International Journal of Advanced Technology in Engineering and Science
Vol. No.4, Issue No. 03, March 2016
www.ijates.com
ijates
ISSN 2348 - 7550

CHANGE DETECTION ANALYSIS OF GROUND WATER QUALITY AND ITS MANAGEMENT IN THE DISTRICT DHANBAD, JHARKHAND, INDIA

Shiv Kumar Gupta[1], Kumar Nikhil[2], Aditya Shrestkar[3], Gaurav Gehlot[4]

[1,3,4]*Students of B.Tech.(Final) in Environmental Science & Engineering, ISM, Dhanbad, Jharkhand, (India)*

[2]*Principal Scientist, CSIR-CIMFR, Barwa Road, Dhanbad, Jharkhand, (India)*

ABSTRACT

Dhanbad, a major coal mining area of India for more than a century, is situated in the middle of the Damodar river basin. The thickness, size, extent and openness of the weathered zone and the interconnections of fractures govern the groundwater movement in the Dhanbad area of Jharkhand and the depth to ground water generally ranges from 2 to 10 m below ground level. Urbanisation and the unregulated growth of the population have altered the terrain and slope morphology of the area. As a consequence, changes have taken place in the surface drainage system which indirectly affects the hydrogeology while the water infiltration ratio has resulted in a lowering of the groundwater. Inadequate environmental protection measures in the coal mining and related industries as well as the presence of active and abandoned coal mines, waste dumps, coal washeries, coking coal plants, thermal power plants, refractories, steel, fertilizer and cement plants have resulted in significant water pollution. In this paper study had been conducted in all the nine block of district Dhanbad. Randomly five villages were selected from each block with well or handpump were selected according to the availability and water sampling, testing and analysis done for pH, EC, TDS, Salinity, Fe, Mn and Zn availability followed by its assessmentand management.

Keywords- Ground water, Coal Mining, Water contamination, Assessment & Management

I. INTRODUCTION

The Dhanbad district consist of 9 blocks namely Baghmara, Baliapur, Dhanbad, Govindpur, Jharia, Nirsa, Topchanchi, Purbitundi and Tundi with 157 number of panchayats and 1052 no. of villages. The total population of the Dhanbad district as per the 2011 census is 26,82,662. The density of population is 1300 person per sq. Km. The decadal growth of population is 11.91 % (2001 -11) [Census of India, 2001 and 2011].

The drainage system of the district is the part of Damodar sub-basin. All the rivers that originate or flow through the district have an easterly or south easterly course. The Damodar is the most important river with an easterly course for about 125 km. streams as Jamunia, Katri, and Pusai are originating from northern hills of Parasnath and Tundi areas. These are flowing from N – S to NNW – SSE and meeting Damodar river. The Barakar river is the most important tributary of the Damodar and their confluence marks the eastern border of the district. It

receives from the west its only tributary, the Khudia, which takes its rise in the extreme west of the district between the Parasnath and Tundi ranges.

The ground water is mainly utilized for domestic needs and for irrigation purposes. The ground water abstraction is mainly through dug wells and bore wells. The bore wells are fitted with hand pumps or submersible power pump. The stage of ground water development in the district is 52.17%. The highest stage of development is in Jharia (105.67%) and Dhanbad (94%) blocks and lowest stage of development is in Tundi (%) block. The Gondwana sandstones in general, are known to constitute good aquifers at many places. However, the yield potential of the areas adjoining active mines in the coal belt is poor. With continued dewatering of the active mine-pits, the neighbouring wells register gradually lowering of water levels. The active mines often act as groundwater "sinks". In contrast, the water logged abandoned mines and pits act as potential sources of groundwater (Singh, 2013).

In Dhanbad district the consolidated and fractured aquifers constituted by the Archaean metamorphic provide better scope for development of groundwater. A lesser discharge from bore wells in the Gondwana group of rocks might be due to the proximity of active collieries, which register considerable mines seepage.

II. MATERIAL & METHODS

Dhanbad district lies in the mid eastern part of Jharkhand state. Giridih bound it in the north, Bokaro in the west, Purulia district in the south and Jamtara district in the east. It is connected through NH-2 and NH-32 from state capital and different district headquarters of the state. The district has total area of 2074 sq. km.and is located between 230 26'- 240 01' North latitude to 860 10'- 860 48' East longitude. Area is included in toposheet no 73I/1, 73I/2, 73I/5, 73I/6, 73I/7 73I/9, 73I/10, 73I/13 and 73I/14 of survey of India (1:50000 scale) [**Fig.1**].

Fig.1: Study area

This study was conducted for the assessment of the Groundwater within five villages selected randomly in all nine blocks. The groundwater sampling, testing and analyzing was done for the complete assessment by taking parameters like pH, EC, TDS, Salinity, Fe, Mn and Zn. Further, statistically analysed and shown graphically to understand in better way. Ground water sampling, testing for the parameters and its chemical analysis is done as per standard methodology followed. All the data were statistically compared with IS:10500 (2012) standards and assessed accordingly.

III. RESULT 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 Dhanbad as 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.

The pH of the groundwater samples was found to be ranging from 6.095 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) [**Fig.2a-2e**].

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. Besides this, 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.

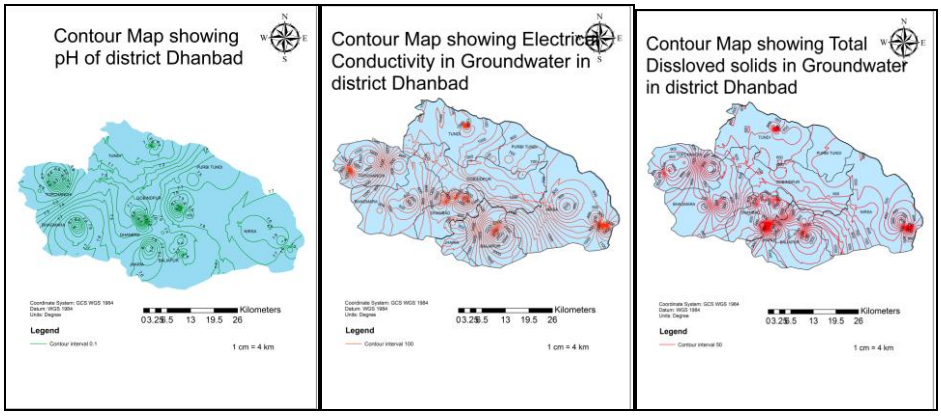

Fig.2a: pH in ground waterFig.2b: EC in groundwater Fig.2c: TDSin groundwater

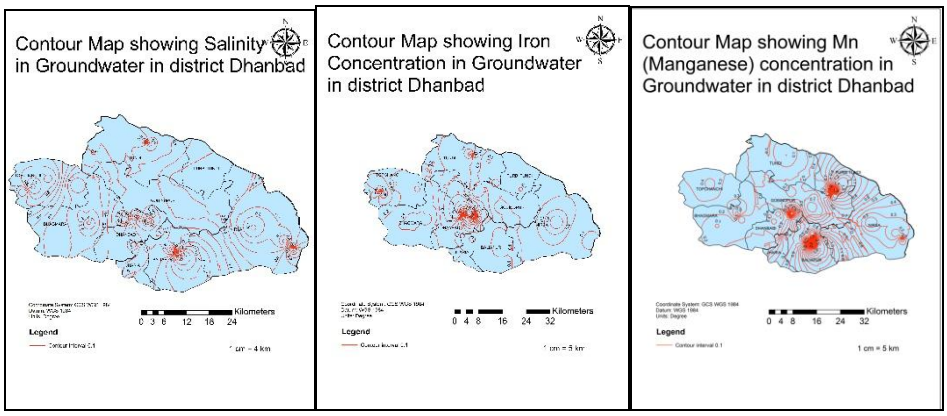

Fig.2d: Salinity in groundwaterFig.2e: Fe in groundwater Fig.2f: Mn in groundwater

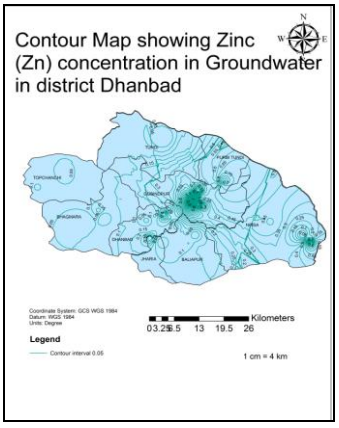

Fig.2g: Zn ingroundwater within district Dhanbad

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 [**Fig.2f-2g**].

IV. GROUNDWATER MANAGEMENT

The ground water is mainly utilized for domestic needs and to a limited extent for irrigation and industrial Purposes. The ground water abstraction is mainly through dugwells, bore wells, Dug-cum-bore wells and filter point wells are also used for ground water abstraction in a very limited area. Ground water potential of the rocks are limited only in secondary porosity. Surface water resources can be utilized for solving the water scarcity. Main problem of water is in Dhanbad urban area comprising of Dhanbad municipal area, Jharia area,

Jorapokhar, Pathardih, Jamadoba, Bhuli and Katras.Against the demand of 35.18 million gallons per day of water supply is only 17 million gallons per day. There is shortage of 18.18 million gallons per day. In summer season scarcity of water is in alarming proportion. Maithon water supply scheme can be a good substitute for supplying surface water to Dhanbad urban areas.20 million gallons of water per day can be supplied from Maithon dam.

Rainwater having in the technique of collection and storage of rainwater at surface or in sub-surface aquifer before it is last as surface runoff. Artificial recharge to ground water is a process by which the ground water reservoir is augmented a rate exceeding that under natural condition of replenishment.The potential recharging zone are: Where groundwater levels are declining on regular basis. Where substantial amount of aquifer has been desaturated. Where due to rapid urbanization infiltration of rainwater into subsoil has decreased drastically and recharging of ground water has diminished.The identification of the area suitable for artificial recharge has been done on the basis of depth of mean post- monsoon water level the area where the average water level of last 10 years is more than 7 mbgl in post monsoon period (November) has been considered for artificial recharge. In Dhanbad district Baghmara, Katras, Jharia and Dhanbad urban areas are showing declining trend. So, rainwater harvesting can be a good option for recharging the desaturated aquifer in these areas. In urban areas rainwater available from rooftops of building, pared and unpaved areas go waste. This water can be recharged to aquifer and can be utilized at the time of need.

In Dhanbad district the consolidated and fractured aquifers constituted by the Archaean metamorphic provide better scope for development of groundwater. A lesser discharge from bore wells in the Gondwana group of rocks might be due to the proximity of active collieries, which register considerable mines seepage.Topchanchi and Tundi blocks being hilly and undulating the drainage is very intensely developed. The construction of Rain water harvesting structures such as gully plugging, contour bunding, gabion structures, check dams and Percolation tanks would increase the storage in surface which will in turn recharge the ground water around it. In mining operation, huge quantity of water is generated and discharged on surface or in natural water bodies without any productive use. Jharia coalfield area has a large amount of coal deposit and every year a huge quantity of water is discharged from coal mines to the rivers to facilitate safe mining. By conservative estimate BCCL (Bharat Cooking Coal Ltd.) coal mines of Jharia region discharges about 3,40,120 GPM (2.22 Mm3/day) of wastewater. This has a visible detrimental effect on the water quality and aquatic lives of the region. Besides, a huge quantity of unused mine water is already available in all the abandoned open cast mines. Baliapur and Govindpur blocks have high density of lineaments. These areas have good potential of ground water so it can be developed with further intensive study. Roof top rainwater harvesting should be adopted in Dhanbad, Jharia, Katras and Baghmara blocks to improve the groundwater scenario. In Baliapur and Govindpur area casing should be placed properly so that caving problem can be avoided (Singh, 2013).

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

VI. ACKNOWLEDGEMENTS

The author(s) are thankful to the Director, CSIR- CIMFR, Barwa Road, Dhanbad-826015, Jharkhand, India for providing all the necessary facility to complete the B.Tech. Project Work and permission to publish this article.

REFERENCES

[1] Binay Prakash Panigrahy, Prasoon Kumar Singh, Ashwani Kumar Tiwari and Bijendra Kumar, 2016, "*Current World Environment ",* Vol. **10**(1), 171-178 (2015).

[2] Singh, T.B.N, 2013, "Ground Water Information Booklet, Dhanbad District, Jharkhand State" *Central Ground Water Board, Ranchi. Jharkhand.*