© INNOVATIVE RESEARCH THOUGHTS | Refereed | Peer Reviewed | Indexed
ISSN : 2454 – 308X | Volume : 04 , Issue : 04 | January – March 2018

Topic: Assessment of water resource: A case study of Yamuna Nagar and Karnal district

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Abstract: Ground water is the major source of drinking and irrigation water in both urban and rural areas. The industrial waste and domestic sewage are the leading causes of ground water pollution. The main focus of this study is to assess the suitability of ground water quality for drinking and irrigation purposes in vicinity of three selected industries (sugar mill, paper mill, thermal power plant) and along Yamuna River located in Yamuna Nagar District of Haryana state, India. Twenty ground water samples were collected for physico-chemical analysis with reference to BIS and WHO standards. The concentrations of pH, Na, Cl, So 4 and Ca were well within the desirable limits at all the locations. However the concentration of EC, TDS, total hardness, alkalinity, potassium and magnesium exceeded the desirable limit in about 65%, 40%, 70%, 95%, 70% and 50% respectively of all the samples. The analysis shows that the area in general is characterized by hard water, hence is not suitable for drinking purpose. Order of abundance of chemical ions were Na> Ca>K>Mg = HCO 3 >Cl>SO 4 >CO 3. The plot for ground water samples in Piper trainer diagram determine that most of the groundwater samples were of Ca Mg Hco 3 and bicarbonate type water. However, the values of SAR, Na%, and RSC indicate that groundwater is suitable for irrigation purposes.

Keywords: Yamuna Nagar, physico-chemical, Ground water, Karnal, Assessment.

Introduction: The quality of water is of vital concern for mankind since it is directly linked with human health, protection of the environment, plant growth and sustainable development (Arain et al., 2008; Dixit & Tiwari 2008; Vasanthavigar et al., 2011). Much of ill health which affects humanity, especially in the developing countries can be traced to lack of safe and whole some water supply (Shyamala, 2008). Increasing population and its necessities have led to the deterioration of surface and sub surface water. Ground water is the major source of drinking and irrigation water in both urban and rural areas. The domestic sewage and industrial waste are the

leading causes of ground water pollution (Garg et al., 1999; Ahmed & Ali, 2000; Khahlown et al., 2002; Gupta et al., 2009; Ullah et al., 2009). In most of the industrialized areas groundwater is the first victim of the local contamination as effluents are more often let into open abandoned wells, which is a type of point source contamination. The quality of ground water depends on various chemical constituents and their concentration, which are mostly derived from the geological data of the particular region (Gupta et al., 2009). Quality of ground water is the resultant of all processes and reactions that act on the water from the moment it is condensed in the atmosphere to the time it is discharged by a well or a spring and varies from place to place and with the depth of the water table. Groundwater crisis is not the result of natural factors. It has been caused by human actions. The industrial effluents if not treated and properly controlled, can pollute and cause serious damage to the groundwater resources (Olayinka, 2004; Anonymous, 2005; Phiri et al., 2005). Once the contamination enters the water source it is difficult and expensive to remove those (Avnish & Saksena, 2010). In developing countries like India, around 80 % of all diseases are directly related to poor drinking water quality and unhygienic conditions (Prasad, 1998; Olajire & Imeokparia, 2001). Extensive studies on groundwater quality have been carried out by various workers Adekule et al (2008), Gurunadha et al., (2001); Mondal et al., (2005); Joshi and Seth (2011); Majolagbe et al., (2011); Memon et al., (2011); Jameel et al., (2011); Raju et al., (2009); Gupta et al.,(2009); Reddy et al., (2011). The present work describes the groundwater quality in vicinity of industrial area and along Yamuna River in Yamunanagar of Haryana. Rapid industrialization has been recorded in the Haryana over the last two decades. More than a thousand medium and large industries with a capital investment of Rs.200 billion have been established in the state. From 1966 to 1997, the total number of industries has increased up to 7 times (Kaushik et al., 2006). Yamuna Nagar is the second biggest industrial town of Haryana. There are many industries like paper-mill, sugar mill, distillery, cement, metal industries, ply board etc. All the industries discharge their waste water into western jamuna canal. Contaminants in waste water are usually a complex mixture of organic and inorganic compounds which make the natural water unfit for human consumption. Not only this, hand pump water of nearby colonies also gets polluted due to the seepage of contaminated water of Western Jamuna Canal (Sharma et al., 2007). The specific objectives of the present study are to determine the groundwater quality near industrial area and Yamuna

River and to delineate regions where groundwater is suitable or unsuitable for drinking and irrigation purpose.

Yamuna Nagar district: Yamuna Nagar district has six blocks namely: Sadaura, Bilaspur, Chhachharauli, Jagadhri, Radaur, and Mustafabad with an area of 1,789.49 sq. km. Sadaura block notices minimum fluctuation in pre-monsoon and post monsoon from all blocks of Yamuna Nagar district. The seasonal fluctuation for June 1984 to October 1984 (Fig 3.3 and 3.6) was 1.3 meters and in June 2017 to October 2017is 1.32 meters indicates rise in water level during 2017 in spite of this, water level is decline by -0.66 meters from June 1984-2017 and -0.64 from October 1984-2017(T 3.2). Radar block has shown maximum fluctuation in pre-monsoon and post monsoon. The seasonal fluctuation for June 1 to October 1984 was 3.22 meters and in June 2017 to October 2017 is -0.46 meters indicates decline in water level during 2017. In Radaur block shows maximum water level is decline by -4.7 meters from June 1984-2017(pre monsoon) and -8.38 from October 1984-2017 (post monsoon).

Karnal district: Karnal district has six blocks namely: Indri, Karnal, Nilokheri, Nissing, Assandh and Charaunda with an area of 2463.38 sq. km. In Karnal district Indri block reveals minimum fluctuation during pre-monsoon and post monsoon. In this block the depth of water level varies from 6.53 meters in June 1984 to 9.30 meters in June 2017 during pre-monsoon period. The lepta of water level in post monsoon period vary from 5.33 meters in October 1984 to 8.61 meters in October, 2017. The seasonal fluctuation in 1984 was 1.2 meters in 1984 whereas 0.69 meters in 2017. Pre-monsoon fluctuation in water level from June 1984 - 2017 is -2.77 meters. Post monsoon fluctuation of water level depth from October 1984 - 2017 is -3.28 meters. Charaunda block noticed maximum fluctuation in both the seasons.

MATERIALS AND METHODS: Ground water samples were collected in good quality plastic cans which has been prewashed with acid and soaked in deionizer water. The hand pumps were continuously pumped prior to the sampling, to ensure that groundwater to be sampled was representative of ground water aquifer. Only high pure chemicals and double distilled water was used for preparing reagents of analysis. Physical parameters like pH, TDS, EC and DO were determined on the site with the help of multi parameter analyzer kit (Multi 340i/SET). All the

samples were stored in ice box maintained at 4ºC and brought to the laboratory for detailed physiochemical analysis. Sodium and potassium were directly determined by using flame photometer. Total hardness, Calcium and Magnesium were estimated by EDTA titrimetric method. The concentration of carbonate and bicarbonate were determined using acid titration method; chloride (Cl-) concentration was measured by AgNO3 titration method; sulfate measured by BaCl3 method using spectrophotometer. The analysis was performed following standard methods of (APHA, 1995). All the results are compared with standard limits recommended by WHO (2004) and BIS (2003).

RESULTS AND DISCUSSIONS: The results of physiochemical parameters of groundwater in vicinity of industrial area and Yamuna River is not good. The results indicate that the quality of water considerably varies from location to location. The order of abundance of chemical ions are $Na > Ca > K > Mg = HCO_3 > Cl > SO_4 > CO_3$.

Conclusion: The results of physio-chemical analysis of groundwater in the vicinity of industries and along Yamuna river of Yamuna Nagar showed that ground water was heavily loaded with electrical conductivity, alkalinity, hardness, potassium and magnesium, indicating that the area in general is characterized by hard water. The evaluation of groundwater quality for irrigation based on SAR, Na%, RSC and PI indicates that ground water is good enough for irrigation purpose and after proper disinfection can be used for drinking and domestic purposes. However, in addition to water quality the factors like climate, rainfall, crop pattern, soil and crop type etc. also have an important role to determine the suitability of water for irrigation.

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