Nature Environment and Pollution Technology © Technoscience Publications	Vol. 7	No. 1	pp. 55-60	2008

POTABILITY STATUS OF GROUNDWATER IN MALEGAON VILLAGE OF NANDED DISTRICT, MAHARASHTRA

P. N. Wavde* and Parveen R. Shaikh
Department of Environmental Science, Yeshwant College, Nanded-431 602, Maharashtra, India
*Current Address: Deptt. of Environmental Science, University of Pune, Pune-411 007, Maharashtra

ABSTRACT

Groundwater quality is influenced by human activities which cause pollution at the land surface, and because most groundwater originates by recharge of rainwater infiltrating from the surface. The rainwater itself may also have an increased acidity due to human activity. The unsaturated zone can help reduce the concentration of some pollutants entering groundwater (especially microorganisms), but it can also act as a store for significant quantities of pollutants such as nitrates, which may eventually be released. Some contaminants enter groundwater directly from abandoned wells, mines, quarries and buried sewerage pipes, which bypass the unsaturated zone and, therefore, the possibility of some natural decontamination processes. Water quality of five tube wells and five dug wells from Malegaon village was assessed monthly for one year for physico-chemical and biological parameters. The results show that the potability of water was unaffected. Average concentration of chemical and biological parameters was observed high in monsoon season, probably due to the percolation of higher quantities of water.

INTRODUCTION

It has been unequivocally demonstrated that water of good quality is crucial to sustainable socio-economic development. Aquatic ecosystems are threatened on a worldwide scale by a variety of pollutants as well as destructive land-use or water-management practices. Some problems have been present for long but have only recently reached a critical level, while others are newly emerging.

Agricultural land use without environmental safeguards to prevent over-application of agrochemicals is causing widespread deterioration of the soil/water ecosystems as well as the underlying aquifers. The main problems associated with agriculture are salinisation, nitrate and pesticide contamination, and erosion leading to elevated concentrations of suspended solids in rivers and streams and the siltation of impoundments. Irrigation has enlarged the land area available for crop production but the resulting salinisation which has occurred in some areas has caused the deterioration of previously fertile soils.

The quality of groundwater depends on the composition of the recharge water, the interactions between the water and soil, soil-gas and rocks with which it comes into contact in the unsaturated zone, and the residence time and reactions that take place within the aquifer. Therefore, considerable variation can be found, even in the same general area, especially where rocks of different compositions and solubility occur. The principal processes influencing water quality in aquifers are physical (dispersion/dilution, filtration and gas movement), geochemical (complexation, acid-base reactions, oxidation-reduction, precipitation-solution, and adsorption-desorption) and biochemical (microbial respiration and decay, cell synthesis).

In developing countries like India, groundwater is often and sometimes the only source of cheap, potable water. It is attractive as a supply option because it is often conveniently available close to where the water is required. It has excellent natural quality, which is generally adequate for potable supply with little or no treatment, and the capital costs of development are relatively low. In addition, development in stages, to keep pace with rising demand is usually more achieved for groundwater than for surface water. As a consequence, hundreds of millions of people in both urban and rural areas depend on groundwater for domestic supplies.

Present paper assess the groundwater quality in the Malegaon village of Nanded district in relation of its potability and the effects of seasonal variations on the groundwater quality.

STUDY AREA

Nanded is the easternmost district of Marathwada region of Maharashtra State. It is bounded by latitude 18°16' and 19°55' N and longitude 76°55' and 78°20' E. The soil of the district is black and fertile. The gross irrigated area is 47,455 hectare, and the net irrigated area 38,317 hectare. Out of this, surface water and groundwater irrigation is 8,883 and 29,434 hectare (1994-95) respectively (Central Ground Water Board 2002).

The present area of work, i.e., Malegaon village finds its location in Ardhapur Taluka, 14 km away to the northwest side of Nanded city. Malegaon is easily approachable by road from Nanded city. The village comprises of 1212.59 hectares of land, out of which 1134 hectares is under irrigation and the remaining is utilized for residential and other purposes. Population of the village is 13741. The migrated people from nearby villages also contribute to the population, which makes it more than 15,000. Groundwater is the only source of water in Malegaon for drinking and domestic purposes. Farmers depend on the rainwater and groundwater for their crops.

The climate of the region is generally dry except during the southwest monsoon. The rainfall recorded for the year June 2004 to May 2005 was 1074 mm. The land region of this area comprises of a well-exposed assemblage of Deccan trap and granite intrusive formations. The Deccan trap formations constitute compact, massive and vesicular basalt. The tops of the rocks are weathered as murum and black cotton soil. The land is used primarily for agriculture. The recharge from rainfall takes place about 12-14 percent for vesicular and jointed basalt and 6-8 percent for weathered basalt from normal rainfall besides recharge from other sources.

MATERIALS AND METHODS

The water samples were selected from the locations near to human settlements, domestic sewage, water logging and agricultural runoff area. Samples of groundwater from the sampling sites were collected and stored in plastic bottles. The bottles were thoroughly cleaned and rinsed with distilled water before collection. Collection and analysis was done monthly for 1 year from January 2005 to December 2005.

The samples were analysed for ten different physico-chemical and biological parameters. Analysis and collection of samples has been done according to standard methods prescribed by APHA (1995) and Trivedy & Goel (1986). The parameters were temperature, pH, total dissolved solids, total hardness, dissolved oxygen, fluoride, chloride, sulphate, nitrate and coliform bacteria.

RESULTS AND DISCUSSION

The results obtained in the present work are given in Table 1. Temperature values were found to fluctuate between 23.0 and 30.2°C. Seasonal averages were found as 25.4 °C in monsoon, 25.6 °C in winter and 27.5°C in summer season. During the year, pH was found to vary within a range of 6.0-8.1, with the seasonal mean values of 7.59 (monsoon), 7.49 (winter) and 7.46 (summer). Total dissolved solids (TDS) were found to fluctuate from 225 to 455 mg/L during the year. The seasonal averages of TDS were recorded as 319, 331 and 372 mg/L in monsoon, winter and summer seasons respectively. Groundwater shows the total hardness concentration between 202 and 475 mg/L. In monsoon, the mean total hardness was 279 mg/L, in winter it was 282 mg/L, while in summer season it was 331 mg/L.

The dissolved oxygen (DO) content of the groundwaters was observed to fluctuate within a range of 2.4 - 5.24 mg/L. The mean values of DO during the seasons were 3.52, 4.31 and 3.29 mg/L in monsoon, winter and summer seasons respectively. The fluoride concentration was found to vary in a range of 0.21-0.58 mg/L, with the mean values of 0.41, 0.38 and 0.28 mg/L in monsoon, winter and summer respectively. Chloride shows the average values during monsoon as 139 mg/L, in winter 115.2 mg/L, and in summer 158.5 mg/L. During the year chloride concentration varied between 68 and 234 mg/L. Sulphate concentration of the groundwater was found to fluctuate from 9.2 to 30.8 mg/L. It shows the mean concentration in monsoon as 19.4 mg/L, in winter 17.4 mg/L, and in summer 13.8 mg/L. Groundwater samples show nitrate amount in the range of 2.9-15.9 mg/L. The seasonal mean concentrations were found to be 8.7, 7.6 and 5.4 mg/L during monsoon, winter and summer respectively.

The number of coliform bacteria was found to vary from 49 to 240 MPN/100 mL with an average content of 102 MPN/100 mL. The seasonal averages were recorded as 127.7, 109.6 and 70.4 MPN/100 mL during monsoon, winter and summer respectively.

Table 1: Physico-chemical and biological characteristics of the waters during the year Jan-Dec, 2005.

Parameters	TW-1	TW-2	TW-3	TW-4	TW-5	DW-6	DW-7	DW-8	DW-9	DW-10	Mean
Temperature	23.8-29.6	23.5-28.4	23.9-28.2	23.0-27.9	23.4-28.2	24.0-29.2	23.4-28.8	24.2-28.4	23.0-29.6	24.4-30.2	26.1
pH	6.52-7.66	7.03-7.40	6.95-8.00	7.00-7.59	6.30-7.45	6.52-8.05	6.60-8.10	6.00-7.28	6.40-7.78	6.39-7.60	7.51
TDS	322-420	257-368	274-352	332-455	274-440	317-340	282-364	245-370	225-333	277-352	340
TH	214-338	235-315	235-346	218-310	202-284	264-326	316-475	235-368	264-334	252-348	297
DO	2.75-4.70	3.43-5.25	2.40-4.43	3.7-4.82	2.72-4.92	3.12-4.31	3.20-4.45	2.61-4.27	3.52-5.24	2.82-4.51	3.7
Fluoride	0.22-0.41	0.23-0.45	0.24-0.46	0.22-0.49	0.21-0.53	0.23-0.47	0.22-0.54	0.21-0.46	0.21-0.47	0.22-0.58	0.35
Chloride	92-172	68-134	94-146	117-175	93-164	127-213	137-234	112-207	107-197	96-190	137
Sulphate	12.6-17.9	10.4-16.5	9.2-17.4	9.6-14.4	9.7-16.4	12.7-22.9	12.1-26.8	19.6-30.8	11.4-24.9	12.3-25.0	16.8
Nitrate	2.9-7.8	3.5-9.0	4.0-8.9	3.7-9.0	4.1-8.8	3.8-8.5	5.3-15.3	3.9-11.5	4.9-14.6	8.0-15.9	7.2
Colifrom Bacteria	49-170	63-140	63-180	49-180	63-140	49-170	63-170	70-180	70-240	63-220	102

All values are in mg/L except temperature (°C), pH and coliform bacteria (MPN/100 mL), TW = tube well DW = dug well

It is obvious from the results that seasonal changes in groundwater are also temperature dependent besides other factors. Significant differences in tube well and dug well water samples probably indicate that temperature can be an imperative environmental factor that can contribute to variations in groundwater. The increase and decrease in temperature is related to atmospheric heat, which is high in summer and low in winter and monsoon. Isaiah et al. (2003) studied groundwater quality of Salem District, Tamilnadu and reported the temperature values varying from 25 to 39°C. Gupta & Deshpande (2003) studied groundwater quality in Bhavnagar in Gujarat. They examined total 18 samples, which showed temperature value range of 30-40°C in September 2000, 28-31°C in January 2001 and 28-40°C in March 2001.

In the present work, tube well water shows maximum pH during monsoon season, and minimum during summer, while maximum pH values during summer and minimum during monsoon were observed in dug well water. The TDS values were maximum during summer and minimum during monsoon season for both tube and dug well waters. Tube well water showed more TDS content comparatively than dug well water. Seasonal changes showed distinct alteration of TDS values in groundwater. The results show that all the samples have total hardness levels beyond desirable limit but within permissible limit of drinking water standards. Groundwater of Malaprabha sub-basin of Belgaum district, Karnataka has been analysed by Varadarajan & Purandara (2003) where the pH level was found to vary between 7.00 and 9.70 in pre-monsoon, and 5.90 and 8.20 during post-monsoon season of 1999. They reported the TDS level to vary from 36-2100 mg/L during pre-monsoon and 22-2280 mg/L during post-monsoon season. Furthermore, they reported the total hardness of groundwater to fluctuate from 10 to 780 mg/L during pre-monsoon and 20 to 828 mg/L during post-monsoon season.

The results obtained in this work showed that seasonal variation in dissolved oxygen levels has a profound influence on water composition. It was observed that dissolved oxygen was maximum in winter season and minimum during summer season. The temperature was low throughout the winter season, affecting an increase in dissolved oxygen. During summer season, an increase in temperature caused low solubility of oxygen that led to decrease in dissolved oxygen. The amount of DO in groundwater of Nagpur (Maharashtra) was estimated and it was found to vary between 5.2 and 6.2 mg/L (Shelke et al. 2002).

The problem of high fluoride in groundwater resources has now become one of the most important toxicological and geo-environmental issues in India. During the last three decades the high fluoride concentration in water resources and the resultant disease fluorosis is being highlighted considerably throughout the world. India is also confronting the same problem and about 25 million people in 8700 villages are consuming water having high fluoride (Handa 1998). These problems probably could not arise in the present study area, since the fluoride content was found suitable for consumption.

Higher chloride content was found in dug well water samples than tube well waters possibly due to the percolation of salts and fertilizers. Seasonal changes in sulphate levels indicate that it was maximum during monsoon season. This rise was probably due to the large-scale use of chemical fertilizers which may have percolated from the surface to groundwater. The present observations illustrate that dug well water appeared to be high in nitrate content as compared to tube well water, however, seasonal variation was the same in both.

Singh et al. (2000) analysed the groundwater of Agra city and concluded that chloride level ranges from 86.4 to 201.4 mg/L, while nitrate concentration from 9.36 mg/L (summer) to 47.24 mg/L (monsoon). Babar & Kaplay (1999) reported that chloride level in groundwater of Parbhani district (Maharashtra) ranges from 21 to 110 mg/L, and sulphate from 5 to 28 mg/L. Sulphate level in groundwater of Nanded city (Maharashtra) was found to be in the range of 10.26 - 34.83 mg/L (Islam & Gyananath 2002).

It is apparent from the results that the total coliforms count was maximum in monsoon, marginally lowered in winter and lowest in summer season. It can also be observed that the dug well water has remarkably more values than the tube well water samples. Infiltration of surface water (contaminated with faecal matter) is considerably high in monsoon season; this may be the probable cause for the high values of coliforms in this season.

The biological contamination of groundwater of Agra city was studied by Singh et al. (2000). They reported the maximum coliform content of 2152/100mL, and the minimum 99/100mL. National Environmental Engineering and Research Institute, Nagpur (1995) studied the groundwater quality at different places from south India. Its data reveal that the total coliform content in Cochin, Kerala vary between 20 and 340/100 mL. A very high count of total coliforms was reported in the groundwater of Manali, which ranged from 1400 to 27500/100 mL. The findings also showed high coliform content in some villages of Tamilnadu. In Sadayankuppam village the groundwater samples were analysed and the total coliform content was found to be extremely high fluctuating between 11400 and 16000/100 mL of water.

The results of the present investigation revealed that the total coliform content of both tube well and dug well water samples was exceeded the prescribed permissible drinking water limit of various health organizations. Coliform bacteria are present in all water samples in high amount. As these bacteria are not pathogenic, there is no jeopardy of developing some bacterial diseases among the humans and animals. There might be a possibility of existence of other pathogenic bacteria in the groundwater.

CONCLUSION

The average results obtained in present study show that all samples could be included in very hard category. The groundwater samples show higher concentration of physico-chemical parameters in monsoon and low in summer season. Furthermore, it is noted that the prescribed permissible limit has not been crossed by all the samples. It can be concluded that the consumption of the groundwater in this region will not detrimentally affect the human population.

ACKNOWLEDGEMENT

The authors are grateful to Dr. N. V. Kalyankar, Principal, Yeshwant College, Nanded (Maharashtra) for his everlasting inspiration during the present research work and for providing the laboratory and library facilities.

REFERENCES

Adak, M.D. and Purohit, K.M. 2001. Status of surface and groundwater quality of Mandiakudar-Part II: Agricultural utilities. Poll Res., 20(2): 219-225.

APHA 1995. Standard Methods for the Estimation of Water and Wastewater, 18th ed. American Public Health Association, Washington DC.

Babar, Md. and Kaplay, R.D. 1999. Groundwater quality around Pingalgad Nala in Parbhani district, Maharashtra, India. Ecol. Env. and Cons., 5(2): 141-143.

Central Ground Water Board 2002. Ground Water Studies in Nanded District, Ministry of Water Resources, Govt. of India, Central Region, Nagpur, p. 7.

Gupta, S.K. and Deshpande, R.D. 2003. Dissolved helium and IDS in groundwater from Bhavnagar in Gujarat: Unrelated to seismic events between August 2000 and January 2001. Proc. Indian Acad. Sci. (Earth Planet Set.), 112(1): 51-60.

Handa, B.K. 1998. Bhujal News, 3: 31-37.

Isaiah, S., Edison, R., Kavitha, B., Sivaraj C., and Suganthi, M. 2003. Study of fluoride in groundwater, survey of dental fluorosis in Salem district. Ecol. Env. and Cons., 9(3): 297-300.

Islam, S.R. and Gyananath 2002. Contamination of chemical fertilizers in Groundwater. J. Ecotoxicol. Environ. Monit., 12(4): 25-290.

National Environmental Engineering and Research Institute 1995. Groundwater Quality - A Status Report, Part II, 39-76.

Rao, M.B. 2002. Methodology for Water Analysis. Indian Institute of Aquatic Biologists Publication, IAAB, Hyderabad.

Shelke, M. E., Tayade, D.T. and Shelke, R.E. 2002. Monitoring of drinking water quality of Nagpur city, Maharashtra, India during August to October 2001. Asian J. of Chemistry, 14(3&4): 1815-1817.

Singh, R.P., Chauhan, B.S., Devendra, S. and Yadav, Y.S. 2000. Seasonal variation in groundwater quality of Agra city. Ind. J. of. Env. Health, 42(2): 59-69.

Tiwari, D.R. 2001. Hydrogeochemistry of underground water in and around Chatarpur city, Dist. Chatarpur(M.P.). Ind. J. of Env. Health, 43(4): 176.

Trivedy, R.K. and Goel, P.K. 1986. Chemical and Biological Methods for Water Pollution Studies. Environmental Publications, Karad.

Varadarajan, N. and Purandara, B.K. 2003. Hydrochemical characteristics of groundwater: A case study. Eco. Env. and Cons., 9(3): 253-262.

World Health Organization 1994. Tech. Report Series No. 532, WHO, Geneva.