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A Comparative Study of Water Supply and Sanitation Practices in Residential and Slum Areas of Mymensingh City, Bangladesh

Sakibul Islam Farhan[1*], and Md. Alim Miah[2]**

[1, 2]Dept. of Environmental Science and Engineering, Jatiya Kabi Kazi Nazrul Islam University, Trishal, Mymensing-2224, Bangladesh

** Corresponding author, E-mail address:sakibulislam1999@gmail.com*

***Corresponding author, E-mail address: alimbau31@gmail.com*

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Abstract: Safe water and sanitation are fundamental for health, preventing disease, child development, and economic prosperity. The objectives of this study were to assess the current states of water supply and sanitation and compare the states of water supply and sanitation between slums and developed residential areas in Mymensingh City. Water samples were collected from selected developed residential areas and slums. A cross-sectional survey approach was used to gather information on water supply, sanitation, and hygiene-related variables. In residential areas, many households rely on submersible pumps (45.8%) and deep tube wells (12.5%) for drinking water. In contrast, in slum areas, most households rely on city corporation supply pipe water (22.5%), which is not safe for drinking because significant amounts of coliform bacteria were found in these water samples. A correlation matrix showed strong positive correlations between EC and TDS (0.9991) and salinity (0.9911), but also negative correlations between EC and resistivity (-0.9737) and ORP (-0.9336) and a weak negative correlation between temperature and DO. In developed areas, 50.4% have toilets, whereas in slums, 49.5% rely on shared or community facilities. Flush toilets (35.8%) and septic tanks (11.67%) are more common in developed residential areas, while pit latrines (34.16%) and pour-flush latrines (18.33%) are more common in slum areas. The survey also shows that slums in Mymensingh City lack proper sanitation compared to developed areas. To improve the current state of the area, Mymensingh City Corporation has to warn the population about safe and hygienic sources of water and sanitation.

1. Introduction

Clean water and adequate sanitation are critical to human health and well-being. Access to these essential services can help prevent disease transmission, promote child development, and increase economic productivity (WHO, 2023). Still, millions of people around the world do not have access to these basic services, especially in low- and middle-income countries (LMICs) (UNICEF, 2022). One of the most significant components of basic health care is the provision of safe water and hygiene-conscious sanitation that safeguard everyone's health (Rana, 2009; Khalifa and Bidaisee, 2018); Desye *et al.*, 2021; Alaqarbeh *et al.*, 2022; Sravanthi *et al.*, 2023). Bangladesh is one LMIC

where there are significant issues with sanitation and water supply. Only 69% of Bangladeshis have access to better drinking water, and 58% have access to better sanitation facilities, according to the World Health Organization (WHO, 2023). The situation is especially bad in metropolitan areas, where services and infrastructure are already under stress due to population increase and rapid development (World Bank, 2020). Only 60.7% of households had basic sanitation, and only 56.3% had the right facilities for hygiene (Ahmed *et al.* (2021).

Mymensingh is Bangladesh's fourth-largest city, with a population of more than 1.2 million. The city's infrastructure for sanitation and water supply has not kept up with the city's recent rapid growth in population. The water supply system in Mymensingh is an intricate network of both public and private suppliers. Approximately 30% of the city's population receives water from the Mymensingh Water Supply and Sewerage Authority, a public water company. 70% of the population that is left depends on private services like rainwater harvesting systems and shallow and deep tube wells (Hossain *et al.* (2021).

The water supply system in Mymensingh is plagued by several challenges, including inadequate infrastructure, poor maintenance, and limited financial resources. As a result, the water supply is often unreliable and of poor quality (Hossain *et al.* (2021). The poor, particularly slum residents, suffer from a lack of essential infrastructure services, specifically inadequate and unsanitary sanitation. In most slum areas, a few pit latrines must be shared by a large number of families. Approximately one-third of slum households used katacha toilets or open holes. Inadequate sanitation is exacerbated by regular flooding, leading in highly unsanitary situations in which human excreta frequently enter drainage canals and water bodies (Mymensingh Pourashava, 2013). The water supply and sanitation status in Mymensingh is a big issue. The city's increasing population is putting a strain on its current infrastructure and services. Climate change is putting growing pressure on the city's water resources.

A comprehensive assessment of Mymensingh's water supply and sanitation situation is required to identify key areas of concern and recommend improvement. This assessment should include a review of the existing water quality and supply, sanitation infrastructure, as well as a survey of the community to understand their needs and concerns.

The objectives of the study are-

- to assess the current states of water supply and sanitation in slum areas and residential areas in Mymensingh City,
- to identify the challenges and opportunities for improving water supply and sanitation services and
- to develop recommendations for improving water supply and sanitation services in the city.

2. Methodology

2.1 Study Area

Mymensingh is a city in central Bangladesh, approximately 120 kilometers north of Dhaka's capital. Mymensingh city has approximately 91.315 square kilometers (35.257 square miles). Mymensingh is located at latitudes 24°02'03" and 25°25'56" north and longitudes 89°39'00" and 91°15'35" east. It serves as the administrative center for both Mymensingh District and Mymensingh Division. Mymensingh City Corporation is the country's seventh-largest city by area and eighth largest by population, with a population of 5,76,927 people. (Wikipedia, 2023).

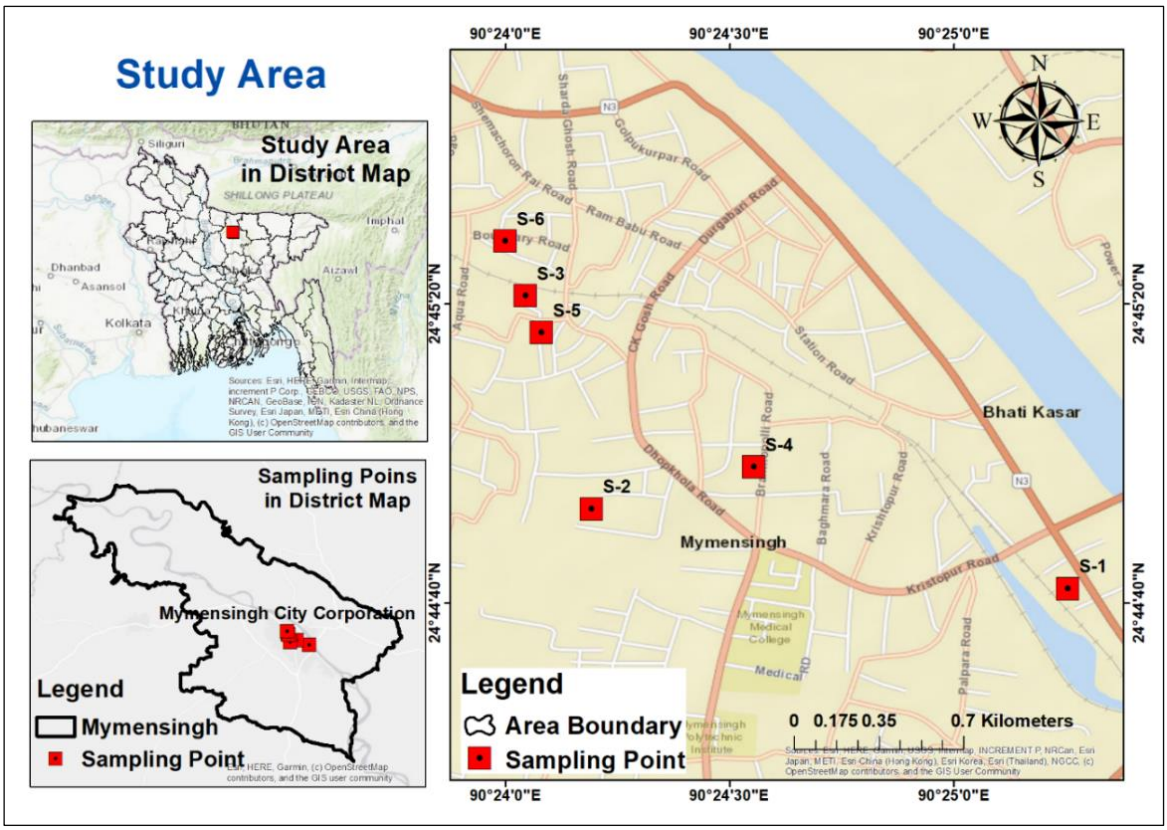

Figure 1. Map of the study area (Mymensingh City Corporation).

2.2 Data Collection

There are 33 wards in Mymensingh City Corporation. Apart from those wards, data was collected from selected areas in Mymensingh city which are residential areas in Mymensingh city and three well-known slums, such as Duldul Camp, Bashbari Colony, and Horizon Sweeper Colony. We collected six water samples and survey data from 120 families from different areas of Mymensingh City Corporation. Among 120 families, 60 are urban developed area people and the rest of the 60 dates were collected from 3 slums in Mymensingh city. Some instruments are used for water sample collection and analysis.

In this study both primary and secondary data sources have been used for data collection. Water samples were collected for selected study area. Primary data were collected through field visit and door to door survey in the slum area. For developed residential area, a google form was created for data collection containing some questions. Questionnaire link address was sent to different wards respondents by emailing. The questionnaire has five specific sections:

- General questions
- Questions about water supply
- Questions about sanitation and drainage
- Questions about solid and liquid waste management
- Questions about health, hygiene and environmental conditions

Statistical reports, articles, published materials, officials' records and literature reviews are also used for getting secondary information. Internet materials are also widely used in this study.

2.3 Data processing, Analysis and Interpretation

Physicochemical parameters such as temperature, EC, absolute EC, TDS, pH, DO, salinity, ORP and resistivity for slum and developed residential area were considered for water quality assessment. These parameters were tested by multimeter. Biological parameters such as total and fecal coliform were considered. Total and fecal coliform was tested by Membrane Filtration Method. The collected data was entered into a computer database and analyzed using statistical software like Microsoft Excel, SPSS etc. GIS software like Google Map pro and ArcGIS version 8 was used for data processing and map.

2.4 Flow Diagram of Methodology

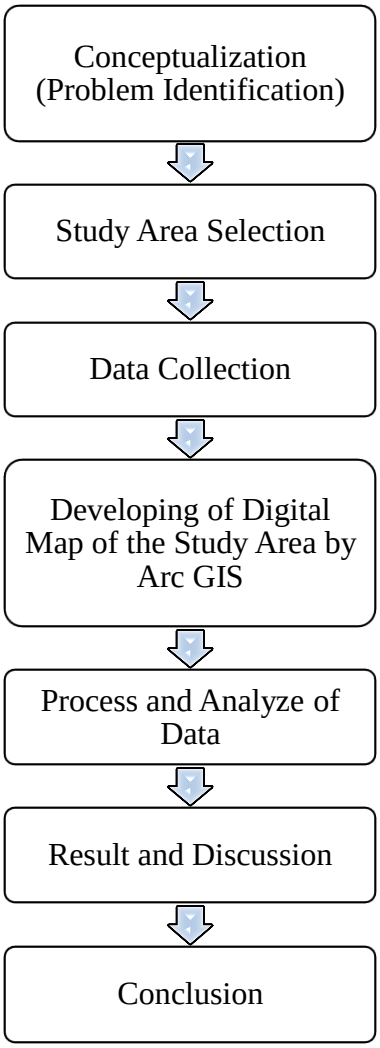

Figure 2. Flow diagram of the methodology.

3. Results and Discussion

3.1 Respondent's Information

A questionnaire survey was conducted in Mymensingh City Corporation. The survey covered 120 households. The questions were selected in such a way that information of housing, financial situation and education etc. could be derived. Among the respondents 43.2% were male and 56.8% were female

indicating that the female was more responsive to participate in the survey. Male were not at home because of their working purposes in slum and residential area, when survey was conducted.

Among the respondents, a maximum of 60.5% of the total population were in 15 to 30 years of age. About 27% of the population were in 30 to 40 years of age and 10.9% were between 41 to 50 years. Other 5.9% of populations were above 50 years. It indicates that most of the data during the survey is collected from the 15–30-year age group (**Figure 3-a**).

It was observed that among the respondents, maximum (65.8%) families include 4-6 persons in that area. About 20% of families include 1-3 persons and 14.2% of families include more than six persons (**Figure 3-b**).

Educational status was grouped as illiterate, only signature, primary, secondary, higher secondary and graduate. The chart shows that the educational status in Developed Residential Area is significantly higher than in Duldul Camp, Bashbari Colony, and Horizon Sweeper Colony. The majority of households have residents who have completed secondary education (36%) or college or university education (30.8%) (**Figure 3-c**). This could be due to a number of factors, such as the availability of schools, the income levels of residents, family status or the cultural values of the community.

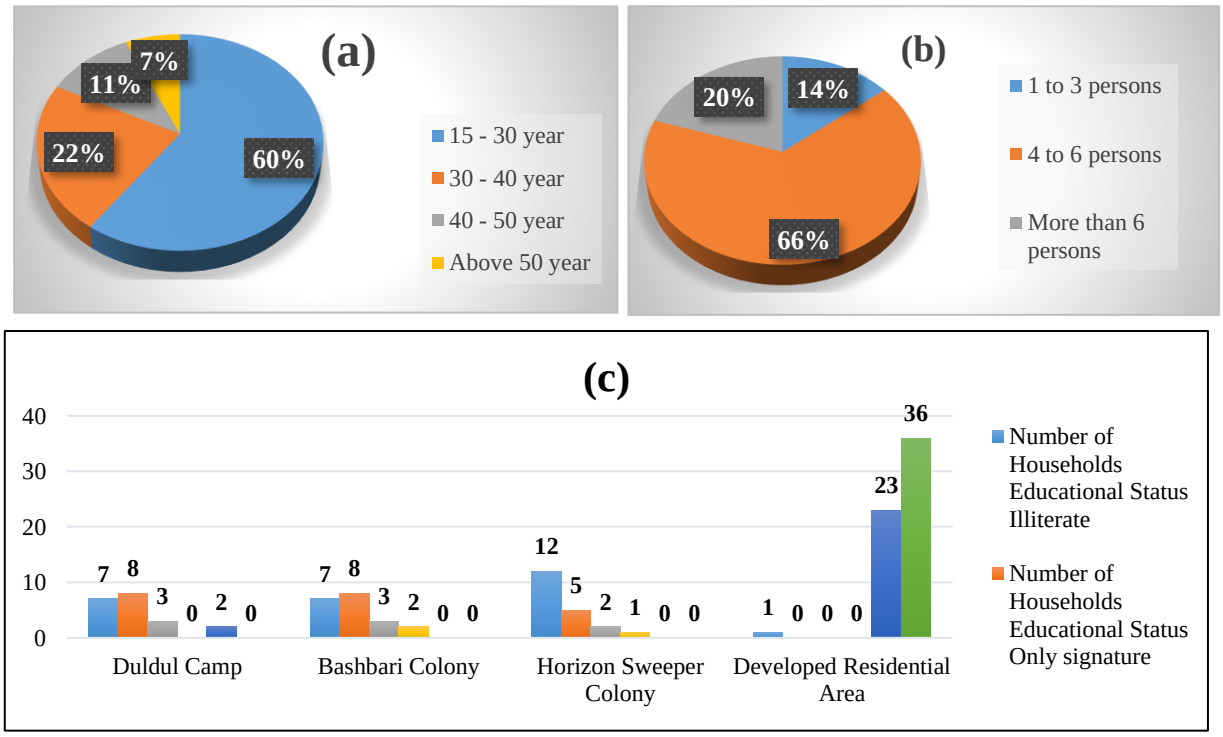

Figure 3. (a) Age Distribution, (b) Family Size, (c) Educational Status of respondents.

3.2 Water Quality Assessment

3.2.1 pH

pH values of all the samples at different locations of the area were in the permissible range of 6.5 to 8.5 according to WHO guideline values and standard values prescribed in Bangladesh ECR,2023. Although from the graph it is shown that the trend of pH value is slightly increasing but if we consider the mean value than it seems to be constant (**Figure 4-a**).

3.2.2 Total Dissolved Solid (TDS)

The standard value of TDS is 1000 mg/L for the drinking water of Bangladesh (ECR, 2023). All the samples (100%) remained within permissible limits (**Figure 4-c**). Water can be categorized as excellent (<300 mg/l), good (300 - 600 mg/l), fair (601 - 900 mg/l), poor (900 - 1200 mg/l), and unacceptable (>1200 mg/l) based on TDS level (Rahman *et al.* (2015); Khan & Farha, 2022). In this study, all the samples were in the range of <300 mg/l means that based on the TDS level the quality of water is in excellent condition.

3.2.3 Dissolved Oxygen (DO)

According to the standard range of 6 - 8 mg/L for drinking water, the DO levels in most samples (S-1, S-2, S-4, and S-6) are considered 'Within Standard'. The samples from Horizon Sweeper Colony (S-3) and Nowmohal (S-5) show DO levels 'Below Standard' (**Figure 4-b**). This suggests potential organic pollution or stagnant water conditions in these areas, which can harm aquatic life and render the water unsuitable for drinking without proper treatment.

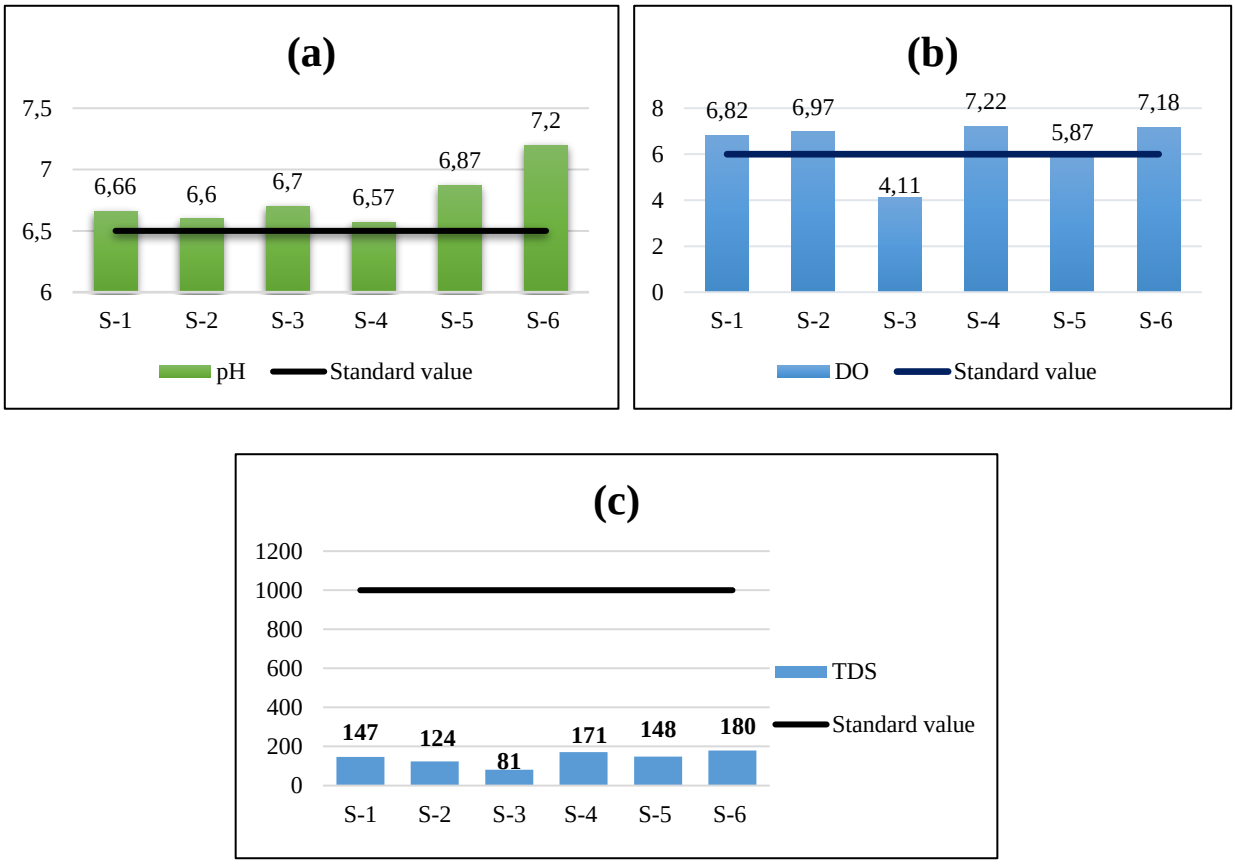

Figure 4. (a) pH value, (b) DO value (mg/l), (c) TDS value (mg/l)

3.2.4 Fecal Coliform

The World Health Organization (WHO) and most regulatory agencies set 0 CFU/100ml as the maximum allowable limit for fecal coliform in drinking water (**Figure 5-a**). This means ideally, there should be no fecal coliform bacteria present in drinking water. Five out of the six samples exceeded the WHO standard for fecal coliform in drinking water. This suggests that the water in these locations is likely contaminated and poses a health risk.

3.2.5 Total Coliform

The standard for total coliform in drinking water is 0 CFU (colony forming units) per 100 milliliters. All samples exceeded this standard. The highest level of contamination was found in S-2 (Bashbari Colony) with 400 CFU/100ml, exceeding the standard by 400 CFU/100ml (**Figure 5-b**). These results suggest that the water in these locations is not safe for drinking without proper treatment. Further investigation is needed to identify the source of contamination and implement appropriate treatment measures to ensure safe drinking water for the communities.

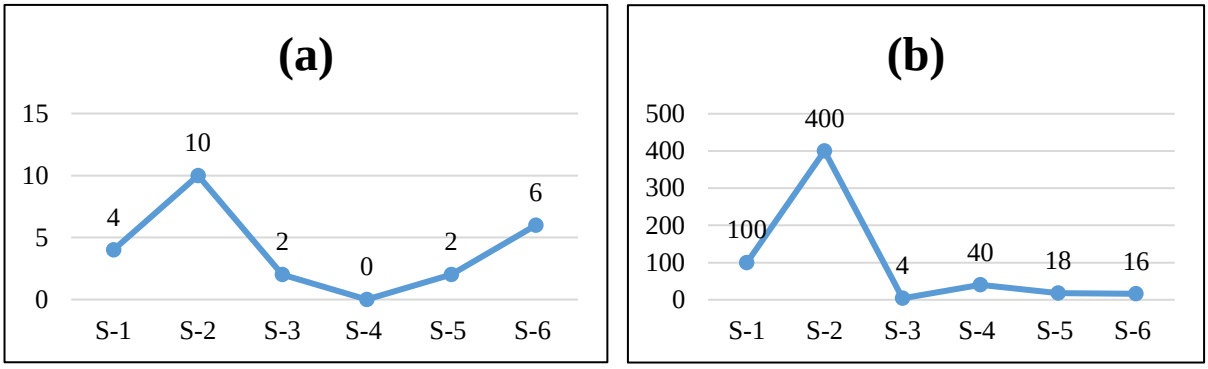

Figure 5. (a) Fecal Coliform (CFU/100ml), (b) Total Coliform (CFU/100ml).

3.3 Correlation Coefficients among the Water Quality Parameters

Table 1. Correlation Coefficients_R-Matrix.

	pH	ORP	EC	Resistivity	TDS	Salinity	Temperature	DO	Fecal Coliform	Total Coliform
pH	1.000									
ORP	-0.934	1.000								
EC	0.394	-0.399	1.000							
Resistivity	-0.320	0.318	-0.974	1.000						
TDS	0.423	-0.429	0.999	-0.976	1.000					
Salinity	0.460	-0.429	0.991	-0.971	0.992	1.000				
Temperature	-0.095	-0.043	-0.708	0.645	-0.685	-0.732	1.000			
DO	0.094	-0.190	0.843	-0.904	0.841	0.827	-0.553	1.000		
Fecal Coliform	0.137	-0.236	-0.081	-0.063	-0.059	-0.035	0.296	0.340	1.000	
Total Coliform	-0.424	0.349	-0.185	-0.007	-0.182	-0.168	0.196	0.346	0.816	1.000

Interpretation and Discussion:

- **ORP and pH:** There is a very strong negative correlation (-0.934) between ORP and pH. This means that ORP and pH tend to move in opposite directions. For instance, high ORP values tend to be associated with low pH values, and vice versa.
- **EC and Resistivity:** There is a strong negative correlation (-0.974) between EC and Resistivity. Similar to ORP and EC, this means that EC and Resistivity tend to move in

opposite directions. High EC values tend to be associated with low resistivity values, and vice versa.

- **TDS and Salinity:** There is a very strong positive correlation (0.992) between TDS and Salinity. These terms likely measure very similar things.
- **Temperature and DO:** There is a weak negative correlation (-0.553) between temperature and DO. This means that there may be a slight tendency for temperature and DO to move in opposite directions.
- **DO and Fecal Coliform:** There is a weak positive correlation (0.340) between DO and Fecal Coliform. However, the correlation is so weak that it may not be statistically significant.
- **EC and TDS:** There is a strong positive correlation between EC (electrical conductivity) and TDS (total dissolved solids). This means that these two measurements tend to increase and decrease together. This makes sense because EC is a measure of the ability of water to conduct an electric current, and TDS is a measure of the total amount of dissolved material in the water. Since most dissolved materials in water conduct electricity, these two measurements are likely to be closely related.

3.3 Water Supply Situation

3.3.1 Water Sources

The sources of water were grouped into Submergible pump, Deep tube-well, City corporation supply pipe water, Public/shared/neighbor's tap. The most common water source in all four areas is the submergible pump. The majority of households in Duldul Camp rely on public/shared/neighbor's tap for their water source. In Bashbari Colony, the majority of households rely on deep tube-wells, while in Developed Residential Area, the majority of households rely on submergible pump water (**Figure 6**). The chart shows that the Developed Residential Area has a higher standard of living than the other three areas. This is reflected in the fact that the Developed Residential Area has a more reliable water source.

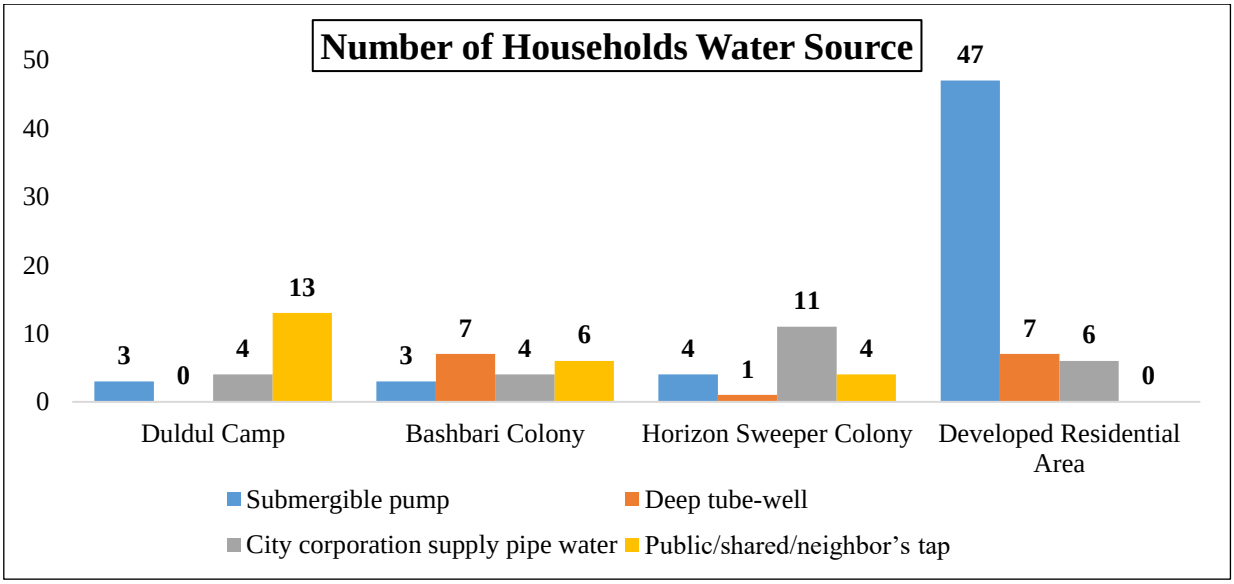

Figure 6. Graphical representation households water source.

3.3.2 Duration of Government Water Supply

The Durations of Government Water Supply were grouped into not connected to government water supply, < 4h per day and 5-12 h per day. The highest number of households not connected to the government water supply is in Developed Residential Area (**Figure 7**) which indicate that the majority of households rely on submergible pump water for their day to day use.

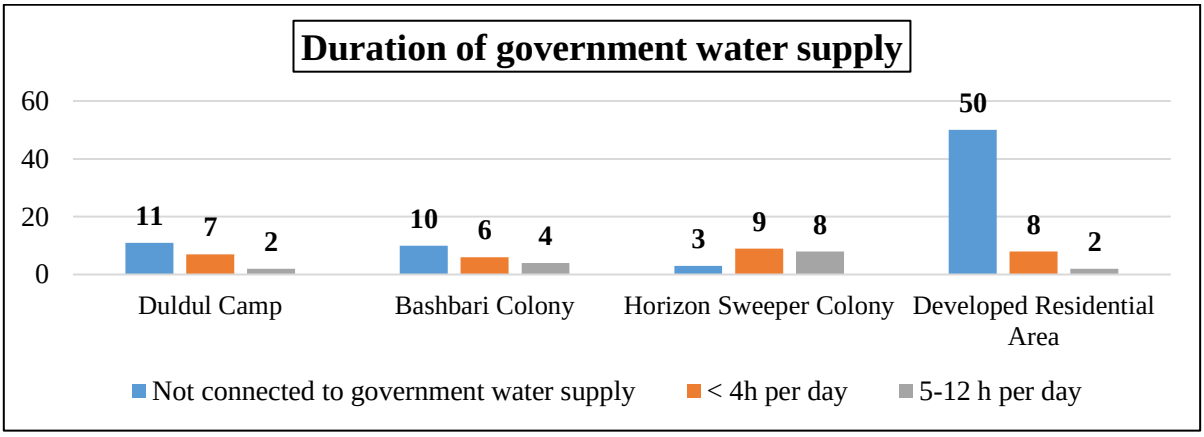

Figure 7. Graphical representation of duration of government water supply.

3.3.3 Water Storage Situation

Among 120 households in different locations of MCC, 61.8% have elevated water storage tanks, 8.2% have ground-level tanks, and 30% have no tank for water storage. Elevated tanks are the most common type of water storage. The developed Residential Area has the most households with any type of tank, while Bashbari Colony and Horizon Sweeper Colony have the most households with no tanks. Elevated tanks are most common in the Developed Residential Area, followed by Horizon Sweeper Colony. Most households in Bashbari Colony and Duldul Camp don't have any tanks (**Figure 8**). About 63.1% of the respondents said their water tank is made out of plastic, 6.3% said concrete, and 30.6% said they don't have a water tank.

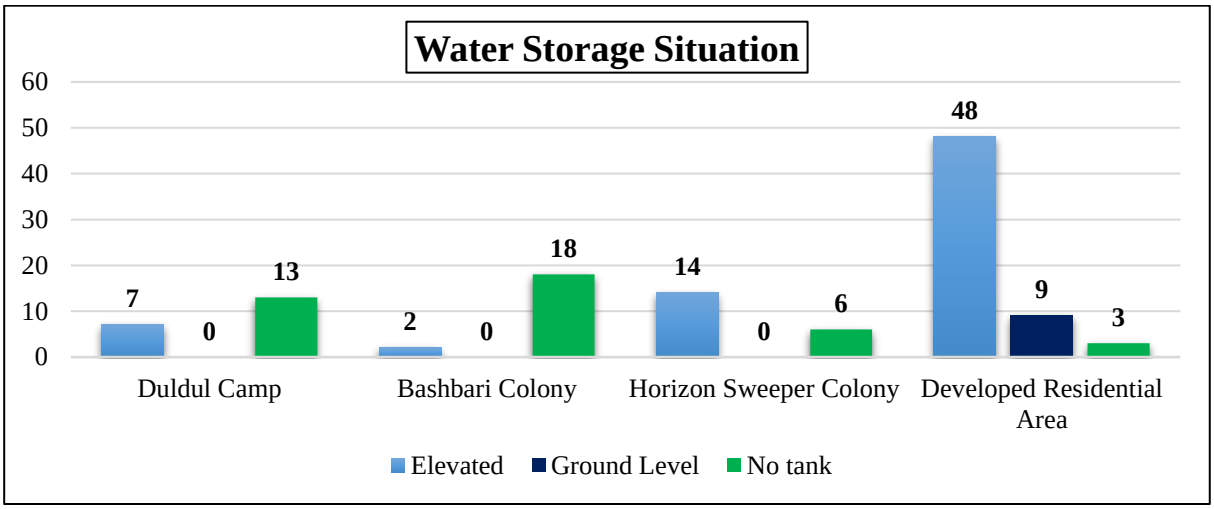

Figure 8. Graphical representation of water storage situation.

Out of 120 responses, nearly half (44%) of the respondents said they didn't know how often their tank gets cleaned, 20% cleaned their tanks every three months or less, 8% reported cleaning their tanks every 1-5 years, 24% said they clean their tanks every 3-12 months. A relatively small proportion

(4%) said they clean their tanks only every five years or more (**Figure 9-a**). The survey shows a gap in awareness about water tank cleaning. Regular cleaning is crucial to prevent bacteria growth in stagnant water and sediment buildup. Water tank should clean annually, more often if needed. This will help ensure safe drinking water for MCC.

The distribution of people who collect drinking water in a household among four categories: male, female, servant and both male and female. In the survey, 45% of the respondents said that females in the household collect drinking water. Whereas 46% said that both male and female collect drinking water, 5% said that males collect drinking water and only 4% said that servant collect drinking water in the household (**Figure 9-b**). The survey results suggest that in MCC households, females are most likely to be responsible for collecting drinking water. The contribution of males was very negligible. This may be possible, because in Bangladesh, the male works outside of home but females were mostly staying at home as housewives.

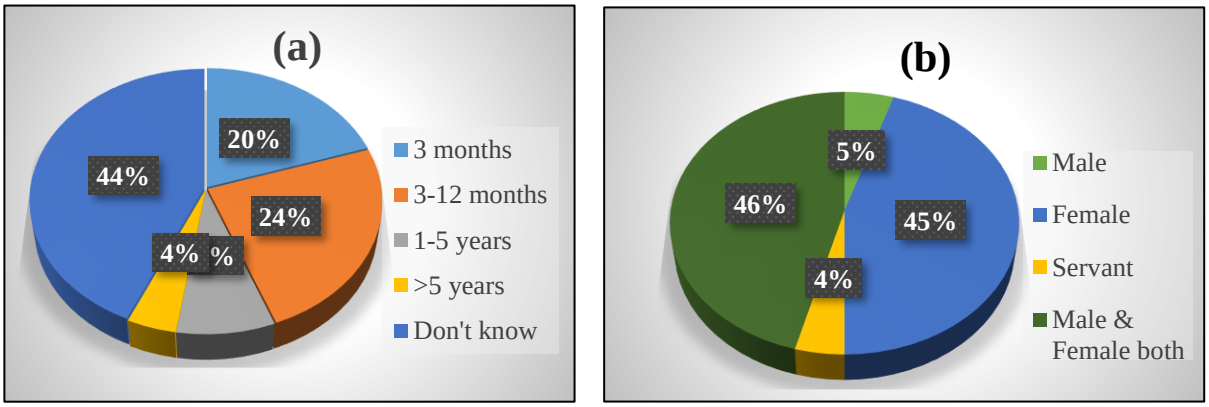

Figure 9. (a) Frequency of tank cleaning, (b) Person involved in collecting drinking water.

3.4 Sanitation Situation

3.4.1 Types of Toilet

A sanitary latrine is a must in the issue of sanitation. Without a sanitary latrine, the concept of sanitation cannot be fulfilled. Out of 120 responses, 50.4% indicated having their own toilet, 27.7% said they use a shared toilet, and 21.8% said they use a community toilet. In developed residential area, most of the households have their own toilets. But in slums, most of the households use shared toilets or use community toilets that were constructed by MCC. It has also been found that many households in slum areas cannot construct sanitary latrines for financial inability and also due to not having enough land to construct latrines.

The types of toilets were grouped into flush toilet, pit latrine, pour-flush latrine and septic tank. Flush toilets are the most common type of toilet in all four locations. Flush toilets are more common in developed residential areas, while pit latrines and pour-flush latrines are more common in less developed areas. This suggests that there may be a correlation between socioeconomic development and the type of toilet used. Septic tanks are only used in Developed Residential Area (**Figure 10**). From the study, it was found that most of the sanitary latrines in the study area were not 100% safe for hygiene in slum areas compared to the developed residential area. In slum areas, the technology is usually a single pit latrine. Despite the positive national coverage findings, communities lack the resources to provide a consistent, trustworthy, and fairly priced maintenance program, such as a mechanism for consistently emptying pits (Ali and Stevens, 2009).

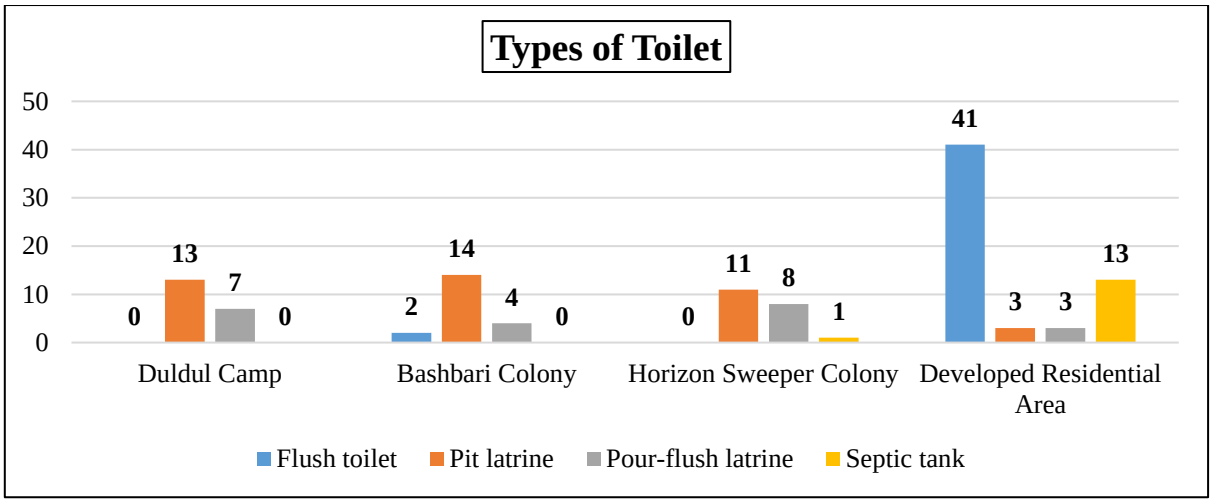

Figure 10. Graphical representation of types of toilet.

Out of the 120 respondents, 74.8% have water facilities in their toilets, while 25.2% have no water facilities in toilets. This finding implies that a significant portion of the populace lacks access to water for their toilets. Several factors, including poverty, a lack of infrastructure, could be responsible for this. In developed residential areas, most of the households have water facilities in their toilet. But in slum areas, a number of populations don't have water facilities in their toilets.

3.4.2 Frequency of Cleaning up Toilet

Almost 36% households cleaned their latrines within 1 to 4 days, 28% cleaned within 5 to 10 days, 12% cleaned within 10 to 20 days and 24% cleaned within >20 days (**Figure 11-a**). Results also showed that in slum areas most of the households used only water for cleaning their latrines. In developed residential area, most of the households used washing liquid (Harpic, etc.), washing powder (Vim, etc.). Cleaning sanitary toilets is an important part of sanitation. The overall sanitation scenario mostly depends on this part.

3.4.3 Distance from Water Source to Sanitation Facilities

Almost 49% of the respondents have their sanitation facilities located 0-10 meters from their water source. This implies that a sizeable number of people or places are situated within a reasonable distance of the water source. This suggests that a significant portion of people or places are located within a short distance of the water source. 29% of the respondents have their sanitation facilities located 11-20 meters from their water source. 17% of the respondents have their sanitation facilities located 20-30 meters from their water source. 5% of the respondents have their sanitation facilities located more than 30 meters from their water source (**Figure 11-b**). Studies have shown that there is a link between access to clean water and sanitation and public health. People who have ready access to clean water are less likely to contract water-borne diseases. Having good sanitation facilities also helps to reduce the spread of disease.

3.4.4 Hand Cleaning

Washing of hands is one of the major criteria in sanitation. The people were grouped into- yes, no, and sometimes on the basis of their hand washing after toileting and before taking any food. About 99% of respondents wash their hand before having meal. Only 0.8% of respondents clean their hands sometimes before having the meal. About 75.6% of respondents clean their hands after using the toilet. Only 24.4% of respondents clean their hands sometimes after toileting. The most common

material used for washing hands after using a toilet is soap, with 82 out of 120 respondents (68.9%) selected this option. Water was the second most common material used, with 28 respondents (23.5%) selecting this option. Ash was used by a very small number of respondents, only 10 (7.6%) (**Figure 12**). The results of this survey show that soap is the most popular material for washing hands after using a toilet, and for good reason. Soap is effective at removing germs and bacteria from hands, which can help to prevent the spread of disease. The World Health Organization suggests washing hands with soap and water for at least 20 seconds to properly eradicate germs (Bloomfield *et al.* (2017). The use of water alone is not as effective as soap and water at removing germs. Ash is not recommended for washing hands, as it may contain harmful bacteria or other contaminants.

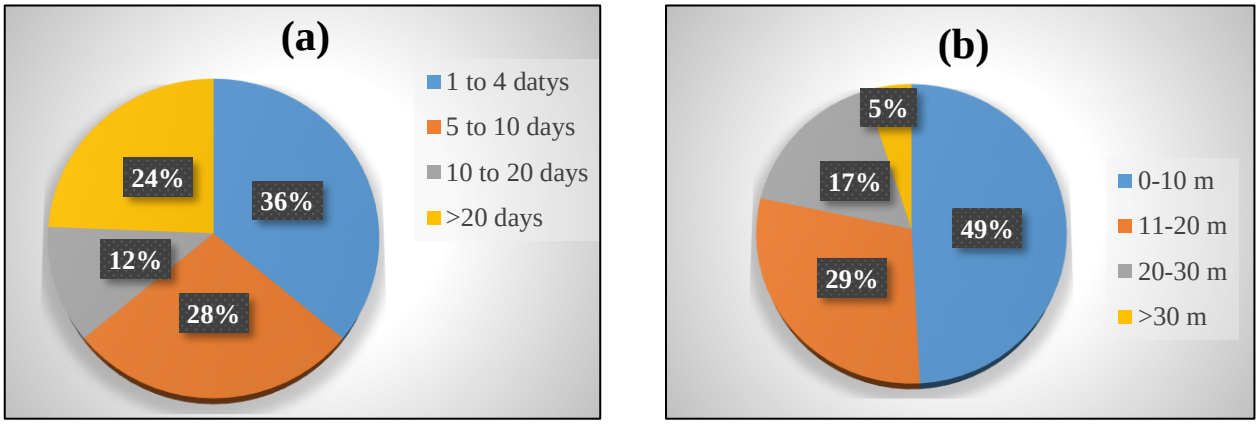

Figure 11. (a) Frequency of cleaning up toilet, (b) Distance from water source.

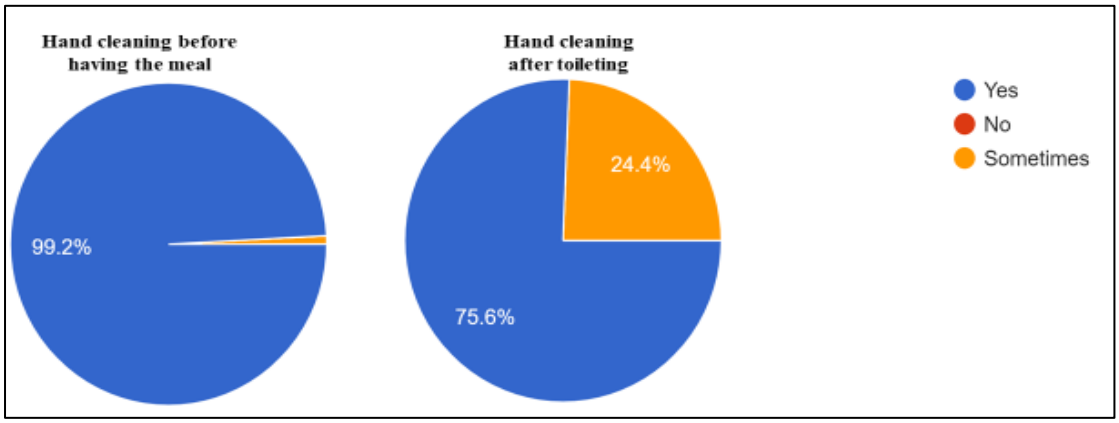

Figure 12. Graphical representation of hand cleaning after toileting and having meal.

3.5 Waste Management Situation

3.5.1 Solid Waste Management

Dumping of household's solid waste was categorized into: give to the city corporation worker, throw into the drain, keep in an open place/ beside the road, city corporation dust bin, dump in the ponds/river, dump at the specified place by the city corporation. The most common method of solid waste disposal in all four locations is throwing waste into dustbins which are then collected by the city corporation. In Duldul Camp, Bashbari Colony and Horizon Sweeper Colony, some waste is also given to the corporation worker, likely for recycling or reuse. However, a significant amount of waste in these three locations is also disposed improperly. This includes dumping waste in drains, in open

places beside the road, and in ponds or rivers. The Developed Residential Area appears to dispose of most of its waste properly via the city corporation dustbins and worker. There is very little improper disposal shown in this area.

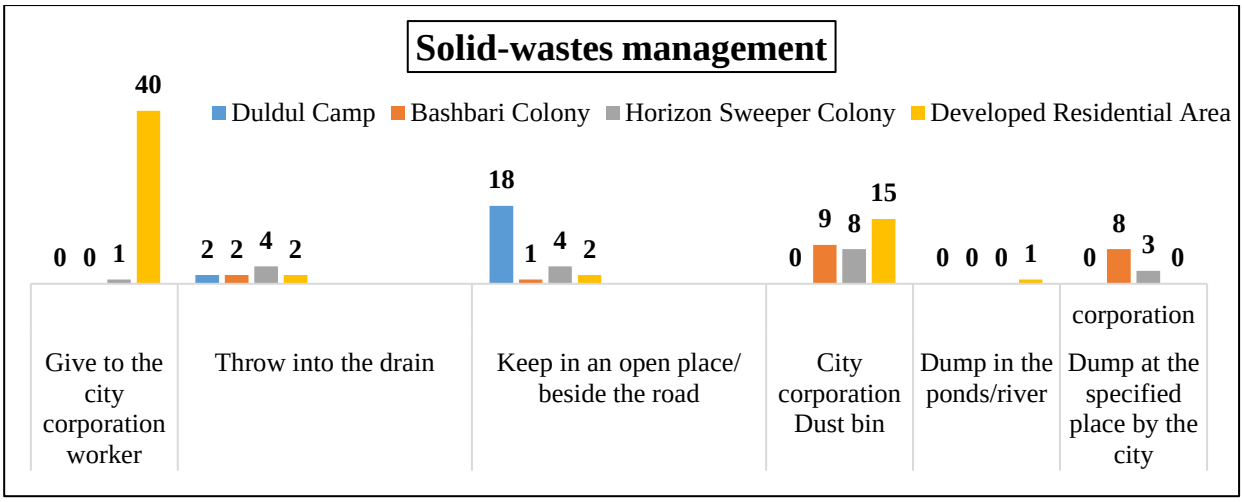

Figure 13. Graphical representation of household's solid waste management.

There may be a need for improved solid waste management systems in Duldul Camp, Bashbari Colony and Horizon Sweeper Colony. This could include education campaigns to encourage residents to dispose of waste properly, as well as improved collection services.

3.5.2 Liquid Waste Management

Dumping of household's liquid waste was categorized into nearest drain, pond/river and sewerage line. The most common method of liquid waste disposal in MCC is the nearest drain. In Duldul Camp, 28% of households dispose of liquid waste this way. A significant proportion of households in these areas dispose of their liquid waste in ponds/rivers, and a smaller proportion dispose of it via drainage ditches. Sewerage lines are only a major disposal method in the Developed Residential Area (**Figure 14**).

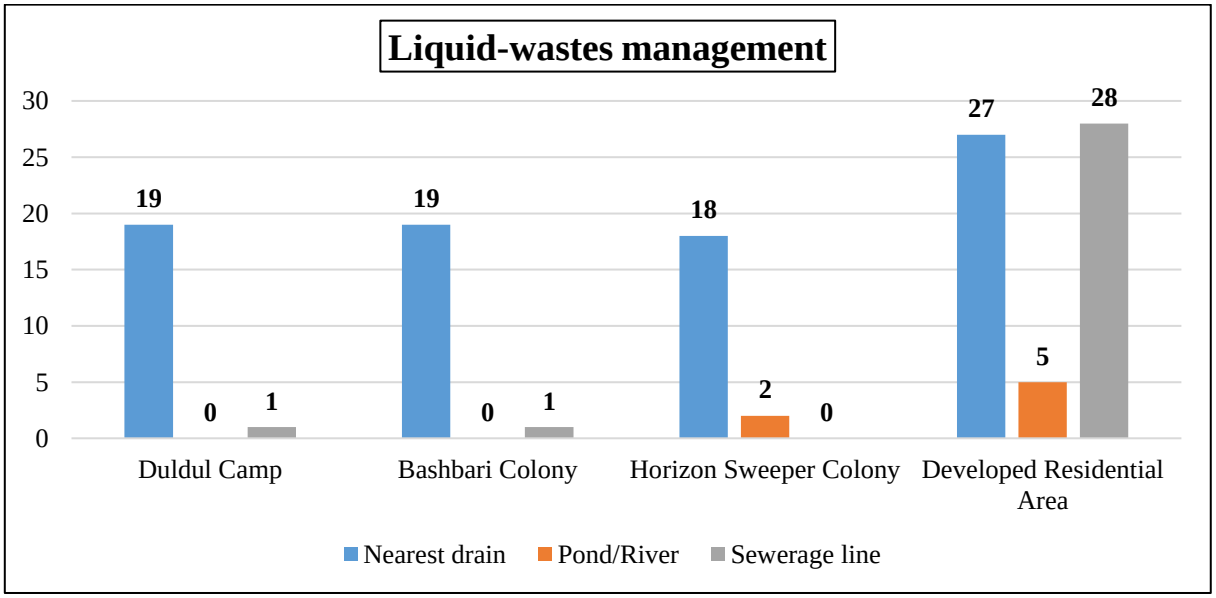

Figure 14. Graphical representation of household's liquid waste management.

This data suggests that a significant amount of liquid waste in MCC is not being disposed of safely. Disposal via drains, ponds, and rivers can contaminate water supplies and lead to public health problems. The fact that sewerage line disposal is most common in the Developed Residential Area suggests that sewerage infrastructure may be a key factor in safe liquid waste management.

3.5.3 Dispose of Toilet Waste

The disposal of toilet waste is grouped into safety tank, open place and hole. According to the survey, 44% of people dispose of toilet waste in safety tank. 33% dispose of it in holes, and 23% use open place for disposing of toilet waste (**Figure 15-a**) In developed residential area, most of household's dispose their toilet waste in safety tank. But in Duldul Camp, Bashbari Colony and Horizon Sweeper Colony, most of the households dispose toilet waste in whole or open place which is unhygienic and unsafe for the people living in this area. It is important to dispose of toilet waste properly to prevent the spread of disease. Improper sanitation can lead to a number of health problems, including diarrhea, cholera, and typhoid fever.

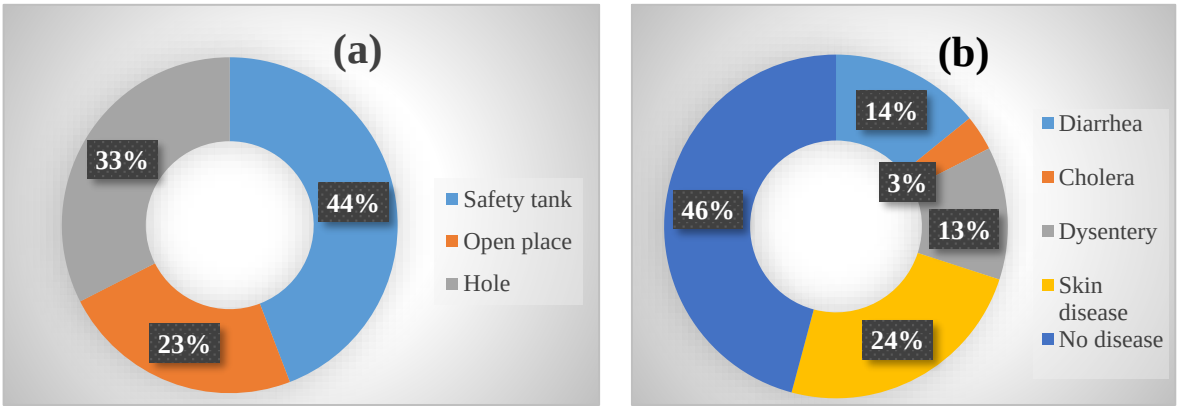

Figure 15. (a) Disposal of toilet waste, (b) Percentage of Health Problem.

3.6 Health and Hygiene Situation

A significant portion of the population (54%) is experiencing at least one of the health conditions listed. Skin disease is the most common condition, affecting 24% of the population. Dermatitis, eczema, fungal infections, rashes, and other conditions that are related to skin diseases are just a few examples. These illnesses could be brought on by several things, including allergies, infections, environmental factors, or poor hygiene. The survey shows that 46% of people reported having no disease. This group of people is made up of people who do not currently have any of the health problems. There are a number of factors that can influence the prevalence of these health conditions, including access to clean water and sanitation, hygiene practices, and socioeconomic factors (**Figure 15-b**).

Out of 120 people surveyed, 62.1% didn't receive messages about hygiene concerns, and 37.9% received messages about hygiene concerns. The people who received messages about hygiene concerns get them from different sources. About 46% of respondents received messages from government agencies, 33% received messages from different NGOs, and 21% received messages from other sources.

About 90% of respondents teach their children about hygienic conditions like washing hands before meals and safe disposal of waste. Only 10% of parents don't teach their children about hygienic conditions. It's encouraging that a large majority (90%) of parents are prioritizing hygiene education for their children. Proper handwashing and waste disposal are essential for preventing the spread of germs and maintaining good health.

However, it's concerning that a significant minority (10%) of parents are not instilling these habits in their children. This highlights the need for continued efforts to raise awareness about the importance of hygiene practices.

4. Conclusions and Recommendations

4.1 Conclusion

The main objective of this study was to assess the current states of water supply and sanitation in slum areas and residential areas in Mymensingh City. The most common water source in Mymensingh city areas is submergible pump. The usage of submergible pump was 45.8%, deep tube-well was 12.5%, city corporation supply water was 22.5% and public/shared/neighbor's tap was 19.2%. The developed Residential Area has a higher standard of living than the other three areas. This is reflected in the fact that the Developed Residential Area has a more reliable water source. It is observed that the water quality of the existing tube wells, hand pumps, private wells are within the standard limits according to physicochemical parameters. Five out of the six samples exceeded the WHO standard for fecal coliform in drinking water. All samples exceeded the standard of total coliform. These results suggest that the water in these locations is not safe for drinking without proper treatment. In developed residential area, most of the households have their own toilets. But in slums, most of the households use shared toilets or use community toilets that were constructed by MCC. The Developed Residential Area appears to dispose of most of its waste properly via the city corporation dustbins and workers. There may be a need for improved solid waste management systems in Duldul Camp, Bashbari Colony and Horizon Sweeper Colony. A significant amount of liquid waste in MCC is not being disposed of safely. Disposal via drains, ponds, and rivers can contaminate water supplies and lead to public health problems.

From this study it may be concluded that the impact of water supply and sanitation practices on the health situation of MCC has pessimistic effect. The main reasons for these health hazard situations are lack of portable water supply system coverage; improper waste management system; lack of knowledge on health hazards; low-income level in slum areas; and, poor wastewater drainage system.

4.2 Recommendation

The following is a summary of the study's recommendations:

- **Community Awareness:** There is a need for public awareness campaigns on sanitation and safe water.
- **Sanitation Infrastructure:** Promote maintenance and cleaning of toilets in public places. Promote the ownership of private restrooms.
- **Water management:** Use surface and groundwater with treatment facilities to meet future demands.

- **Waste Management:** Use eco-sanitation to get rid of waste and recover nutrients. Collecting and properly disposing of solid waste on a regular basis. Enforce waste management regulations that limit pollution.
- **Hygiene Promotion:** Encourage the adoption of hygienic practices in communities by means of education and possible fines. The city corporation needs to keep its drains clean.

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