Journal of Ecology and The Natural Environment Vol. 1(6), pp. 156-159, September, 2009
Available online at http://www.academicjournals.org/JENE

Full Length Research Paper

Bacteriological assessment of groundwater in Arkavathi and Vrishabhavathi basins, Bangalore, Karnataka

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Accepted 27 July, 2009

In the newly developed and old parts of Bangalore city, municipal, domestic and industrial effluents are channelized into an open sewerage system. Most of the wells situated within 2 km radius of this open sewerage networks were found to be profoundly loaded with total and facal coliform. The average counts of total and facal coliform from the lake samples were 227 and 79 CFU/100 ml, 82 and 14 CFU/100 ml from the open wells and 63 and 34 CFU/100 ml from the bore wells respectively. The level of contamination is beyond the permissible limit for indicator organisms in groundwater during winter season, which can render the consumer more vulnerable to health risks.

Key words: Coliform, groundwater, health impact, indicators.

INTRODUCTION

Water used for drinking should be of potable nature which means it could be consumed in desired amount without adverse effect on health. The issue of quality water supply is assuming paramount importance in Bangalore city in view of rapid urbanization which is increasingly dependent on groundwater supplies particularly in areas that are densely populated (Gupta et al., 2004; Jayalakshmi and Belagali, 2005; Nair et al., 2006; Prakash and Somashekar, 2006).

Together, lack of proper amenities in many housing colonies and apartments have compounded the problem. On the other hand, on accent of improper sewage disposal facilities both in the old and new areas, groundwater supplies are significantly getting contaminated.

Bangalore city lies in Arkavathi and Vrishabhavathi river basins still, majority of the people suffer from drinking water scarcity and new housing colonies depend more on ground water for domestic purpose. In this context, the present study is aims to investigate the suitability of ground water for drinking by considering bacteriological parameters like total coliform (TC) and facal coliform (FC). as higher TC and FC counts in water that indicates the presence of enteric pathogens in water (Fatoki et al., 2001).

MATERIALS AND METHODS

The water samples collected from the source using standard methods were filtered through a thin sterile membrane filter (pore size 0.45 µm) kept on a filter fitted with suction flask.

The filter discs (Sartorious, Cellulose Nitrate filter) containing the filtered and trapped microorganisms were aseptically transferred to a sterile Petri dish having an absorbent pad saturated with a selective medium, and incubated at 37°C for 24 h. The colonies developed were counted using colony counter (Digital Colony Counter, DCC-100).

Results are expressed in terms of CPU/100 ml of water sample by using the formula;

$$\text{No. of Colony forming Units (CFU) per 100 ml of water} = \frac{\text{Colony Count}}{\text{Volume of Sample}} \times 100$$

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Table 1. Characterization of the sampling sites and coliform count of water samples.

Types of Sample	Number of Samples	TC and FC CFU/100 ml					
		Total coliform			Faecal coliform		
		Min.	Max.	Avg.	Min.	Max.	Avg.
Lakes	7	238	104	227	68	106	79
Open wells	13	2	214	82	Nil	38	14
Bore wells	43	6	104	63	Nil	88	34

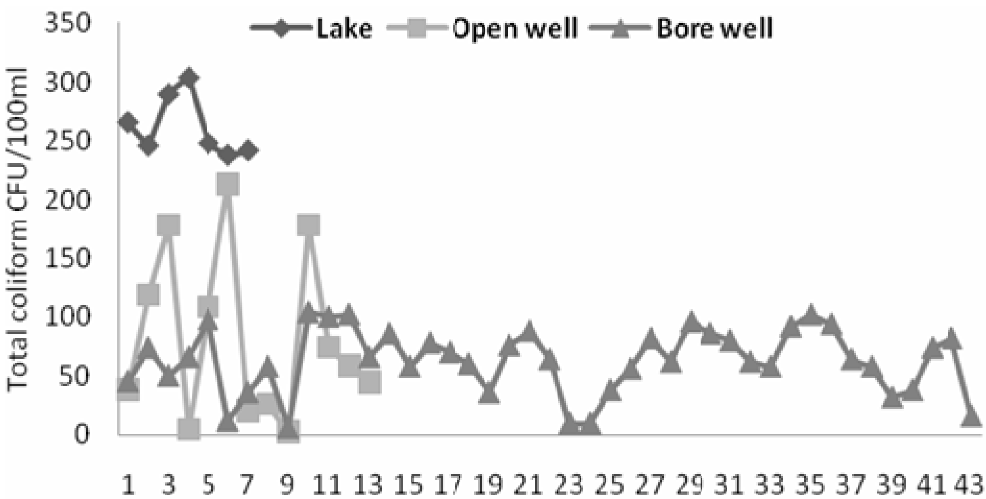

Figure 2. Density of Total coliform in Lake, open and bore well samples.

RESULTS AND DISCUSSION

Coliforms are normal inhabitants of digestive tracts of animals, including human and are found in their wastes, besides soil material (Subba Rao, 2004). They are also considered as indicator organisms of water pollution caused by faecal contamination which is a serious problem due to the potential for contracting diseases from pathogens (disease causing organisms). Although the concentrations of pathogens from faecal contamination are small, the possible occurrence of a number of different pathogens is large.

The range of TC and FC detected from the lake samples varied from 238 - 304 and 68 - 106 CFU/100 ml; from the open wells, 2 - 214 and 0 - 38 CFU/100 ml and from bore (tube) wells, 6 - 104 and 0 - 88 CFU/100 ml (Table 1). Comparatively higher counts were obtained during winter (December - January). Total coliforms were noticed in all the samples from lakes, bore wells and open wells, while faecal coliforms were present in all the samples of lakes, 95% of bore wells and 69% of open well (Figures 2, 3).

Among 63 locations, all the samples showed TC and FC counts above the permissible limits (except 4 and 2 samples in open and bore wells respectively). As per WHO guidelines TC and FC count should be zero in water used for drinking purpose. As such the present circumstances indicate gross pollution of ground water (Polo et al., 1998) via percolation under natural hydraulic pressure. Faecal coliform are a subset of the total coliform bacterial group found in human and animal intestinal wastes. The faecal coliform bacteria group includes the genera Escherichia and to a lesser extent, Klebsiella and Enterobacter. They are more precise indicators of the presence of sewage contamination than total coliforms.

Highest proportion of indicator organisms were found in samples from Sumannahalli, Bangalore University gate, Kempanna layout, Rajaginagar, Munishwara nagar, BTM layout, Jai-Bheema nagar, Ananda nagar, Kalyan nagar, Mathikere, Karianna layout and Chalkere as well as Mathikere, Kalkere, Ulsoor and Belandur lakes (Figure 1). As per field observation, it was noticed that sewage disposal practices like soak pits, pit latrines and septic tanks were in use. Cracks or holes in the well casing must have allowed microbial contamination of ground water through the permeable soil layer. Low bacterial counts were observed in the samples of Wilson garden and Ganga nagar where well established underground drainage system exists.

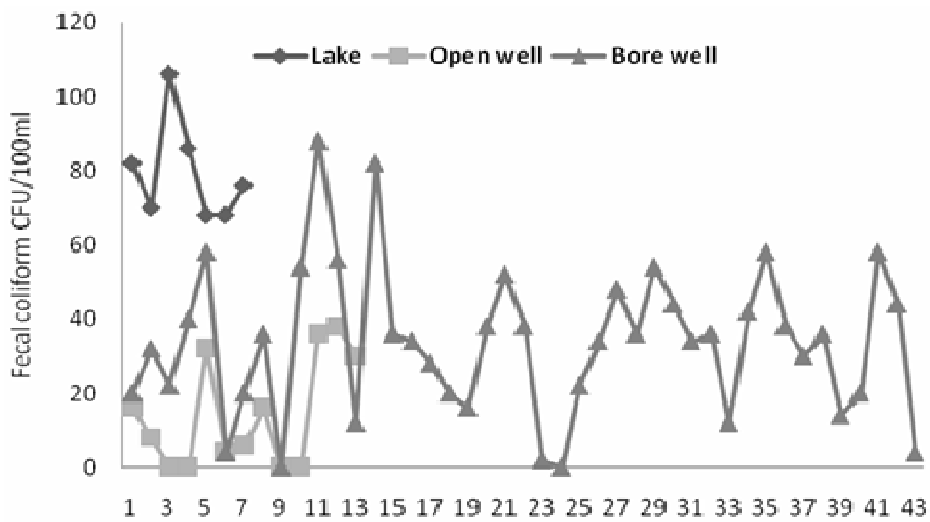

Figure 3. Density of Faecal coliform in Lake, Open and Bore well samples.

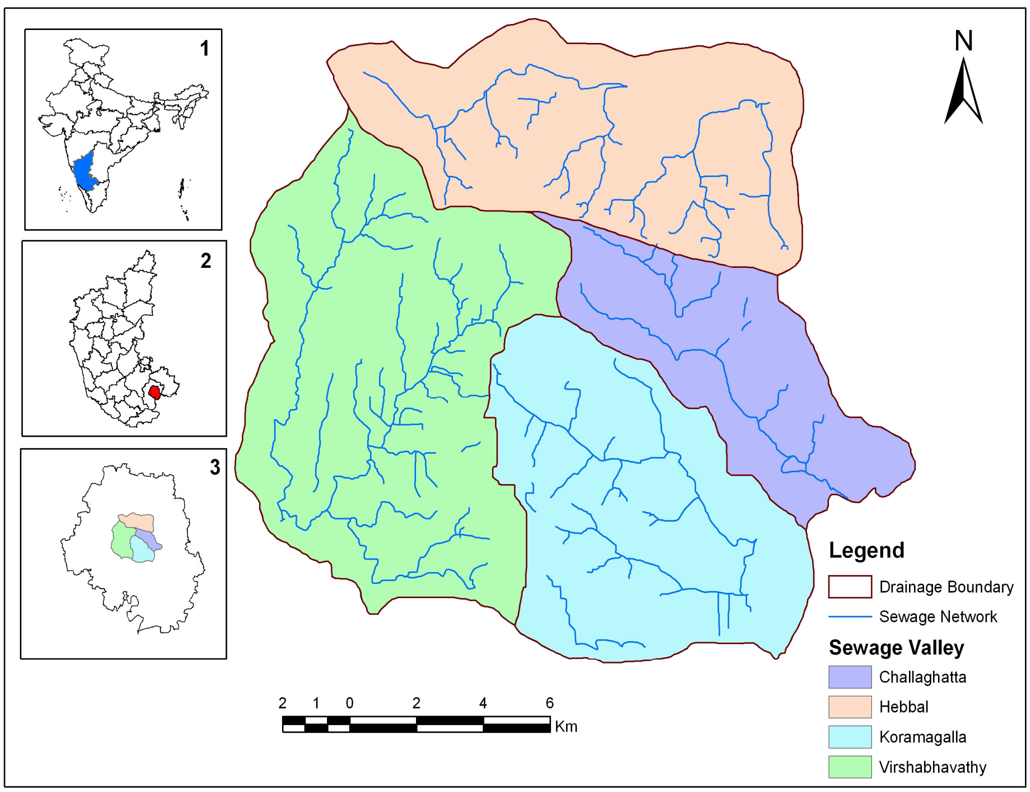

Figure 1. Map of the study area along with sewerage network system.

Bluefort et al. (1996) also reported that the contamination of ground water in Pennsylvania and Maryland, USA is due to sewage disposal practices like pit latrine, septic tank and soakage pit system. US Geological survey reported the presence of TC and FC in 30% wells in USA tested under National Water Quality Assessment Programme. Proximity of contaminating surfaces and interaction with surface water are some of the factors, likely to control the presence and transport of coliform bacteria in ground water.

ACKNOWLEDGMENTS

The author thanks the Board of Research in Nuclear Science/Bhabha Atomic Research Centre (BRNS/BARC), Mumbai for providing facilities and financial assistance to carry out the work.

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