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FAECAL POLLUTION OF FRESHWATER ENVIRONMENTS IN BANGLADESH

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The sanitary quality of any water source is conventionally measured by estimating the concentration of faecal coliform bacteria. An investigation was carried out over 12 months to determine the faecal pollution of 5 ponds in and around Dhaka city from May 1988 to April 1989. The results showed that four of the 5 studied ponds, were heavily polluted by faecal matter. These data suggested that these ponds are potential sources of health hazards which is important from a public health point of view.

KEYWORDS: Faecal pollution, ponds, Bangladesh.

INTRODUCTION

A pond is a manmade water ecosystem. Bacteria naturally occur in this ecosystem; some are transient, entering the water from air or soil or from industrial or domestic sources. Others, such as pathogenic bacteria, originate from excreta, can be of great importance because they may affect the health of both humans and animals who use the water. The presence of a high concentration of faecal coliform bacteria indicate the possible presence also of pathogenic organisms which may cause diarrheal diseases.

This coliform group of bacteria are gram-negative, rod-shaped and ferment lactose with the production of gas.¹ They consist of *Escherichia coli*, *Klebsiella spp.*, *Enterobacter spp.* and *Citrobacter spp.* Among them enterotoxigenic *E. coli* (ETEC) have been found to produce toxins and causes severe cholera-like disease.² These ETEC have been isolated from Buriganga river in Bangladesh.³

The faecal pollution of a running water system in Bangladesh has been studied.^{4,5} However, information on the faecal pollution of closed water system like ponds is scanty. The present study, therefore, investigated the faecal pollution of pond water in and around Dhaka city, Bangladesh.

MATERIALS AND METHODS

Five ponds in and around Dhaka city were studied.

1. Description of Ponds (see Fig. 1)

Mirpur Botanical Garden Pond (Pond # 1): This pond was considered as a control pond. It is situated inside the Botanical Garden of Dhaka and protected from human use. The surface area of this pond is 2925 m² and the maximum depth is 5.22 m. The bank of

this pond is highly built and there is no drain connected to this pond. Little macrovegetation and planktons were found in this pond.

Mirpur Stadium Pond (Pond # 2): This pond is situated near the National Stadium 2 in Mirpur. The surface area of this pond is 6000 m² with a maximum depth 1.55 meter. On the southern side of this pond, a daily market is situated. In the eastern side, there is a slum. The northern and western sides are always covered with faeces due to indiscriminate defaecation of the slum-dwellers. Every day hundreds of people use this pond for washing, bathing and swimming. This pond is rich in floating aquatic macrophytes and planktons.

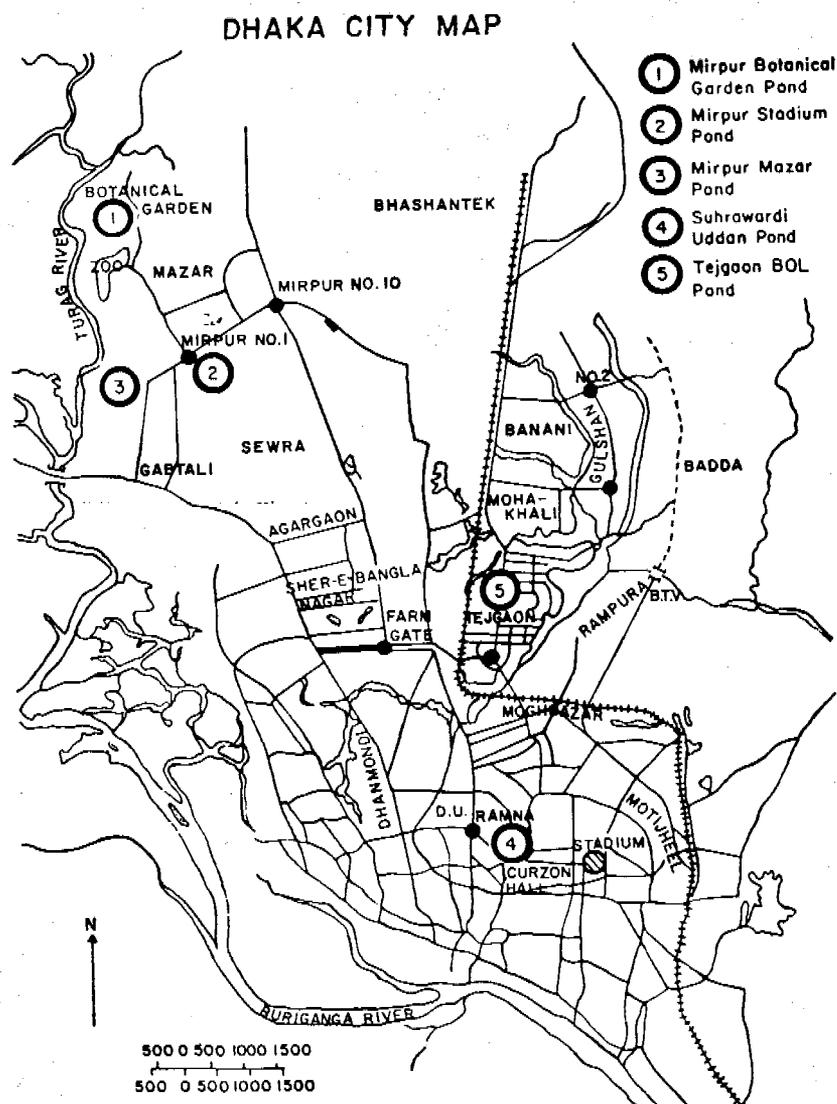


FIGURE 1 Map of Dhaka city showing the sampling sites. Sampling sites (○).

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 Mirpur Mazar
 Pond
 Suhrawardi
 Uddan Pond
 Tejgaon BOL
 Pond



Mirpur Mazar Pond (Pond # 3): Pond # 3 is situated by the side of a mazar of a saint. The surface area of this pond is 1872 m² with a maximum depth of 3.09 m. Hundreds of transient people who live around the mazar use this pond for various purposes, e.g. cooking, washing, bathing and swimming. There is a market very near this pond, and the vendors use water from this pond to water their vegetables. Faeces were found on the banks of this pond due to indiscriminate defaecation by the transient population around the pond. Water hydrophytes and planktons were abundant in this pond.

Suhrawardi Uddan Pond (Pond # 4): Pond # 4 is situated inside a park (Shuhrawardy Uddayan), with a surface area of 4500 m² and maximum depth 5.05 m. This pond is also used by people for various purposes. Little macrovegetation and plantation were found in this pond.

Tejgaon Bangladesh Oxygen Ltd. Pond (Pond # 5): Pond # 5 is situated in Tejgaon Industrial Area. On the western and northern banks of this pond, there is a daily market and there are also restaurants on the eastern and northern sides. The surface area is 4250 m² with a maximum depth 3.45 m. Hundreds of people also use this pond water for various purposes, like bathing, swimming, washing. All the restaurants use this water for washing.

2. Sample Collection

Water samples were collected from these ponds every 15 days between May 1988 and April 1989. 500 ml water was collected in pre-sterilized 500 ml narrow-mouth Nalgene plastic bottles and transported to the laboratory inside an insulated box with cool packs and processed within 6 h of collection.

3. Processing of Samples

Ten-fold dilutions of the water samples were prepared in phosphate buffered saline (PBS) and then 0.1 ml was spread onto duplicate plates of membrane filter coliform (MFC) agar. The plates then were incubated at 44°C for 18–24 h. The characteristic blue colonies were counted as faecal coliforms. The dilution chosen for counting was that which contained 30 to 300 colonies per plate. When the coliform count in a water sample was very low, then 100 ml of the water sample was passed through a 0.45 µm membrane filter and then the filter was placed on MFC agar media and incubated at 44°C for 18–24 h. After incubation, the characteristic colonies were counted as faecal coliform and further identification was carried out following standard procedures.⁶

RESULTS AND DISCUSSION

The faecal coliform counts of 120 water samples (5 ponds × 24 samples over one year) are presented in Table I. The highest count was observed in pond 2 and the lowest in pond 4. No faecal coliforms were isolated from pond No. 1 which was protected. The faecal coliform count varied from 1.63×10^4 to 6.48×10^5 cfu/100 ml in the four ponds. No significant difference of faecal coliform counts was observed in the 4 ponds. The counts remained high in the 4 ponds throughout all seasons of the year.

The results showed that all the ponds, except pond 1, were highly contaminated by faecal matter. However, the waters from these ponds are used by hundreds of people every day for various purposes, e.g. bathing, washing, cooking and occasionally for drinking. Water from ponds 2, 3 and 5 are used to moisten the raw vegetables like

TABLE I
Faecal coliform counts/100 ml in 5 ponds* in Dhaka

Months	Pond # 1 CFU/100 ml	Pond # 2 CFU/100 ml	Pond # 3 CFU/100 ml	Pond # 4 CFU/100 ml	Pond # 5 CFU/100 ml
May 1988	<1.00	1.12×10^5	6.45×10^4	1.98×10^4	1.13×10^5
June	<1.00	1.31×10^5	5.05×10^4	2.48×10^4	8.90×10^4
July	<1.00	6.70×10^4	6.45×10^4	4.45×10^4	4.30×10^4
Aug	<1.00	2.32×10^5	1.88×10^5	4.33×10^4	6.10×10^4
Sept	<1.00	1.70×10^5	3.33×10^4	3.63×10^4	2.04×10^5
Oct	<1.00	3.61×10^5	1.85×10^5	9.05×10^4	4.97×10^5
Nov	<1.00	5.50×10^4	2.38×10^4	3.05×10^4	5.55×10^4
Dec	<1.00	7.18×10^4	4.55×10^4	4.62×10^4	5.25×10^4
Jan 1989	<1.00	1.28×10^5	2.28×10^4	1.63×10^4	3.10×10^4
Feb	<1.00	6.48×10^5	6.00×10^5	4.11×10^5	3.50×10^5
Mar	<1.00	2.55×10^5	9.00×10^4	5.70×10^4	1.45×10^5
Apr	<1.00	2.85×10^5	2.00×10^4	4.55×10^4	1.68×10^5

*Pond # 1 protected from human use, in botanical garden: the rest are used heavily by humans (see Text)

cabbage, tomato, cucumber, etc. in the market, which are then eaten raw as salads. Therefore, there is a high risk of transmitting pathogenic bacteria which can cause diarrhoea. Water with 10^3 cfu/100 ml of coliforms looks clean to the naked eyes, and people may not aware of the high contamination levels of waters or the health implications. The use of such highly contaminated water to prepare food may also increase foodborne transmission of diarrhoeal illness. In Gambia, microbiological examination of weaning foods in various stages of preparation has confirmed that highly polluted water (1.7×10^2 – 1.1×10^4 *E. coli* per 100 ml) which was used to prepare the food was a major source of faecal contamination.⁷

Moe *et al.*⁸ carried out a study on bacterial indicators of risk of diarrhoeal disease from drinking water in the Philippines. They collected water from springs, open dug wells, boreholes, etc. and found that when the water supply was grossly contaminated (>1000 *E. coli* per 100 ml), the rates of diarrhoeal disease were significantly higher and it appears that in this situation water becomes a major source of exposure to faecal contamination and diarrhoea pathogens.

Gracy *et al.*⁹ carried out a study on environmental pollution and diarrhoeal disease in Jakarta, Indonesia. They collected water from Ciliwung river, wells, etc. and found a high degree of bacterial contamination of these water resources. Enteric pathogens were also isolated from the river water. The high faecal coliform counts of the four ponds also correlates with the isolation of various pathogenic bacteria from these ponds, e.g. *V. cholerae non-01*, *Aeromonas spp.* and *Plesiomonas spp.*¹⁰⁻¹² These data suggested that this background of faecal pollution of the environmental surface waters contributes to the high prevalence of gastrointestinal disease in this city.^{13,14} Similar conditions probably exist in many other cities in tropical countries. This study gives some insight into the infectious nature of the pond eco-systems from which disease can be contracted and is therefore important from a public health point of view.

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CFU/ml	Pond # 5 CFU/100 ml
1.13 × 10 ⁵	
8.90 × 10 ⁴	
4.30 × 10 ⁴	
6.10 × 10 ⁴	
2.04 × 10 ⁵	
4.97 × 10 ⁴	
5.55 × 10 ⁴	
5.25 × 10 ⁴	
3.10 × 10 ⁵	
3.50 × 10 ⁴	
1.45 × 10 ⁵	
1.68 × 10 ⁵	

humans (see Text)

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