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STATUS OF WATER QUALITY IN THE PROXIMITY OF DEOGHAR TOWN IN THE JHARKHAND STATE OF INDIA

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ABSTRACT

Deoghar, one of the oldest towns of the Jharkhand state, is with religious importance of high esteem. The place at present is highly congested and the population overgrowth has much exceeded the carrying capacity to push the prevailing infrastructure to the stage of critical derangement. The State as well as Central government have taken initiatives to launch infrastructure development programmes in and around the town. For addressing the issues of ecological solutions to the problems emanating from developmental activities, a fact finding survey was considered necessary by the present authors to evaluate the status of different variables pertaining to water and air factors of the environment in and around Deoghar. As such the present work was kept concerned with the assessment of the impact of developmental activities on water quality of the sites in question. Data reveal the fact that groundwater in the project area in general is soft, with the hardness level below the desirable limit of 300 mg/l. , the samples being free from heavy metals like cadmium, arsenic, lead, chromium etc. Groundwater samples drawn from tube wells were seen to remain free from fecal coliform and total coliform and hence potable and suitable for human consumption after treatment process. Surface water quality data revealed the samples from monitoring stations to be well within the standard prescribed by CPCB for Class B, Class D and Class E types of water for most of the parameters except for oil and grease None of the heavy metals of interest are in unacceptably high concentration.

KEYWORDS : Urban Development, Surface Water Quality, Ground Water Quality, Water Quality Criteria, Water Standard

Development of a state is always linked with different types of environmental problems, of which worthwhile are the impoverishment of biodiversity and deterioration of water quality. While planning and designing infrastructure with roads, highways or other developmental work the main aspects generally taken in to consideration relate to engineering and economic perspectives, with indifference to most of the environmental attributes. Traffic, highway, and construction factors are likely to augment environmental degradation in different ways.

Increased road capacity and improved pavements can reduce travel time, lower the cost of the travel, and lower the cost of the vehicle use. It also increases the access to the market, jobs, education, health services and reducing transport costs for both freight and passengers. Improvement and creation of new infrastructure generally escalate the quality of life, but for all the positive aspects of any developmental project, there may also be significant negative impact on nearby communities and the natural environment (Tsunokawa et al.,1977).

Disturbances to the natural environment may include air pollution, soil erosion, change of streams and underground water, and interference with animal and plant lives.

Considering the foregoing Deoghar, an important town of Jharkhand State with cultural and spiritual heritage of antiquity and incredibility diffusing from its Baidyanath Jyotirlinga temple was selected for the present study. The town also known as Baba dham and Baidyanath dham, is very overcrowded and congested so that the existing infrastructure has lost its carrying capacity. Since it has no other alternative than to grow peripherally, both the State and the Central Governments have been launching various infrastructure-development projects in and around the town (Palit and Mukherjee, 2011 and Ramachandra,2008).

Considering the importance of addressing the ecological problems likely to arise from developmental activities, this study concerns itself with the evaluation of the status of water quality in the nearby areas of the town.

STUDY SITE

Deogarh, located between $24^0$03' and $23^0$38' N latitude and $86^0$28' and $87^0$04' E longitude in the western part of Santhal Paraganas, is bounded by Bhagalpur district in north, Dumka in south east and Giridhi in west to cover an area of 2481 sq. Km.. The place has a picturesque location. To the north of the town there is a wood called Baba Jungle, named after a fakir to the north-west is a low wooded hill called Nandan Pahar and to the east about 10 miles away there is a low range of hills known as Trikuti or

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Trikutaparvata. Geologically the district is mainly covered by Chhotanagpur granite gneissic complex of Archean age associated with some metasediments and metabasic rocks. The Gondwanas have been developed in tectonic basin fill deposits and rest on Archaean basements which mainly consist of paches of alluvium, sandstones, shales, coal seams to get exposed in Karon and Madhupur blocks of the district(Jha ,2012 and Trivedi et al.,1997).

There are a number of small hills in the south-east, south and southwest. The clusters of rocky hills covered with forest appear as series of long ridges with intervening depressions. Most of the rolling uplands are cultivated by highland crops. The average elevation of the district is 247 m above m.s.l, However hill ranges like Phuljari (750 m), Teror (670 m) and Degaria (575 m) break the monotony of the landscape. Important rivers flowing in the district are the Ajay, the Paltro etc. These rivers gather a large number of tributaries which form the land scape full of Tanrs and Dons. There are two rivulets, the Yamunajor and Dharua flowing close to the town. The countryside around Deoghar has an attractive set-up with undulations, water courses and small hills. It sustains a population of 11, 65,390 persons (Census of India, 2001) (Bala, 2010; 2011 and Clarke, 2006).

Climate

The district experience hot summer (March to May) heavy monsoon rains (June to September) and cool dry winter (October to February). Average annual rainfall is 1239 mm, mean summer maximum temperature is 43^0C and mean winter minimum temperature is 8^0C.

Soils and hydrogeology

Alluvium occurring along the river channels and adjoining areas and are mainly composed of fine to coarse sand and clays. Laterites occur in isolated patches. The hard and compact granitic rocks i.e. the Chotanagpur granite gneiss, covers about 70% of the district area wherein weathering, fracturing and jointing have introduced secondary porosities to afford existence and movement of groundwater. Thus the groundwater occurs unconfined in the weathered mantle and semi-confined to confined in the fractures underneath. Groundwater also extends in the narrow stretches of alluvium along stream courses, the potentiality of which is not promising.

MATERIALS AND METHODS

Water sampling locations and sampling of surface water

An integrated study of physical, chemical and biological components of the water bodies were done to determine the health of the water bodies. The monitoring was done once in month of October 2012. The sampling was done in the morning hours from three water bodies locations viz. Pond (Kushina more) (SW1), Dharwa river (SW2) and Pond (Hindalobaram, Mohanpur) (SW3) . These sampling sites were selected to represent the water quality at different points of the proposed new developments.

Grab samples were collected in one-litre pre washed polythene cans from the surface from each station in the morning to assess various physico-chemical parameters. Two field replicates were collected from each station. Few parameters, which undergo changes quickly such as temperature, pH, DO, conductance along with alkalinity, hardness and TDS, were evaluated on the spot at the field immediately after collection. The analysis was done based on APHA,1981 and NEERI, water and wastewater analysis (2005). The various physical and chemical parameters that were analyzed in the current study are: Temperature, pH, conductivity, Total dissolved solids, Alkalinity, Total hardness, Calcium, Magnesium, DO, COD, Sodium, Potassium, Phosphates, Nitrates. Water qualities of the samples were compared with CPCB fresh water classifications (Table, 1).

Groundwater sampling locations sampling of ground water Quality

In order to access the groundwater quality of the study area, three groundwater samples were collected from tube wells at Hindalobaram Mohanpur (GW1), Baranpur village (GW2), Kushina more (GW3) in the month of October 2012. Analysis of ground water was carried out as per procedure of APHA in a NABL accredited laboratory and compared with BIS 10500, 1991.

RESULTS AND DISCUSSIONS

Surface Water quality

Through out the stretch two type of surface water resources were noticed, the flowing water resources viz.

Table 1: Water Quality Criteria and Standards for Freshwater Classification

Parameters	BOD (mg/l)	pH	TDS (PPM)	D.O in mg/l	Lead (Pb) in g/l	Oil and Grease in mg/l
CPCB Standard Class B (For outdoor bathing)	3.0	6.5-8.5	--	5.0		
CPCB standard Class D (For propagation of wild life, fisheries)	3.0	6.5-8.5	--	4	0.1	0.1
CPCB standard Class E (For irrigation)	--	6.0-8.5	0-700	--	--	--

Table 2: Analysis of physico-chemical characteristics of Surface water samples collected from different sites in Deoghar, Jharkhand

No.	Parameters	SW1	SW2	SW3
1	Colour			
2	P^H	6.9	6.16	6.79
3	Total Suspended Solid (mg./l)	18	43	25
4	Total Dissolved Solid (mg./l)	263	163	187
5	Total Hardness (mg/l)	112	44	84
6	Dissolved Oxygen (mg/l)	5.8	6	5.2
7	BOD , 3 days at 27^0C (mg./l)	8	5.0	12.0
8	COD (mg./l)	30	20.0	40.0
9	Oil & Grease (mg./l)	BDL	BDL	BDL
10	Salinity (ppt.)	BDL	BDL	BDL
11	Chloride (mg/l)	14.86	9.29	8.36
12	Sulphates as SO_4 (mg/l)	10	8.5	10
13	Lead (mg/l)	<0.03	<0.03	<0.03
14	Arsenic (mg/l)	<0.01	<0.01	<0.01
15	Cadmium (mg/l)	<0.01	<0.01	<0.01
16	Iron (mg/l)	0.26	0.22	0.25
17	Chromium (Total) (mg/l)	<0.2081	<0.2081	<0.2081
18	Total Coliform / 100 ml.	$1.2x10^3$	$1.1x10^3$	$5.2x10^2$
19	Fecal Coliform /100 ml.	$8.5x10^2$	$8.0x10^2$	$2.8 x10^2$

Legend: SW1= Pond at Kushina more; SW2= Dharwa river and
SW3=Pond at Hindalobaram, Mohanpur, BDL = Below Detection Limit

Table 3: Analysis of physico-chemical characteristics of Ground Water samples collected from different sites in Deoghar, Jharkhand

No.	Parameters	GW1	GW2	GW3	Standard (BIS 10500)
1	Odour (TON)	Odourless	Odourless	Odourless	Unobjectionable
2	Colour (Hazen)	1	1	1	5
3	Taste	Acceptable	Acceptable	Acceptable	Agreeable
4	Turbidity (NTU)	3.5	4.8	3	5
5	Total Dissolved Solid (mg/l)	375	396	561	500
6	pH	7.01	6.35	6.91	6.5 to 8.5
7	Alkalinity (mg/l)	148	100.0	248.0	200
8	Total Hardness (mg/l)	172	224	252	300
9	Residual Chlorine (mg/l)	<0.01	<0.01	<0.01	0.2
10	Nitrate (mg/l)	8.49	9.99	12.5	45
11	Fluoride (mg/l)	<0.02	<0.02	<0.02	1.0
12	Phenol (mg/l)	<0.001	<0.001	<0.001	0.001
13	Total Nitrogen (mg/l)	9.5	11.5	15	--
14	Boron (mg/l)	<0.1	<0.1	<0.1	1
15	Chloride (mg/l)	27.86	63.16	74.3	250
16	Sulphate (mg/l)	25	30	50	200
17	Bi Carbonate (mg/l)	180.56	122	302.56	--
18	Cyanide (mg/l)	<0.05	<0.05	<0.05	0.05
19	Calcium (mg/l)	48.1	44.89	67.33	75
20	Magnesium (mg/l)	12.48	26.88	20.16	30
21	Manganese (mg/l)	<0.03	<0.03	<0.03	0.1
22	Zinc (mg/l)	0.05	0.13	0.28	5
23	Aluminium (mg/l)	<0.006	<0.006	<0.006	0.03
24	Iron (mg/L)	0.54	0.9	0.45	0.3
25	Chromium (VI) (mg/l)	<0.05	<0.05	<0.05	0.05
26	Copper (mg/l)	<0.05	<0.05	<0.05	0.05
27	Mercury (mg/l)	<0.001	<0.001	<0.001	0.001
28	Cadmium (mg/l)	<0.01	<0.01	<0.01	0.01
29	Arsenic (mg/l)	<0.01	<0.01	<0.01	0.05
30	Lead (mg/l)	<0.03	<0.03	<0.03	0.05
31	Total Coliform / 100 ml.	<1,<10,<100	<1,<10,<100	<1,<10,<100	0
32	Fecal Coliform /100 ml.	<1,<10,<100	<1,<10,<100	<1,<10,<100	0

Legend: GW1=Hindalobaram Mohanpur; GW2= Baranpur village and GW3=Kushina more.
<1 indicate No Colony developed in 1 ml. Sample. <10 indicate No Colony developed in 0.1 ml. Sample

<100 indicate No Colony developed in 0.01 ml. Sample.

rivers, streams, canals and drains and stagnant water-resources, viz. ponds, ditches etc.

The analytical results (Table, 2) reveal that in all the three water bodies pH ranged from 6.1 to 6.9; DO from 5 to 12 and COD from 20 to 40 with other parameters showing somewhat uniformity in quality which may be due to nature and use of the water body by local people. It may be mentioned here that source SW2 is a river but its water quality is as good as a pond because the flow of river is almost stagnant and use is same like a pond.

The findings(Table, 1 and 2) indicate that in all the monitoring stations the water quality is well within the standard for Classes B, D and E types of water for most of the parameters except for oil and grease as prescribed by the Water Quality Criteria and Standards for Freshwater Classification . None of the heavy metals of interest are in unacceptably high concentration in the water samples studied.

Ground water quality

Analysis of the groundwater samples and their comparison with the Indian drinking water Standard (BIS 10500, 1991) reveals the following characteristics (Table, 3)

- pH values suggests that the water is alkaline in nature. The total dissolved solids (TDS) is above the desirable limit (500mg/l) in Kushina more sample (561 mg/l) but is well below the permissible limit of 2000mg/l . TDS is below the desirable limit at Hindalobaran and Baranpur villages . Chloride concentration is well below the desirable limit (250mg/l) in all locations . Sulphate and Nitrate concentrations are low and within the permissible limits, thus indicating very low degree of organic pollution. Fluoride is absent in all samples.
- Amongst the cations, Calcium (Ca) and Magnesium (Mg) are below the permissible limit (200mg/l). Concentration of iron is below the desirable limit (1.0 mg/l) in two samples.
- Groundwater in general is soft in the area and the Hardness is below the desirable limit of 300 mg/l. It is worth mentioning that groundwater samples are free from heavy metals like cadmium, arsenic, lead, chromium etc.
- Bacterial quality of groundwater shows all the samples drawn from tubewells are free form fecal coliform and total coliform and hence the water samples are potable.

Thus it is worth mentioning that groundwater samples are free from both heavy metals like cadmium, arsenic, lead, chromium etc. and fecal bacteria which speak in favour of their suitablity for human consumption subsequent to conventional treatments.

CONCLUSION

The present work, new of its kind for the area, places the baseline data pertaining to quality of water resources in conformity with the objective to identify and evaluate the possible impact of urban expansion on the concerned aquatic and terrestrial eco-systems. There is an urgent need to materialize periodic surveillance of both water and air qualities collaterally with bio-monitoring step by step keeping parity with the successive stages of urban development for environmental optimization.

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