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WATER, SANITATION, ENVIRONMENT and DEVELOPMENT

Monitoring bacteriological quality of groundwater

Ebenezer A Barnes, E Bosque-Hamilton, and Rose Osafo

Introduction

Groundwater is increasingly being used as a source of potable water supply especially in rural areas. This is because it is known to be safe and adequately protected from anthropogenic influences unlike surface water sources. However, recent investigations have shown that such supplies are vulnerable to human activities. This includes the indiscriminate disposal of waste, human and agricultural near borehole or hand-dug well locations.

Leachate from these wastes may introduce pathogenic microorganisms and organic material into aquifers. In Ghana, leachate transport is probably accelerated by fractures in the basement complex. Hitherto, most of the monitoring activities in the country were geared towards the measurement of static water levels and chemical quality.

Information on bacteriological quality has therefore been rather scanty. However, recent monitoring has included bacteriological sampling but restricted to particular project areas of interest and on ad-hoc basis.

To address this problem, bacteriological sampling was included as part of an ongoing groundwater monitoring project in the Accra Plains. The objective was to provide information on the bacteriological status of groundwater in the Accra plains and to serve as baseline data for other rural communities in the country with similar sanitary environment.

Location and description of the Accra Plains

The Accra Plains is located along the south-eastern coastline of the country and covers approximately 6000 km^2. It is bounded on the north and east by the Volta River, on the west by the Akwapim ranges and on the south by the Gulf of Guinea. The plains is inhabited by small scattered rural communities whose main occupations include crop and animal farming.

Materials and methods

After an initial reconnaissance survey, seven borehole supplies at Abokobi (AB), Amrahia (AM), Oyarifa (OY), Accra (AC), Afienya (AF), Ashaiman (AS), and Sam & Sam farms (SS) were selected for bacteriological monitoring. Four of the sampling stations at Oyarifa, Amrahia and Sam & Sam farms are sited in cattle grazing grounds. The other boreholes are used for domestic supplies.

Water samples were collected monthly over a period of 3 years from January, 1987 to February, 1990. The samples collected in the field were kept at 4°C in an ice chest and later sent to Water Resources Research Institute laboratory for total and faecal coliform analyses. The membrane filter technique was employed for the determination of both total and faecal coliform (WHO, 1987).

Results and discussion

No clear pattern was observed in the monthly distribution of both Total and Faecal coliform in all the boreholes monitored. However, trends emerged in the yearly mean counts. The yearly mean Total and Faecal (*E.Coil*) coliform counts are therefore illustrated in Figure 1 and 2 respectively.

Very high total coliform bacteria counts were recorded at all the stations in 1987 (Fig 2). This was particularly observed at livestock rearing areas that is, Oyarifa (OY), Amrahia (AM), Sam and Sam (SS) and Ashaiman (AS).

Mean Faecal coliform counts also followed the same pattern. The highest average Total and Faecal coliform counts were observed at Ashaiman (88 CFU/100 ml) in 1989 and Amrahia (9 CFU/100 ml) in 1987, respectively.

Interestingly, the bacteriological quality of almost all the boreholes improved during the latter parts of the study. Possibly, this may be attributed to public awareness and improved sanitary conditions around supplies. The borehole at Sam and Sam however, deteriorated in bacteriological quality.

The yearly mean faecal coliform count increased from 6 CFU/100 ml to 8 CFU/100 ml during the study.

Another fact worth noting is that no faecal bacteria were observed at the supplies not located in cattle grazing grounds (Abokobi and Accra) except at Afienya. The borehole at Afienya had 2 CFU/100 ml in 1987 but by the end of the study no faecal coliform was recorded.

Drinking water standards require no *E. coli* in 100 ml of water sample (WHO, 1984) and the presence of *E. coli* in the supplies indicate that some of the supplies are unsuitable for human consumption.

Sources of contamination

Domestic waste disposal

In most of the human settlements in the Accra plains, there are no well defined places for disposal of domestic wastes. Wastes are therefore indiscriminately thrown about encouraging bacterial activities. Bacteria then infiltrate into the groundwater at places where the water table is high. Wells in these areas could also be easily contaminated by leachate from excreta disposal facilities such as pit latrines, septic tanks etc.

As the population has grown, the amount of waste substances has also increased. Lack of effective waste disposal therefore has enhanced insanitary practices and conditions.

Agricultural contaminants

Livestock farming is one of the main occupations in the plains. All the livestock farms do not have storage facilities for animal waste and so they are disposed of haphazardly. These waste contaminate the groundwater by seeping through fissures, faults and joints.

Conclusion

The results indicate the contamination of some borehole supplies in the Accra Plains by microorganisms of faecal origin. This evidence is based on the presence of the *E.coli* ranging from 0 to 9/100 ml of water sample in the analyzed samples collected during the study.

Interestingly, faecal coliform were present in all the boreholes sited in the cattle grazing environment. With the exception of the supplies of Sam & Sam, the quality of all the boreholes improved in the latter part of the study probably due to more public awareness and improved sanitary conditions around borehole sites.

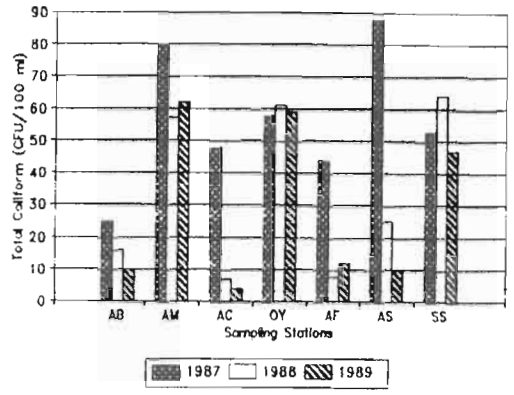

Figure 1. Yearly mean total coliform of the boreholes (1987-1989)

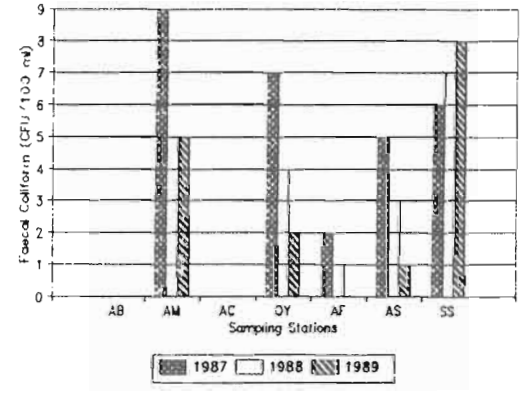

Figure 2. Yearly mean faecal coliform of the boreholes (1987-1989)

References

WHO (1984). *Guidelines for drinking water quality. vol. 2. Health criteria and other relevant information.* WHO Publication, Geneva.

WHO (1987). *Global environmental monitoring systems (GEMS) water operational guide.* WHO Publication, Geneva.