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Study of Groundwater Quality for Drinking Purposes in Khelna Basin, Aurangabad, Maharashtra

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ABSTRACT

Groundwater is generally less susceptible to contamination and pollution when compared to surface water bodies. The present paper deals with suitability of water for drinking purpose in part of Khelna river basin Aurangabad district, Maharashtra. Geologically, the area is occupied by Deccan Trap lava flows of upper Cretaceous to Eocene age. A total of fifty-one groundwater samples were collected and analyzed for major physicochemical parameter in order to understand the different geochemical processes. The groundwater is alkaline in nature. The higher amount of total hardness in a few samples is due to application of fertilizer for agricultural contributing the higher concentration of ions.

KEYWORDS: *Groundwater quality, drinking purpose, Khelna River, Aurangabad, Maharashtra.*

INTRODUCTION

Water is a prime natural resource, a basic human need and a precious national asset. Water is essential to all forms of life and makes up 50-97% of the weight of all plants and animals and about 70% of human body. Two- thirds of the earth surface is covered by water. Water is very important to life; without water our life cannot move. Availability of quality freshwater is one of the most critical environmental issues of the twenty first century. Groundwater is an important water resource for agriculture in rural and urban parts of India. (Mohamed Hanipha and Zahir Hussain, 2013; Tiwari and Singh, 2016). The alarming rate of population growth, improvements in technology, and the prevailing trend of depletion of groundwater resource has raised some severe environmental problems (Kumar et al., 2019; Naladala et al., 2020). The quality of drinking water has increasingly been questioned from health point of view for several decades (Garg et al., 2009; Singh et al., 2018). Therefore, information on hydrochemistry of freshwater is significant to evaluate the quality of groundwater, especially in coastal areas which influences the suitability of groundwater for various needs. The water quality may yield information about the environment through which the water has circulated. Environmental problems associated with groundwater vary from place to place and depend on the geology, hydrologic and climatic conditions, and geochemical factors. The contamination of water not only affects its quality but also threatens human health, economic development and social prosperity (Milovanovic, 2007; Naladala et al., 2018;

Naidu,et al, 2021) Groundwater is the prominent environmental asset for the survival of life and is an essential human essence which is harnessed for a variety of household, industrial or agricultural purposes (Bouslah et al. 2017; Tyagi et al. 2013; Kumar et al, 2021). With overexploitation of groundwater, there has been large scale depletion of groundwater which has put the sustainability of groundwater as freshwater supply in a precarious situation (IPCC, 2007; Poudel et al., 2017; Biswas et al., 2018).

The state of Maharashtra covers 9.37% of India's total geographical area, but shares only 1.43% of the total surface water potential and 3.17% of the total groundwater potential. In Maharashtra, groundwater is the main source of water supply for drinking and domestic uses in rural area. Approximately, 80% of the state drinking water and about 51% of its irrigation needs are met through groundwater resources. Recurring droughts in the state of Maharashtra aggravated the already stressed water resources. Even in the assured rainfall zone, some areas have reached over-exploited stage of groundwater development. Therefore, an immediate attention is needed as far as management of water resources is concerned (GSDA, 2020). Groundwater quality data give important clues to the geologic history or rocks and indications of groundwater recharge, discharge and storage. Pollutants released on the ground surface may rapidly reach the aquifer and travel long distance in a very short time through preferential pathways (Walton, 1970; Tazioli *et al*, 1995; Joseph *et al*, 2010; Deshpande et al, 2015). Groundwater is, therefore, equally vulnerable to contamination from many sources. It has, therefore, become of the essence to endeavour at identifying the different sources of contaminants and evaluate the physical and chemical quality of the groundwater. The present study attempted at examining the groundwater quality for drinking purposes in Khelna basin, Sillod block of Aurangabad of Maharashtra, India.

STUDY AREA

The study area lies in Sillod block of Aurangabad district, covers an area of 275 sq km. containing thirty seven villages and lies between latitudes 20°18′N to 20°35′N and longitudes 75°26′E to 75°46′E and falls in the Survey of India Toposheet 46P/7 and 46P/11. The area is mainly drained by Khelna River which rising in the Ajanta range and this very much longer tributary flows past Kelgaon. Chichpur, Palod, Anvi. Ayhana and Bhokardan and joins the Purna at Jaffrabad of Jalna district. The entire study area is covered by basaltic lava flows (Deccan Trap) of upper Cretaceous to lower Eocene age while alluvium occupies a small portion. Deccan traps are a thick pile of basaltic flows, horizontally disposed and apparently more or less uniform in composition. Each individual flow is a typical section, which varies from porous weathered base to a massive middle unit, becoming increasingly vesicular towards the top. The ground water occurs under water table and semi confined to confined conditions in Deccan Trap Basalt. The groundwater in isolated alluvial pockets occurs under both water table and semi-confined conditions.

METHODS OF INVESTIGATION

In the present study, samples were collected in pre cleaned polyethylene containers of one litre capacity. The fifty-one groundwater samples were collected from those wells only which are extensively used for drinking and irrigational purposes. Field samples were analyzed immediately (APHA, 2005) for hydrogen ion concentration (pH) and electrical conductivity (EC), using pH and EC meters. Total dissolved solids (TDS) were computed by using the formula $0.64 \times EC$. Total hardness (TH) as $CaCO_3$ and calcium (Ca) were analyzed titrimetrically, using standard EDTA. Magnesium (Mg) was calculated by taking the differential value between TH and Ca concentrations. The flame photometry method was used to assess the concentration Na and K. Total alkalinity (TA) as $CaCO_3$, bicarbonate (HCO_3) was estimated by titrating with HCl. Chloride (Cl) was determined titrimetrically by standard $AgNO_3$ titration. The concentration of SO_4 was evaluated using a UV-visible spectrophotometer. The physico-chemical parameters of the analytical results of groundwater were compared with standard guideline values recommended by BIS (2012) and WHO (2011).

RESULT AND DISCUSSION

The suitability of ground water for drinking purpose was determined keeping in view the effects of various chemical constituents in water on the biological system of human being. Understanding the quality of groundwater is important as its quality because it is the main factor determining its suitability for domestic, drinking, agricultural and industrial purposes (Deshpande and Aher, 2011). Physico-chemical characterization of the groundwater samples is given in Table 1.

Table 1: Statistical analysis of physico - chemical groundwater quality with drinking water standards (BIS, 2012; WHO, 2011)

Parameter	Drinking water standards	Minimum	Maximum	Mean	Std. Deviation
pH	6.5-8.5	7.10	8.40	7.780	0.35
EC	-	320	3550	1046.80	513.27
TH	200-600	128	1420	408.54	203.39
TDS	500-2000	208	2308	680.58	333.60
Na	200	19	205	77.53	40.99
K	12	0.20	149	8.13	24.70
Ca	30-100	40	402	109.34	58.27
Mg	75-200	7.0	101	32.80	20.62
HCO_3	200-600	80	888	289.41	127.62
Cl	250-1000	36	700	162.19	110.33
SO_4	200-400	16	203	55.58	36.99

(All parameter is in mg/L except pH and EC in µS/cm)

pH is the measure of hydrogen ion concentration value in water which indicates whether a solution is acidic, neutral or basic. The pH required has to be in the range of 6.5–8.5 for the drinking purpose (BIS, 2012). In present study pH concentration is ranges from 7.10 to 8.40 with mean value 7.78, which shows that it is within the permissible limit as prescribed by BIS (2012) and indicating alkaline in nature. Electrical Conductivity (EC) measures the ability of a material to conduct an electric current such that the higher EC indicates enrichment of salts in the groundwater. Electrical conductivity is a measure of water capacity to convey the electrical current. In the study area Electrical Conductivity concentration ranges from 320 to 3550 µS/cm, with mean 680.52 µS/cm. The value of electrical conductivity may be an approximate index of the total content of dissolved substance in water. It depends upon temperature; concentration and the type of ions present (Hem 1985; Aher 2017). In natural waters, dissolved solids consist mainly of inorganic salts such as carbonates, bicarbonates, Chlorides, sulphates, phosphates, and nitrates of calcium, magnesium, sodium, potassium, iron, etc., and a small amount of organic matter and dissolved gases. In the present study, the values of total dissolved solids (TDS) in the ground water vary from 208 to 2308 mg/L with mean 552.76 mg/L. (Table 1), indicating that mostly all groundwater samples lie within the maximum permissible limit, Low to medium TDS is observed in the most of the samples which indicates the influence of rock–water interaction in relation to recharge water (Deshpande et al, 2020). Hardness may be considered a physical and chemical parameter of water. It represents the total concentration of Calcium and magnesium ions, reported as calcium carbonates. The total hardness values in the study area ranges from 128 to 1420 mg/L with mean 408.54 mg/L (Table 1). The maximum allowable limit of TH for drinking purpose is 600 mg/L and the most desirable limit is 200 mg/L as per the BIS standard. As evident from the results, about 10% of the samples exceed the maximum permissible limit of 600 mg/L (BIS, 2012), indicate that application of fertilizer for agricultural contributing the higher concentration of ions (Deshpande and Aher, 2012). The presence of calcium in drinking water is natural geological source, industrial waste, mining by products and agricultural wastes (Deshpande and Aher, 2011a). In ground water of the study area, the value of calcium ranges from 40 to 402 mg/L, with mean 109.34 mg/L (Table 1). Except one well within the permissible limits 200 mg/L prescribed for drinking water (Table 2). The principal sources of magnesium in the natural waters are various kinds of rocks, sewage and industrial wastes. Magnesium concentration in the groundwater samples of study area ranges from 7 to 101 mg/L with average 32.80 mg/L (Table 1). Majority of the sample in the study area are within the maximum permissible limit prescribed BIS (2012) (Table 2). Chlorides are compounds of chlorine. They remain soluble in water, unaffected by biological processes, therefore, reducible by dilution. The chloride content in ground water of the study area varies from 36 to 700 mg/l with average 162.19 mg/L (Table 1). Almost of the groundwater samples show chloride (Cl^-) concentration within the allowable limit given by BIS (2012). The sources of sulphate in rocks are sulphur minerals, sulphides of heavy metals which are of common occurrence in the igneous and metamorphic rocks (Reddy et al, 2014). The concentration of sulphate in the study area varies from 16 to 203 mg/L with mean 55.58 mg/L. all the samples of the study area fall within the guideline level of BIS (2012). Alkalinity is the measure of the capacity of the water to neutralize a strong acid. From the potability viewpoint, alkalinity is not a significant parameter. The bicarbonate alkalinity of the study area varies from 80 to 880 mg/L with mean 289.41 mg/L. Sodium (Na) and Potassium (K) are present in a number of minerals. The increasing pollution of groundwater has resulted in a substantial increase in the sodium content of drinking water (Reddy et al, 2012; Aher et al, 2020; Deshpande et al, 2020a). Sodium (Na) values of the study area ranges from 19 to 205 mg/L, with mean 77.53 mg/L, whereas potassium values range between 0.20 to 149 mg/L with mean 8.13 mg/L, indicating majority of the samples of the study area fall within prescribed level of drinking water (BIS, 2012; WHO, 2011).

CONCLUSION

The present study was carried out in a Khelna basin of Sillod block of Aurangabad district, which always facing water scarcity. The main source of drinking water is dug wells and bore wells, the study was an attempt to examine and evaluate the suitability of the available groundwater for drinking purposes. Based on the chemical analysis of the selected parameters, it was concluded that majority of the groundwater wells are within permissible limits according to BIS (2012) and WHO (2011) standards except few locations which indicate that application of fertilizer for agricultural contributing the higher concentration of ions. The present study signifies that hydrogeological processes like rock-water interaction, ion exchange and domestic and agricultural waste are the chief controlling factors for the groundwater chemistry, and thus regular monitoring and assessment of the groundwater quality is essential.

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