 0.016	0.5
3	Lead (Pb)	8	0.01-0.035	0.021 ± 0.010	10	0.01-0.04	0.022 ± 0.012	0.5
4	Nickel (Ni)	6	0.01-0.12	0.030 ± 0.044	8	0.009-0.08	0.027 ± 0.023	--
5	Zinc (Zn)	9	0.01-0.026	0.016 ± 0.007	8	0.001-0.021	0.007 ± 0.007	5
6	Iron (Fe)	14	0.009-0.15	0.041 ± 0.040	9	0.002-0.11	0.034 ± 0.033	0.3
7	Cobalt (Co)	2	0.04-0.09	0.065 ± 0.035	3	0.004-0.01	0.007 ± 0.003	--
8	Arsenic (As)*	4	0.13-0.068	0.049 ± 0.025	3	0.05-0.09	0.067 ± 0.021	0.5

(* = ppb) (N= No. of samples (out of 19) in which heavy metals occurred.)

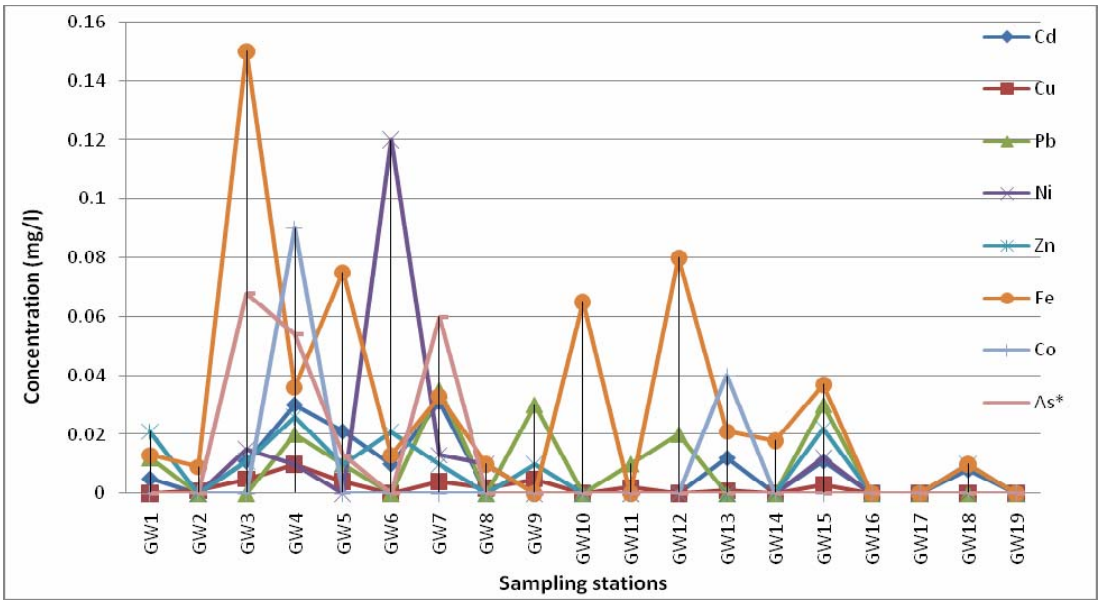

Figure 2. Distribution of various heavy metals at different locations during pre- monsoon season.

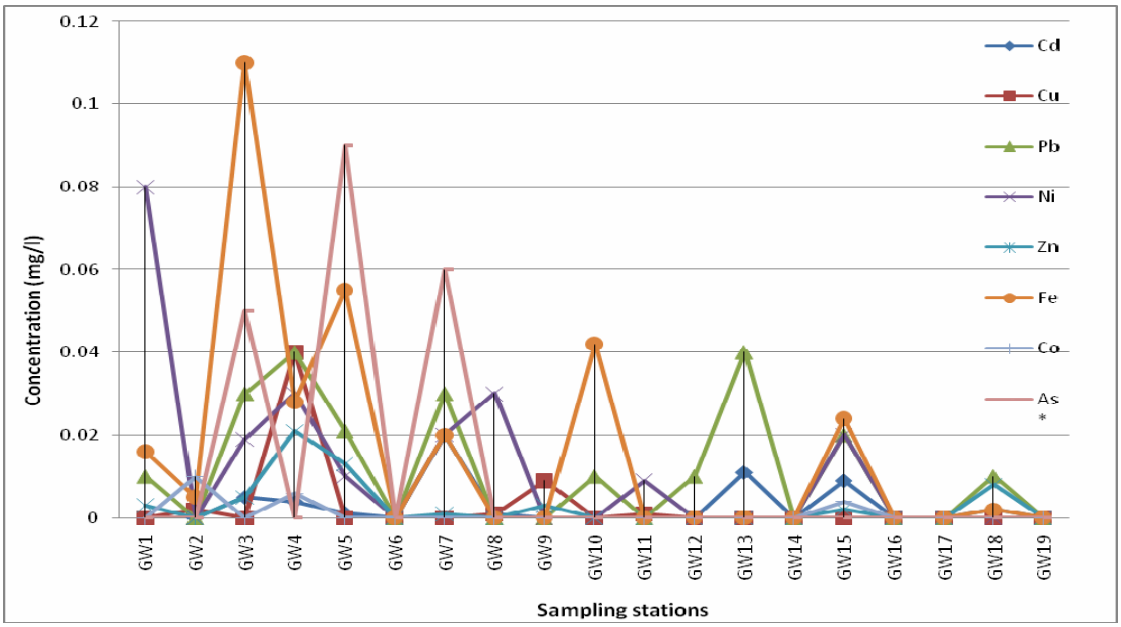

Figure 3. Distribution of various heavy metals at different locations during post- monsoon season.

CONCLUSIONS

The metal concentrations at all the locations were within permissible limit (IS: 10500) during both seasons. It was observed that the metals concentrations were slightly higher in pre monsoon that post monsoon The concentration of these metals may increase in near future due to heavy industrialisation and uncontrolled mining and related activities. Precautionary measures have to be adopted by upcoming various industries to protect heavy metal concentration in the ground water.

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REFERENCES

Adekunle Adebayo S. Impact of industrial effluent on quality of well water within Asa dam industrial estate, IIorin Nigeria. Nature and Science 2008, 6(3).

American Public Health Association: APHA. Standard method for the examination of water and waste water (20th edition) Washington D.C. 1998.

Annual Report, 2007. Central Pollution Control Board. Available at http://www.cpcb.nic.in.

IS: 10500, Drinking Water Specification: 1992. (Reaffirmed 1993)

Jinwal A and Dixit S. Pre and post monsoon variation in physico-chemical characteristic in groundwater quality in Bhopal, India. Asian j. Exp. Sci. 2008, 22(3).

Reddy M.V and Singh G. Assessment of heavy metals concentration levels from ground water of Dhanbad city in highly industrialized Jharia coalfields. Jr. of industrial pollution control, 1994, 10(2).

Sargaonkar A and Deshpande V. Development of an overall index of pollution for surface water based on a general classification scheme in Indian context. Environ. Monit. Assess 2003, 89: 43-67.

Stanley E. Fundamental of environmental chemistry. Lewis publishers, USA 1993.

Sudhkar M. R and Mamatha P. Water quality in sustainable water management, Current science 2004, vol. 87(7).