

## Ground Water Assessment in Orissa Region of Angul-Talcher

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**Abstract:** The examination was completed to survey the effects of industrial and mining activities on the ground water quality in Angul-Talcher region of Orissa. The quality was evaluated in terms of physico-chemical parameters. Ground water samples were collected from thirteen (13) open well at different areas in study region during pre and post monsoon season. The physico-chemical parameters such as pH, Electrical conductivity, TDS, Total hardness, Ca hardness, Mg hardness, Ca ion, Mg ion, Chloride, and COD were analyzed (APHA, 1998) to know the current status of the groundwater quality. Drinking water quality (IS: 10500) of pre-monsoon season was better than post monsoon season. Few water samples were slightly alkaline along with high dissolved solids.

**Key Word:** Water quality, Ground water, Drinking water standard, Physico-chemical parameters.

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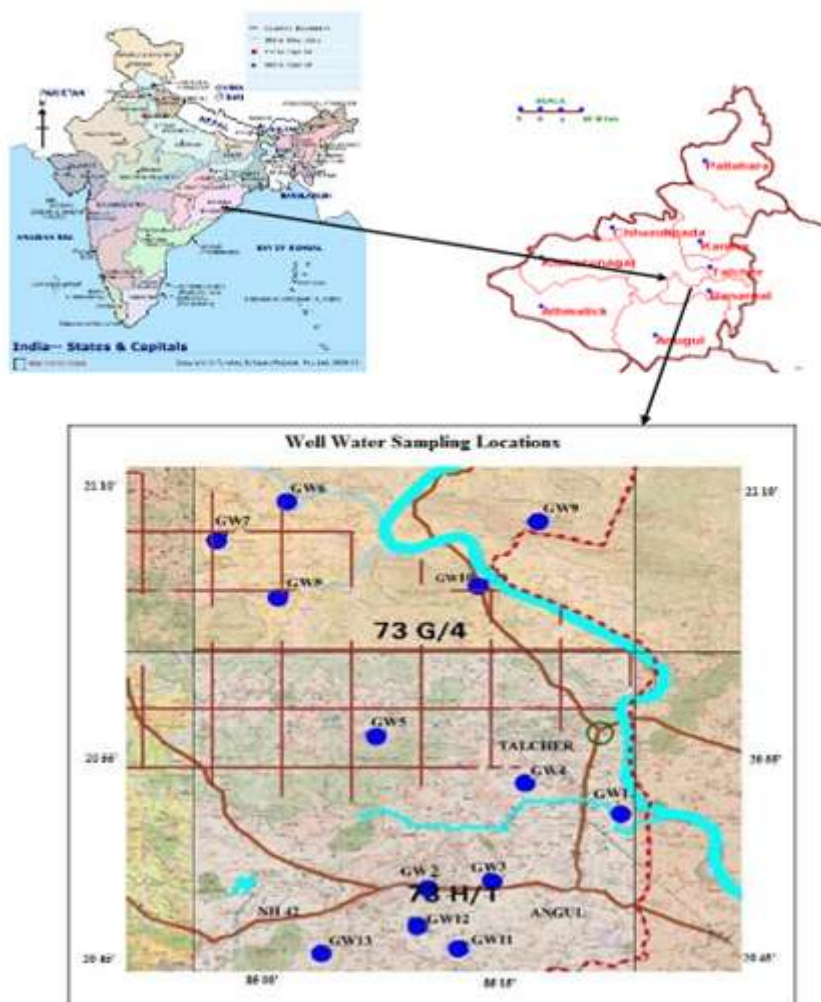
### I. Introduction

The safe portable water is absolutely essential for healthy living. Ground water is ultimate and most suitable fresh water resource for human consumption in both urban as well as rural areas. The importance of ground water for existence of human society cannot be overemphasized. There are several states in India where more than 90% population are dependent on groundwater for drinking and other purpose (Ramachandraiah, 2004). Ground water is also frequently using as the alternative source for agricultural and industrial sector. In India, there are over 20 million private wells in addition to the government tube wells (Datta, 2005). The wells are generally considered as the worst type of ground water sources in the term of physio-chemical contamination due to the lack of concrete plinth and surrounding drainage system (WHO, 1997). Over burden of the population pressure, unplanned urbanization, unrestricted exploration and dumping of the polluted water at inappropriate place enhance the infiltration of harmful compounds to the ground water (Pandey and Tiwari, 2009).

There are various ways as ground water is contaminated such as use of fertilizer in farming (Altman and Parizek, 1995), seepage from effluent bearing water body (Adekunle, 2009). Most of the industries discharge their effluent without proper treatment into nearby open pits or pass them through unlined channels, resulting in the contamination of ground water (Jinwal and Dixit, 2008). The incidence of ground water pollution is highest in urban areas where large volumes of waste are concentrated and discharge into relatively small areas (Rao and Mamatha, 2004). The hydro-geochemical conditions are also responsible for causing significant variations in ground water quality (Mahanta et. al., 2004). The paper makes an attempt to carry out qualitative analysis of some physico-chemical parameters of ground water in study area.

### II. Study Area

The Angul-Talcher area lies between latitudes 20° 37' N to 21° 10' N and longitudes 84° 53' E to 85° 28' E. and situated at an average height of 139 m above Mean Sea Level(MSL). Vast mineral deposits, availability of water and good infrastructure conducive for industrialization in the Brahmani river basin has resulted in heavy industrialization of the area. Many small, medium and large scale industries such as coal mines (Mahanadi Coalfields Limited), Super Talcher Thermal Power plant (Kaniha), Talcher Thermal Power Stations (Talcher), Nalco smelter and its captive power plant and other iron & steel industries are situated in the region. The ground water quality of the study area is adversely affected by the industrialization. Increased population and improper drainage system have potential to influence the ground water quality. Geographical location of study area is shown in the Figure 1.



### III. Sample Collection

The sampling locations consist of urban as well rural area. Ground water samples were collected from thirteen (13) well at various locations within study area during pre and post monsoon season. Details of sampling locations along with their latitude and longitude are illustrated in Table1. Samples were collected in plastic container to avoid unpredictable changes in characteristic as per standard procedure (APHA, 1998).

Code	Sampling Location	Latitude	Longitude
GW1	Dasnala Village, well water	20° 53' 33"	85° 14' 33"
GW2	Kandasar Village, well water	20° 50' 33"	85° 07' 58"
GW3	Girang Village, well water	20° 50' 52"	85° 10' 08"
GW4	Sharma Chak, well water	20° 54' 44"	85° 11' 15"
GW5	Danara village, well water	20° 56' 36"	85° 06' 12"
GW6	Takua Village, well water	21° 06' 04"	85° 03' 10"
GW7	Baragundari Village, well water	21° 04' 47"	85° 00' 02"
GW8	Kamarel village, well water	21° 02' 10"	85° 02' 50"
GW9	Blinda village, well water	21° 05' 20"	85° 11' 40"
GW10	Ekgharia Village, well water	21° 02' 38"	85° 09' 39"
GW11	Nuashahi village, well water	20° 48' 10"	85° 09' 00"
GW12	Tulsipal village, well water	20° 49' 00"	85° 07' 40"
GW13	Longibeda village, well water	20° 47' 50"	85° 04' 20"

Table 1. Well water Sampling Locations within the study area

#### IV. Physico-Chemical Analysis of Ground Water

The collected samples were analyzed for different physico-chemical parameters such as pH, Electrical conductivity, Turbidity, TDS, Total hardness, Ca hardness, Mg hardness, Ca ion, Mg ion, Chloride, and COD as per the standard methods (APHA, 1998), and the results were compared with the Indian Standards (IS: 10500) for potable water.

#### V. Results and Discussion

The water quality analysis of different ground water samples have been carried out for pH, Electrical conductivity, TDS, Total hardness, Ca hardness, Mg hardness, Ca ion, Mg ion, Chloride, and COD. The status of water quality of these ground water sources are presented in table 2.

pH value of ground water samples varied between 6.4 to 7.4 and 7.0 to 9.2 during pre and post monsoon season respectively. The pH value of Dasnala village, well water (GW1) was found to be 9.2 which are beyond the permissible limit as per IS: 10500. Turbidity of samples was found within the permissible limits except the Blinda village, well water (GW9) in pre monsoon season. It may be due to absence of bricking of well.

Electrical conductivity varied between 140 to 606  $\mu\text{mhos/cm}$  to 420 to 839  $\mu\text{mhos/cm}$  in pre and post monsoon season. The same trend was observed in the case of TDS of various ground water sources. It varied from 69 to 318 mg/l and 172 to 485 mg/l in pre and post monsoon respectively. Total hardness in all the samples were found to be within standard limits ( $< 300 \text{ mg/l as CaCO}_3$ ). Values are slightly higher in post monsoon than pre monsoon season. In few samples the ions of calcium and magnesium have crossed the standard limit (IS: 10500) during post monsoon season.

Chloride content of the ground water samples were in the range of 15- 135 mg/l to 18.5-75.5 mg/l in pre and post monsoon season respectively. The COD values of various ground water samples were found from 9.3 – 47.5 and 11.3 – 45.5 mg/l during pre and post monsoon season respectively. Highest values of COD were found 47.5 Kamarel village open well water (GW6) during post monsoon season. It may be due to seepage from sewage drainage or industrial discharge in nearby localities.

**Table 2. Concentration of various parameters in pre and post monsoon seasons**

Codes	pH		Turbidity (NTU)		Elec. Cond. ( $\mu\text{mhos/cm}$ )		Total Hardness (mg/l)	
	Pre Monsoon	Post Monsoon	Pre Monsoon	Post Monsoon	Pre Monsoon	Post Monsoon	Pre Monsoon	Post Monsoon
	GW1	6.8	9.2	3.7	6.2	250	465	56
GW2	6.4	7.3	3.8	7.4	162	408	46	102
GW3	7.3	7.1	0.9	1.5	146	694	130	146
GW4	6.9	7.0	6.6	4.3	145	497	28	115
GW5	7.4	7.3	4.2	7.1	140	620	28	127
GW6	6.8	7.3	3.6	4.0	170	420	50	112
GW7	6.7	7.1	3.1	5.0	148	642	12	146
GW8	6.9	7.2	8.7	6.5	540	649	164	125
GW9	7.1	7.0	10.2	9.5	295	733	36	205
GW10	7.1	8.2	3.5	4.7	154	839	20	170
GW11	7.2	7.5	8.3	8.0	429	479	120	110
GW12	7.1	7.0	9.4	9.3	331	351	165	170
GW13	7.3	7.1	4.6	4.0	606	696	178	148
<b>Mean</b>	7.0	7.4	5.4	6.0	270	576	79	147
<b>SD</b>	0.29	0.62	2.88	2.32	161.69	148.58	62.04	30.09
<b>IS: 10500</b>	6.5 – 8.5		5.0 – 10*		--		300 - 600*	

\* – IS: 10500 Permissible limit in the absence of alternate source

Codes	TDS (mg/l)		Ca Ion (mg/l)		Mg Ion (mg/l)		Chloride (mg/l)		COD (mg/l)	
	Pre Monsoon	Post Monsoon	Pre Monsoon	Post Monsoon	Pre Monsoon	Post Monsoon	Pre Monsoon	Post Monsoon	Pre Monsoon	Post Monsoon
GW1	124	265	47.2	203.5	152.1	137.8	34	39.5	9.3	19.2
GW2	80	249	84	172.8	50.8	134.9	24	30.5	15.5	25.5
GW3	172	337	175	266.0	82.0	162.4	135	41	9.3	11.3
GW4	72	272	63	228.3	11.5	97.2	22.5	36.5	12.4	17
GW5	69	307	63	245.0	11.5	118.9	15	32.5	9.3	41.5
GW6	84	270	42	226.5	136.1	87.7	22.5	35.5	12.4	45.5
GW7	72	363	21	260.5	14.8	171.4	27.5	18.5	15.5	36.5
GW8	268	323	200	252.8	244.4	98.0	17	42.5	13.4	22.8
GW9	146	485	57.7	412.8	52.9	163.6	57	58.6	43.5	36.5
GW10	76	400	30	319.8	32.8	172.6	17.5	75.5	15.5	25.2
GW11	228	289	181.7	216.8	193.9	95.5	50.5	33.5	31.5	24.5
GW12	187	397	271.2	321.3	231.7	170.2	62.5	41.5	47.5	22.5
GW13	318	337	331	280.5	187.0	146.8	44.5	30.5	21.4	12
Mean	145.8	330	119.0	262.0	107.8	135.1	40.7	39.7	19.6	26.3
SD	83.67	67.46	97.27	62.01	86.7	32.32	32.49	14.11	12.57	11.13
IS: 10500	500 - 2000*		75 - 200*		30 - 100*		250 - 1000*		---	

\* - IS: 10500 Permissible limit in the absence of alternate source

Correlation matrix was prepared within the studied parameters in pre and post monsoon season and tabulated in Table 3 and 4 respectively. The total dissolved solids and electrical conductivity can be used to delineate each other. Conductivity is proportional to the dissolved solids; total hardness was positively correlated with chloride, calcium and magnesium ions. The strong correlation-ship between these parameters could be due to changes in land use, mining and improper effluent discharge in the study area. The correlation among parameters of both seasons has shown the analogous trends of seasonal variation, it may be due to the weathering and heavy rain fall in study area during monsoon.

**Table 3. Pearson Correlation Matrix of Pre-monsoon Season**

	pH	Elec cond.	TDS	Total hardness	Ca ion	Mg ion	Chloride	COD	Turbidity
pH	1.00	0.24	0.37	0.33	0.39	0.12	0.40	0.23	0.16
Elec cond.		1.00	0.94	0.79	0.78	0.79	0.00	0.36	0.52
TDS			1.00	0.91	0.88	0.80	0.31	0.33	0.38
Total hardness				1.00	0.96	0.86	0.43	0.30	0.30
Ca ion					1.00	0.75	0.40	0.39	0.32
Mg ion						1.00	0.14	0.34	0.44
Chloride							1.00	0.22	-0.14
COD								1.00	0.77
Turbidity									1.00

**Table 3. Pearson Correlation Matrix of Post-monsoon Season**

	pH	Elec cond.	TDS	Total hardness	Ca ion	Mg ion	Chloride	COD	Turbidity
pH	1.00	-0.01	-0.23	-0.19	-0.25	0.05	0.30	-0.10	-0.02
Elec cond.		1.00	0.57	0.56	0.55	0.42	0.50	-0.09	-0.31
TDS			1.00	0.98	0.97	0.69	0.56	0.10	0.31
Total hardness				1.00	0.98	0.74	0.58	0.03	0.23
Ca ion					1.00	0.58	0.61	0.10	0.27
Mg ion						1.00	0.31	-0.19	0.03
Chloride							1.00	-0.06	0.11
COD								1.00	0.30
Turbidity									1.00

### VI. Conclusion

In general ground water quality of Angul- Talcher region is not harmful to human beings. Except few instances where some parameters such as COD at Blinda, Danara and Takua Village, well water and turbidity at Blinda Village, well water were crossed prescribed limits of drinking water (IS: 10500). The reason behind this may be due to industrial and mining activities, weathering and erosion of bed rocks. Most of parameters showed analogous trend in seasonal variation. The values are comparatively high in post monsoon. It indicates that the extent of pollution occurred due to mining, industrial discharge, urbanization and other anthropogenic activities increased human interventions in the ground water quality. Correlation studies have also indicated the contribution of changes in land use, industrial discharge and runoff during post-monsoon season.

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