Observation of supply water quality and sanitation system in different slum areas of Dhaka City

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Bachelor of Science in Civil Engineering

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DECLARATION

We thus certify that the study described in this thesis, with the title **“Observation of supply water quality and sanitation system in different slum areas of Dhaka City”** is our own. Every source that was used for this study has been properly recognized and credited. This thesis has not been submitted, either in part or in full, for any other academic degree at any other institution.

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I would like to dedicate this work to my parents and beloved teachers, who raised and guided me in every single moment of my life.

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In the name of Allah, the Most Gracious, the Most Merciful,

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ABSTRACT

This study focuses on the problems with access to clean drinking water and sanitation in a few Dhaka metropolitan slums, namely Jhilpara, Chalantika, Korail, BNP, and Kalyanpur. The study examines the sanitary infrastructure in these locations and looks into the quality of the water that is supplied for drinking. The provision of basic public services has become more challenging due to the uncontrolled settlements' explosive expansion. These slums' residents frequently experience severe water shortages, low-quality water, and inadequate sanitary facilities, all of which raise health risks and aid in the spread of illnesses that are transmitted by water. The purpose of this study is to evaluate the condition of these slum communities' sanitation systems as well as the supply water quality, in every slum, three distinct locations were chosen to gather samples in order to guarantee a reliable evaluation of the water quality. Additionally, a survey was carried out to evaluate each slum's sanitary infrastructure. The quality of the drinking water that was supplied was assessed using a number of parameters, including pH, turbidity, electrical conductivity (EC), temperature, total dissolved solids (TDS), total suspended solids (TSS), color, iron (Fe), nickel (Ni), lead (Pb), arsenic (As), and Escherichia coli (E. coli).

The findings indicate that the drinking water quality provided to the impoverished areas of Jhilpara, Chalantika, Korail, BNP, and Kalyanpur varies. Generally, slums like Jhilpara, Chalantika, Korail, and BNP demonstrate significant levels of pollution, with the presence of E.coli identified in the water. There are several particularly favorable criteria, like as color, turbidity, pH, and EC (electrical conductivity), TSS (total suspended solids), and TDS (total dissolved solids). On the other hand, Korail and BNP slums have not satisfied standard value dissolved oxygen levels, and Korail, BNP and Kalyanpur slums have not satisfied standard value temperatures levels. Nickel (Ni), iron (Fe), lead (Pb), and arsenic (As) are among the pollutants found in all slums. There are minor variations in several factors, both advantageous and detrimental. Among the five slums, the drinking water quality in Karail and BNP slums is in The water quality is better in the Kalyanpur slum, whereas it is in the poorest condition.

From the questionnaire survey it is observed that, the sanitation system in the slum area is not adequately equipped, leading to residents facing constant health risks. To improve the overall sanitation system of the slum, it is essential to provide sufficient toilets, ensure an adequate supply of water, implement a well-organized plan, and execute effective management strategies. This will ensure proper sewage disposal, cleanliness, and a healthy environment.

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LIST OF ACRONYMS

Acronyms	Description
DWASA	Dhaka Water Supply and Sewerage Authority.
BCSIR	Bangladesh Council of Scientific and Industrial Research.
WHO	World Health Organization.
ECR	Environment Conservation Rules.
HBRI	Housing and Building Research Institute
DPHE	Bangladesh, the Department of Public Health Engineering
DCC	Dhaka City Corporation
NTU	Nephelometric Turbidity Units.
pH	Potential of Hydrogen.
DO	Dissolved Oxygen.
TDS	Total Dissolved Solids.
TSS	Total Suspended Solids.
EC	Electrical Conductivity.
Pd	Lead
Ni	Nickel
mg/L	Milligrams per liter
μS/cm	microsiemens per centimeter.
E. coli	Escherichia coli
As	Arsenic

CHAPTER- I
INTRODUCTION

1.1 Background

One of nature's easily available elements is water. It is a significant source of life as we know it. Numerous tasks, such as drinking, washing, taking a bath, cleaning, cooking, irrigation, and other domestic and commercial uses, are frequently completed with it. Regretfully, human activity and the natural world regularly contaminate the water sources we have access to. The lives of people and animals are at risk due to pollution of surface water, groundwater, and ocean. Although water is frequently viewed as a reusable resource, it must be maintained with care since pollution from increasing economic expansion, urbanization, and human activity brought on by population growth poses a serious threat to it.

Almost every industry, including forestry, navigation, agriculture, and forestry, depends on water, which is more valuable than it has ever been in human history.

Mining, drinking, sanitation, and fishing, among other things. Some have prophesied that clean water will become the "next oil" in energy because of its declining supply and rising demand global (Rahaman et al., 2012). There is a severe freshwater issue in Bangladesh, particularly in the cities. Water in impoverished metropolitan areas is becoming less plentiful and of lower quality. Furthermore, Dhaka, one of the world's megacities due to its high population density and rapid urbanization, is seeing an even worsening of the country's population problems. In the Dhaka Metropolitan Area, the percentage of people living in slums has climbed from 25% in 1996 to 37.4% in 2007. This represents just 4% of the total population .(UN 2012) Every year in Bangladesh, diarrheal disease claims the lives of about 3 million children under the age of five, and each child experiences an average of three episodes of diarrhea per year. (Badhan et al., 2017). Use of fresh water and sanitary sanitation practices is advised in order to easily prevent diarrheal illnesses (WHO 2000). In many places, the rate of sanitation coverage is far lower than the national average just 13.5% in urban slums (USAID 1999). The nation's capital and primate city, Dhaka, is expanding at a rate of about 5% a year. Bangladesh's rapid urbanization has had negative effects on a number of areas. Mass poverty, the growth of slums and squatter communities, the lack of urban services including power, water, fuel for cooking, solid waste disposal, sanitation, sewerage, and other necessities, and the deterioration of the social, neighborhood, and physical environments are a few negative repercussions. In the slums, the majority of people are impoverished, and they are all denied access to urban amenities based on Demand.

The slum sections of Dhaka city have extremely poor sanitation and water supplies. While just 48% of slums have sanitary latrines, around 69% of them have access to water supplies. (CBSG 2010). The Dhaka city slum population frequently faces problems with water delivery and drinking water quality in their day-to-day lives. Therefore, it is imperative that the current state of this city's slum dwellers' access to clean drinking water be investigated and evaluated.

1.2 Study Area

The study area consists of Jhilpara, Chalantika, Karail, BNP and Kalyanpur slums, each with three designated sample point. Jhilpara three points are named JH-01, JH-02, JH-03 and Chalantika Basti three points are Cha-04, Cha-05, Cha-06 and Karail Basti three points are KO-07, KO-08, KO-09 respectively. And three points of BNP slum are named Bnp-10, Bnp-11, Bnp-12 and three points of Kalyanpur slum are Ka-13, Ka-14, Ka-15. We must choose slums based on a number of considerations in addition to access to drinking water.This process is extremely significant. Key factors include: water demand, social and health concerns, economic conditions, population density, location and geographical position, and so forth. These slums were chosen because of their ecological importance and presence. The sampling point was strategically selected to capture variations in water quality across different locations and assessing the impact of pollution on slum ecosystems. The effects of slums, both natural and man-made, are included in the study field.

Fig 1.1 Study Area

1.3 Objective

The following are the study's objectives.

I. To observe the quality of supply water in different slum areas of Dhaka City.

II. To assess the sanitation systems in various slum areas of Dhaka City.

CHAPTER- II
LITERATURE REVIEW

2.1 General

As essential to existence as oxygen, sunshine, and food, water forms the basis of all living things. Because of its quality, which has become a major worldwide concern in the twenty-first century, scientists, researchers, legislators, water specialists, artists, and citizens from a wide range of backgrounds have come together to work on it, with a focus on including students. In December 2017, the UN Environment Assembly (UNEA) recognized this crucial fact by passing Resolution 3/10, which was named "Addressing water pollution to protect and restore water-related ecosystems," during its third session. Since access to potable water is frequently insufficient in urban slums, the provision of safe drinking water is crucial for maintaining public health. Bangladesh's capital city of Dhaka has many impoverished neighborhoods with poor access to water. Slums still struggle with issues of water availability and quality, even with advancements in urban water supply infrastructure. The quality of ordinary tap water in Dhaka's slum regions is examined, and its feasibility as a sustainable source of drinking water is assessed, in this review of the literature.

Many houses in slums do not have piped water connections, and the infrastructure for supplying water is often subpar. Because of poor upkeep and their close proximity to sanitary facilities, residents sometimes rely on common water sources, which can become contaminated. According to a World Bank research (World Bank.,2015) 22% of people living in Dhaka's slums do not have access to clean drinking water. In these areas, waterborne illnesses like cholera, typhoid, and diarrhea are common, and this scenario makes them more likely. A large portion of homes in the slums rely on shared or shoddy latrines due to the poor sanitation infrastructure in place. Because there are inadequate sanitary facilities in certain places, open defecation is still a frequent practice, which exacerbates health hazards and environmental damage. Studies reveal that more than half of Dhaka's impoverished residents utilize communal or outdated sanitation facilities, resulting in unsanitary surroundings and potential health risks for the general population.

2.2 Dhaka City Slum and Case Study Area.

2.2.1 Jhilpara Slum in Dhaka city

"Jhil" denotes a canal in Bengali, whereas "Jhilpara" describes a location next to a canal. The Jhilpara Slum may be found in the northwest region of Mirpur Thana. As was previously noted, Mirpur is renowned for having the greatest proportion of slums relative to other places, meaning that its residents are lower income populations. The Jhilpar slum is situated in, under the DCC's administrative division, section [15] 7 in ward [16] 6 in the Mirpur district. (Islam et al., 2006). The Jhilpar slum is situated in SPZ17 (spatial planning zone) 13, according to the administrative division of RAJUK. (DAP 2008). With a population of over 20,000 people and an area of 8.3 hectares, Jhilpar is one of the oldest slums in Dhaka. Jhilpar Slum has an average population density of 2,410 people per hectare, more than any average residential density in the area. Hyderabad. Four thousand homes with both male and female parents live in the slum (Islam et al., 2009). Interestingly, there is another kind of dwelling in this slum as well, which can be believed to be a "composite household," in which a senior family member is duty-bound to look after younger members while their parents are not there. Participants in such a households may not always have blood ties (Islam et al., 2006). Consequently, the majority of the hanging toilets are in the back portion, while a few, albeit inadequate, sanitary latrines are positioned in the front (Islam et al., 2009). Since the location is a low-flood plain, all of the dwellings are even with a reasonable quantity of rainfall, prone to recurring floods, especially in the back section.

Fig. 2.1 The state of housing in the Jhilpara community

2.2.2 Chalantika Slum in Dhaka City

Located in the Dhaka City Corporation region lies the Chalantika informal community, commonly referred to as Jheelpar Slum. This town is home to about ten thousand (10,000) inhabitants. Rural migrants who were compelled to migrate owing to poverty and lack of opportunities live in these dwellings. Chances for revenue in remote locations. The government has built up the settlement. Undeveloped terrain on which unstable dwelling structures are located. Most of the residences are lined house, yet there are also visible detached and semi-detached homes. Because the town is located in Bangladesh's major city of Dhaka, it faces all of the same standard difficulties as Dhaka. With 20 million residents, Dhaka is now the world's megacity with the highest rate of growth. (Dana et al., 2011)

The majority of homes utilize water delivered by pipes and taps, often for two to three hours each day the evening the community, also known as Jheelpar Slum, is primarily made up of lower-class individuals, including textile workers and household assistance. The land on which people are living is owned by the government.so, the people living in this community do not hold any title over the items over the terrain. The Chalantika Informal Settlement will hereafter be known as the “Community of Chalantika"

Fig.2.2 The state of housing in the Chalantika community

2.2.3 Kallyanpur Slum in Dhaka City

With 20,000 or more residents, Kallyanpur Slum is one of Dhaka's bigger informal settlements. The government organization Housing and Building Research Institute (HBRI) owns the property on which the village is located. The government property was occupied by the colony starting in the late beginning in the 1980s. As a result, there are apparent disagreements between the squatters and the owner. However, individuals do not own official papers verifying their land title. Approximately one-third of the inhabitants are internal refugees who fled the erosion of their riverbanks in their place of origin. Houses are lined in the majority of cases. Individuals often reside in nine square meter single-bedroom homes, which can hold, on average, four people. Bamboo and repurposed corrugated iron. Holding an average family of four, it reflects the 7-9 sq. m common home scenario found in other Dhaka informal communities. In the summer, the dwellings became unbearably hot since they have just one front door and no other windows. year. Additionally, the absence of a ventilation system to expel smoke from cooking fires leaves the homes amplify the hearing

Fig.2.3 The state of housing in the Kallyanpur community

2.2.4 Korail Slum in Dhaka City

In terms of area (364,230 sq. m.) and populationn (more than 100,000), the Korail Informal Settlement is said to be the largest informal settlement in Dhaka. Due to open disagreements between the Department of T&T, PWD and the ex-private landowners. Due to the fact that it is next to upscale residential regions and upscale business districts, such as Gulshan, Banani, and Mohakhali, a sizable portion Poor and disadvantaged people are drawn to dwell in this region. most of the of them reside in makeshift tin-shed houses, and a tiny percentage of them are partly dwelling that is mostly or completely prefabricated and has permanent walls.

Fig.2.4 The state of housing in the Korail community

2.2.5 BNP Slum in Dhaka City

One of the biggest slum regions in Dhaka is the BNP slum, which is situated in Sher-e-Bangla Nagar. According to several studies, this slum is home to over 50,000 people and occupies about 20 acres of land. The majority of people living here are employed in a variety of jobs and come from low-income households. Near Dhaka, the majority of the people living in the BNP slum work in low-paying employment. Lots of them are employed as street vendors or hawkers, garment workers, day laborers, rickshaw pullers, and domestic workers.The majority of the inhabitants work in temporary positions, and their monthly salary is pitiful. They are so frequently compelled to live in cramped, uncomfortable circumstances. There are issues with education, sanitation, and water scarcity for the people living in this slum.

Fig.2.5 The state of housing in the BNP community

2.3 Sources of Drinking water Pollution in Slum Area

A number of causes contribute to the serious problem of drinking water contamination in Dhaka's slum regions. Poor living conditions in Bangladesh's capital city of Dhaka have a direct impact on the availability of clean water for the slum population. The following are major causes of contaminated drinking water in certain areas:

Inadequate Sanitation Facilities:

- **Source of Pollution**: Groundwater and surface water contamination in slum regions is caused by open defecation, shoddy latrine construction, and a breakdown of sewage systems. The proximity of water sources to sewage systems results in waste frequently mingling with the water supply.(WaterAid Bangladesh 2016)
- **Sewage and water sources:** get mixed together as a result of inadequate sanitation infrastructure. Surface and subsurface water in slum areas are frequently contaminated by open drains and insufficient sewage facilities.(Akter et al., 2012)

Industrial Waste and Chemicals:

- **Source of Pollution:** Since Dhaka is a major industrial center, numerous firms, particularly those that produce chemicals, textiles, and leather, release untreated or partially treated industrial effluents into adjacent bodies of water. Especially in impoverished communities with inadequate infrastructure, these pollutants have the potential to seep into the water supply.(World Bank 2018)

Poor Water Distribution Infrastructure:

- **Source of Pollution:** An abundance of impoverished people depend on unauthorized or unofficial water connections, which are frequently ill-maintained and prone to pollution. These pipes commonly cross open drains or trash dumps, which allows pollutants to get into the water supply that people consume.(Journal of Water, Sanitation, and Hygiene 2017)

Solid Waste Dumping:

- **Source of Pollution:** Solid garbage accumulates in public spaces, drains, and places close to water sources because Dhaka's slums lack efficient waste disposal infrastructure. Rainfall has the potential to carry hazardous microorganisms, plastics, and chemicals into water systems**.** (icddr b et al., 2020).

2.4 Parameters of Concern

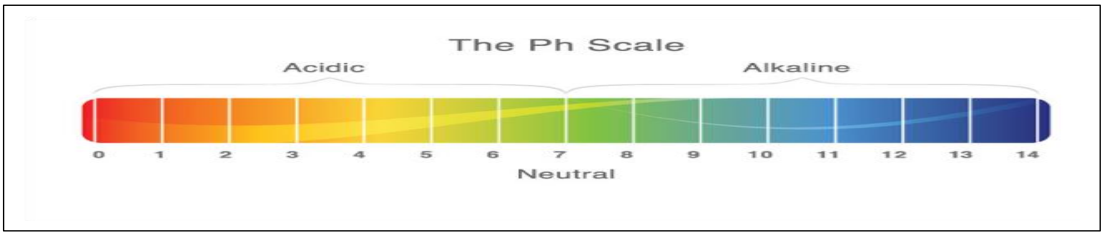
Chemical, physical, and biological characteristics are included in water quality metrics. Depending on the water factors that are of importance, it can either be monitored or studied.

The Environment Conservation Rules 1997 (Standard, 1997) set environmental standards with the goal of reducing the amount and concentration of pollutants released into the environment. (Uddin et al., 2021).The guidelines and requirements for water quality have been derived from the Bangladesh Environment Conservation Act, 1995 (GoB, Act 1 of 1995). Important water consumption factors for drinking, fishing, farming, irrigation, and industry are listed here.

This will outline the significance of the variables we look at in order to determine the water quality.

2.4.1 pH

The chemical word pH describes how basic or acidic a solution is. The pH of water sources should range from 6.5 to 8.5 on a scale. According to (Gorde et al., 2013), a pH of 7 is regarded as neutral, while values below 7 indicate acidity and values over 7 suggest alkalinity. The survival of aquatic organisms, as well as the toxicity and solubility of chemicals and heavy metals in the water, are significantly influenced by the pH of the water. Ensuring that water bodies remain in good health and that aquatic species survive depends on maintaining an ideal pH level.



The Bangladesh Environment Conservation Rules (1997) state that a pH of 6.5–8.5 is the minimum required for drinking water.

2.4.2 Dissolved Oxygen (DO)

Water's dissolved oxygen concentrations depend on a number of variables. The saturation point of oxygen in water is a function of temperature, whereby colder waters tend to store more oxygen. When water is agitated—that is, runs through a stream or a trickling filter—it usually has a higher DO content than stagnant water because it has more surface area in contact with the air. Aerators also raise the concentrations of DO and the surface area of air to water. Water's capacity to contain oxygen declines with

Increasing salinity. To ensure the health of the aquatic life in a body of water, the ideal DO range is 4.0–6.5 mg/l. Reduced DO levels are indicative of organic matter and water contamination. Capable life forms start to decline if DO (from the breakdown of organic wastes) falls below 4.0 mg/l. Higher living forms are eliminated or driven away when aerobic conditions are present.

2.4.3 Total Dissolved Solids (TDS)

The Total Dissolved Solids (TDS) concentration in water is measured. Safe levels vary depending on the source, however in freshwater, the usual range for TDS is between 50 and 500 mg/l (Gorde et al., 2013). TDS levels over normal can affect the flavor of water and signal possible pollutants. Various aquatic life forms can be greatly impacted by high TDS levels, especially when caused by dissolved salts.

2.4.4 Electrical Conductivity (EC)

The electric conductivity of water (EC) is a measure of its TDS. Although standard EC values differ, freshwater normally has a range of 50 to 800 µS/cm (Fikresilasie et al., 2011). Raised EC indicates increased TDS and possible problems with water quality.

2.4.5 Temperature

The temperature of water affects chemical and biological reactions. Temperatures between 10 and 25°C are considered ideal for freshwater habitats, while safe levels vary depending on the species. Severe heat can cause stress to aquatic organisms and change the dynamics of an ecosystem.

2.4.6 Turbidity

Turbidity analyzes the amount of suspended particles in water to determine its clarity. The designated usage of the water body determines the safe levels. High turbidity, defined as criteria below 5 NTU (Nephelometric Turbidity Units) (Gorde et al., 2013), can affect aquatic environments and impede light penetration

2.4.7 Iron (Fe)

In the earth's crust, iron is the second most prevalent metallic element. It is vital to both plant and animal metabolism. Drinking water that contains iron and manganese generally has no negative impact on humans. However, because iron and manganese oxidize to the $Fe3+$ and $Mn4+$ states, which produce colloidal precipitates, such water turns murky and is exceedingly unappealing from an aesthetic perspective when exposed to the air so that oxygen can enter. Since oxidation rates are slow, reduced forms can linger in aerated waters for a while.

This is particularly true when manganese oxidation occurs and the pH falls below 9 or below 6 with iron oxidation. When specific inorganic catalysts are present, microorganisms may work to boost the rates. The Environment Conservation Rules (1997) state that the acceptable range of iron in drinking water is between 0.3 and 1.0 mg/l. The World Health Organization (WHO) considers a recommendation value of 0.3 mg/l for taste threshold or aesthetic concerns.

2.4.8 Arsenic (As)

Due to its high toxicity and substantial health risk, arsenic the 12th most prevalent element in the biosphere and the 20th most abundant element in the earth's crust is categorized as carcinogenic to humans and is frequently found in drinking water as a trace inorganic contaminant. In Bangladesh, there is now serious worry over the presence of high quantities of arsenic in groundwater, particularly from shallow aquifers. Since tubewell water drawn from shallow aquifers provides the majority of Bangladesh's people with their primary supply of drinking water, arsenic poisoning of the country's groundwater poses a special challenge.

Both the urban and rural water supplies rely significantly on groundwater, with hand pump tubewells being the primary means of obtaining groundwater in rural areas. The geologic origin of arsenic in Bangladeshi groundwater is likely the reason for its current discovery, as groundwater has just recently been widely utilized for drinking in rural areas during the past 20 to 30 years.

Bangladesh's drinking water limit for arsenic is 0.05 mg/l (50 µg/l), under the Environment Conservation Rules (1997). Arsenic in drinking water should not exceed 0.01 mg/l (10 µg/l), according to WHO guidelines.

2.4.9 Nickel (Ni)

Because nickel is a heavy metal, it can harm the reproductive system if it gets into the body in excess. Certain research indicates that being exposed to nickel, especially at high concentrations, The maximum permissible content of nickel in drinking water, as determined by the World Health Organization (WHO), is 0.07 mg/L (70 µg/L). Above this threshold long-term exposure may raise the chance of nickel-related health problems.

In Bangladesh, the Environment Conservation Rules (1997) set acceptable levels for a number of contaminants, including heavy metals like nickel, in drinking water. The maximum amount of nickel that is permitted in drinking water, as per current standards, is 0.1 mg/L (milligrams per liter).

2.4.10 Lead (Pd)

Prolonged exposure to lead pollution in drinking water can have serious health effects, including impotence and other reproductive problems, especially in males. Lead is a hazardous heavy metal that may build up in the body over time and have an impact on several organ systems, including the reproductive system.

Lead in drinking water is subject to regulations imposed by the Environment Conservation Rules (ECR) of 1997 in Bangladesh. The ECR, 1997 states that 0.05 mg/L (50 µg/L) of lead is the maximum amount that can be present in drinking water.

2.4.11 Escherichia coli (E. coli)

Animal and human intestines are frequently home to the bacterium known as Escherichia coli, or E. coli. While the majority of types are not harmful, some, like E. Coli O157, can result in serious sickness. Drinking water tainted by fecal matter which can include dangerous bacteria, viruses, and parasites is usually indicated by the presence of E. Coli. It implies possible microbial contamination that might result in waterborne illnesses when detected in drinking water. Symptoms such as diarrhea, vomiting, nausea, and abdominal discomfort can occur when consuming water tainted with hazardous strains of Escherichia coli. More serious instances can result in life-threatening illnesses like renal failure, especially in susceptible groups like small children, the elderly, or people with compromised immune systems.

2.4.12 Sanitation in Slum Areas (Focusing on Single Pit Latrines)

- **Groundwater Contamination**: Because single pit latrines are frequently built shoddily and without liners, human waste can leak into the surrounding soil. This can cause pollution of groundwater, which is frequently utilized for residential or drinking reasons, in heavily populated places such as slums.

- **Overuse of Latrines**: A single pit latrine may be utilized by several families due to high population density, which speeds up the filling process. Contamination of surface water can arise from overflowing latrines, particularly in the monsoon season.

- **Proximity to Water Sources**: Pit latrines are often situated near hand pumps or wells in impoverished areas, which raises the risk of latrine waste and water supply pollution.

- **Health Risks:** Water-related diseases including cholera, diarrhea, and typhoid, which are prevalent in Dhaka's impoverished neighborhoods, can be transmitted via contaminated water sources.

2.4 Relevant studies

The chemical and microbiological analysis of water samples from the Korail slum will be discussed in this publication. Although the pH levels of the water samples were within permissible bounds, the investigation draws attention to problems including the existence of dangerous bacteria like E. coli.. (ijeast et al., 2021)

This study details the unofficial water supply systems utilized by inhabitants and focuses on water access and affordability in Korail and adjacent slums. It offers information on the social and economic dynamics of the water supply in the region and includes a field survey of fifty Korail inhabitants.(Sanjida et al., 2020).

Regarding research on the quality of drinking water in Dhaka's Jhilpara slum, "Assessing the Right to Water of the Urban Poor in Dhaka City" is a pertinent study that looks at problems with water accessibility in slum regions, including Jhilpara. The issues that urban slum inhabitants confront with regard to infrastructure and water quality are discussed in this research, which can be accessed through GeoJournal. Policy implications are also discussed.(Kuhu Sharma et al., 2021)

The paper "Water Crisis and Urban Poor: The Case of Poor Communities in Dhaka City, Bangladesh" by a good place to start if you're looking for research on drinking water problems in the Chalantika informal settlement. It looks at the problems with water quality and availability that urban poor neighborhoods confront, highlighting the people's firsthand accounts and the ways different players take advantage of the situation. The study sheds insights on how slum residents obtain water while emphasizing the wider socioeconomic ramifications. This document is available for you to access.(Habib et al., 2009)

Water quality, supply issues, and public health concerns are covered in a number of publications when it comes to research on drinking water availability in Kallyanpur and adjacent Dhaka slums. The Dhaka Water Supply and Sewerage Authority (DWASA) plays a major role in delivering water, as an important research on Dhaka's slums, particularly Kallyanpur, shows. Unfortunately, there is still a lack of water and inadequate sanitation, which has an impact on people's quality of life and health. Many slum dwellers do not have access to clean drinking water, despite the fact that DWASA water is frequently used and polluted, according to studies.

In one study, for example, chemical characteristics like as pH and chloride levels were found to be within acceptable limits in two Dhaka slums, including Korail; nevertheless, microbiological contamination was found to be severe, with fecal coliform bacteria and E. Coli bacteria discovered in the water.(Subrata et al., 2021)

The Kalyanpur slum field surveys' results, together with those of additional research by (Mahbub et al., 2005) and (Hossain et al., 2010), demonstrate how nearly identical the communities are in terms of socioeconomic level, housing, utility services, and political standing, as well as health and Along with home quality, education, and monthly income, there were some discernible differences. A Few socioeconomic traits include inadequate home quality, low literacy, and inferior educational position of Their state of health may have been influenced by the slum inhabitants.

CHAPTER- III
METHODOLOGY

3.1 General

The most precious natural resource in the world, water is necessary for both life and growth (Kumar et al., 2010). Both temporally and spatially, its quality fluctuates. Water assessment Quality, samples are collected from three places in a slum, considering locality Influenced by sampling point, geographic location, time of collection, Techniques, and procedures also affect water quality. The following sections will be Discuss the impact of geographical areas, Jhilpara, Chalantika, Karail, BNP and Kalyanpur slums and detail our drinking water quality assessment methodology.

3.2 Flow Diagram

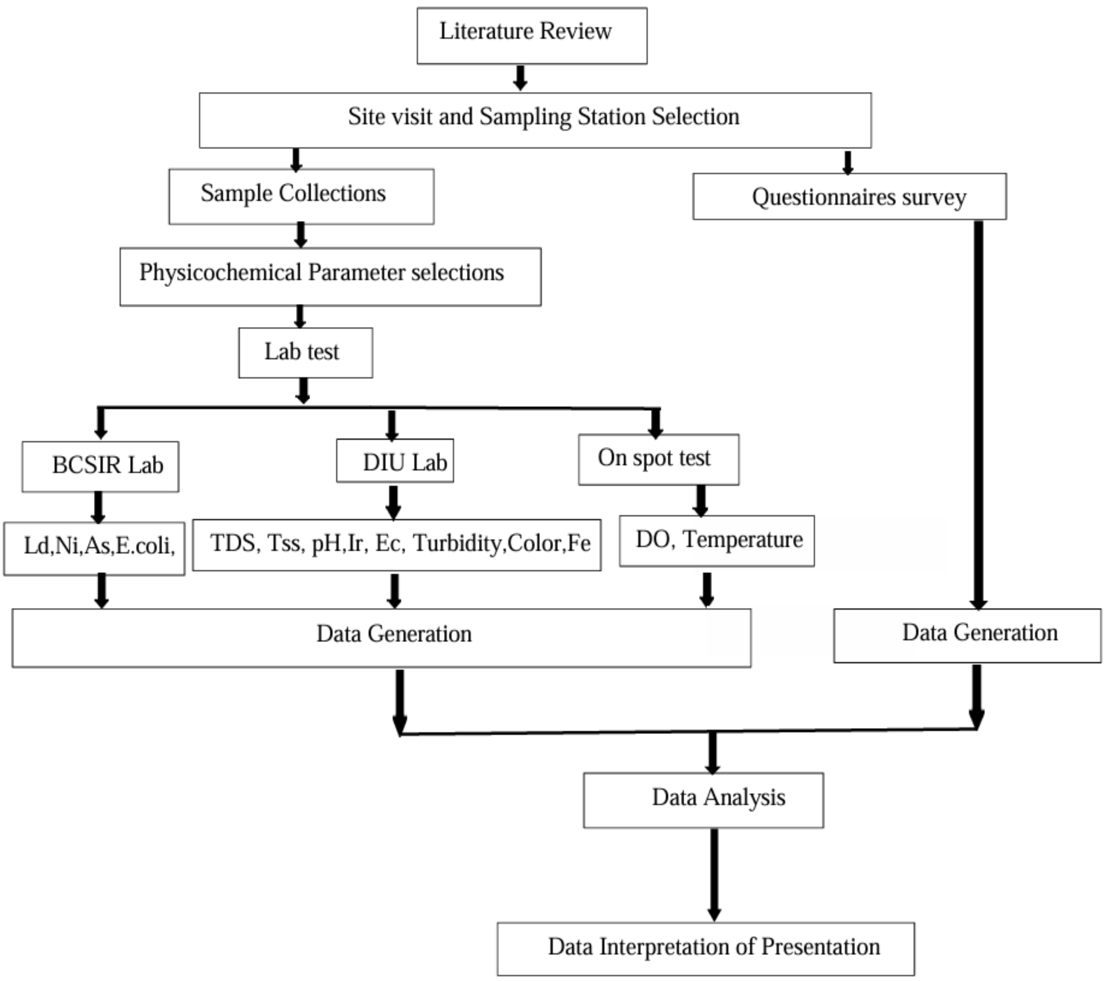


Fig.3.1 Diagram OF Methodology

3.2.1 Selection of Sampling Points

For a number of reasons, choosing sampling locations in impoverished neighborhoods to evaluate the tap water quality is essential, particularly when taking into account sustainable supplies of drinking water in a heavily populated and developing city like Dhaka City. The uneven distribution networks, frequent contamination spots, and informal settlements can all contribute to varying levels of water quality in slum regions. To guarantee that the study catches this variability, samples are taken at various points. Slum communities frequently have outdated, badly maintained water supply infrastructure. Several sampling locations can help determine whether the pollution is coming from the local infrastructure (e.g., damaged pipes) or the source water. Researchers can determine whether the slum's water quality is consistent throughout by taking samples at several sites. This is crucial for social fairness and public health. Chemical and microbiological contamination is frequently more likely in impoverished communities. Specific dangers (such heavy metals and bacterial contamination) (shown in Fig. 3.1). can be identified with the use of targeted sampling, which also yields the data required to reduce health hazards. Accurate water quality data are necessary for sustainable water solutions. Obtaining samples from multiple locations guarantees that actions are founded on a comprehensive understanding of the issues throughout the region. Improved water management regulations for impoverished areas can be derived from data collected at various sample sites, particularly with regard to infrastructure upkeep, water vendor licensing, and the availability of clean water.

For a thorough understanding of the water quality in slum areas, sampling point selection is essential. This guarantees that solutions adopted are equitable, effective, and sustainable for improving access to safe drinking water.

We have worked with 5 slums. A total of 15 samples were collected from 5 slums. Samples were collected from three Jhilpara slums, three from Chalantika slums, three from Karail slums, three from BNP slums and lastly from Kalyanpur slums. The reason for collecting samples from different collections is that the quality of drinking water varies temporally and spatially, making it almost impossible to accurately represent water quality with a single sample collected from a single location.

Table 3.1: Locations of the sampling points of Different Slum Area

Slum Name	Station Code	Coordination	
		Latitude	Longitude
Jhilpara,Mirpur-2	JH-01	23.8074594	90.3553635
	JH-02	23.8071625	90.3551174
	JH03	23.8077392	90.3551644
Chalantika ,Mirpur 7	ChA-04	23.8155337	90.3610129
	ChA-05	23.8155337	90.3606435
	ChA-06	23.8167032	90.360617
Korail Basti,Banani	KO-07	23.7833712	90.4080367
	KO-08	23.7840789	90.4047745
	KO-09	23.7848717	90.4067449
BNP Slum, Sher-E-Bangla Nagar	BNP-10	23.776509	90.3679773
	BNP-11	23.7770551	90.3695018
	BNP-12	23.776363	90.3697103
Kallyanpur Slum	KA-13	23.7827082	90.3587833
	KA-14	23.7838939	90.3588333
	KA-15	23.7841363	90.3568237

During site investigation, we opted to leverage expertise gained from past publications. The Jhilpara slum area was first separated into three zones, followed by the slum areas of Chalantika, Karail, BNP, and Kalyanpur. In order to determine the whereabouts of these regions, we initially drove by CNG through the slums of Jhilpara, Chalantika, Karail, BNP, and Kalyanpur . On that particular day, we observed the state of the slums and conducted an inspection to determine which taps or faucets are most frequently used to get drinking water. In light of this, we chose the sampling locations. This marked the beginning of our investigation. As a result, our sample was unique from that of another source. We make sure the places of origin are isolated from one another prior to sample collection.

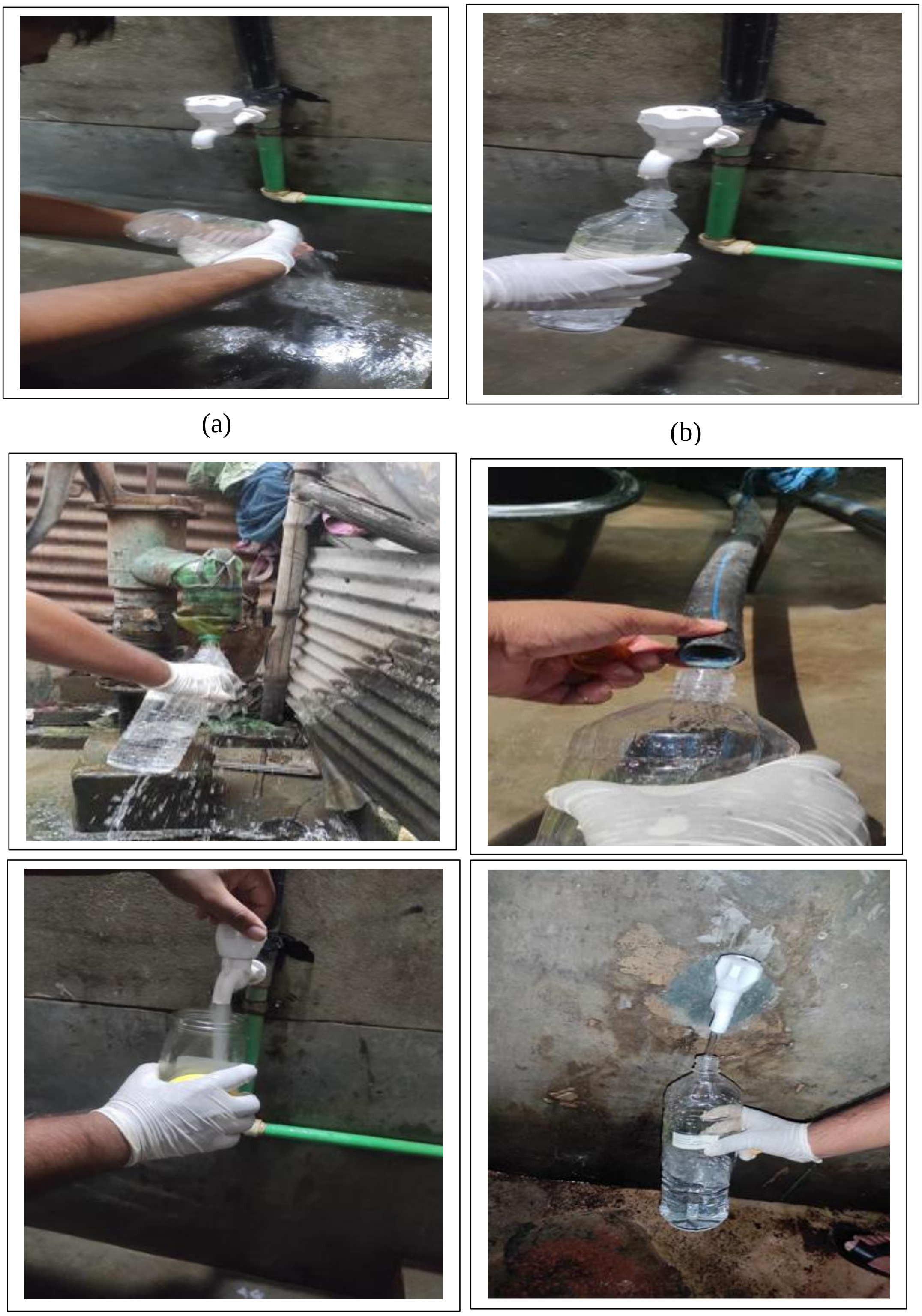
The samples also needed to be easily accessible and collectible so that we wouldn't run into any issues when gathering them. We examine the physical, chemical, and topographical aspects of slums. The places should, in our opinion, be significant and emblematic of the quality of drinking water. The drinking water quality determined the selection of sampling locations. We take into account the slums' physical, chemical, and topographical features. We believed that the sites have to be significant and symbolic of the quality of drinking water. The selection of sampling locations was based on the drinking water quality.

3.2.2 Literature review

Before collecting the samples and locations we study the previous papers related to this to understand the criteria. We have studied many papers based on Jhilpara, Chalantika, Karail, BNP and Kalyanpur slums. After studying various papers, we have selected some important parameters which are helpful in understanding water condition.

3.2.3 Collection of Sample

In slums where tap water was the primary source of drinking water, we gathered samples. In September, we took samples and conducted analyses of the slum water. We rented a CNG to make it easier for us to gather drinking water samples from the appropriate locations. In order to maintain hand sterility during sample collection, we use hand gloves. Three types of bottles are used to collect drinking water samples. Samples of water were taken out of 500 g glass bottles, 1-liter plastic bottles, and 2-liter plastic bottles. Before the experiment, the bottles were washed and rinsed three times with water to avoid contamination. Following the sampling process, every tool and technique was employed to safeguard the water samples from any pathogenic or fungal assault.Our primary goal is to assess the drinking water's quality and level of contamination. Therefore, we take great care when gathering samples. We fill the bottle with drinking water from the slum in order to collect the water before taking the sample. Quickly seal the sample vial. and kept in a secure location. Each sample's necessary details, including the place and date of collection, are recorded in the notebook.



(a) (b)

(c) (d)

Fig.3.2 Water Sample collection process (a) Bottle rinsing (b,c,d) Water collation

After collecting the samples, the sample bottles were stored and they were taken to the lab for analysis. (shown in fig. 3.3)

Fig.3.3 Sample placed primarily in the lab

3.2.5 Parameter Selection and On-Spot Test

Water evaluation is the process of examining and analyzing water samples in order to determine their chemical, biological, and physical characteristics. This study is crucial for a variety of applications, including industrial, agricultural, environmental monitoring, and the security of water usage. The 13 criteria we chose for this task are given in Section 2. Depending on which of these 13 characteristics we select, several are examined in situ (Figure 3.4), including temperature, pH, and DO. The qualities of these can be altered by temperature and weather.

Fig.3.4 On spot physiochemical parameters test (DO, pH & Temperature Test)

3.2.6 Lab Test

In our university lab, certain parameter samples from the field were obtained after all sample collection and on-site testing was finished. Once there, tests are conducted on the remaining criteria, which include Color, Turbidity (NTU), Total Dissolved Solids (TDS), and TSS, as seen in Figure 3.5, 3.6, 3.7, 3.8, 3.9.

Table 3. 2: Physicochemical parameter Lab test and Method

Physicochemical Parameter	Unit	Methods/ Equipment
pH	--	pH Meter. Model No: (HACH_HQ pH/ORP)
DO	mg/l	DO Meter. Model No: (HACH_HQ2100) Portable Multi-Meter
Color	mg/l	Spectrophotometer. Model No: (HACH_DR-6000)
TSS	mg/l	Oven Dry Process
TDS	mg/l	Oven Dry Process
EC	µS/cm	EC Meter.
Temperature	°C	pH Meter. Model No: (HACH_HQ pH/ORP)
Turbidity	NTU	Turbidity Meter. Model No: Hach2100Q
Arsenic(As)	mg/l	3114.C
Nickel (Ni)	mg/l	3113.B
Lead (Pd)	Mg/l	3111.B
E.coli	--	ISO 7251--2005
Iron (Fe)	--	Following standard kits

Fig.3.5 Iron kits &Testing

(a)

(b)

(c)

(d)

Fig.3.6 Samples test in laboratory (a) pH, DO and Turbidity test (b) Spectrophotometer, (c) Preparing sample for TDS test, (d) Sample after removing from oven.

(a) (b)

Fig.3.7 Samples test in laboratory (a) Digital Balance (b) Electrical conductivity (EC) Testing

Fig.3.8: Heavy metal testing machine (BESIR Lab)

Fig.3.9 E.coli Testing Machine (BESIR Lab)

CHAPTER- IV
RESULT AND DISCUSSIONS

4.1 General

A paper's summary and discussion are its primary components. The work's output has been discussed in this section. There, the work completed, the outcomes of the tests, whether the result is good or poor, the reasons behind the good result, what has to be done to improve the bad result, etc., are all discussed. This section discusses a number of crucial paper components. Therefore, it is important to exercise caution when working on the findings to prevent errors and the emergence of false information.

To get the greatest findings possible, a variety of analyses have been carried out in this study report. We examined the water quality of slums like Jhilpar, Chalantika, Korail, BNP, and Kalyanpur. Many parameters were tested, and the results showed that while some of them fall outside of the minimum limits, others of them satisfy the standard quality of drinking water. Thus, the findings of this study suggest that the drinking water is tainted. The general degree of pollution is so high that human health can be impacted.

4.2 Variation of pH

The bar chart is shown in Fig 10 it represents the value of pH. The Y-axis shows the value of pH and the X-axis represents the Slum name.

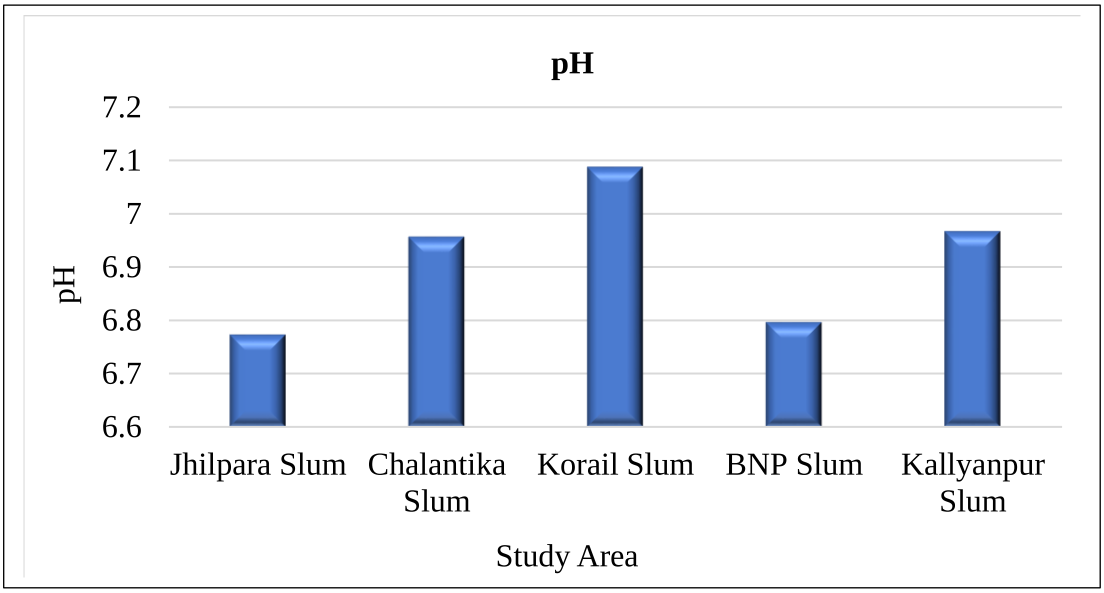


Fig.4.1 Variation of pH in different Slum

The drinking water pH variations amongst five slums are displayed in a bar chart. The pH range between 6.5 to 8.5 is appropriate for safe drinking water, according to Bangladeshi drinking water guidelines. The chart's pH values are broken out here. A pH of around 6.65, somewhat acidic but within Bangladeshi standards, is found in the Jhilpara Slum. Near neutral and within a safe level, the pH of Chalantika Slum is around 6.9.At a pH of around 7.1, Korail Slum is regarded as safe and neutral.BNP Slum: a rather acidic pH of 6.75, but still within tolerable bounds. In the neutral and safe range, the pH of Kallyanpur Slum is almost 7.0.

As a result, the water in all of the slums on the chart is typically safe to drink, having an acidity and alkalinity level that all satisfy the Bangladeshi the requirement.

4.3 Variation of DO and Temperature

The bar chart is shown in Fig 10 it represents the value of "DO". The Y-axis shows the value of DO and the X-axis represents the Study area.

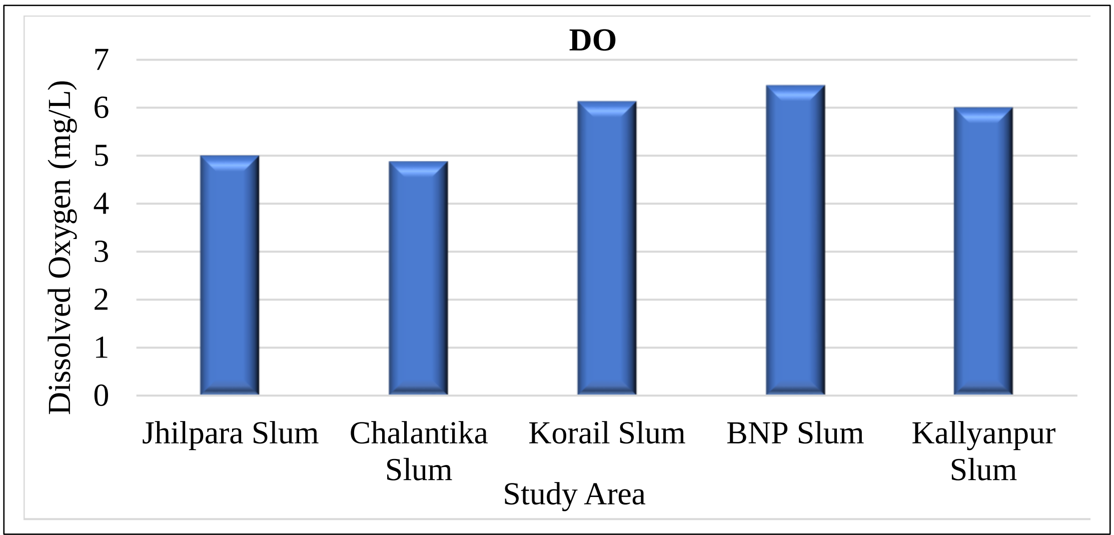


Fig.4.2 Dissolved oxygen Levels in Different Slum

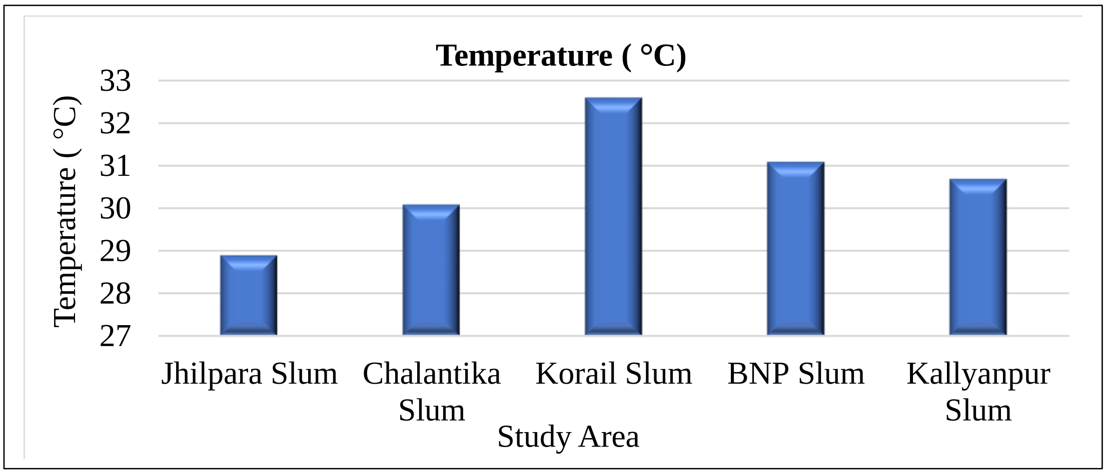


Fig.4.3 Temperature (°C) Levels in Different Slum

The dissolved oxygen (DO) levels in the various Dhaka slums are shown in this bar chart. The red dashed line represents the 6 mg/L dissolved oxygen standard for Bangladesh. The greatest DO level, 6.45 mg/L, is found in BNP Slum. The lowest DO level, 4.88 mg/L, is found in the Chalantika Slum. Comparing these two slums to others, Korail Slum (6.12 mg/L) and Kallyanpur Slum (5.99 mg/L) both have comparatively high DO levels. Near the bottom of the range is Jhilpara Slum (4.99 mg/L).

Within this graph: The appropriate range for oxygenated water is more closely approached by BNP Slum and Korail Slum. Less DO is found in Jhilpara and Chalantika Slum, which may indicate lower-quality water in those areas—possibly as a result of pollution or insufficient water treatment facilities.

Temperature has an impact on the development of bacteria and pathogens in water as well as the solubility of gasses (like DO). Harmful microbes may develop more easily in warmer environments.

The water temperature range shown in this graph is quite close to the ideal range for drinking water in the Jhilpar and Chalantika slums. But the water temperature in the slums of Kallyanpur, Korail, and Chalantika is higher than what is considered appropriate, which might impact pathogen development in the water as well as the solubility of gases like dissolved oxygen (dissolved oxygen). Climates that are warmer facilitate the growth of harmful microbes.

4.4 Variation of Turbidity (NTU)

The Bangladesh Drinking Water Quality Standards (ECR, 1997) and World Health Organization (WHO) standards specify that the requirement for drinking water turbidity in Bangladesh is ≤10 NTU (Nephelometric Turbidity Units). To ensure efficient disinfection and for aesthetic reasons, the WHO recommends a more strict limit of ≤5

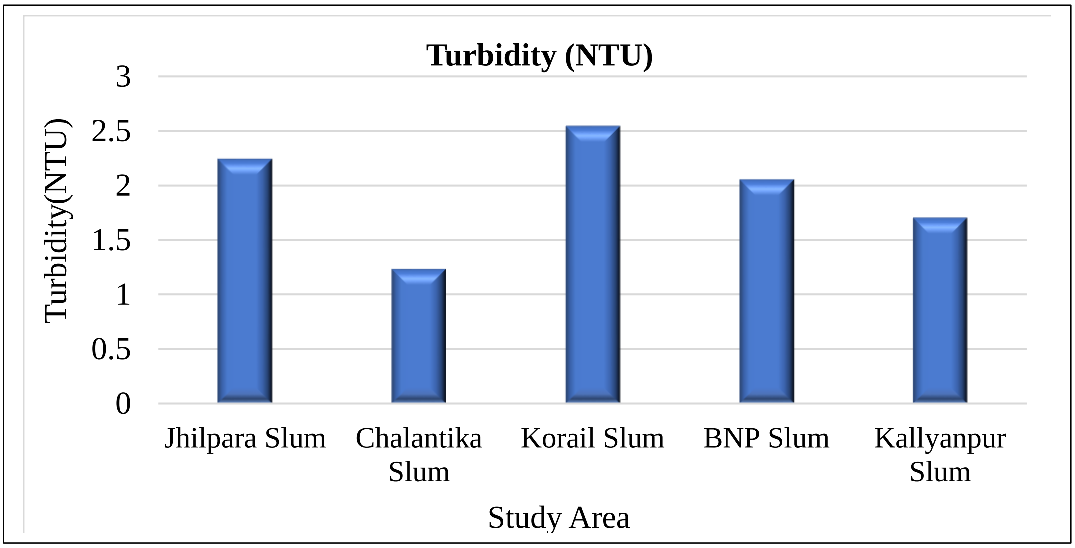


Fig.4.4 Turbidity (NTU) Levels in Different Slum

The turbidity level of 2.54 NTU is greatest in Korail Slum. With a turbidity level of 1.24 NTU, Chalantika Slum has the lowest. Kallyanpur Slum (1.71 NTU) has lower turbidity levels than Jhilpara Slum (2.24 NTU) and BNP Slum (2.05 NTU).

As can be seen in the graphic, all of the slums have turbidity levels below the 5 NTU threshold, indicating that the water is probably safe to drink. Though Korail Slum (2.54 NTU) has comparatively cloudier water, which may be an indication of the presence of suspended particles, silt, or organic material, Chalantika Slum has the lowest turbidity (1.24 NTU), signifying cleaner water.

4.5 Variation of Electric Conductivity (EC)

The electric conductivity (EC) values of drinking water from many Dhaka slums are shown in the bar chart. The EC values are given for five slums, with Jhilpara Slum having the lowest EC value at 256.33 µS/cm and Kallyanpur Slum having the highest at 368 µS/cm.The electric conductivity (EC) values of drinking water from many Dhaka slums are shown in the bar chart. The EC values are given for five slums, with Jhilpara Slum having the lowest EC value at 256.33 µS/cm and Kallyanpur Slum having the highest at 368 µS/cm.

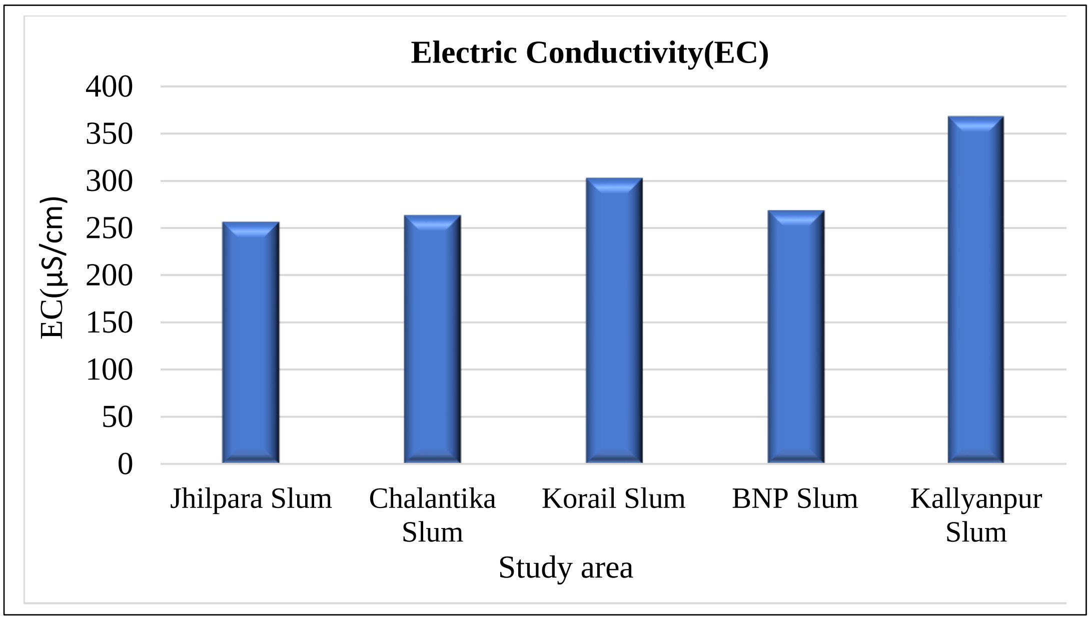


Fig.4.5 Electric Conductivity Levels in Different Slum

In Bangladesh, the Department of Public Health Engineering (DPHE) sets the norm for electric conductivity in drinking water, which usually falls between 300 and 800 µS/cm. In light of this chart:While still falling inside the permissible range, Korail Slum and Kallyanpur Slum surpass the 300 µS/cm restriction.The EC readings of Jhilpara, Chalantika, and BNP, the other three slums, are marginally lower than 300 µS/cm, indicating considerably lower conductivity within acceptable levels.

4.6 Variation of Colour

The slum names are listed on the x-axis, and the color levels are displayed on the y-axis is Study area.

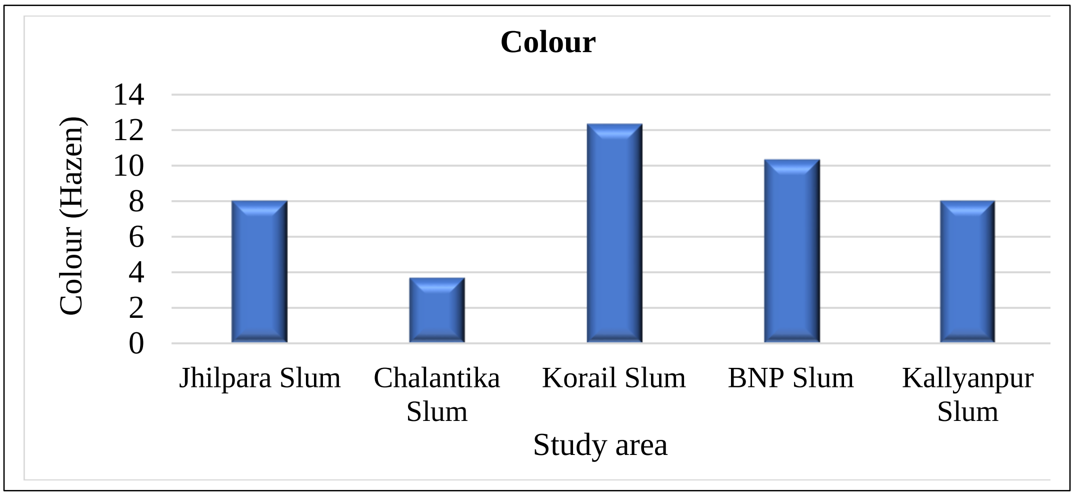


Fig.4.6 Colour Levels in Different Slum

According to the Bangladesh Standard, water may not be visually attractive if its color is more than 15 Hazen. The maximum color measurement on this chart, 12.33 Hazen for Korail Slum, is still within the acceptable range but is getting close to the upper limit, suggesting that there may be issues with contamination or appearance in Korail and BNP slums.

4.7 Variation of Total Suspended Solids

Total Suspended Solids (TSS) in mg/L for several Bangladeshi slum areas are shown in the Pie chart. The slums that are mentioned include Kallyanpur Slum, BNP Slum, Korail Slum, Jhilmil Slum, and Chalantika Slum. These are the precise values:

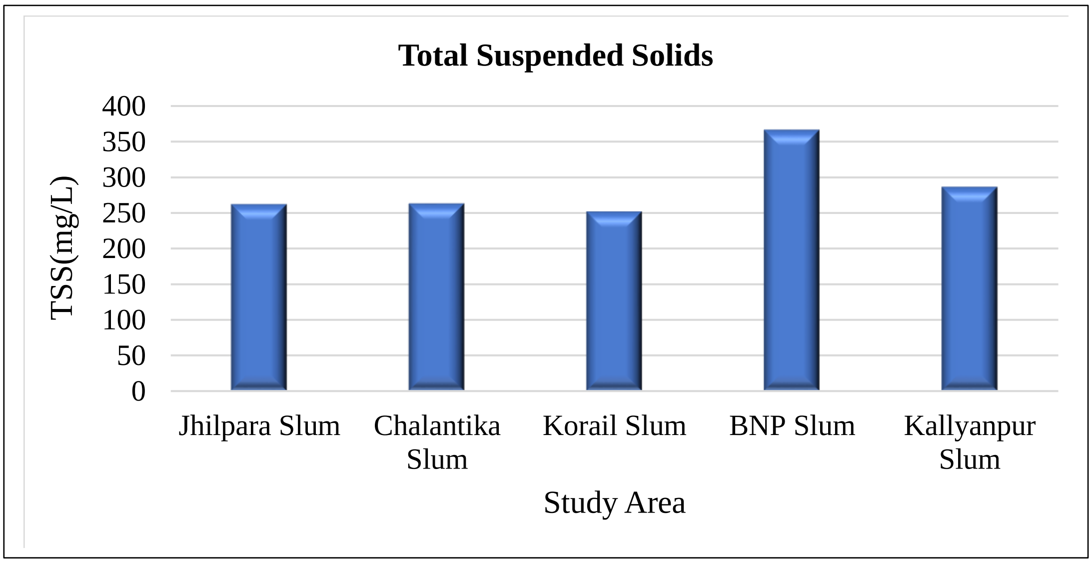


Fig.4.7 TSS Levels in Different Slum

4.8 Variation of Total Dissolved Solids

The drinking water quality of five distinct Dhaka slums is shown by the bar chart, which shows the Total Dissolved Solids (TDS) values, expressed in mg/L.

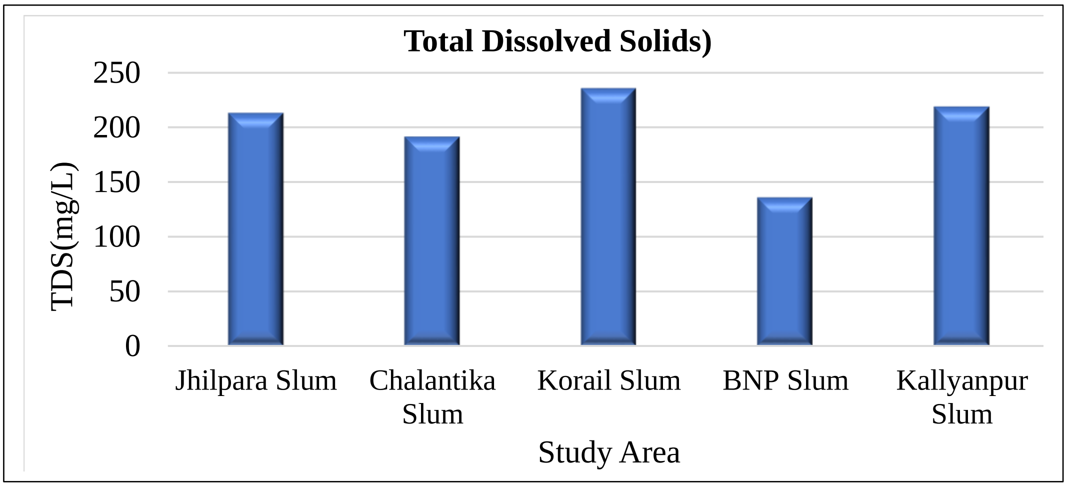


Fig.4.8 TDS Levels in Different Slum

TDS level in Jhilpara Slum: 212.67 mg/L.TDS is 191 mg/L in the Chalantika Slum. Korail Slum: At 235.33 mg/L, the TDS level is the highest.BNP Slum: At 135.33 mg/L, the lowest TDS level is recorded. The total daily dose (TDD) value for Kallyanpur Slum is 218.67 mg/L.

Bangladesh's drinking water guidelines state that for safe consumption, the allowable level for TDS is normally 1000 mg/L or below. The TDS levels displayed on the chart are all well within this upper limit. Based just on TDS levels, this shows that the water in these slums is within the safe drinking range.

4.9 Variation of E.coli

The presence of E. Coli in drinking water samples from five Dhaka City slum areas is shown in Table that is provided.

Table4.1 E.coli Test Result

Parameters	Slum Name				
	Jhilpara Slum	Chalantika Slum	Korail Slum	BNP Slum	Kallyanpur Slum
E.Coli	Present	Present	Present	Present	Absent

- E. Coli is found in the Jhilpara Slum E. Coli is Present
- Chalantika Slum E. Coli is Present
- Korail Slum E. Coli is Present
- BNP Slum E. Coli is Present
- No E. Coli is found in the Kallyanpur Slum.

E. Coli shouldn't be found in drinking water, according WHO recommendations and Bangladeshi drinking water quality requirements. E.coli is a sign of fecal contamination, which can result in cholera, typhoid, and other watery illnesses.

Based to the Table:

E. coli contamination has been found in four of the five slums (Jhilpara, Chalantika, Korail, and BNP), indicating low water quality and a significant risk of waterborne illnesses in these places. The water in Kallyanpur Slum is the only one without E. coli, which makes it somewhat safer in terms of microbiological pollution.

4.10 Variation of Arsenic (As), Lead (Pb), Nickel (Ni) and Iron (Fe).

Table 3.2 Arsenic (As), Lead (Pb), Nickel (Ni) and Iron (Fe) Test Result

Parameters	Slum Name					BD Standard (mg/L)	(WHO) Standard (mg/L)
	Jhilpara Slum	Chalantika Slum	Korail Slum	BNP Slum	Kallyanpur Slum		
Nickel (mg/L)	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.1	0.02p
Lead (mg/L)	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.05	0.01
Arsenic (mg/L)	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.05	0.01
Iron (mg/L)	0.7	0.43	0.8	0.67	0.77	0.3-1.0	0.3*

(Above the value, marked with Star (*) the taste of the drinking water may be Changed)

Arsenic, lead, and nickel levels in drinking water from five specific slum areas were analyzed for heavy metal pollution, and the results showed that the levels were below acceptable limits. In heavily populated slum regions where access to potable water is frequently impeded by problems with the water delivery system, the presence of heavy metals in drinking water can be extremely dangerous to one's health. Arsenic (As) levels are below 0.005 mg/L, which is substantially less than the 0.01 mg/L World Health Organization (WHO) standard, based on test results. Chronic arsenic exposure can cause cardiovascular problems, cancer, and negative impacts on the physical and mental development of children. Nonetheless, the present findings are positive since arsenic levels are still within the safe limit. One extremely hazardous element that is especially deadly for kids is lead (Pb). Long-term lead exposure can impair a child's ability to learn and pay attention by causing neurological and developmental problems. The test result showed a lead level of less than 0.01 mg/L, which is under the WHO-recommended limit. While this is regarded as safe, lead poisoning in impoverished neighborhoods might arise from aging water systems or industrial pollutants in the vicinity, which could present health hazards later on. Thus, it is crucial in these places to conduct routine water quality monitoring and make pipeline system upgrades.

The amount of nickel (Ni) was determined to be below 0.01 mg/L, well below the safe limit of 0.07 mg/L set by the WHO. Usually, pipeline metal alloys or industrial waste are the two ways that nickel gets into drinking water. Chronic nickel exposure raises the risk of cancer, respiratory problems, and skin allergies. The current findings indicate that even while the amount of nickel is within safe bounds, water quality has to be continuously monitored in order to avoid pollution in the future. Despite the fact that the quality of the drinking water is safe at the moment, these test findings show that further action is required to preserve it and guard against future contamination concerns. Due to outdated or broken water delivery systems, there may be more danger of contamination in slum areas where access to clean water is frequently restricted. Thus, enhancing the slums' water supply infrastructure, keeping pipes and supply systems in good condition, and educating the population about the safety of drinking water are crucial actions. Safe water supply and prevention of future pollution can be achieved via concerted efforts by NGOs and municipal governments.

4.11 Variation Types of respondents

4.11.1 Response to the Safety of Supplied Water in Slum Areas

The bar chart "The water used for drinking is safe" displays opinions on the safety of the drinking water from different Dhaka city slum neighborhoods. The proportion of participants who indicated "Yes" or "No" when asked if the water they drink is safe is displayed in the chart. These impoverished locations are depicted: Slum of Kallyanpur: No, 70.55% Indeed, 29.41%, BNP Slum Yes: 39.22% No: 68.63% ,Korail Slum: Yes: 21.57% No: 78.43%,The Chalantika Slum The largest percentage of respondents that said "No" was 92.16%. Yes: 7.48% (the least amount of respondents that said "yes"). Jhilpara Slum: No: 70.59% & Yes: 29.41%.

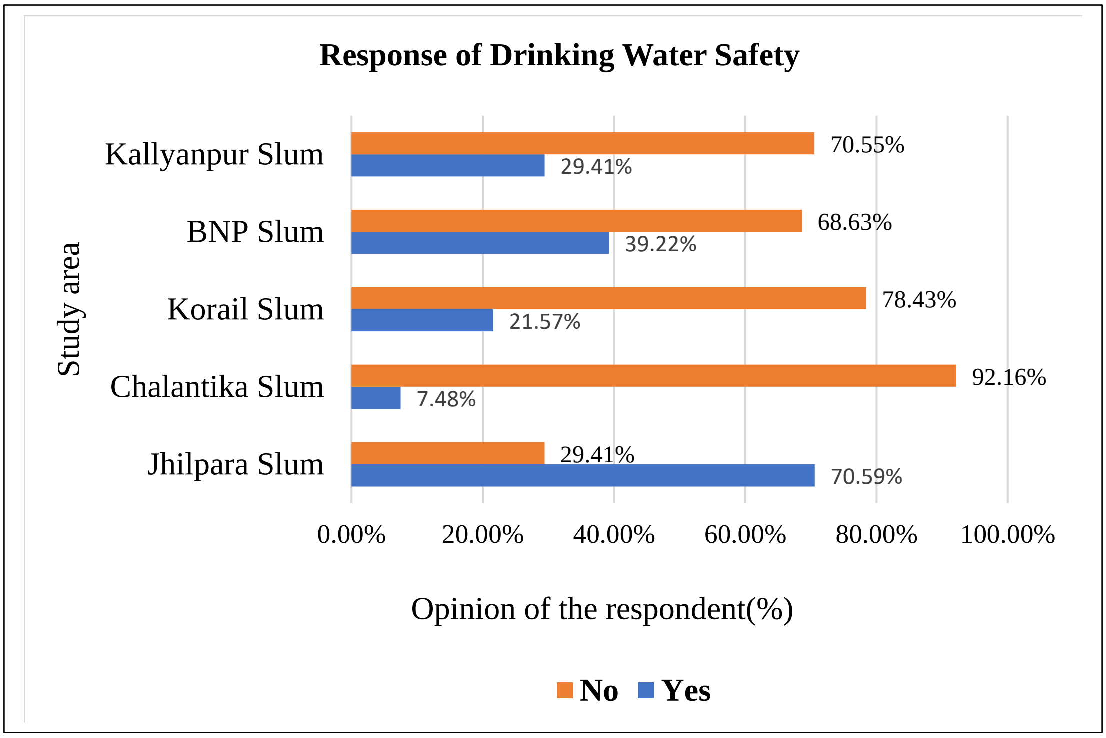


Fig.4.9 Perceived Safety of Drinking Water by Slum Area.

The greatest number of persons (92.16%) who think the water is unsafe to drink are located in the Chalantika Slum. Conversely, the largest proportion of respondents (29.41%) say that the water in Kallyanpur and Jhilpara Slums is safe to drink, albeit this is still rather low.

The data together indicates that a sizable majority of participants across all slum regions believe their drinking water to be dangerous.

4.11.2 Supply Water-Related Health Issues in Different Slum Areas

The percentage of persons reporting various health issues in various Dhaka city slum regions is displayed in the bar chart named "Water Related Health Issues". "Healthy People" (blue), "Itching" (yellow), "Typhoid" (gray), "Hepatitis" (orange), and "Diarrhea" (light blue) are the ailments that are listed. The slum areas investigated are:

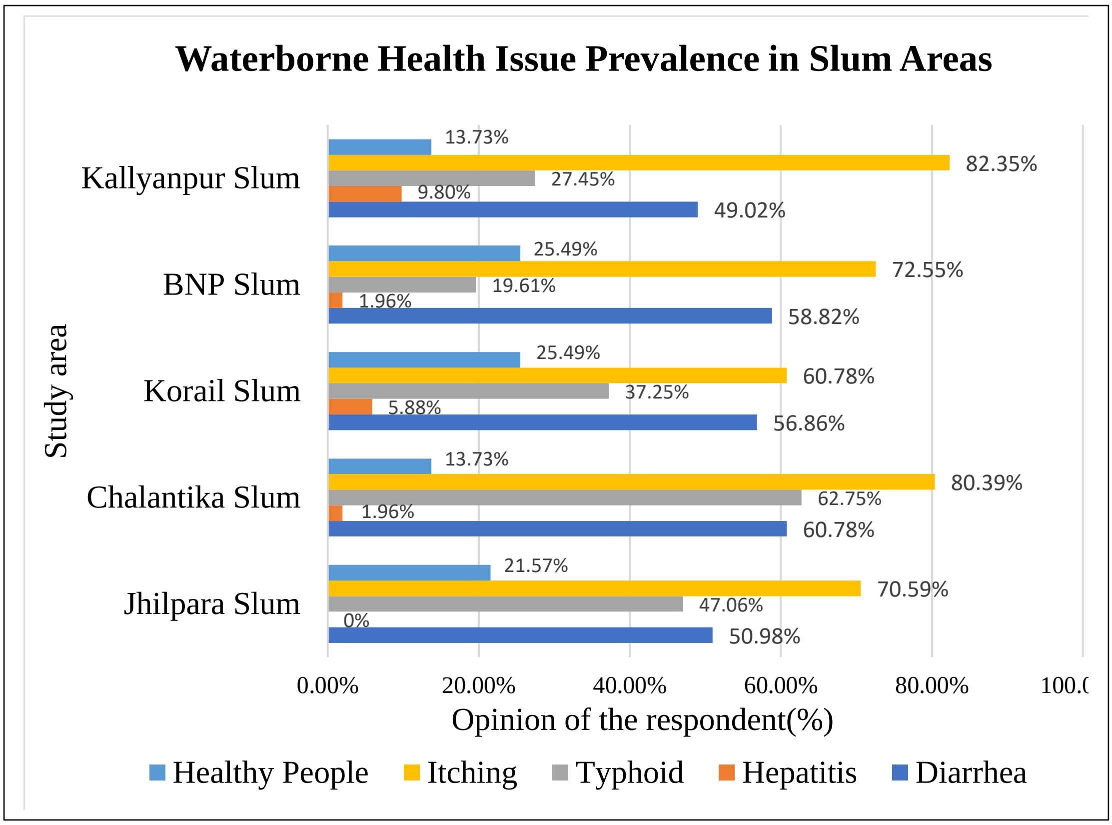


Fig.4.10 Views of Respondents Regarding Slum Area-Related Health Issues"

Throughout all slums, itching is the most prevalent health problem; in Kallyanpur (82.35%) and Chalantika (80.39%), this is especially true. Jhilpara (47.06%) and Korail (37.25%) had the highest typhoid cases recorded. Most people get diarrhea at some point in their lives, with Chalantika having the greatest prevalence (62.75%). Overall, there is a minority of healthy people; the slums of Kallyanpur and Chalantika have the lowest percentage of healthy people (13.73%).Itching and diarrhea in particular are highlighted in the chart as being highly prevalent health problems associated with water.

4.11.3 Water Supply Service Satisfaction Levels in Various Slum Areas.

The "Satisfaction of Water Supply" bar chart shows how satisfied people are with the water supply in various Dhaka city slum regions. "Very Good" (blue), "Very Bad" (orange), "Roughly" (gray), and "Bad" (yellow) are the categories for the replies. The following slums are listed in the survey: The greatest level of discontent is seen in BNP Slum, where 58.82% of respondents rated their water supply as "Very Bad."The greatest number of persons (56.86%) who thought the water supply was "bad" were found in the Chalantika Slum.Despite having a sizable portion of negative replies, Jhilpara Slum stands out with the highest "Very Good" satisfaction rate (19.61%). Korail Slum's water supply is rated as "Very Bad" by 41.18% of residents, which is a rather high level of unhappiness given the lack of "Very Good" evaluations.

The graph shows that there is general unhappiness with the water supply in all slum areas, with a significant proportion of respondents choosing "Very Bad" or "Bad" as their response.

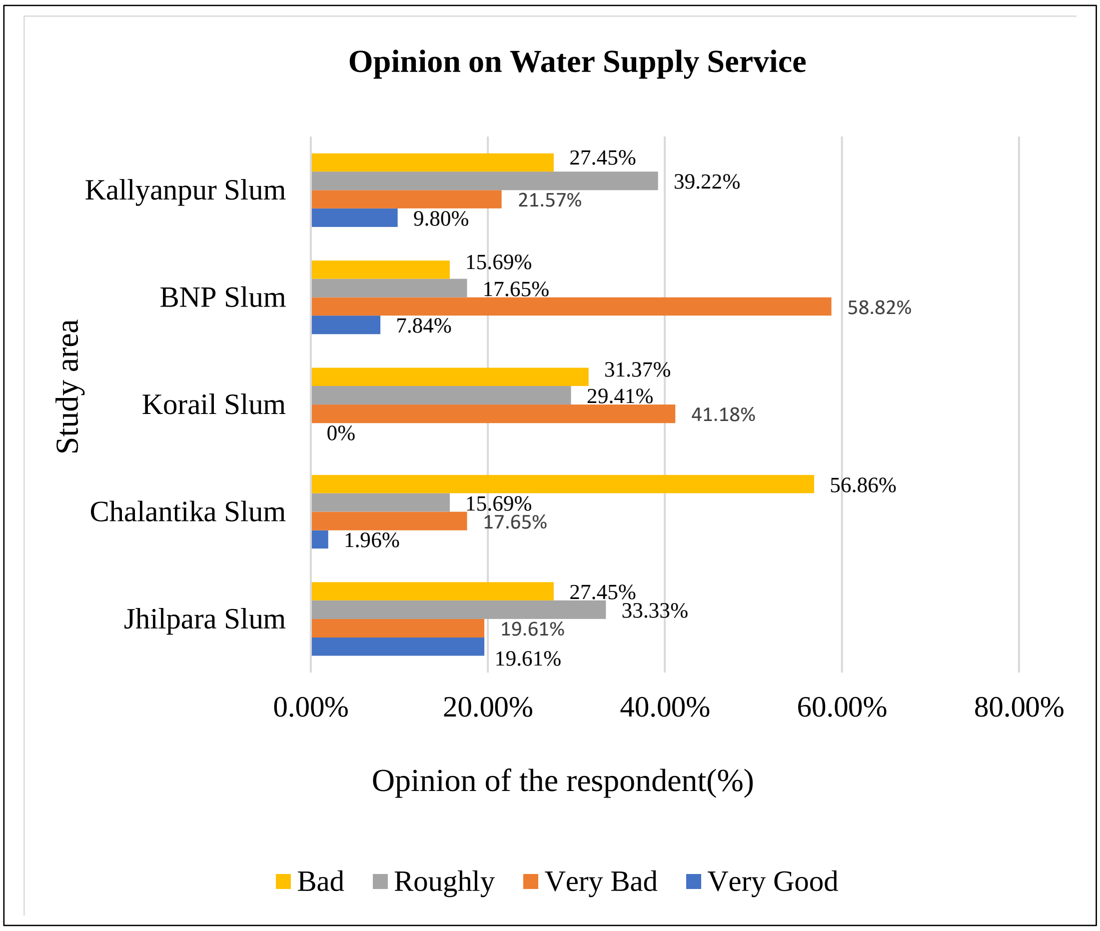


Fig.4.11 Perspectives of Respondents on Area-By Slum Area Water Supply Services"

4.11.4 People in different slum areas use various water treatment techniques.

The methods used to treat drinking water in different Dhaka city slums are displayed in the bar chart named "Treat of Drinking Water". It displays information from five slums: Jhilpara, Kallyanpur, BNP, Korail, and Chalantika. It also puts the various water treatment techniques into four categories: boiling (blue bars), filtering (gray bars), chlorination (orange bars), and direct DWASA water (yellow bars).

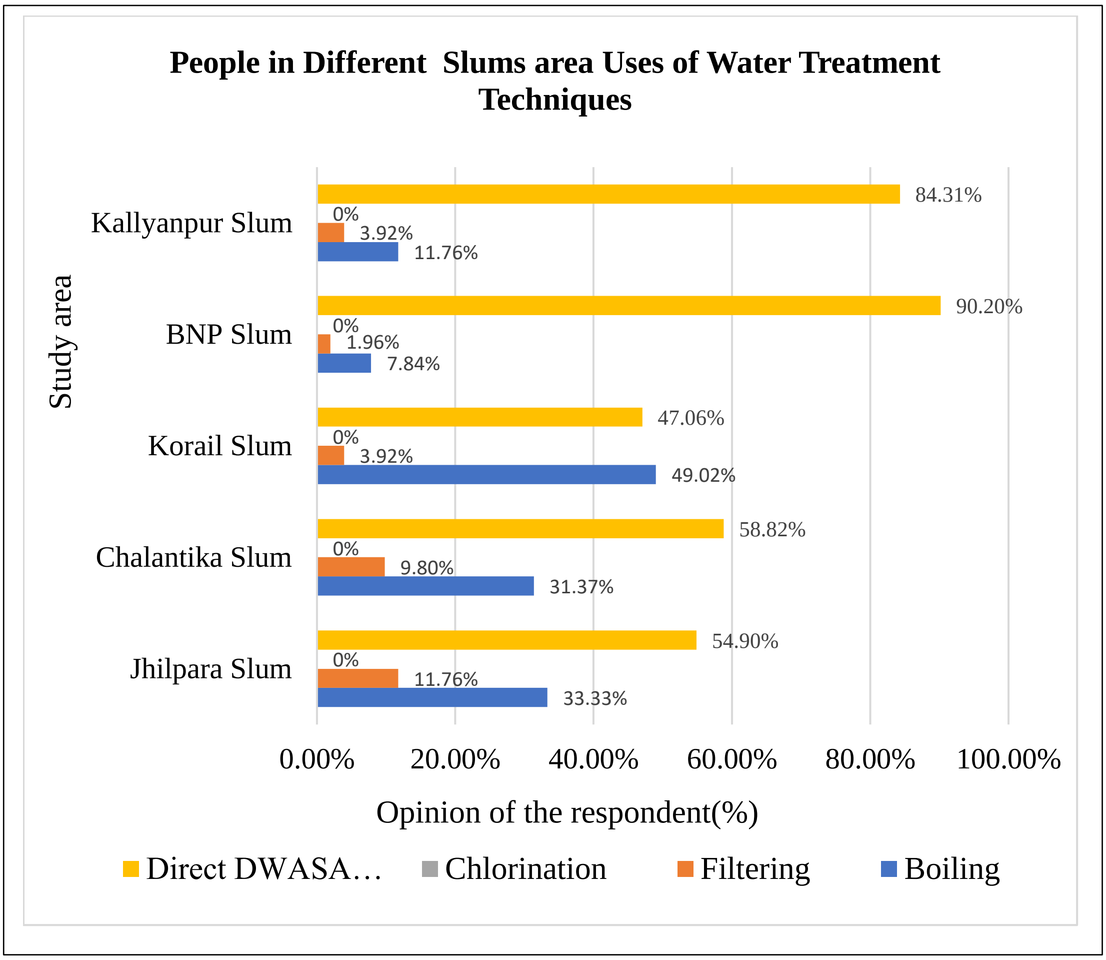


Fig.4.12 Different Slums area Uses of Water Treatment Techniques

Throughout all slums, direct DWASA water is the most common source of drinking water, with Korail Slum having the lowest dependency (47.06%) and BNP Slum having the greatest (90.20%).The second most popular technique is boiling, which is particularly popular in Korail (49.02%), Chalantika (31.37%), and Jhilpara (33.33%). In Chalantika (9.80%) and Jhilpara (11.76%), filtering is primarily utilized. The least frequent is chlorination, with trace amounts found in the Korail, BNP, and Kallyanpur slums.

4.11.5 Households Sharing a Toilet in Slum Area

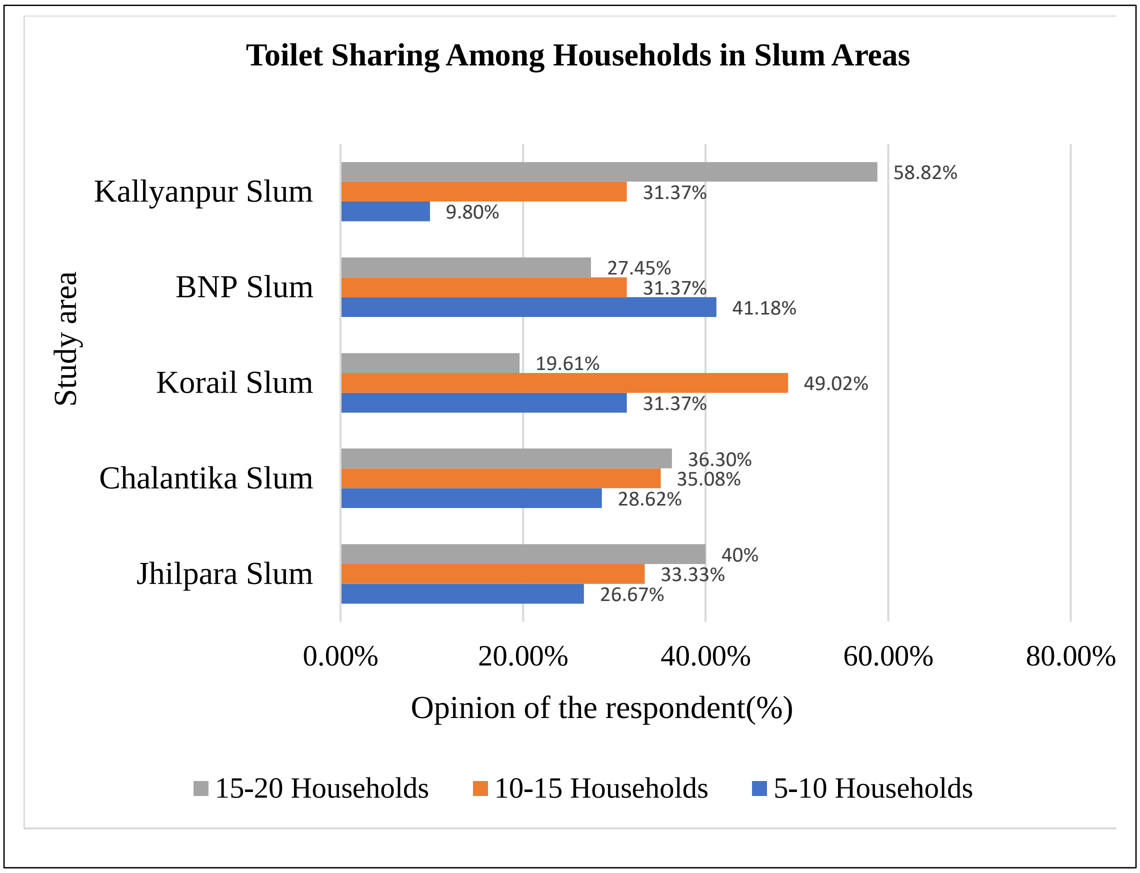


Fig.4.13 Households Sharing Toilets in Selected Slum Areas.

In the Korail and Kallyanpur slums, a significant proportion of households particularly those in the 10-15 and 15-20 family categories—share restrooms with bigger groups.While Jhilpara has a little greater percentage for bigger groups, BNP and Jhilpara slums have a more balanced distribution across the three categories. There is a similar proportion of around 25–30% for each of the three groups in Chalantika Slum.

This graphic illustrates how circumstances for sharing toilets varied between Dhaka's slum regions. Many households share a single toilet in certain slums, such as Kallyanpur, which may be a symptom of a high usage density.

CHAPTER- V
CONCLUSION AND RECOMMENDATIONS

5.1General

In the slums of Jhilpar, Chalantika, Korail, BNP, and Kalyanpur, the drinking water quality is described in this thesis. Three stations in each slum provided samples, which were then examined for a number of characteristics that are useful in determining the quality of the drinking water. A portion of these tests were carried out in a lab, while others were done on location. An understanding of the quality of drinking water and its temporal and geographical fluctuations is being gained through analysis based on the findings of these tests.

5.2Conclusion

Analyzing physical and chemical characteristics reveals differences in the drinking water quality of the slums of Jhilpara, Chalantika, Korail, BNP, and Kallyanpur. E. coli is a sign of high pollution levels, which are typically seen in slums like Jhilpara, Chalantika, Korail, and BNP. Satisfy the standard value parameters include pH, turbidity, color, total suspended solids (TSS), electrical conductivity (EC), and total dissolved solids (TDS). In Karail, BNP, and Kalyanpur slums, the temperature is higher compared to the standard values, but in Korail and BNP slums, dissolved oxygen (DO) displays higher compared to the standard values. In every slum, arsenic (As), iron (Fe), lead (Pb), and nickel (Ni) are present in BD Standard amounts. Out of the five slums, the drinking water quality is lowest in Korail and BNP slums and highest in Kallyanpur slum.

From our questionnaire survey the resident of our survey areas claim that they have ample access to water and don't complain to its amount, although they have expressed concerns about the water's quality. Particularly with the issue with color and odor. In Dhaka's slum areas, hygiene issues are critical due to inadequate sanitation facilities, lack of clean water, and poor waste management. Overcrowding and limited access to basic services exacerbate the spread of waterborne diseases and other health risks, posing significant public health challenges.

Since hygiene requirements are not fulfilled. They live in a cramped and cramped environment. They are used to acknowledging that the environment and their top worry are both on garbage disposal. The research recommends raising awareness of health, health care, and nourishment among the residents to supply enough water supplies for drinking and doing housework, be sure appropriate and long-term usage of sanitation and water and the handling of liquid in ecologically sustainable manner.

5.3 Recommendations

The drinking water quality in five slums is examined in this thesis paper. However, only three stations in each slum were examined, making it challenging to draw conclusions about the general state of the slum from the data. In addition, we questioned 51 residents of each slum as part of a survey we did on cleanliness practices there. There were 255 survey respondents in all throughout the five slums, which further complicates the process of extrapolating generalizations about the state of the slum population from this sample.

The following advice is for the future:

I. Additional stations might be installed to collect more precise drinking water quality data.
II. In this study, we examined a few heavy metals, but further testing may be conducted to better assess the quality of the drinking water and obtain more accurate results.
III. We interviewed 51 residents from each slum as part of a study on cleanliness habits among slum dwellers. However, it is challenging to obtain a precise understanding of hygiene habits due to the small sample size. A larger sample would allow us to obtain more reliable results.

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Appendix

Parameters	Jhilpara Slum				Chalantika Slum				Korail Slum				BNP Slum				Kallyanpur Slum			
	JH-01	JH-02	JH-03	Mean Value	CHA-4	CHA-5	CHA-6	Mean Value	KO-07	KO-08	KO-09	Mean Value	BNP-10	BNP-11	BNP-12	Mean Value	KA-13	KA-14	KA-15	Mean Value
pH	6.8	6.77	6.75	6.77	7	6.96	6.91	6.95	7.06	7.22	6.98	7.08	6.73	6.87	6.79	6.79	7.11	7.03	6.76	6.96
DO	5.19	5.56	4.23	4.99	4.83	5.29	4.51	4.87	5.15	6.05	7.16	6.12	6.28	5.47	7.61	6.45	6.76	7.09	4.14	5.99
Temperature (°C)	29.2	28.8	28.7	28.9	30.1	30.2	30	30.1	36.4	30.4	31	32.6	30.9	30.7	31.7	31.1	30.8	31.4	29.9	30.7
Turbidity (NTU)	2.73	2.09	1.91	2.24	0.71	2.3	0.7	1.23	0.54	2.6	4.49	2.54	3.16	2.33	0.67	2.05	1.74	0.98	2.4	1.70
EC	262	252	255	256.33	276	258	257	263.66	303	313	293	303	290	302	214.3	268.76	370	388	346	368
Colour	11	7	6	8	1	9	1	3.66	2	12	23	12.33	17	10	4	10.33	7	6	11	8
TSS(mg/L)	247	299	239	261.66	230	240	317	262.33	253	274	227	251.33	381	307	410	366	378	227	253	286
TDS(mg/L)	215	197	226	212.66	227	209	137	191	248	193	265	235.33	184	176	46	135.33	148	260	248	218.66
Fe(mg/L)	0.6	1	0.5	0.7	0.4	0.4	0.5	0.43	0.4	1	1	0.8	1	0.9	0.1	0.66	1	0.6	0.7	0.766

Table 1: Full Data sheet

Parameters	**Jhilpara Slum**	**Chalantika Slum**	**Korail Slum**	**BNP Slum**	**Kallyanpur Slum**	**BD Standards (mg/L)**	**WHO Standards (mg/L)**
pH	6.77	6.95	7.086	6.79	6.96	6.5-8.5	6.5-8.5
DO	4.993333333	4.876666667	6.12	6.453333333	5.996666667	6	-
Temperature (°C)	28.9	30.1	32.6	31.1	30.7	20°-30°C	-
Turbidity (NTU)	2.243333333	1.236666667	2.543333333	2.053333333	1.706666667	10 NTU	5 NTU
EC	256.3333333	263.6666667	303	268.7666667	368	300-800 µS/cm	1200
Colour	8	3.666666667	12.33333333	10.33333333	8	15 Hazen	-
TSS(mg/L)	261.6666667	262.3333333	251.3333333	366	286	-	
TDS(mg/L)	212.6666667	191	235.3333333	135.3333333	218.6666667	1000	-
Fe(mg/L)	0.7	0.433333333	0.8	0.666666667	0.766666667	0.3-1.0	0.3*
Arsenic (As)	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.05	0.01
Lead (Pb)	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.05	0.01
Nickel (Ni)	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.1	0.02 (P)
E.coli	Present	Present	Present	Present	Absent	-	-

Table 2: Mean Value Data sheet.

Questionnaires

Do you think the water you use for drinking is safe?		
Slum Name	**Yes**	**No**
Jhilpara Slum	70.59%	29.41%
Chalantika Slum	7.48%	92.16%
Korail Slum	21.57%	78.43%
BNP Slum	39.22%	68.63%
Kallyanpur Slum	29.41%	70.55%

Have you or anyone in your family experienced any water-related health issues in the past year?					
Slum Name	Diarrhea	Hepatitis	Typhoid	Itching	Healthy People
Jhilpara Slum	50.98%	0%	47.06%	70.59%	21.57%
Chalantika Slum	60.78%	1.96%	62.75%	80.39%	13.73%
Korail Slum	56.86%	5.88%	37.25%	60.78%	25.49%
BNP Slum	58.82%	1.96%	19.61%	72.55%	25.49%
Kallyanpur Slum	49.02%	9.80%	27.45%	82.35%	13.73%

How satisfied are you with the current water supply service in your area?				
Slum Name	Very Good	Very Bad	Roughly	Bad
Jhilpara Slum	19.61%	19.61%	33.33%	27.45%
Chalantika Slum	1.96%	17.65%	15.69%	56.86%
Korail Slum	0%	41.18%	29.41%	31.37%
BNP Slum	7.84%	58.82%	17.65%	15.69%
Kallyanpur Slum	9.80%	21.57%	39.22%	27.45%

If yes, how would you treat water?				
Slum Name	Boiling	Filtering	Chlorination	Direct DWASA Water
Jhilpara Slum	33.33%	11.76%	0%	54.90%
Chalantika Slum	31.37%	9.80%	0%	58.82%
Korail Slum	49.02%	3.92%	0%	47.06%
BNP Slum	7.84%	1.96%	0%	90.20%
Kallyanpur Slum	11.76%	3.92%	0%	84.31%

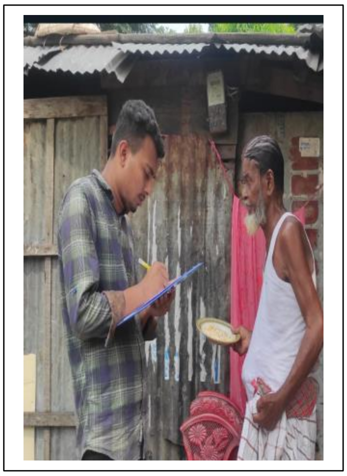
Do you treat your drinking water before use?		
Slum Name	Yes	No
Jhilpara Slum	45.10%	54.90%
Chalantika Slum	39.22%	60.78%
Korail Slum	52.94%	47.06%
BNP Slum	5.88%	94.12%
Kallyanpur Slum	15.69%	84.31%

What type of toilet do you use?			
Slum	Simple Pit	Vip Latrine	Open Dedication
Jhilpara Slum	100%	0%	0%
Chalantika Slum	100%	0%	0%
Korail Slum	100%	0%	0%
BNP Slum	100%	0%	0%
Kallyanpur Slum	100%	0%	0%

How many families use one toilet?			
Slum	5-10 Households	10-15 Households	15-20 Households
Jhilpara Slum	26.67%	33.33%	40%
Chalantika Slum	28.62%	35.08%	36.30%
Korail Slum	31.37%	49.02%	19.61%
BNP Slum	41.18%	31.37%	27.45%
Kallyanpur Slum	9.80%	31.37%	58.82%

Some Pictures of Survey Questionnaires







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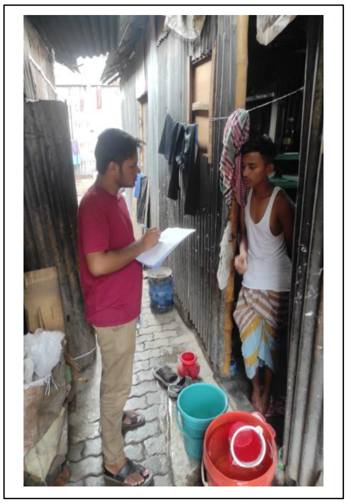

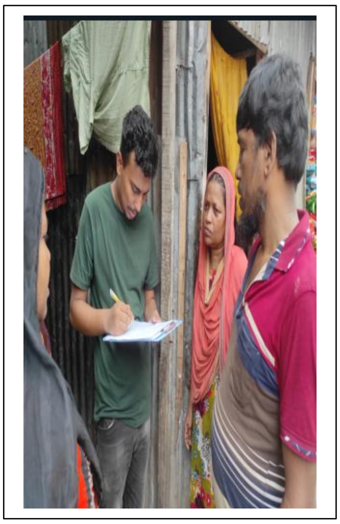
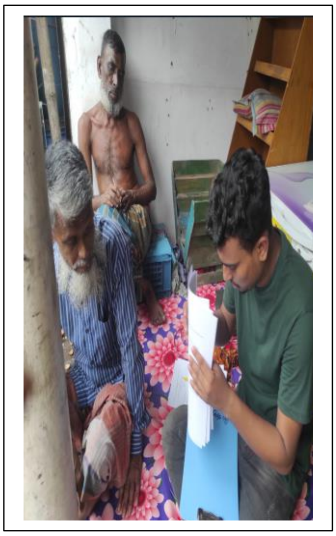

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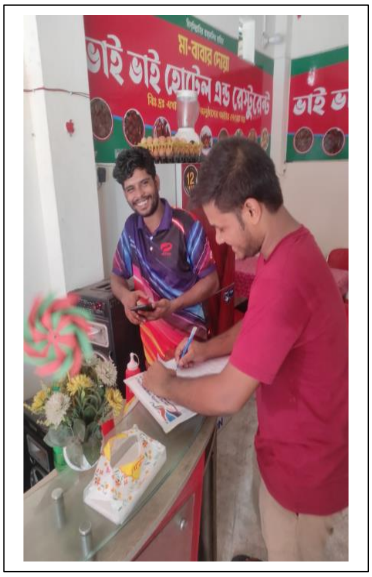

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