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GROUND WATER QUALITY STUDY IN DISTRICT DHANBAD, JHARKHAND, INDIA THROUGH GIS APPLICATION

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ABSTRACT

Groundwater contamination with heavy metals released from mining activities is a worldwide environmental problem. The leachate generated from minewaste and overburden dumps may have the potential to pollute the surrounding water resources. It comprises overburden, run-of-mine rock as well as discard, slurry and tailings from the preparation/ beneficiation or extraction plants assessment of heavy metals contamination in soils using data on the total content of the individual heavy metals. In the process of mining huge amounts of water discharged on surface to facilitate the mining operation. Groundwater is the principal source of drinking water in our country and is that once contaminated; it is difficult to restore its quality. Hence, there is a need and concern for the protection and management of groundwater quality. Anthropogenic activities and improper management of natural resources also led to unequal distribution of major and minor elements in nature. In district Dhanbad in all 9 block five villages were randomly selected to study chemical properties through chemical analysis of groundwater sampled from wells and hand pumps which ever was available to study pH, EC, TDS, Salinity, Fe, Mn and Zn concentration.In this paper the variation of ground water quality results were shown by utilizing GIS as a tool.

Keywords: Groundwater, Coal Mining, GIS, Contamination and Dhanbad

I. INTRODUCTION

In coal mining and industrial areas, the surface and ground water is usually polluted and contaminated. In such areas, water is being contaminated by overburden dump. Surface impoundments, artificial recharge, waste disposal in wet excavation, mine water, industrial effluents, acid mine drainage, tailing pods, etc. (Chandra, 1992). The water bodies of this area are the greatest victims of such operations (Abishek, et.al.,

2006). Several environmentalists have studied environmental impact of coalmining across the globe (Chadwick et.al., 1987; Filho,1994; Tiwary and Dhar, 1994; Tiwary, 2001; Swer and Singh, 2004). The effluents of coke oven plants and coal beneficiation plants result water pollution. The coal washeries discharges effluents containing coal fines from the sedimentation tanks pour into river or stream causes environmental pollution (Tiwary and Abhishek, 2004 & 2005).

II. MATERIAL & METHOD

This study was conducted by doing groundwater sampling at 45 different locations withinthe district Dhanbad (**Fig.1**) in all 9 blocksof Dhanbad, Tundi, Topchanchi, Balliapur, Nirsa, Govindpur, Purbi Tundi, Jharia and Baghmara andfive villages(**Fig.1**) in each blockwere randomly selected to study chemical properties through chemical analysis of groundwater sampled from wells and hand pumps which ever was available to test pH, EC, TDS, Salinity, Fe, Mn and Zn concentration. The results of ground water chemical quality were shown by utilizing GIS as a tool. All the parameters studied were sampled and tested through standard methodology and results were shown through application of GIS as a tool.

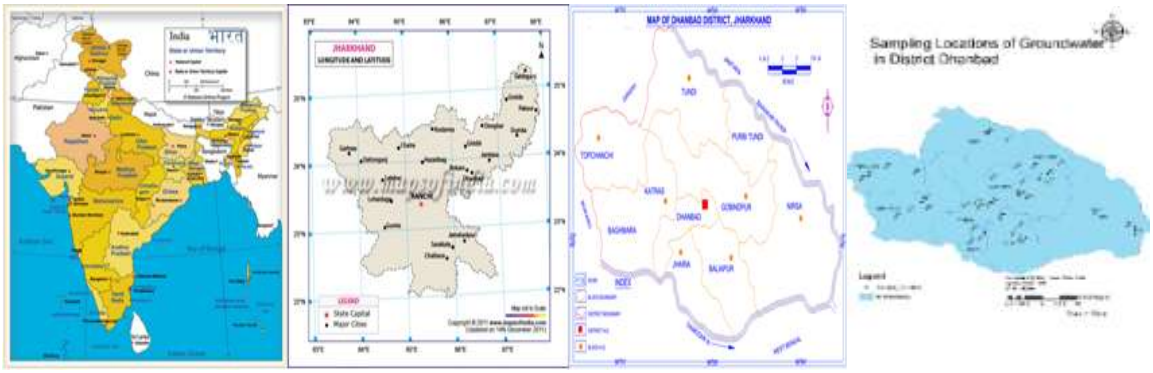

Fig.1: Study area and Groundwater sapling locations

III. RESULTS AND DISCUSSION

The Jharia is the most extensively explored and exploited coalfield and sole repository of much needed prime coking coal in India. It is a part of the Gondwana coalfields and lies in the heart of the Damodar valley at south of the Dhanbad city. Detail investigation of groundwater chemistry for the suitability of drinking and domestic uses in the district Dhanbadas a whole within 9 blocks including jharia and five villages in each block were sampled,collected and analyzed for pH, electrical conductivity (EC), total dissolved solids (TDS) , salinity, Fe, Mn and Zn. In majority of the samples, the analyzed parameters are well within the desirable limits and water is potable for drinking purposes with few exceptions.Statistical data analysis suggested that there is positive correlation between EC vs TDS and Salinity vs EC which were observed.Pearson correlation analysis shows perfect correlation EC vs TDS and Salinity vs ECrevels that EC is a measure of dissolved solids which is saline in nature in the groundwater within the district Dhanbad (**Table.1**).

	pH	TDS	EC	Salinity	Fe	Mn	Zn
pH	1						
TDS	-0.45666	1					
EC	-0.65574	0.858241	1				
Salinity	-0.79039	0.870049	0.944315	1			
Fe	-0.57736	0.246175	0.404065	0.443955	1		
Mn	0.109527	0.398088	0.393982	0.323381	-0.15026	1	
Zn	0.430323	-0.66115	-0.53593	-0.56847	-0.1568	0.157543	1

Table.1: Pearson correlation coefficient analysis of some of the chemical characteristics of ground water within the district Dhanbad

The pH of the groundwater samples was found to be ranging from6.095 to 8.345 and with mean of 7.2. However, the accepted concentration of pH in drinking water given by IS: 10500 (2012) is 7-8.5. The overall conductivity ranges from 2.2 µS/cm to 3010 µS/cm and mean 1506 µS/cm. The TDS were varied from 58.2 mg/L to 1489 mg/L. The permissible limit for TDS is 500 – 2000 mg/l as per IS: 10500 (2012). The differences in TDS values may be attributed to the variation in geological formations, hydrological processes and prevailing mining conditions in the region (Binay, et.al. 2015).The salinity of ground water was found from 0.05ppm to 1.580ppm whereas the desirable and permissible limit of Fe for drinking water as specified by IS: 10,500 is to be within 0.3 mg/l to 1 mg/l. Iron concentration in the groundwater of the study area, which ranges from 0.039 mg/l to 1.40 mg/l which is above the permissible limit of IS: 10500 (2012).

Groundwater contamination with heavy metals released from mining activities is a worldwide environmental problem. The leachate generated from mine waste Overburden dumps may have the potential to pollute the surrounding water resources. Besidesthis, different types of agricultural pesticide, insecticide, fungicide with different grade chemical fertilizers. This study conducted to evaluate the heavy metal concentrations in the groundwater of coal mining area. Groundwater samples analyzed based on their heavy metal concentrations such as Mn and Zn. Subsequently, statistical methods employed to identify the controlling factors affecting the heavy metal constituents of the groundwater. Finally, the results were compared with the Drinking Water Quality Standard of the World Health Organization (WHO), India Standard for Drinking Water Specification (IS: 10500) and United States Environmental Protection Act (USEPA). The results of the present study indicate that, the concentration of Mn shown their presence in groundwater samples above the desirable limit recommended for the drinking water Quality Standards which is 0.1 – 0.4 mg/l. But well in prescribed limit

for Zn 3.00mg/l to 5.00mg/l. Concentration of Mn in the groundwater samples varied from 0.001 to 2.240 mg/L whereas concentration of Zn varied from 0.606 to 0.792 mg/L.

IV GIS ANALYSIS

The various thematic layers on pH, EC, TDS, Salinity, Fe, Mn and Zn concentrations have been generated using GIS contouringmethods.Spatial distribution maps for pH, EC, TDS, Salinity, Fe, Mn and Zn have been created forDhanbad district. The ground water quality classification map fromthematic layers (**Fig.2**) based on the IS 10500 (2012) by BIS Standards for drinking water. The classification of water quality is essential for an assessment ofsuitability for domestic, agriculture or industrial uses (Chatterjee et.al., 2010).

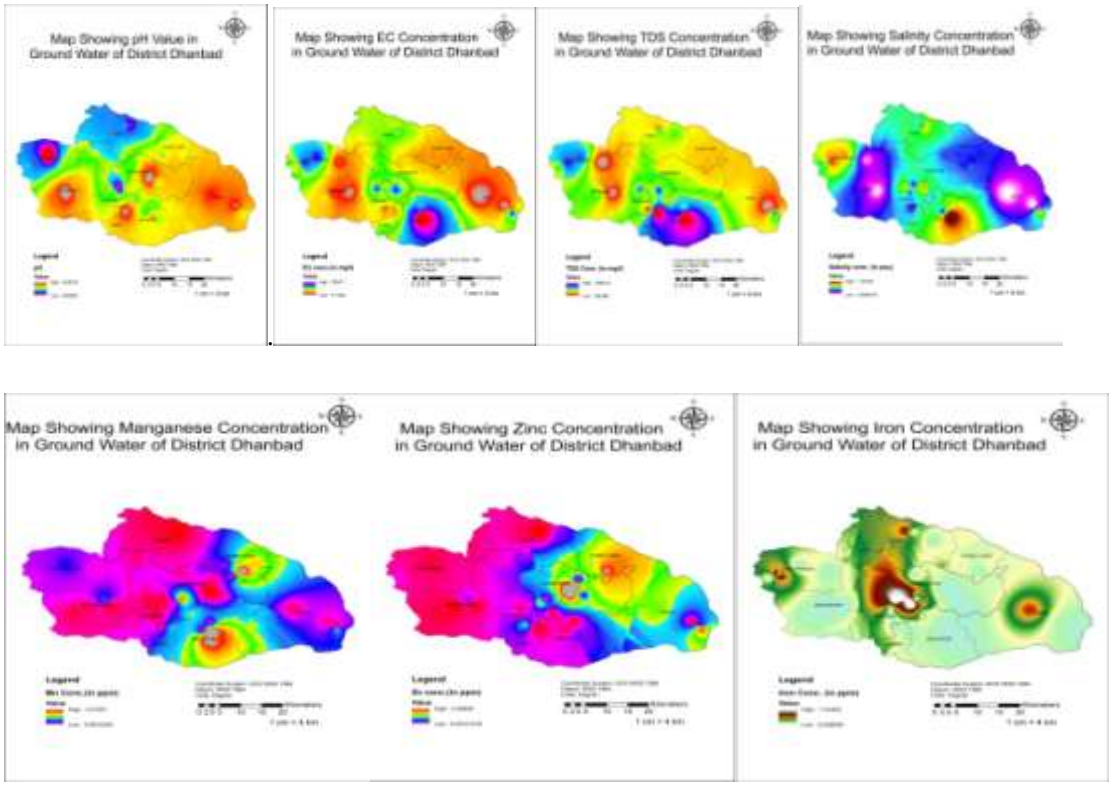

Fig.2: GIS map showing pH, EC, TDS, Salinity, Fe, Mn and Zn concentrations in groundwater in district Dhanbad, Jharkhand

V. CONCLUSION

The groundwater of district Dhanbad is slightly acidic to alkaline in nature. In majority of the samples, the analyzed parameters are well within the desirable limits and water is potable for drinking purposes. However, concentrations of pH, EC, TDS, Salinity, Fe, Mn and Zn exceed the desirable limit at few sites and needs treatment before its utilization. The groundwater of this area is very much affected by various natural sources and mining activity. The results were shown through the GIS tools for each parameters studied within the

district Dhanbad. Probable groundwater management has been suggested to control the pollution and maintain the quality within the permissible limit of drinking water.

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