

SHORT COMMUNICATION

WATER QUALITY OF MAHA OYA STREAM IN PERADENIYA

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Accepted 5 December 2007

ABSTRACT

The water quality of the Maha Oya stream that runs across the University of Peradeniya, was determined using water samples collected from four different locations along the stream. Water samples were assessed for selected bacteriological parameters, temperature, pH and turbidity, during the wet and dry seasons, at weekly intervals over a period of 5 weeks in each season. A sociological survey was conducted concurrently to study the impact of two communities (line house and agricultural) living along the stream bank, on water quality. The bacteriological analysis revealed that stream water is not suitable for drinking or bathing at any of the locations, according to Sri Lankan standards and WHO guidelines. Temperature, pH and turbidity of stream water fluctuated among the locations investigated according to geographical and environmental factors and run off into the stream. The sociological survey revealed direct discharge of faecal matter into the stream at certain locations. Both, agricultural and line house communities were aware of pollution of water in the stream. The study revealed the unsanitary quality of water in the Maha Oya and the need to implement suitable methods of solid waste and waste water disposal.

Key words: total coliform, faecal coliform, sociological survey

INTRODUCTION

Maha Oya is a natural fresh water stream originating in the Hantana mountain range (latitude: 7°26' North and longitude: 80°60' East) of the Kandy district in the Central Province of Sri Lanka. At higher elevations, the Hantana mountain range is covered by natural forests and grasslands. Water percolating through small springs in this area collect to form the stream. Down stream, at a distance of about 4.5 km from the origin, a community water project distributes untreated water through a series of communal taps to a line house community (populated area). Further down stream, at a distance of about 6.3 km from the origin, the stream flows adjacent to a paddy field, around which a small farming community lives. The stream is used for bathing and washing clothes by both communities, and for drinking by certain occupants. As the stream passes through the University premises and before it joins river Mahaweli, the university piggery (located between the community water project and populated area), the dairy farm (located between the populated area and rice

fields) and the occupants living along the stream bank discharge waste water into the stream.

Maha Oya offers a suitable ecological niche to investigate the influence of human interaction on water quality and hygiene. This short term study reports certain water quality parameters measured to assess the suitability of stream water for general use and for consumption in particular.

MATERIALS AND METHODS

Assessment of water quality

Water samples were collected from four locations along the stream; forested area (≈ 3 km from origin), populated area (≈ 5 km from origin), agricultural area (≈ 6.3 km from origin) and university premises (≈ 11 km from origin) during the wet and dry seasons, on a weekly basis between 11.00 am and 12 noon. Five water samples were collected in each week from each location, in duplicate.

Water samples were collected 5 cm below the water surface for assessing (i) total coliform

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(ii) faecal coliform and (iii) faecal *Streptococci*, using standard methods (Bisen and Verma, 1994; Toronzos and McFeters, 1997). Pour plates were prepared to enumerate the Heterotrophic Plate Count (HPC) using nutrient agar (American Society for Microbiology, 2002; Black, 1993; Pourcher *et al.*, 1991). Water pH and the turbidity were measured using a calibrated pH meter and a spectrophotometer respectively. The temperature was measured at a depth of 5 cm.

Concurrently, a sociological survey (Fink and Kosecoff, 1985) was carried out using a questionnaire to find out the attitudes of people living adjacent to the Maha Oya stream, on the quality of stream water. A stratified random sample of 30 houses, representing 18 from the populated area (line houses) and 12 from the agricultural area was selected.

RESULTS

The total coliform counts (per 100 ml of water) in the four locations ranged from 3.0×10^3 to 5.0×10^4 cfu in the wet season and 1.4×10^3 to 2.6×10^4 cfu in the dry season. The faecal coliform counts ranged from 3.6×10^2 to 7.0×10^3 cfu in the wet season and 8.8×10^2 to 6.9×10^3 cfu in the dry season. The counts of both total and faecal coliforms were significantly higher in the populated area than in other locations, during both seasons (Fig. 1). A significantly higher number of total coliforms was observed in the

wet season in the populated area when compared to the dry season. The HPC of the four locations ranged from 1.7×10^5 to 4.3×10^5 cfu in the wet season and 1.8×10^5 to 2.6×10^5 cfu in the dry season. There was no significant difference in the HPC among the four locations or between the wet and dry season at any of the locations. The faecal *Streptococci* counts ranged from 5.2×10^2 to 1.9×10^3 cfu in the wet season and 1.9×10^2 to 1.7×10^3 cfu in the dry season. The source of faecal pollution was determined using the FC/FS (faecal coliform/faecal *Streptococci*) ratio. According to the results, the source of faecal pollution during the dry season in the forested and populated area was human, while in the other locations during both seasons, the source of faecal pollution was human and animal waste.

Among the four locations, the lowest water temperature was in the forested area with an increase in temperature down stream. There was no significant difference in temperature between the wet and dry seasons at any location. The wet season had a higher turbidity in all four locations. The forested area had the lowest turbidity during both dry and wet seasons, while turbidity was highest in the agricultural area in the wet season and near the populated area in the dry season (Table 1). A significant difference in pH between the wet and the dry seasons was observed in the agricultural area. The pH of stream water in the populated area was lower when compared to the other locations during both seasons (Table 1)

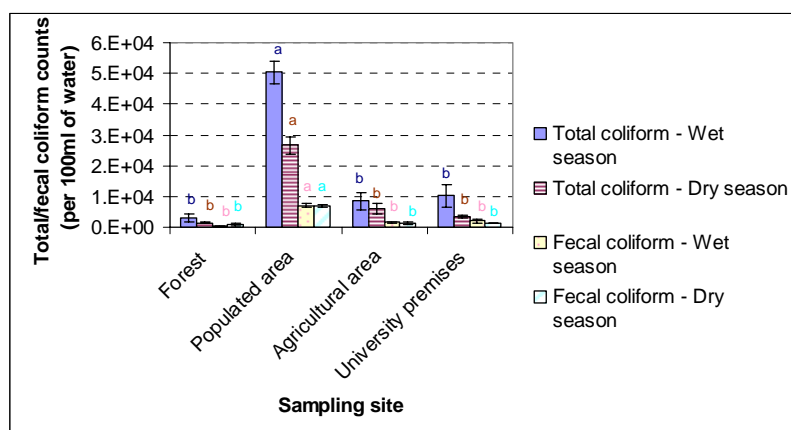


Figure 1. Total coliform and faecal coliform counts in four locations of Maha Oya during the wet and dry season. (Bars representing the two counts in two seasons followed by the same letter are not significantly different at 5% level –DMRT.)

Table 1. Physical and chemical parameters of water from four locations along Maha Oya during wet and dry seasons.

| Location | Wet season | | | Dry season | | |
|---------------------|-------------------|----------------------|--------------------|-------------------|---------------------|-------------------|
| | Temp. °C | Turbidity | pH | Temp. °C | Turbidity | pH |
| Forest area | 21.0 ^c | 0.0494 ^b | 6.33 ^{ba} | 21.6 ^c | 0.0268 ^c | 7.45 ^a |
| Populated area | 24.0 ^b | 0.0608 ^{ba} | 6.07 ^b | 24.4 ^b | 0.0478 ^a | 6.42 ^b |
| Agricultural area | 25.0 ^a | 0.0628 ^a | 6.23 ^b | 25.2 ^a | 0.0380 ^b | 7.40 ^a |
| University premises | 25.1 ^a | 0.0550 ^{ba} | 6.74 ^a | 25.2 ^a | 0.0308 ^c | 7.47 ^a |

(Values followed by the same letter in a column are not significantly different at 5% level, DMRT)

The sociological survey confirmed that stream water is used for drinking, bathing, washing clothes and cultivation (Fig. 2a). The community living around the populated area contributed to polluting the stream by direct discharge of faecal matter into the stream (Fig. 2b and 2c). The run off water from the university piggery and dairy farm added to the pollution. According to the completed questionnaires, stream water did not pose a serious health risk to

both communities. However, the majority in both communities was not satisfied with the quality of water in the stream running near their homes. Implementation of proper garbage disposal methods, granting of permission to build toilets, refraining from directing run off from the piggery and the dairy farm to the stream, were some of the suggestions made by the occupants of both communities to keep the stream water unpolluted.

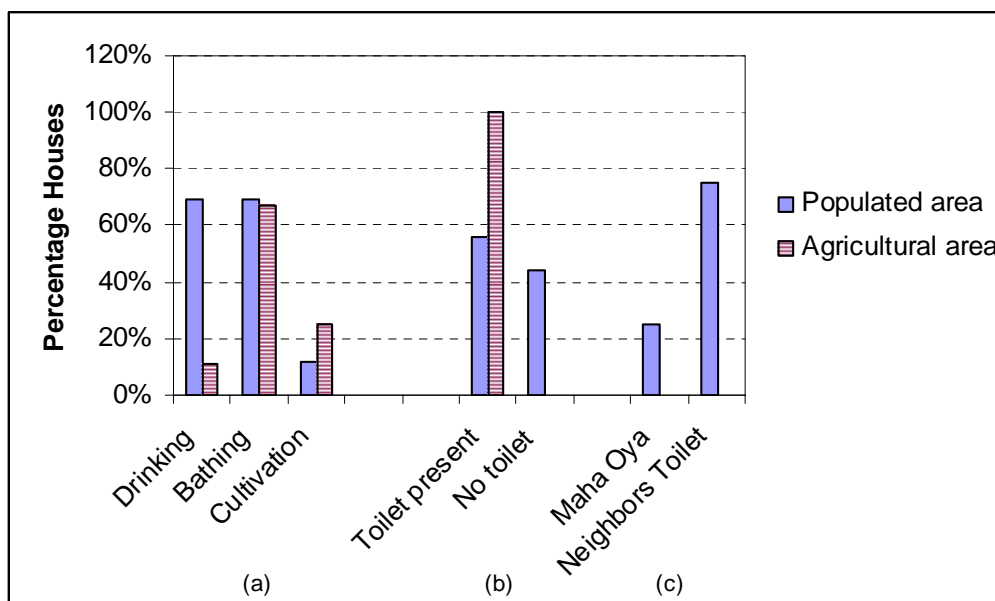


Figure 2. Stream water usage and habits of communities along Maha oya stream water usage (b) availability of toilets (c) alternatives used in the absence of toilets.

DISCUSSION

In all the water samples tested, the total coliform and faecal coliform counts far exceeded those stipulated by the Sri Lanka Standards Institute and the WHO respectively, for drinking water (0-10 cfu and 0 cfu/100ml of water respectively) and bathing water (1000 cfu and 200 cfu/100ml of water respectively). These counts were significantly higher in the populated area and the sociological survey confirmed that faecal matter is directly disposed into the stream at this location due to the lack of proper toilet facilities and poor sanitary conditions of the community. The mixed sources (animal and human) of faecal pollution in the other locations, is largely due to the run off from the dairy farm and piggery.

The increase in water temperature down stream is attributed to the difference in elevation, as the forested area is located at 900 m and the university premises at 470 m. The high turbidity in the wet season in all four locations is to be expected. However, the very high turbidity level in the agricultural area is a result of paddy cultivation, during which large amounts of top soil gets washed into the stream.

The decrease in pH during the wet season is due to the high rain fall that was received, as even unpolluted rain water is slightly acidic with a pH between 5 and 6. The lowest pH of water near the populated area (line houses) is probably due to the large amount of household refuse that is discharged directly into the stream at this location. Decomposition of organic matter produces CO₂, which dissolves in water as carbonic acid, thereby lowering the pH.

The sociological survey revealed that all communities were not satisfied with the quality of water in the stream flowing near their homes and blamed the occupants in the populated area and the University livestock farms for polluting the stream. The need to implement regulations, as suggested by occupants themselves, regarding disposal of solid waste and waste water into the stream is paramount to make Maha Oya waters safe for bathing and drinking, specially in relation to microbial activity.

REFERENCES

- American Society for Microbiology. (2002). *Applied and Environmental Microbiology*. 68 (12): 5796-5803.
- American Public Health Association. (1992). *Standard methods for examination of water and wastewater*, American Public Health Association, Washington, DC.
- Bisen, P.S. and Verma, K. (1994). *Handbook of Microbiology*, CBS Publishers & Distributors. Pp.134-145.
- Black, J.B. (1993). *Microbiology, principles and applications*. Prentice Hall. Pp. 864.
- Fink, A. and Kosecoff, J. (1985). *How to Conduct Surveys*. SAGE Publications. Pp.117.
- Iman, U. (1998). *Water quality in Maha Oya*. M. Sc. Thesis. University of Peradeniya, Sri Lanka. Pp. 260.
- Pourcher, A.M., Devriese, I.A., Hernandez J.F. and Delattre J.M. (1991). Enumeration by a miniaturized method of *E. coli*, *Streptococcus bovis* and enterococci as indicators of the origin of faecal pollution in waters. *J. Appl. Bacteriol.* **70**: 525-530.
- Toronzos, G.A., McFeters, G.A. (1997). Detection of indicator microorganisms in environmental freshwaters & drinking waters. *Manual of environmental microbiology*, American Society for Microbiology. Pp. 184 - 193.