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High Degree of Fecal Contamination in River, Lake and Pond Waters in/and around Dhaka City of Bangladesh

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Abstract: This study is designed to understand the fecal contamination of surface water bodies in and around the Dhaka city, Bangladesh. Total eleven surface water sites such as rivers (three), lakes (two) and ponds (six) were considered under study. People are using those rivers, lakes and ponds for various purposes, like bathing swimming and washing. All rivers lakes and ponds are connected to the single and or multiple drainage system(s). The range of the fecal coliform contamination of the surface water in this study varies from 9.7×10^2 to 9.8×10^5 cfu/100 mL in eleven sampling sites. In the public health point of view surface water should be in the acceptable level of contamination. Local improvements in water quality might be feasible by source controls and diversion of polluted water.

Key words: Surface water, fecal contamination, public health, rivers, ponds, lakes

INTRODUCTION

Water is life. It is essential for sustaining basic human functions, health and food production, as well as for preserving the integrity of the world's ecosystems. Access to safe drinking water is a basic right for all human beings. A child's well-being is highly dependent on both the quality and the availability of water and how well we manage this precious resource.

At the beginning of the 21st Century, ca. 18% of people of the world do not have access to safe drinking water and nearly 40% lacks adequate sanitation facilities. Only ca. 35% of the urban wastewater was treated in Asia in 2000 and 14% in Latin America. Only a negligible percentage of treatment was reported for Africa[1].

Water-borne pathogens mainly include parasites, bacteria and viruses. Drinking water sources are contaminated by human and/or animal waste and sewage. The most important source of water contamination in developing countries is human feces. Today, ca. 2.4 billion people do not have access to even a simple latrine[2]. As a result, human waste heavily pollutes many rivers and lakes in developing countries. For example, count of fecal coliforms in Asia's major rivers can be 50 times higher than that of the guidelines set by WHO[3]. Children face dangerous health risks when come into contact with such water through washing, bathing or drinking.

Diarrhoeal diseases claim the death of nearly two million children every year and have killed more children in the last 10 years than all people lost to armed conflict since World War II[4]. In 1998,>99% of these deaths (for children under 14 years of age) occurred in developing countries[5].

The coliforms are Gram-negative, rod-shaped bacteria that ferment lactose with the production of gas[6]. Coliforms include *Escherichia coli, Klebsiella* spp., *enterobacter* spp. and *citobacter* spp. of which enterotoxigenic *E. coli* (ETEC) has been found to produce toxins and cause severe cholera-like disease[7]. These ETEC has been isolated from Buriganga river in Bangladesh[8].

Fecal coliforms live in the intestinal tract of warm-blooded animals such as humans, pets, farm animals, and wildlife and are excreted in the feces. Fecal coliforms indicate the presence of water and food- borne human disease causing bacteria, such as those causing typhoid, dysentery, hepatitis A, hepatitis E and cholera. Unlike fecal coliforms, disease-causing bacteria generally do not survive long enough in the water, outside the body of animals, to be detected. This makes their direct monitoring difficult. So scientists and public health officials consider the presence of fecal coliforms an indicator of disease bacteria in the water[9].

This study is designed to report on the fecal contamination of surface water (rivers, lakes and ponds) in and around the Dhaka city, Bangladesh.

MATERIALS AND METHODS

Sampling site: The sampling sites in/and around the Dhaka are as follows (Fig. 1)

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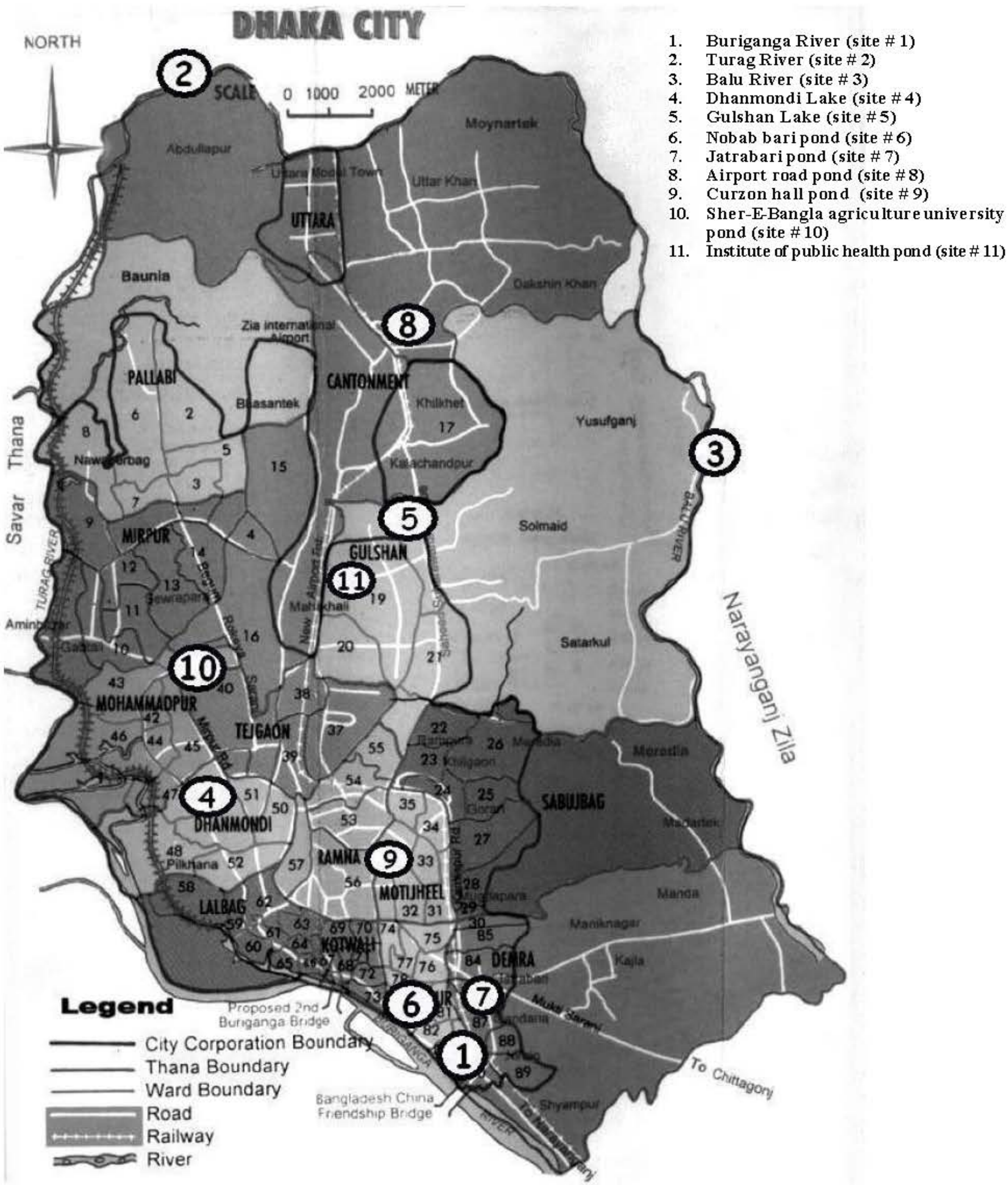

Fig. 1: Map of Dhaka city

1. Buriganga River (site # 1)
2. Turag River (site # 2)
3. Balu River (site # 3)
4. Dhanmondi Lake (site # 4)
5. Gulshan Lake (site # 5)
6. Nobab bari pond (site # 6)
7. Jatrabari pond (site # 7)
8. Airport road pond (site # 8)
9. Curzon hall pond (site # 9)
10. Sher-E-Bangla agriculture university pond (site # 10)
11. Institute of public health pond (site # 11)

Sample collection: Water samples were collected from those sites every 15 days interval between April 2004 and June 2004. Five hundred milli liter of water sample were colleted aseptically by pre-sterilized bottle and transported to the laboratory as early as possible using ice pack in insulated box.

Laboratory preparation of samples for bacteriological study: In case of highly polluted water samples ten-fold dilutions were made in Phosphate Buffer Saline (PBS), of which 0.1 mL of each dilution was spread onto duplicate plates of Medium for Fecal Coliform (MFC) agar. The plates were then incubated at 44.5°C for 24-48 h. In case of low polluted water 100 or 10 mL of water sample was passed through a 0.45 μm of sterile Millipore membrane filter and then the filter was placed on MFC agar plate and incubated at 44.5°C for 24-48 h. The characteristics blue colonies were counted as fecal colforms and further tests were carried out to identify coliform bacteria following standard procedure APHA[10].

Chemicals and culture media: All the chemicals used were of analytical grade and were obtained either from E. Merck or from Sigma chemical company. Culture media were purchased from Oxoid Limited.

RESULTS AND DISCUSSION

For the enumeration of fecal contamination, total 66 surface water samples (11 sites×2 times sampling per month×3 months) were tested. The highest count was observed in site # 1 and the lowest count was observed in site # 10. The range of the fecal coliform contamination of the surface water in this study varies from 9.7×10^2 to 9.8×10^5 cfu/100 mL in eleven sampling sites (Table 1 and 2).

The site # 1 (Buriganga river) is a very busy place. Feces also found on the bank of the river because of huge number of transient people. There are also more than thousands small industries are situated (leather, chemicals) in the bank of the river and most of them are dispose effluent directly to the river without treatment. There are various types of food market in the baseline of river (different types of vegetables and food markets). Most of the time, vendors use water from this river for vegetable washing and watering. It can be said that there is strong chance to transmit fecal organism to the community.

The site # 10 (Sher-E-Bangla agriculture university pond) is less used by the common people. This pond was almost clean. Little planktons were found in this pond. One mini drainage channel has connected to the pond. This high degree of fecal contamination of the environment is a major cause of the immense problem of gastro-intestinal infections in that city and probably in many similar cities in developing countries in the tropics[11].

Gasana *et al.*[12] carried out a study on Impact of Water Supply and Sanitation on Diarrheal Morbidity among Young Children in the Socioeconomic and Cultural Context of Rwanda (Africa). They showed that contaminated water has its impact on the health of children aged 0 to 5 years (more susceptible to diarrhea).

Table 1: Fecal coliforms counts/100 mL in rivers and lakes of Dhaka city

Month	Sampling No.	Site # 1 cfu/100 mL	Site #2 cfu/100 mL	Site #3 cfu/100 mL	Site # 4 cfu/100 mL	Site # 5 cfu/100 mL
April, 2004	1st Sampling	7.6×10^5	1.1×10^5	4.9×10^4	3.9×10^4	2.6×10^5
	2nd Sampling	9.8×10^5	9.7×10^4	6.4×10^4	4.6×10^4	3.9×10^5
May, 2004	1st Sampling	4.9×10^5	3.3×10^4	2.9×10^4	1.5×10^4	4.2×10^5
	2nd Sampling	2.5×10^5	4.8×10^4	3.8×10^4	3.1×10^4	1.9×10^5
June, 2004	1st Sampling	6.0×10^5	2.6×10^4	2.2×10^4	9.1×10^3	7.9×10^4
	2nd Sampling	7.1×10^4	5.1×10^4	4.3×10^4	1.3×10^4	9.7×10^4

Table 2: Fecal coliforms counts /100 mL in six ponds of Dhaka city

Month	Sampling number	Site # 6 cfu/100 mL	Site # 7 cfu/100 mL	Site # 8 cfu/100 mL	Site # 9 cfu/100 mL	Site # 10 cfu/100 mL	Site # 11 cfu/100 mL
April, 2004	1st Sampling	7.2×10^5	8.1×10^5	4.0×10^3	5.1×10^4	2.6×10^3	6.1×10^5
	2nd Sampling	9.7×10^5	7.5×10^5	4.9×10^3	3.9×10^4	1.1×10^3	5.5×10^5
May, 2004	1st Sampling	4.9×10^5	5.5×10^5	2.2×10^3	1.6×10^4	1.8×10^3	7.9×10^5
	2nd Sampling	8.6×10^5	6.4×10^5	3.8×10^3	2.3×10^4	4.2×10^3	8.8×10^5
June, 2004	1st Sampling	2.5×10^5	3.8×10^5	1.9×10^3	1.8×10^4	2.3×10^3	3.8×10^5
	2nd Sampling	1.7×10^5	2.1×10^5	4.6×10^3	1.2×10^4	9.7×10^2	1.1×10^5

In the point of public health concern potable water should be in the acceptable range of contamination i.e. zero fecal coliform per hundred mililitre of water. Poor group of people are living by the side of the river Buriganga. They use river water for their domestic purposes. Fisherman during fishing drinks river water. As stated earlier the highly fecal contaminated water frequently causes abdominal disorder including blood dysentery, which is alarming to the people concern. Local improvements in water quality might be feasible by source controls and diversion of the polluted water.

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