

# Assessment of Drinking Water Quality Consumed by Floating People in Dhaka City, Bangladesh

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**ABSTRACT:** Due to influx of floating people, it is becoming a challenge for Dhaka city, Bangladesh to provide safe and adequate supply of drinking water to city dwellers. Present study aims to assess few physicochemical and microbiological property parameters of drinking water collected from six different locations of the city where a substantial number of floating people resides. The study reveals that about 60% floating people choose DWASA distribution pump as their water source and 7% use public toilets as source which is unhygienic. About 90% people consume water without adopting any purification measures such as boiling, filtering etc. Turbidity, pH, CO<sub>2</sub>, alkalinity, hardness, chloride and iron content of all water samples tested meet Bangladesh Standard set by ECR' 97. Presence of alarming level of fecal and total coliform indicates existence of pathogenic organism which may induce potential health threat to the people. The study again reveals that lack of awareness among people regarding health and hygiene, improper collection and handling, usage and storage of water are the main reasons behind contamination of drinking water.

**KEYWORDS:** Floating people, Drinking water, Socio-economic condition, Physico-chemical quality, Microbiological quality.

## I. INTRODUCTION

Water is one of the most important and most precious natural resources. It is essential for all living organism from simplest plant and micro-organism to the most complex living system known as human body. Safe, wholesome and adequate drinking water is one of the basic human rights and key to sustainable development of a country as well. However, developing countries like Bangladesh have been suffering a lot due to lack of access to safe, sufficient drinking water and adequate sanitation services [1, 2]. Moreover, influx of floating people in cities now a day is a burning issue especially for urban areas in developing countries, thus making the condition more critical [3].

Floating population is a terminology used to describe a group of people migrating from rural or sub-urban areas to urban areas with a dream of better future and reside on a temporary dwelling such as road side, bus station or railway station etc for a certain period of time but are not generally considered in part of the official census count. This migration rate is very high for Dhaka city, being the capital city of Bangladesh. The problem has been condensing gradually with population explosion. Lack of opportunity in rural areas, incidence of rural unemployment due to flood, drought, river erosion and such natural calamity, seasonal labour, landlessness, debt, lack of willingness to work in rural areas trigger people to come to the cities for a better future [3]. Thus these people create an extra pressure on the city's existing resources like drinking water source and housing sector. Being unsuccessful to maintain balance among income, expenditure and high living standard compared to rural area, they are compelled to lead a very unhealthy and unhygienic life and more pointedly tend to make the city unclean and add to the steady deterioration of its environment.

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Dhaka Water Supply and Sewerage Authority (DWASA) of Bangladesh is supplying water to the Dhaka city dwellers through its distribution network after proper treatment of water drawn from the surrounded rivers and underground sources [4]. Quality of drinking water is closely associated with human health and providing safe drinking water is one of the important public health priorities [5]. The present research is conducted to analyse the socio-economic condition of floating people dwelling in Dhaka city as well as the quality of water that the floating people use for drinking purpose.

## II. SURVEY AND EXPERIMENTAL PROGRAM

### A. SURVEY AREA

The study has been undertaken with a view to identify the socio-economic condition as well as environmental condition e.g. drinking water quality, water supply and collection facilities available for the floating people in Dhaka City. To comprehend the real situation of floating people, a questionnaire survey has been carried out at six different locations (Table 1) of Dhaka city where significant number of floating people resides. Hundred families have been considered as sample from the floating population at the selected sites. Water collection point of floating people at every location has also been identified in this survey and listed as “Source of water” in the following Table-1.

Table -1: Study area and source of water of the floating people residing in the study area

Sampling Site	Location	Source of water
1	Hatirpool, Dhaka	Personal House
2	Polashi, BUET, Dhaka	BUET Hall
3	Poribagh, Dhaka.	Officers Quarter
4	Dhaka Medical College & Hospital, Dhaka.	DMC Hall
5	Farmgate , Dhaka	Public Toilet
6	Malibagh Railgate, Dhaka	Personal House

Primary data and information have been collected by the researchers in the period of October 2016 to November 2016 through structured questionnaires. The collected data has been interpreted and represented with some statistical methods. Moreover, secondary data and information have been collected from Dhaka Water Supply and Sewerage Authority (DWASA), Bangladesh Bureau of Statistics (BBS) and other published and unpublished sources.

### B. SAMPLE COLLECTION AND EXPERIMENTAL ANALYSIS

Meaningful and reliable sampling assesses the validity and reliability of analytical findings. Therefore utmost care is exercised to ensure that the analysis were representative of the actual composition of the water sample in the study. Besides the questionnaire survey, samples have been collected from three different points of each of the six locations, one from the source and the rests from the containers used by a specific family for drinking and other purposes respectively. Samples have been collected in serialized bottles and prior to filling the samples, bottles were rinsed two or three times with the water to be collected. Collected samples have been promptly (within six hours of collection) carried to the Environmental Engineering and Microbiology Laboratory to assess the physico-chemical and microbiological property parameters of drinking water.

The standard test procedures have been adopted in the study. HACH pocket pH meter and 2100 P HACH Turbidimeter have been used to evaluate pH and turbidity in the collected water samples. Standard titration methods were adopted to determine alkalinity, hardness, chloride and CO<sub>2</sub>. Iron concentration was determined following standard test procedure. To investigate the fecal and total coliform counts present in the collected water sample, membrane filter method was used in this study.

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## III. RESULTS AND DISCUSSIONS

### A. SOCIO-ECONOMIC CONDITION OF FLOATING PEOPLE

#### III.A.1 Population Census, occupation and monthly income

According to Bangladesh Bureau of Statistics (BBS, 2011) total number of floating people in Dhaka city was 73454 in 2011 with a total of 147674 in the whole country (Fig. 1). Fig. 1 also represents that number of floating population is maximum at Dhaka compared to other districts in Bangladesh. And influx of floating people in the city is increasing day by day in order to avail variety of opportunity to make a better future.

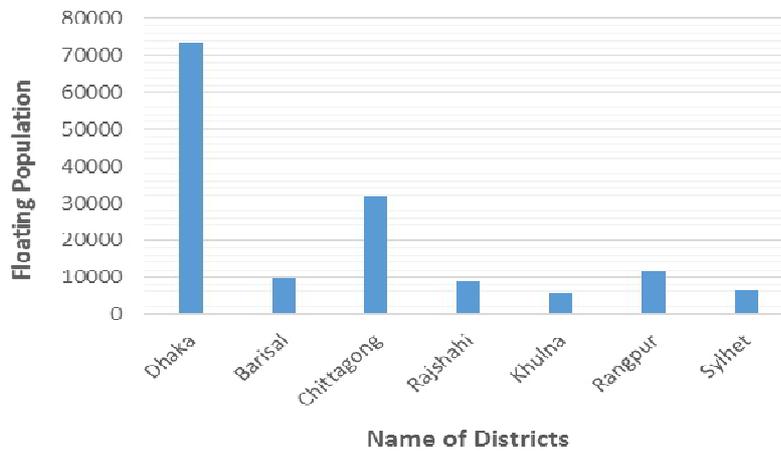


Fig. 1. Floating people in Bangladesh (BBS, 2011)

Graphical representation of questionnaire survey among 100 numbers of floating families who resides in the above mentioned locations (Table 1) in Dhaka city are shown in Fig. 2, Fig. 3 and Fig. 5.

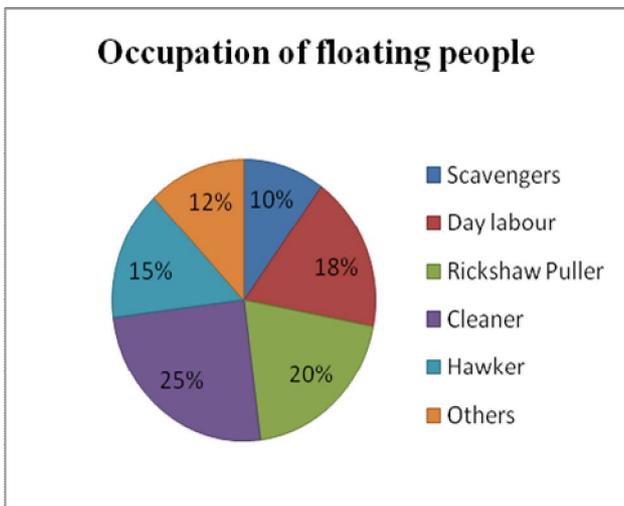


Fig. 2. Occupation of floating people

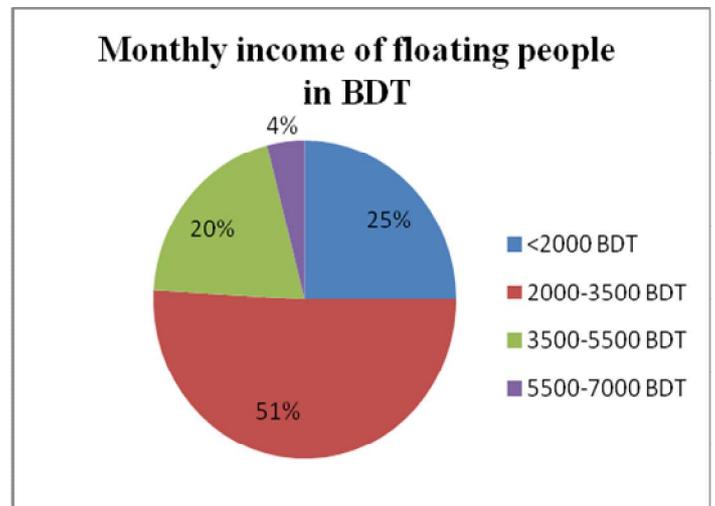


Fig. 3. Monthly income of floating people in BDT

From Fig. 2 it has been observed that most of floating people work as rickshaw puller, day labour and cleaner etc. On the other hand, Fig. 3 reveals that about 25% of these people earn less 2000 BDT in a month which is less than national

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minimum wage. More than 50% of the total floating people's monthly income is between 2000-3500 BDT which is less than national skill wise minimum wage, 20% people earn around 3000-5500 BDT, and monthly income of a very small number (4%) of people's is about 5500-7000 BDT. Such people can't afford to rent their residences and collect other daily necessities due to extremely less amount of income. This people who live under abject poverty become satisfied when can manage their daily food. Some photographs are added in Fig. 4 to visualize the dwelling condition, house hold environment, cooking and drinking water storage of a particular family residing on road side.

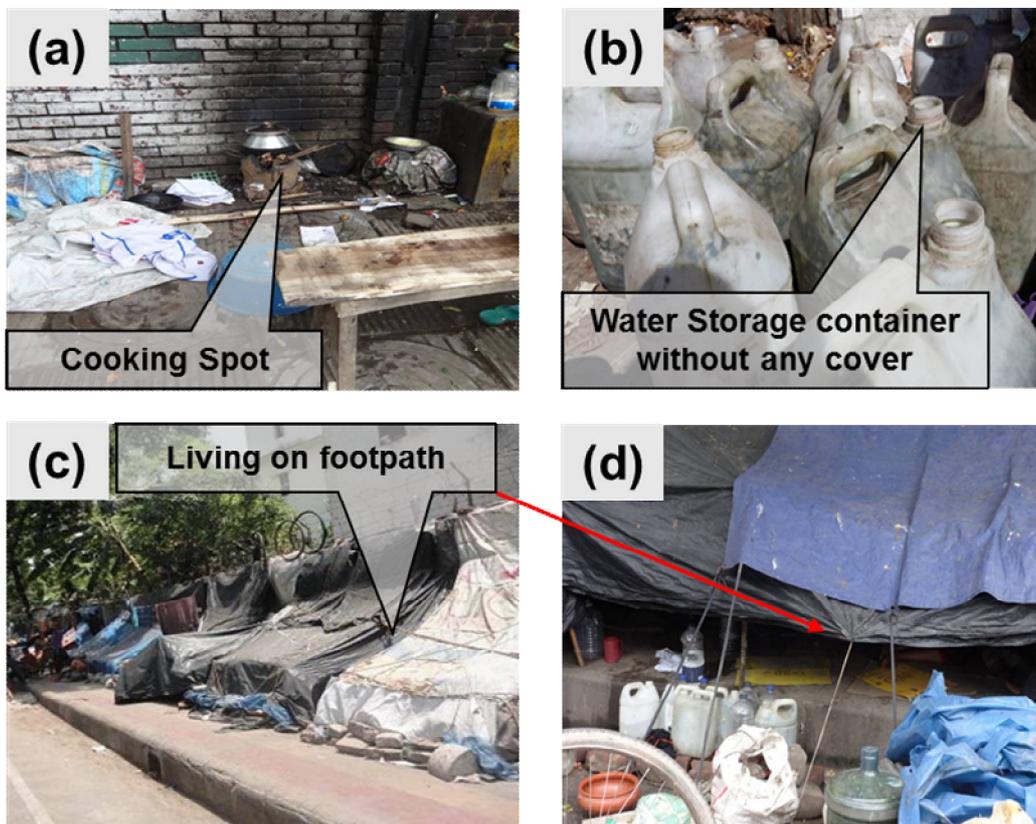


Fig. 4. Photographs showing the environment of households of floating people: (a) Cooking on a dirty place (b) Water storage container without any cover (c) & (d) Living on footpath making a tent by polythene.

Fig. 4(c & d) shows picture of some families of floating population living on footpath. They usually make their residences by making tent using polythene. Fig. 4(a) shows cooking spot of a family residing on a dirty and abandoned place. During questionnaire survey it has been often noticed that such people do not use any cover (Fig. 4 (b)) on their water storage container and do not clean it when they refill the container. So, there remains a significant chance of contamination of water.

### III.A.2 Water source, collection and water usage pattern

Floating people often choose their source of water collection closer to their residing places. Fig. 5 points out that majority of the people (about 60%) choose WASA distribution pump house as the source of collection of water. On the other hand about 26% of them collect water from nearby mosques. About 7% of them collect water from the public toilet which is unhygienic, unhealthy and a matter of concern too.

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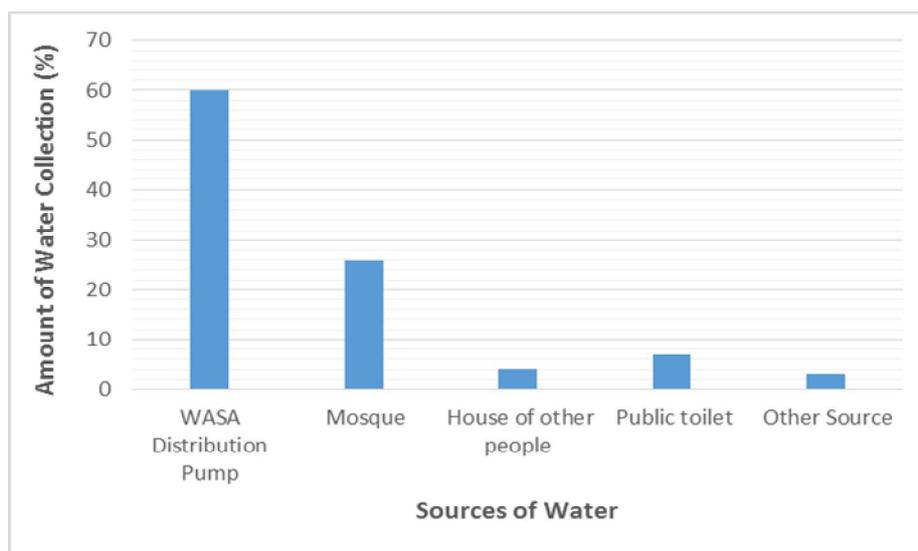


Fig. 5. Sources of water collection of floating people

From questionnaire survey it has been observed that about 80% of floating people have been using the collected water for drinking and cooking purposes and 20% of them have been using it for drinking as well as washing utensils and cleaning households. Also during survey it has been recorded that 90% of the people have a belief that their collected water is absolutely suitable for drinking and they do not adopt any water purification measure such as boiling, filtering etc.

### B. WATER QUALITY ASSESSMENT

To assess the different water quality parameters three different water samples have been collected from each location. In each place floating people collect water from nearby available drinking water source. In this study water sampling has been done at the water collection point of floating people and this has been defined as “source” water in the following discussions. Other than this, such community use two types of container for water reserving purposes, one (Storage 1) of which is used for drinking and cooking purposes and the other container (Storage 2) is used for cleaning, washing and other domestic purposes. Duplicate sampling has been undertaken at each point of study area and average value of each parameter are presented in the following discussions. The measured values of selected physicochemical parameters namely pH, turbidity, CO<sub>2</sub>, alkalinity, chloride, hardness, iron, fecal and total coliform counts of water have been summarised in Fig. 6 and Fig. 7.

#### III.B.1 Physicochemical quality of collected water

It has been observed from Fig. 6 that pH of source water consumed by floating people were in between the drinking water standard, 6.5 to 8.5 provided by Bangladesh Environment Conservation Rules (ECR 1997) [7]. Also, water samples collected from the storage container 1 (water used for drinking and cooking purpose) and storage container 2 (water used for cleaning, washing and other purposes) of floating people had standard pH values. On the other hand, though hard water is suitable for human consumption, some unsatisfactory phenomena limits the usage of hard water for domestic and industrial purposes. Limitations are that hard water creates adverse action with soap and imparts scaling in boilers while heating. Standard of hardness for drinking water in Bangladesh is between 200 to 500 mg/l as CaCO<sub>3</sub>. All the collected water samples including source water and storage container water had hardness values in between the standard level.

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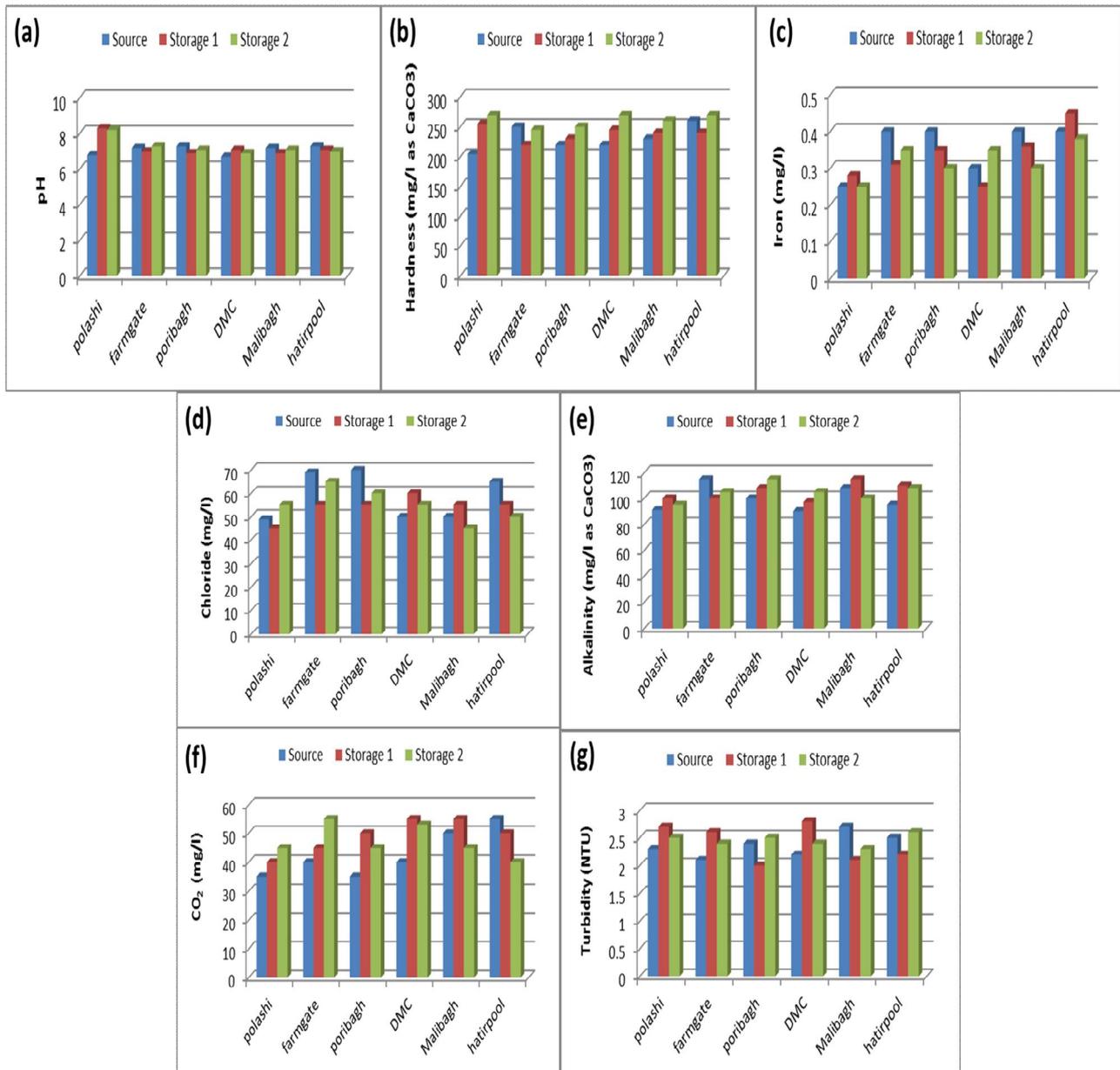


Fig. 6. Physicochemical parameters of collected water samples: (a) pH, (b) Hardness, (c) Iron, (d) Chloride, (e) Alkalinity, (f) CO<sub>2</sub> and (g) Turbidity.

Iron of reasonable concentration in water does not have harmful effect on consumers. But, it creates offensive stains in plumbing fixtures and laundry operations, and support growth of iron bacteria in distribution systems. Drinking water standard for iron is 0.3-1.0 mg/l (ECR'97) in Bangladesh. Fig. 6 illustrates that, except the water samples collected from Polashi, all collected samples have iron concentration in between the standard range. Chloride at a concentration above 250 mg/l conveys salty taste to water and becomes objectionable to the consumer not accustomed

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to this elevated level of chloride. Although reasonable concentration of chloride in water is not harmful to people, drinking water standard of chloride is in the range of 150 to 600mg/l and it is again relaxed to 1000mg/l for coastal people in Bangladesh [7]. However, Fig. 6 points out that chloride concentrations of all collected water samples were low and below the standard range.

In spite of having little public health significance of alkalinity in water, higher concentration of alkalinity in water is usually unpalatable. There was very little fluctuation of the values of alkalinity (90-115mg/l) in the water samples collected in this study from different locations. ECR 1997 has not prescribed any standard of alkalinity for drinking water in Bangladesh. Again, concentrations of Carbon-di-oxide in both the source water and storage container of the floating people were in the range of 35-55 mg/l. Similar to alkalinity, ECR' 97 has not set any standard of Carbon-di-oxide for drinking water. Turbidity level of all water samples were satisfactory (2-3 NTU) and were below 10 NTU, the standard level given by ECR.

### III.B.2 Microbiological quality of collected water

Fig. 7 points out the presence of coliform bacteria in some water samples whereas the drinking water standard of fecal and total coliform is zero in Bangladesh (ECR 1997). Source water at most of the sampling locations did not contain coliform bacteria. However, most of the water samples collected from the storage containers of floating people contain coliform bacteria except Poribagh and Malibagh area. One of the reasons behind this is that often floating people do not use any cover to their water storage container (Fig. 4). They also do not have proper knowledge of sanitation and hygienic condition. Moreover, due to their degraded living condition, sometimes these people can't able to live a healthy life. Presence of total and fecal coliform has been noticed in the Farmgate and DMC (Dhaka Medical College) area. Though, presence of coliform is reasonable in the Farmgate area as people collect water from public toilet, presence of total and fecal coliform counts at the DMC water is very alarming and indicates microbial contamination of water supply system in this zone.

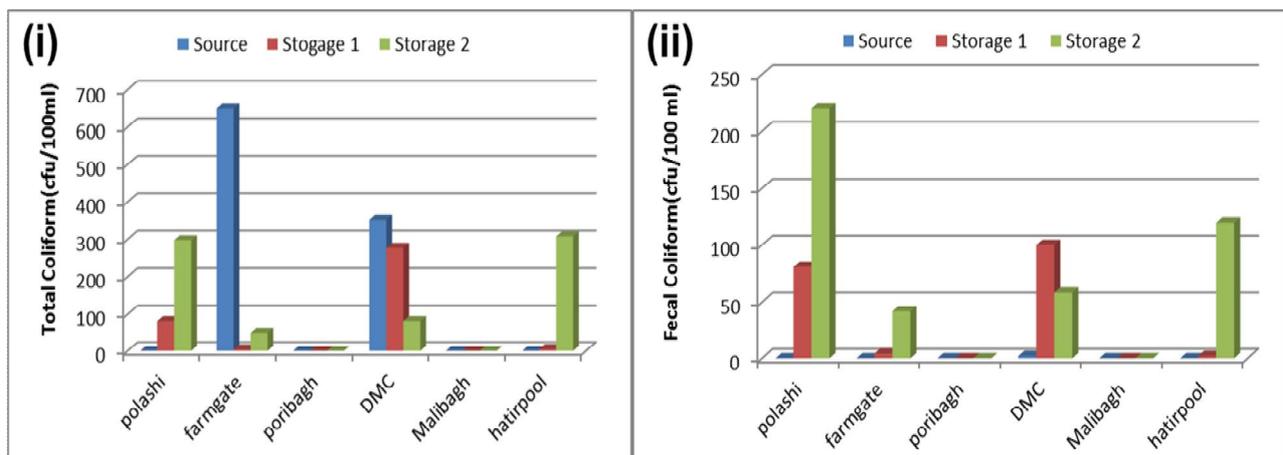


Fig. 7. Microbiological parameters of collected water samples: (i) Total Coliform, (ii) Fecal Coliform

## IV. CONCLUSIONS

Continuous influx of floating people in Dhaka city has been creating extra pressure on the city's existing water supply, sanitation and dwelling system. As life expenditure cost in Dhaka city is much higher compared to the rural and suburban areas, these people have been compelled to lead a very unhygienic and unhealthy life maintaining a very low standard of living. Thus creating nuisance and adding to the steady deterioration of the environment as well as flora and fauna of the city.

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Assessment of the physico-chemical and microbiological property parameters of drinking water collected from the source and storage of few floating dwellers in Dhaka City reveals that pH, turbidity, CO<sub>2</sub>, alkalinity, hardness, chloride and iron content of the sample meet the Bangladesh standard set by ECR'97 as well WHO guideline values [6,7]. But the microbiological quality of the sample varies at different locations. Presence of fecal and total coliform indicates existence of pathogenic organism which may induce potential threats to the health of floating population. More over it has been observed that in most cases people are not aware of the health and hygiene practice, proper sanitation system and cleanliness measures. As a result pure water collected from source becomes contaminated because of improper handling, malpractice adopted during usage and storage. Government as well as non government organization should work together to understand and analyse the urgency of this critical situation and incorporate some pragmatic solutions such as creating health and hygiene related awareness programs, developing pilot project of relocating floating population to somewhere else ensuring them a better life, supply pure drinking water to the floating dwellers at a minimal cost and finally decentralize urbanization to create more job opportunities in the rural and suburban areas so that people are not encouraged to migrate into the cities.

## V. ACKNOWLEDGMENT

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