# A Survey to Access Household Water Quality at Narayanganj Industrial Zone

A project submitted
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*Dedicated to my parents*

## Certification Statement

This is to certify that the project titled “A Survey to Access Household Water Quality at Narayanganj Industrial Zone” submitted for the partial fulfillment of the requirements for the degree of Bachelor of Pharmacy from the Department of Pharmacy, BRAC University constitutes my own work under the supervision of **Imon Rahman**, Senior lecturer, Department of Pharmacy, BRAC University that appropriate credit is given where I have used the language, ideas or writings of another.

Signed,

_____

Countersigned by the Supervisor

_____

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## Abbreviations

DEO = Distributed Object Environment

EC = Environment Clearance

TDS = Total Dissolved Solids

DO = Dissolved Oxygen

COD = Chemical Oxygen Demand

TSS = Total Suspended Solids

WHO = World health Organization

MDG = Millennium Development Goals

UNICEF = The United Nations Children's Fund

JMP = Joint Monitoring Programme

E. coli = *Escherichia coli*

NGO = Non-Governmental Organization

BCAS = Bangladesh Center for Advance Studies

DDT = DichloroDiphenylTrichloroethane

# Abstract

Deterioration of the water quality leads towards disastrous health effects among the inhabitants of the industrial areas. This study is a brief overview on the unavailability of safe water for house hold purpose of an industrialized area named Narayanganj. The study also addresses how the health is detoriating among the inhabitants of that perticular area due to lack of safe water. Narayanganj was chosen as the study area because the city contains a number of industries such tannery industry, cement industry, brick industry, and food industry etc. A detailed questionnaire was made to find out inhabitants' opinions and complaints on supplied water quality. The study shows that 35% and 23% of the people are suffering from dysentery and diarrhea respectively due to improper quality water facilities. 90% of the people mentioned about lacking of safe water which clearly reflects the finding of the study.

# CHAPTER 1

# INTRODUCTION

## 1.1 Background of the study:

We never know the worth of water till the well is dry. Water is one of the most essential elements for life, for the survival of living being (Cabral, 2010). There should be safe, accessible and adequate availability of supplied water for a healthy lifestyle because health can become significantly benefitted by developing drinking water safety and accessibility (WHO, 2008). By drinking or using polluted water severe alteration of food chain as well as various waterborne diseases will appear which is harmful for human and is a threat for the existence of other living creatures. Every possible effort has to make to attain a safe and unharmed quality of drinking water. Quality of water refers to the standards, required to meet the primary usages of water. Water quality is highly waning due to the inevitable contamination of it through microbes, heavy metals as well as unhygienic human activities. In every aspect of human lives, water is essential in a vital manner and thus quality of household and drinking water is the basic right for every single habitat in the universe.

Access to safe water has become a matter of great struggle for people. In developed countries like Europe and North America, it is a mandatory rule to have well-treated and pure water for individual house, but it is not observed in developing countries. As a result, waterborne infections are becoming usual phenomena (Fenwick, 2006). There is no accessibility of developed sanitation for people who are around two and a half billion, and as a result of every year, the number of child mortality has become one and half million due to diarrheal diseases. According to the WHO, the death of water associated diseases exceeds 5 million people per year. From these, more than 50% are microbial intestinal infections, with cholera standing out in the first place (Grabow, 1996).

Maintaining the chemical, physical and biological integrity of water is very essential to evaluate and maintain the essential quality of both household and drinking water for safe sanitation and healthy lifestyle purposes (Bain, Bartram, Elliott, Matthews, McMahan, Tung, Chuang & Gundry, 2012). Discharge of leakage from water tanks, atmospheric deposition, industrial and domestic effluent wastes, radioactive waste, marine dumping are major reasons behind water pollution. It causes severe chemical and microbiological hazards on human health. Industrial waste as well as Heavy metals can accumulate in river and lakes after disposal. As a result, it provides detrimental effects to humans and animals. Toxins and poisonous substances in industrial waste are the major cause of reproductive failure, acute poisoning and immune suppression. polluted water can be caused by various infectious

diseases like typhoid, cholera fever etc. (Juneja and Chauhdary, 2013) and other diseases gastroenteritis, diarrhea, vomiting, skin and kidney problem are spreading through (Khan and Ghouri, 2011). Concentration of Insecticides like DDT is rising along the food chain. These insecticides are very harmful for human health (Owa, 2013).

In 2015 water quality testing became an essential element of safe drinking water which has been increasingly attaining consideration of the MDG. It is under MDG#7 and in which target 7.3 states to give the sustainable access of safe drinking water and basic sanitation to half proportion of people within 2015 (Bain, Bartram, Elliott, Matthews, McMahan, Tung, Chuang & Gundry, 2012). A World Health Organization (WHO) and UNICEF Task Force stated recently that it is "essential that new targets for post-2015 efforts should include water quality". Water testing performs a vital role in confirming the appropriate operation of water supplies, identifying the drinking water safety, examining disease outbreaks and affirming methods and preventative actions (Bain, Bartram, Elliott, Matthews, McMahan, Tung, Chuang & Gundry, 2012). There are challenges in low resource settings which is significant to implement extensive and accurate testing of water quality. As a result, most often effective decision making can't be made due to insufficient information of quality and extent provided by the water test. For the more significant part of the water-related health hazards, microbial contamination is responsible (WHO, 2008). According to WHO, using fecal indicator bacteria especially *Escherichia coli,* the microbial quality of drinking-water be examined which are chosen to detect the fecal contamination presence instead of direct pathogen identification (Bain, Bartram, Elliott, Matthews, McMahan, Tung, Chuang & Gundry, 2012). Water-borne diseases (i.e., gastrointestinal illness, diarrhea) caused by various viruses, bacteria and protozoa have been the reasons of several outbreaks. In developing countries, such as those in Africa, millions are infected by water-borne diseases. World Health Organization states that each year 3.4 millions of people, especially children has become the victim of this water related diseases (Berman, 2009). On the basis of UNICEF assessment, contaminated water results in the death of around 4000 children every year. WHO announces that around 2.6 billion people have less access to clean drinkable water, which is the primary cause of death for over 2.2 million annually and there over 1.4 million are children (Hawthrone, 2018). According to WHO, quality of water will be improved by reducing approximately 4% of the burden of global diseases (Rose, 2015).

For a well and sound life, sufficient amount of safe drinking water has become a serious prerequisite. However, not only primary reason behind the death of people, especially

children around the world can be said as a waterborne disease but also in many trade economies these it is also an essential economic blockade issue (Fawell&Nieuwenhuijsen, 2003). Natural contaminant like contaminants which are inorganic and originate from the geological ledge as well as anthropogenic pollution-causing chemicals and microbes in a varying extent can be present in water. Surface waters are more prone to contamination than groundwater. There are some sources of contamination possible which are human-made and from which one might be more important than other. It is categorized as diffuse sources and point sources (Hunter, 1997). Treatment works of a sewage system and outflow from the premises of the industries can be said as point sources. These sources are readily detectable and maintainable; on the other hand, in the case of a hard surface like roads and agricultural land runoff, it cannot be maintained merely. After a specific time, these sources could emerge the contamination load with a significant transformation (MacKenzie, Hoxie, Proctor, Gradus, Blair, Peterson, Kazmierczak, Addiss, Fox, Rose, 1994). Pathogens can be contained not only from the agriculture and industry sites where there is a possibility of chemical spilling but also from the intensive farm units containing slurries (Reeves and Lan, 1998). Septic tanks and latrines in a poor site can also become a potential source of contamination in several countries. Local industries occur odd way of chemical disposal and handling can lead the water sources to become contaminated. Blue-green algae or Cyanobacteria growth in an excessive manner is caused by surface water which is still or slow flowing of nutrient leaching or run-off. While performing treatment of drinking water, it is interfered with numerous species causing taste and odor due to the introduction of harmful chemicals (Hunter, 1997). As considering health issues with insufficient treatment, there could be a possibility of producing toxins frequently. Contamination can also be caused if there is undesired chemical residue present in the water system due to improper optimization and this could result in sedimentation into water pipes. Materials like iron became rusty and turned into iron oxides which enter into water distribution system as a pollutant and cause contamination. Diffusion can occur through plastic pipes when oil splitting occurs to the soil and thus problems of taste and odor of the water results in water contamination. While performing plumbing water get contaminated by copper or lead as a result of inappropriate connection and liquid back-flow into the distribution system which can be either microbiological or chemical contaminants.

Depending on the supply requirements as well as the vulnerability and nature of the source, treatment of drinking water is applied to supplies of public water comprising with a series of

barriers in a variety of treatment trains (MacKenzie, Hoxie, Proctor, Gradus, Blair, Peterson, Kazmierczak, Addiss, Fox, Rose, 1994). Extensively these construct systems for oxidation, filtration, coagulation and flocculation. Chlorine is commonly used as an oxidative disinfectant. Not only robust and successful barrier against pathogens can be achieved by this, but also residual measurements can be easily carried out which will play a role as an indicator of disinfection as well as a water distribution preservative. The safety of drinking water is considered on the basis of international guidelines or national standards where Drinking-Water Quality by WHO Guidelines is the most significant one of these. Numerous aspects of safety of water are described by the support of an extent of elaborated documents and constant revision (Fawell&Nieuwenhuijsen, 2003).

## 1.2 Sources of drinking water:

Surface waters (reservoirs, rivers, ponds, lakes) and groundwater is the two fundamental sources of drinking water.

**Table 1: Improved or unimproved source of drinking-water on the basis of JMP Classification**

| Source class | Source types |
|---|---|
| 1. Drinking-water source (unimproved) | Unprotected spring, Unprotected dug well, cart with small drum or tank, surface water (e.g., river, dam, stream, pond, lake etc.) and bottled water |
| 2. Drinking water source (improved) (yard or plot, piped to dwelling,) | Inside the plot or yard, dwelling of the user, there is a connection of piped water |
| 3. Other drinking water source (improved) | Tube wells, protected Dug wells, public taps, protected springs and collection of rainwater. |

**Source: Onda, LoBuglio & Bartram, 2012**

Using this approach, there are almost 5.8 billion people uses drinking water from improved sources estimated by UNICEF and WHO, whereas unimproved water sources are used by783 million (Onda, LoBuglio & Bartram, 2012). As there are some improved sources may provide water that is chemically or microbiologically contaminated whether at the time or by the source, safe water can be assured by treating the improved source which can act as an

indicator for the purpose of using safe water with overestimating the population. On the other side, safe drinking water cannot be found from most unimproved sources and as a result under-accounting of secure water coverage is hampered because of finding small amount of safe water from unimproved sources. The United Nations Children's Fund states that only 46% of the population of Kenya has access to improved water sources. Since not all water from improved sources meets World Health Organization (WHO) guidelines for potable water and since access to enhanced water may be intermittent, an even higher percentage do not have consistent access to safe water (Onda, LoBuglio& Bartram, 2012). In rural Kenya, where there has been slow progress toward improved water systems, there is another option for attaining safe water. For the people of Kenya and others throughout the developing world, safe drinking water is delivered by water treatment products in household-level which is a quick and inexpensive substitute process. Since the household-level products have health benefits and in a well-documented manner, motivating consistent use remains a significant challenge. Target 7c of the Millennium Development Goals (MDGs) of the United Nations, to halve the "proportion of the population without sustainable access to safe drinking-water" between 1990 and 2015 (Onda, LoBuglio& Bartram, 2012). The Joint Monitoring Programme for Water Supply and Sanitation (JMP) of the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) reports progress towards meeting this goal. The MDG indicator resembles that "the proportion using water from an improved source in households," and is indicated by other countries. Sources are classified as improved or unimproved as shown in Table 1, according to whether they are "protected from outside contamination." Consequently, the MDG indicator conflates access to certain water sources with the utilization of safe water. Nevertheless, the mechanisms of data and monitoring concerning water sources safety at a nationwide scale when targets of MDG were flowed and remained meager. For the measurement of a figure in percentage easily installed to the state and global scales as well as amenable for use as an objective given the sorts of information accessible, there was no authentic alternative pathway at the time when MDGs were developed (Onda, LoBuglio& Bartram, 2012).

The estimated proportion of the global population and the types of an improved source using these as their primary source of drinking water.

**Table 2: Types of improved drinking water source**

| Source Category | Description |
|---|---|
| 1.Standpipe | People can collect water from standpipe or public tap from the public water point. It is also known as a public tap or public fountain which can have one or more taps. These are typically made of masonry, concrete or brickwork. |
| 2. Protected dug well | Protected dug well works to protect from runoff water by a casing or well lining that is elevated above platform and ground level by which spilled water is diverted away from the well. It is also covered to protect the dug from bird droppings and animal falling into the well. |
| 3.Yard connection or Household | Household connection, also called Piped water into dwelling, can be defined as a connection of piped water service with in-house. It is plumbed to one or more taps. Yard connection also called Piped water to yard/plot can be defined as a connection of piped water to tap outside the dwelling which is situated in the plot or yard. |
| 4.Rainwater | It is a process where rain is harvested or collected from surfaces and reserved in a tank, cistern or container to use |
| 5.Borehole | Borehole or tube well is a deep hole that has been bored, drilled or driven with the objective to reach groundwater supplies. Casing or pipes are used to construct boreholes/tube wells which obstruct the hole of small diameter from dent in and secure the source of water by runoff water from infiltration. |

**Source: Bain, Bartram, Elliott, Matthews, McMahan, Tung, Chuang & Gundry, 2012**

Modern day technologies are vastly used as water quality monitoring systems. Environmental researches have shown impurity in supplied water to be one of the predominant problems and thus resulting in the deterioration of water quality. This occurs due to the presence of infectious agents or widely known as virus or bacteria. Various chemical substances are equally responsible for the spoilage of ideal water constitution. Safe water supplies and consumption is still defective without the proper storage systems and without adequate authorization regarding containers as well as handling issues. Many communicable diseases

can be managed effectively by improving the sanitation and hygiene water usage practices (Bain, Bartram, Elliott, Matthews, McMahan, Tung, Chuang & Gundry, 2012).

## 1.3 Microbial contamination:

Water is getting highly polluted through various agents decreasing the quality of it and making our daily lives harder to even survive. Pathogens, basically the microorganisms are causing fatal diseases through their sheer presence in drinking and household water. Microfungal contamination of water is not only getting through our casual lives but also our bloods to suck out our basic immune system and paralyze antibodies to fight against the microbes (Rahman and Paul, 2011).

The diarrheal disease caused by pathogens is the most significant aspect of drinking water quality due to contamination. The problem originates as a result of impurity of water by fecal matter containing pathogenic organisms, especially in human fecal matter. In nineteenth century, there was a prevalence of diseases like cholera and typhoid type waterborne disease and greatly affected the cities in Europe and North America (Fawell&Nieuwenhuijsen, 2003). It is a serious cause of disease in the developing world. Hence, it is necessary to treat drinking water by killing pathogens to break the cycle of fecal-oral. It can also be done by obstructing fecal matters to water sources. However, hand washing and other hygiene practices can be good approaches to minimize the spreading capacity of infection from person to person (Fawell&Nieuwenhuijsen, 2003).

Contaminated water bodies contain various inorganic and organic matters. The changes of temperature can pollute water. Thermal pollution can be commonly caused by industrial manufacturers and power plants due to utilization of water as coolant. The specific contaminants leading to pollution include a full spectrum of chemicals, pathogens, and physical changes such as elevated temperature and discoloration (Cabral, 2010). While many of the substances that are regulated may be naturally occurring such as calcium, sodium, iron, manganese, etc. The natural material of water from the contaminant usually segregated and analyzed by the concentration. Water which is used can be negatively affected by natural substances of high concentration. Pathogens can be harmful for our body. Bacteria release toxins and viruses damage our cells. Pathogenic bacteria contribute to different globally significant diseases, such as pneumonia, which can be caused by bacteria such as Streptococcus and Pseudomonas. Different food borne illnesses can also occur which can be

caused by bacteria such as Shigella, Campylobacter, and Salmonella (Cabral, 2010). Examples of pathogens are stated below.

- *Burkholderiapseudomallei*
- *Cryptosporidium parvum*
- *Giardia lamblia*
- *Salmonella*
- *Parasitic worms* includingthe *Schistosomatype*
- *Listeria* and viruses such as *Cryptosporidium* (Cabral, 2010).

**Table 3: The primary bacterial diseases transmitted through drinking water.**

| **Disease** | **Causal bacterial agent** |
|---|---|
| Cholera | *Vibrio cholerae*, serovarieties O1, and O139 |
| Gastroenteritis caused by vibrio | Mainly *Vibrio parahaemolyticus* |
| Typhoid fever and other severe salmonellosis | *Salmonella enterica*subsp. *entericaserovarParatyphi* *Salmonella enterica*subsp. *entericaserovarTyphi* *Salmonella enterica*subsp. *enterica*serovar*Typhimurium* |
| Bacillary dysentery or shigellosis | *Shigelladysenteriae* *Shigellaflexneri* *Shigellaboydii* *Shigellasonnei* |
| Acute diarrheas and gastroenteritis | *E. coli*, particularly serotypes such as O148, O157, and O124 |

**Source: Cabral, 2010**

Organic water pollutants include:

- Detergents.
- Food processing waste, which can include oxygen-demanding substances, fats and grease.
- Disinfection by-products found in disinfected drinking water, such as chloroform.

- Insecticides, a massive range of organ halides and other chemical compounds
- Pharmaceutical drugs and their metabolites including hormonal medicines (e.g., contraceptive pills) or antidepressant medications. Without costly upgrades, these molecules are small as well as challenging for treatment plants to dispel.
- Petroleum hydrocarbons, including fuels such as, gasoline, diesel fuel, jet fuels, and fuel oil and lubricants such as, motor oil, and fuel combustion byproducts, from storm water runoff.
- Organic compounds which are volatile (Industrial solvents from inappropriate storage)
- Trichloroethylene
- Perchlorate
- Various chemical compounds found in personal cosmetics and hygiene.
- Polychlorinated biphenyl (PCBs)

Chlorinated solvents don't mix well with water thus fall to the bottom of store and become denser. These are dense liquids with non-aqueous phase (Zhu & Yang, 2014).

Inorganic Water pollutants include:

- Ammonia from food processing waste
- Fertilizers containing nitrates and phosphates used in agriculture and also commercial and residential use.
- Chemical waste as industrial by-products
- Heavy metals from motor vehicles and acids.
- Creosote preservative is secreted into the aquatic ecosystem.
- Bromate
- Antimony
- Arsenic
- Copper etc. (Zhu & Yang, 2014).

Therefore, various other factors are also responsible for water getting polluted. Human handlings can be one of the primary reasons behind it. Principal transmission routes of infectious diseases can occur because of unhealthy usages of water by the consumers.

## 1.4 Chemical contaminants:

Human body uses water in all its cells, organs and tissues to help regulate its temperature and maintain all our bodily functions. Waterworks as a solvent which transports several essential molecules and particles to the blood around the body. 70% of our bodily organs are made entirely of water. So it is needless to say, that water forms the basis of our body and it can destroy our regular blood circulation due to unusual constituents on it, as waste products of contaminated water (Chorus and Bartram, 1999)

It is essential to know the probable risks of consuming contaminated water to protect people from further diseases and take necessary precautions. From different pollutants, different diseases can breakthrough in a deadly way. Vast discussion regarding this is provided below (Lautenberg, 2016).

Chemicals in the water can have negative effects on health. Human body can be affected by the chemical toxicity. When the body takes up the substance, the structure of the chemical substance might be changed or metabolized to more or less toxic. For example, carbon tetrachloride, once a commonly used solvent, is changed by the body into a more toxic chemical that causes liver damage. For some other chemicals, metabolism changes the chemical into a form that is more easily eliminated by the body. Exposure to chemicals occurs when we touch or drink water or any food made of contaminated water. Chemicals can affect any system of the body including nervous system, digestive system, respiratory system, and even the reproductive system. Leakage of chemicals can contaminate groundwater or nearby wells and basements from landfills. As a result, if it is being untreated for a long time without any preventive actions, the people will consume the water which can lead them to different life-threatening diseases (WHO, 2003)

There are many sources of chemical contaminants in drinking water.

***1. Arsenic:*** Bangladesh and Bengal side of the Indian subcontinent, South America as well as the Far East around the world is the location where diseases are caused by arsenic. When human is exposed to it by drinking contaminated water will be followed by cancer. Exposure to arsenic not only causes peripheral vascular disease and hyperkeratosis like adverse effects but also a reason behind cancer of liver, lung, bladder and skin. Long-term exposure to arsenic from drinking water and food can cause cancer and skin lesions (IPCS, 2001). Significantly thickening and arsenic-contaminated drinking water can cause pigmentation of

skin in drinking water. Arsenic exposure can result in cancer in the skin, lungs, bladder and kidney. Arsenic causes Vomiting, nervous system damage and several other symptoms which are stomach related with large amount but in a short period of time. However, many local factors along with nutritional status are demonstrated by the epidemiological data as significant. Assessing exposure of arsenic has some difficulties which should be brought under consideration. Due to millions of wells are placed in Bangladesh with a short distance between the wells, there is a possibility of varying arsenic concentration in a significant manner (IARC, 2003).

***2. Fluoride:*** In Africa, Indian sub-continent and the Far East, Fluoride is another life-threatening waterborne disease. The range of fluoride concentration can be exceeded up to 10 mg/l (IPCS, 2002). Dental fluorosis which is an unsightly condition of mottling teeth due to high fluoride intake. If it goes higher, the density of bone will be increased due to skeletal fluorosis. This can also lead to deformity of fractured and crippling skeletal. Excessive amounts can make teeth yellow and cause damage to the spinal cord. Fluorides can cause lung and bladder cancer. There can also be an association between the consumption of fluoridated water and hip fractures. It can even enhance risks of spontaneous abortion or congenital malformations (WHO, 2003).

***3. Selenium and uranium:*** After consumption of drinking water, some adverse effects have been observed on human body due to selenium and uranium. Decreased prothrombin time as well as changed peripheral nerves is two serious effects among selenium adverse effects. There are several skin problems, nails weakening and hair loss which can also be considered by adverse effect due to selenium intake (Barceloux, 1999). In groundwater, uranium is mixed with rocks, especially granitic rocks as well as deposits of other minerals. It is a toxin in the kidney which is connected with increased excretion of fractional calcium as well as microglobulinuria in an increased manner in spite of normal range being observed in the population. Considering the exposure through drinking water, uranium is a recent topic which has more scope of research (WHO, 2003).

***4. Iron and manganese:*** Manganese and iron can cause harmful contamination of water in high concentration if the source is anaerobic. They become oxidized to form low soluble oxides when there is aeration of water; thus turbidity and discoloration is observed particularly. Though there are some supplies which can be used as a substitute by the

consumers but those supplies are considered aesthetically safe but not microbiologically (WHO, 2003).

**5. *Lead:*** Human body consumes lead which is then distributed to the liver, kidney, bones and brain. It is reserved in the bones and teeth and keep accumulating over time. The amount of lead is measured in blood to assess the exposure of lead in human body. It can accumulate in the body and thus damage the central nervous system. Lead is a cumulative toxicant and can cause great hamper to human health. The toxicity affects children's health with serious consequences. Lead exposure also causes anemia, hypertension, renal impairment and toxicity to the reproductive organs (Lautenberg, 2016).

**6. *Agricultural chemicals:*** Another source of chemical contamination is agriculture. Nitrate is the most significant contaminant here which has a bad impact on the formula milk of the babies. It causes ''blue baby'' syndrome in the brain by restricting oxygen, in bottle-fed infants under three months of age (Fan and Steinberg, 2001). It can cause headache, dizziness, nausea, flushing, skin irritation, low blood pressure, itching and increases burning and tingling under the tongue. Infection caused by microbial contamination is a significant risk factor. According to WHO Guideline, the value of nitrate should be 50 mg/l. But after the study, it is seen that above 50-100 mg/l is greater observed than below 50 mg/l (Avery, 1999). Moreover, pesticides can damage the nervous system and cause cancer because of the carbonates and organophosphates that they contain. Different studies have been carried out analyzing the effects of pesticide exposure on neurological function. Chlorides can cause reproductive and endocrinal damage. High intensity and cumulative pesticide exposure contributes to depression among pesticide applicators. Exposure to pesticides can cause hormonal disorders. It also increases risks in respiratory systems (Fawell and Standfield, 2001). Pesticides exposure can contribute to risks in diabetes. Different life threats associated with pesticides are classified based on long-term effects (such as cancer, diabetes, neurological deficits, skin diseases, genetic disorders, depression or even death) and short-term effects (such as abdominal pain, vomiting, diarrhea, nausea, headaches, etc.) (Pesticide action network UK, 2017)

**7. *Urban pollution:*** A potential source of contaminants are human and industry dwellings in which solvents and heavy metals are common such as trichloroethene or tetrachloroethene that are collected from petroleum oils particularly or from groundwater sometimes (WHO, 2003). These pollutants occur at a certain concentration to interfere health. Moreover, there

are some aromatic hydrocarbons which contain low molecular weight creates intense problems of odor in drinking water (Fawell&Nieuwenhuijsen, 2003).

***8. Endocrine disrupters:*** Chemicals that interfere with the endocrine system (e.g., imitative natural hormones) are known as endocrine disrupters. This endocrine disrupter has numerous adverse effects which are linked with reproductive system such as hypospadias, declining sperm count, cancer of the testes and breast and cryptorchidism, etc. (Joffe, 2001). Alkylphenols, bisphenols, alkyl phenol, phthalates, polyethoxylated, ethoxylates, human hormones, pesticides, and pharmaceuticals have all been involved and sewage flowing released to surface water has been observed to contain numerous substances. As sewage effluents are received by some surface waters, it can be used as sources of drinking water afterward (*i.e., water re-use*), most importantly if the water is appropriately treated; thus the harmful substances will be removed (Fawell and Chipman, 2000). Though there is a report based on the effect on sewage effluent exposure to fish and other wildlife but having rare evidence on tap drinking water consumed by humans till now (Fawell&Nieuwenhuijsen, 2003).

## 1.5 How Water Quality should be controlled:

The measurements of water quality is as important as maintaining its purity for safe household management. To avoid contamination and maintain the ideal standards, it is essential to focus on the handling of surface water sources. It is found from various researches that about 171 million people are using surface water directly as the primary source (Kuberan, Singh, Kasav, Prasad, Surapaneni, Upadhyay and Joshi, 2015). Evaluating the exact amount of unhygienic water getting used for household purposes is perhaps an alarming sight. From poverty in rural areas to an unhealthy lifestyle in affluent cities, people are profoundly indifferent to the after effects of consuming contaminated water (Zhu and Yang, 2014).

Water quality can be controlled through the proper knowledge of water sources among the world and using the appropriate guidelines for diminishing the leading causes of water contamination. From the location of water resources around the world, we can see that only3% of the Earth's water is fresh water. Most of it is in icecaps and glaciers (69%) and groundwater (30%), while all lakes, rivers, and swamps combined only account for a small

fraction (0.3%) of the Earth's total freshwater (Bain, Bartram, Elliott, Matthews, McMahan, Tung, Chuang & Gundry, 2012).

The typically designed usages of water are:

- Maintenance and extension of wildlife, fish and shellfish,
- Recreation, public drinking water supply,
- Agricultural,
- Industrial,
- Navigational,
- Household usages and other purposes (Trevett, carter and tyrrel, 2004)

## 1.6 Water quality of Shitalakhya River in the context of Bangladesh:

Bangladesh is called the land of rivers. There are almost 800 rivers in which 405 rivers are considered significant. The total length of waterways is nearly 24,140 kilometers (Banglapedia, 2014). Major rivers in Bangladesh for example, Turag, Buriganga, Shitalakhya, Balucan be considered as the most poisonous and polluted river due to the establishment of industries nearby (Islam MS, 2011). These river waters are constantly being contaminated by blind discharge of commercial and pathological wastage, partially treated or untreated sewage effluents, untreated wastage from adjacent industries well as residential area, polluted runoff of surface sewage and some other industrial and domestic wastage. Numerous reports are available based on the reasons and solutions of water pollution and their reduction, but no detail study has been done before in the industrialized zone of Narayanganj area to observe the sources of household water and safe drinking water availability. There are some major ionic constituents, contents of trace metals from surface and ground water and various physical parameters are assessed by which numerous studies have been conducted before to figure out the presence of heavy metals in the major rives and canals. And from the reports it is seen that Turag, Shitalakhya, Buriganga, Tongi and Balucan in Dhaka city are found with a huge amount of domestic wastage, industrial liquid effluents and untreated sewage which is one of the major reasons behind surface water contamination (Rahman S, Khan MT, Akib S, Biswas SK, 2013). Therefore, this study will be one of the first attempts to indicate the safe water sources availability in the industrialized zone like

Narayanganj located near Shitalakhya River and observe the pattern of diseases in the affecting area caused from the contaminated water use.

In Narayanganj, Shitalakhyais the river which is regarded as one of the feeders of Brahmaputra. For the muslin industry, Narayanganj was very popular in the past. The stream of the river is the southwest direction at the initial stage. After that, it shifts its course to Narayanganj in the east and Dhaleswari near Kalagachhiya afterwards. The river is almost 110 kilometers or 68 miles long near Narayanganj in length and having 300-meter width. While measured at Demra the stream of the river is found 74 cubic meters per second (Majumdar, 1971). Already the route of Shitalakhyahas been shifted twice. Because of this significant change, the stream of water has been affected indirectly. In the 21st century, the flow of the Brahmaputra was carried away by the channel of Jamuna River. Before that, it took a route to near the Garo Hills in the west and then shifted to the south-east part Dewanganj. The branch of Shitalakhya was created while moving Mymensingh and Jamalpur area as well as it happened when the mainstream of Brahmaputra leads to the Dhaleshwari. The Shitalakhya River consorted the Brahmaputra and then fell into Dhaleshwari (Murshed, 2012). Because of this significant location, at the bank of the Shitalakhya River, many factories and industries are established. However, these industries do not even follow or practice the treatment method of wastewater and toxic water. As a result, by the improper discharging process, a massive amount of toxic and wastewater mixed up in the Shitalakhya River directly or sometimes indirectly. Besides, household and municipal sewage sludge from the Narayanganj urban areas are mixed up with this river without being treated. The people who are living near the Shitalakhya River hugely dependent on the water for various household activities such as bathing, cooking and cleaning purposes of their day to day life. Hence, the dominance of pollution is rising at a higher rate day by day due to the heavy metals as well as various toxic substances are carried out by the industrial wastes and effluents (WARPO,2000). Poisonous substances containing the agrochemical wastes get accompanied with germs as well as various nitrogenous elements. These harmful elements significantly affect Shitalakhya River, and as a result, the river becomes liable to behaves as their sink.

Furthermore, the people living in the slums nearby the river causes pollution to the river system by making unhygienic toilets which have consequences of carrying out various harmful micro-organisms creating severe environmental hazards to the aquatic life as well as causing numerous human health-related problems (Ahmed and Reazuddin, 2000). Data

shows that the dissolved oxygen concentration in the Shitalakhya River varies from 2.1 to 2.9 mg/l which is monitored by the DOE (Saad, 2000). The data is also informed that from 1981 to 1990 the Ph ranges was between 7.1 to 6.5. BCAS data showed that the EC was 110 mg/l in Shitalakhya River before 1998, but it increases up to 140 mg/l during 1998 because of the detrimental agricultural activities and industrialization (BCAS, 2000). It is also seen that the TDS rises from 216 to 446 mg/l. Because of different leather and textile industries, the standard limits of DO, COD and TSS had been surpassed which dump their chemical wastes and effluents in the Shitalakhya River. As well as, the concentration level of lead, cadmium, zinc and chromium were also higher than their allowed limits (BCAS, 2000). In Dhaka city, some studies have been carried out in Bangladesh to figure out about the river water deterioration with sediments and chemical properties (Ahmed and Reazuddin, 2000). Several current studies demonstrate that the industrial trace metals and effluents profoundly affected the different rivers of Dhaka city where Shitalakhya River is the most important one. Also, influences of anthropogenic sources of the river have been examined by environmental conditions. A study was held in 2007 regarding the water quality and risk assessment of Shitalakhya River due to the impact of industrial effluents (Pia, Akhter, Sarker, Hassan, Rayhan, 2018).

Further studies should be conducted based on the exposure of chemical contamination on the affected area as well as a comparison based on different parameters among the standard and existing limits. As a result, there would be a clear scenario of chemical analysis of the Shitalakhya River water bodies by assimilating the existing limits and standard limits as well as the risk factors of agro-ecological conditions of Shitalakhya River. Also, it will open the window to know of water pollution and possible detrimental consequences of Shitalakhya River as well as to examine the extent of contamination is being expanded and the condition of the people living in that affected area.

# CHAPTER 2

# METHODOLOGY

## 2.1 Research Objectives and Goals:

The main objective of the research is to understand the overall view of quality of drinking water in Narayanganj district. Therefore, the main research goal was to know the possible causes behind degradation of the quality of water and possible diseases that people may have in because of lack of safe drinking water.

## 2.2 Research Design and Methods:

Research was designed in 3 steps. Firstly, extensive literature review was done to understand the overall condition of drinking water in Bangladesh especially in Narayanganj district. We choose Narayanganj because there is a presence of lot of industries such as tannery industry, cement industry, brick industry, and food industry and so on. All of the waste is going to the river Shitalakhya directly. So, we choose the locality near Shitalakhya River for conducting the research. Secondly, indemnification of the water source and GPS tacking of the locality of our study area was done to validate our research. In this step we narrow down our study area for conducting the detailed survey. Lastly, a detailed questionnaire was made to get the overall idea which clearly shows the condition of drinking water of this area and also describes the diseases that they have because of this unsafe and polluted water.

A total of 300 participants filled the survey and 250 were found as completely validated. The data that we collect from the study area was analyzed by using SPSS V 21.

## 2.3 Research Questions:

20 research questions (RQ) were compiled during the preparation of the questionnaire, which are as follows:

RQ 1: What is your Gender?

RQ 2: What is your profession?

RQ 3: What is your monthly income?

RQ 4: Where do you collect your drinking water?

RQ 5: Where did you collect water when there was no tube well?

RQ 6: Is water available throughout the year in your tube well?

RQ 7: Is the water safe?

RQ 8: What do you use to collect water?

RQ 9: How many times women collect water every day in average?

RQ 10: What kind of troubles you face while collecting water?

RQ 11: What condition of water or water related problems are found in the water source you use?

RQ 12: Any government or non-governmental organization worked to solve drinking water problems?

RQ 13: In which purposes you use water?

RQ 14: Do you have any other water related problems in your house?

RQ 15: Mention waterborne diseases in your house for last one year

RQ 16: What kind of measures you have taken to get rid of these diseases?

RQ 17: Do you use any method of water purification?

RQ 18: Do or did you collect rain water?

RQ 19: What kind of environmental problems are associated with the water of your area?

RQ 20: Where do you collect water during disaster?

# CHAPTER 3

# RESULT AND DISCUSSION

In this study, the male and female participants are respectively 169 and 81. A total of 300 participants were taken initially but there were some unfilled questionnaire and that was not validated and was not for our use. Lastly, 250 participant's answer was found as completely validated. The percentage of male participants is about 68% and female participants are about 32%.

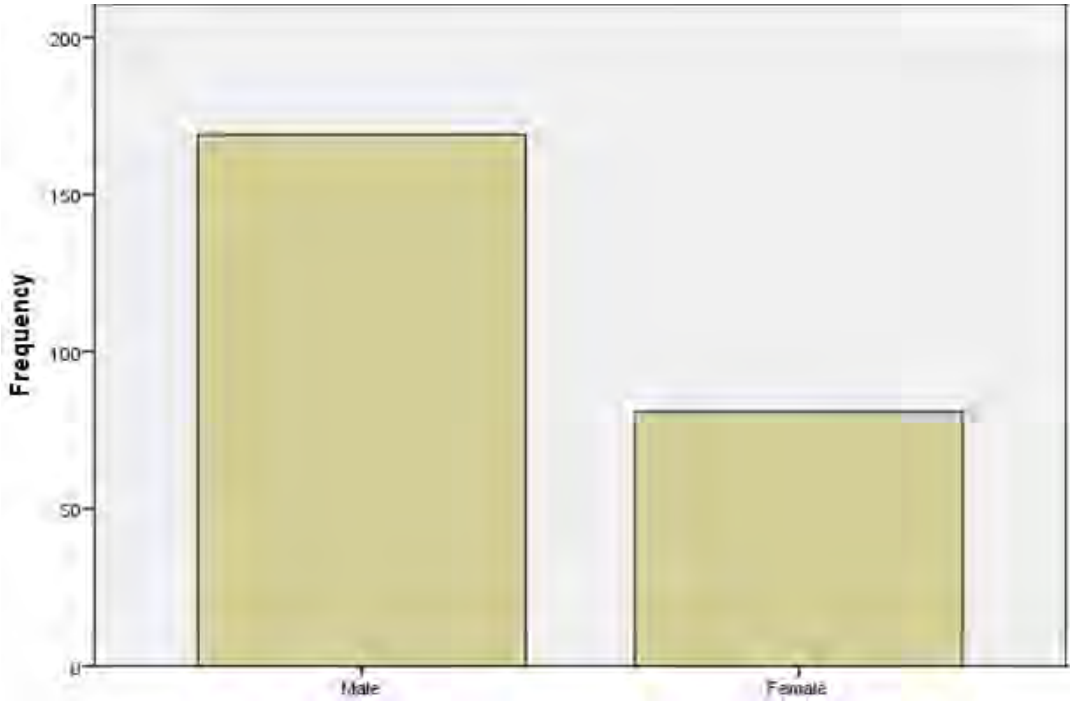


**Figure 1: What is your gender?**

**Table 4: What is your gender?**

| | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Male | 169 | 67.6 | 67.6 | 67.6 |
| Female | 81 | 32.4 | 32.4 | 100.0 |
| Total | 250 | 100.0 | 100.0 | |

A variety of people with a variety of profession lived there. While doing our survey it is found that people with various professions such as: daily labor, rickshaw puller, housewife, fisherman, mechanic, boatman, driver, shopkeeper, boatman and so on. About 13 % of them are by profession is a day labor and most of the women we found is housewife and it is 32.4%.

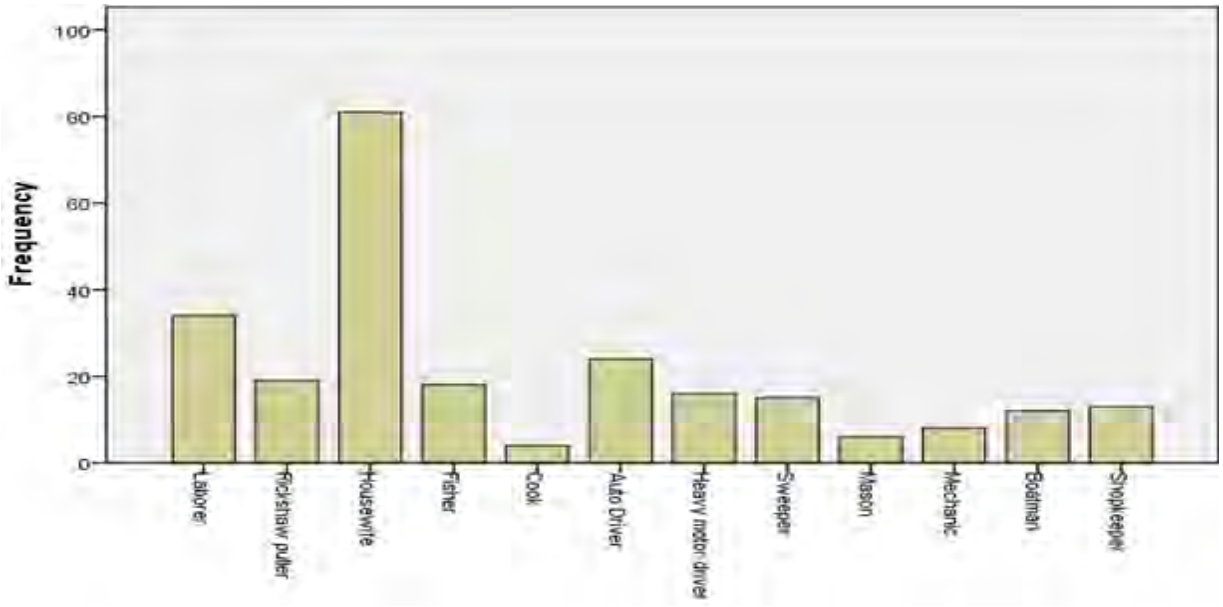


**Figure 2: What is your profession?**

**Table 5: What is your profession?**

| | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Laborer | 34 | 13.6 | 13.6 | 13.6 |
| Rickshaw puller | 19 | 7.6 | 7.6 | 21.2 |
| Housewife | 81 | 32.4 | 32.4 | 53.6 |
| Fisher | 18 | 7.2 | 7.2 | 60.8 |
| Cook | 4 | 1.6 | 1.6 | 62.4 |
| Auto Driver | 24 | 9.6 | 9.6 | 72.0 |
| Heavy motor driver | 16 | 6.4 | 6.4 | 78.4 |
| Sweeper | 15 | 6.0 | 6.0 | 84.4 |
| Mason | 6 | 2.4 | 2.4 | 86.8 |
| Mechanic | 8 | 3.2 | 3.2 | 90.0 |
| Boatman | 12 | 4.8 | 4.8 | 94.8 |
| Shopkeeper | 13 | 5.2 | 5.2 | 100.0 |
| Total | 250 | 100.0 | 100.0 | |

In the survey of 250 people, about 54% people said that their income is 2000-5000 taka only. About 39% said that their income is around 5000-10000 taka and only 1.6% said that their income is above 15000 taka. As most of the people are not economically well off, they cannot effort buying safe drinking water. They have no other way but to take the drinking water from the pipe water supply. Moreover they said that there is a deep water pump system available in the area for collecting water but it is too expensive for them

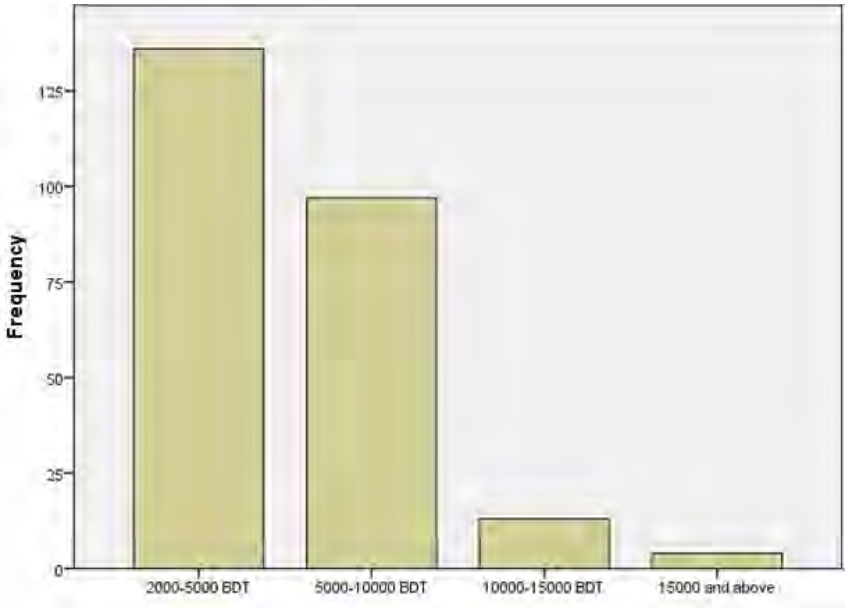


**Figure 3: People's monthly income**

**Table 6: People's monthly income**

| | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| 2000-5000 BDT | 136 | 54.4 | 54.4 | 54.4 |
| 5000-10000 BDT | 97 | 38.8 | 38.8 | 93.2 |
| 10000-15000 BDT | 13 | 5.2 | 5.2 | 98.4 |
| 15000 and above | 4 | 1.6 | 1.6 | 100.0 |
| Total | 250 | 100.0 | 100.0 | |

In this case about 52% said that they collect water from pipe water. 38% and 10% people collect water from deep tube well water and tube well respectively. People collect water from tube well found a bad smell and low quality of water for drinking and also pipe water contains the same problem. As they can't afford the water from deep pump machine in their area, most of them have no choice but to take it from the pipe water supply

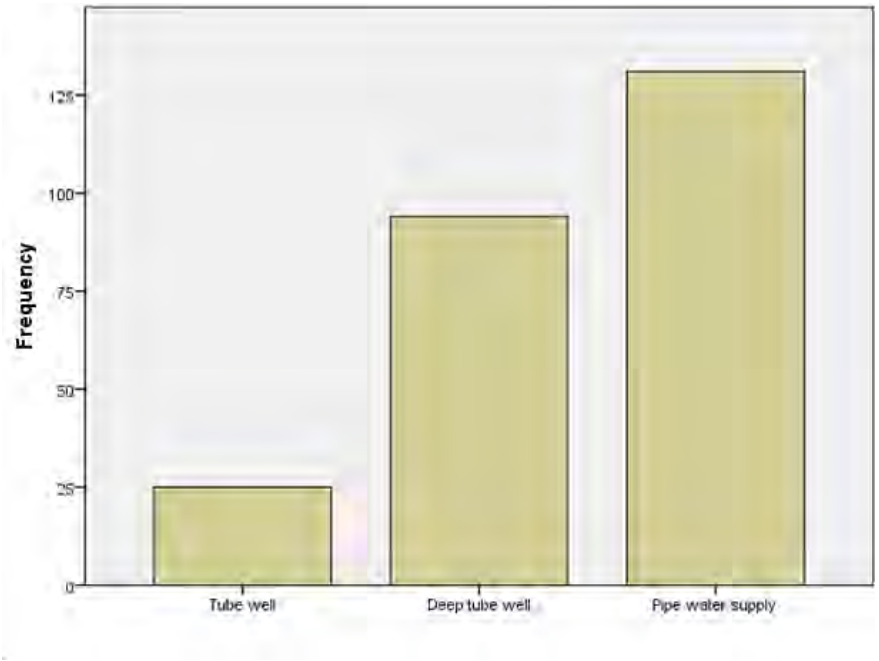


**Figure 4: Source of collecting drinking water**

**Table 7: Source of collecting drinking water**

| | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Tube well | 25 | 10.0 | 10.0 | 10.0 |
| Deep tube well | 94 | 37.6 | 37.6 | 47.6 |
| Pipe water supply | 131 | 52.4 | 52.4 | 100.0 |
| Total | 250 | 100.0 | 100.0 | |

Again, after asking people that where they collect water when there is no tube well. About 42% said that they collect from community tube well. But 58.4% said that they collect from river and pipe water. Though the source of water is not safe for drinking, they collect water from these sources. The reason behind this is community source is very far from their house and water is also not available in that source. Some community people is also not let them collect water from their source.

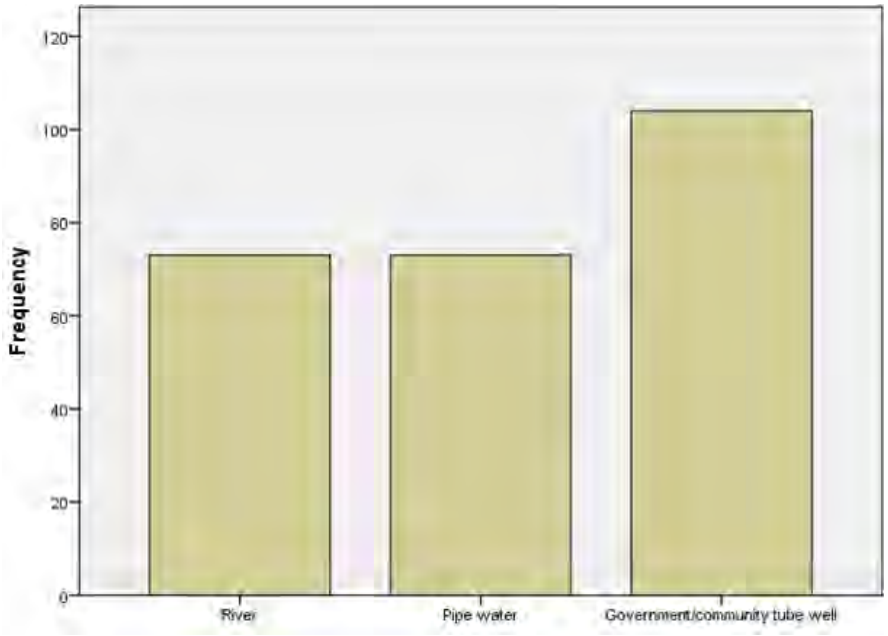


**Figure 5: Peoples source of collecting drinking water when there was no tube well**

**Table 8: Peoples source of collecting drinking water when there was no tube well**

| | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| River | 73 | 29.2 | 29.2 | 29.2 |
| Pipe water | 73 | 29.2 | 29.2 | 58.4 |
| Government/community tube well | 104 | 41.6 | 41.6 | 100.0 |
| Total | 250 | 100.0 | 100.0 | |

In the question regarding the availability of water, 90% said that water is available in all the time and only 10% said that there is a lack of water availability in the tube well.There are 5 pipe water supply found in the area and 3 deep tube well is installed with charge. Those 5 pipe water supply covers almost all parts of the affecting area. But a few people said that there were the problems of water availability.

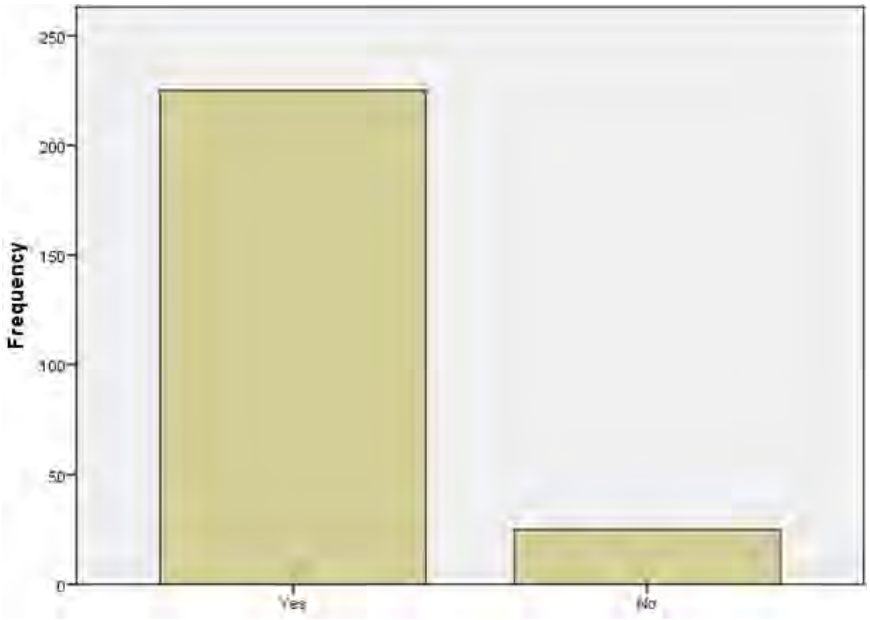


**Figure 6: Availability of water in the tube well**

**Table 9: Availability of water in the tube well**

| | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Yes | 225 | 90.0 | 90.0 | 90.0 |
| No | 25 | 10.0 | 10.0 | 100.0 |
| Total | 250 | 100.0 | 100.0 | |

After asking people regarding the safety of water that they collect from the source 90% people said that though water is available all the time but water is not safe in that source. They become ill after using this water. As in that place a lot of industries are present, the waste from the industry mix with the water source and thus pollutes the water. Rest of the people said that they do not know about the safety of the source.

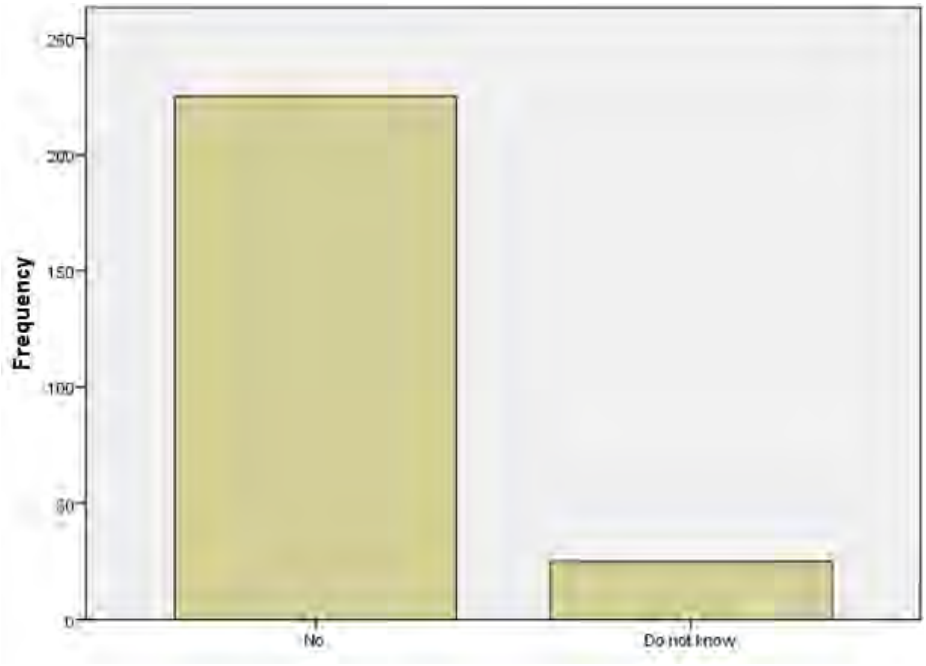


**Figure 7: Safety of Water that they collect for household purpose and drinking**

**Table 10: Safety of Water that they collect for household purpose and drinking**

| | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| No | 225 | 90.0 | 90.0 | 90.0 |
| Do not know | 25 | 10.0 | 10.0 | 100.0 |
| Total | 250 | 100.0 | 100.0 | |

Among 250 participants 59% people said that they use silver ewer to collect water from the source. About 31% people said that, they use silver ewer and plastic bottle both to collect water from the source. 10% people said that they use silver ewer and silver pot to collect water. They use silver ewer to collect the water from the source as well as store it in the house. A few families are observed to store it by plastic bottles. They said that for the short need they often used plastic bottles or silver pot.

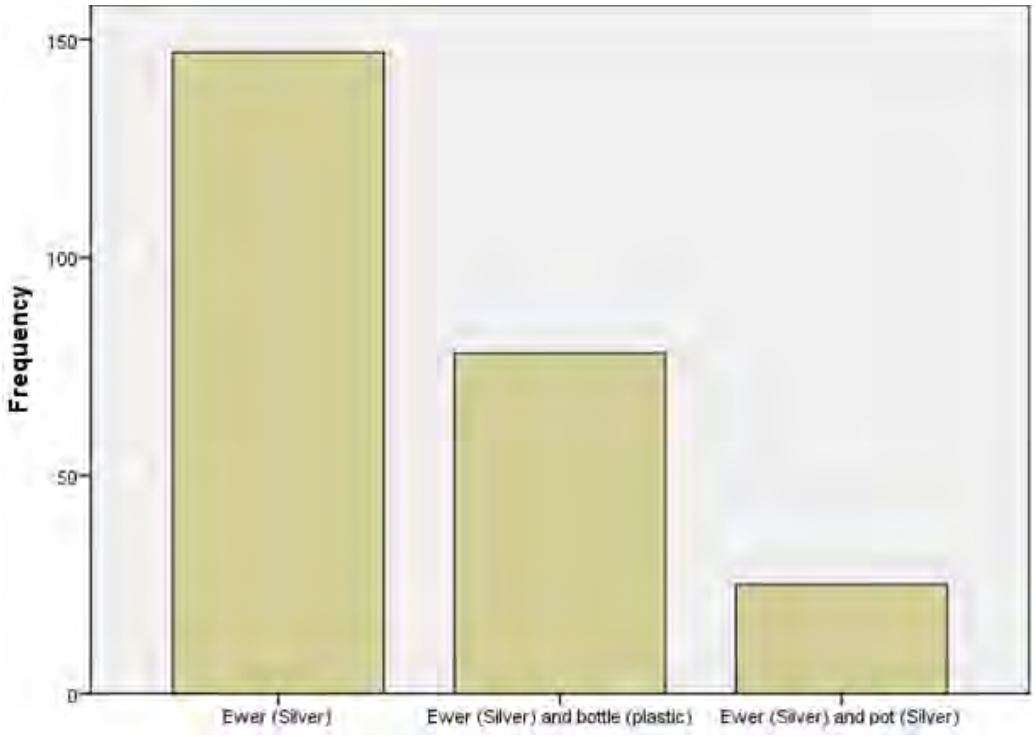


**Figure 8: Materials use to collect water**

**Table 11: Materials use to collect water**

| | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Ewer (Silver) | 147 | 58.8 | 58.8 | 58.8 |
| Ewer (Silver) and bottle (plastic) | 78 | 31.2 | 31.2 | 90.0 |
| Ewer (Silver) and pot (Silver) | 25 | 10.0 | 10.0 | 100.0 |
| Total | 250 | 100.0 | 100.0 | |

In the question of "who mainly collect water from the source?" Maximum people said that women mainly collect water for all the purpose drinking and household both. 55% women collect water thrice a day and 45% women collect water twice a day. People also ensure s that they are not sending their children for collecting water.

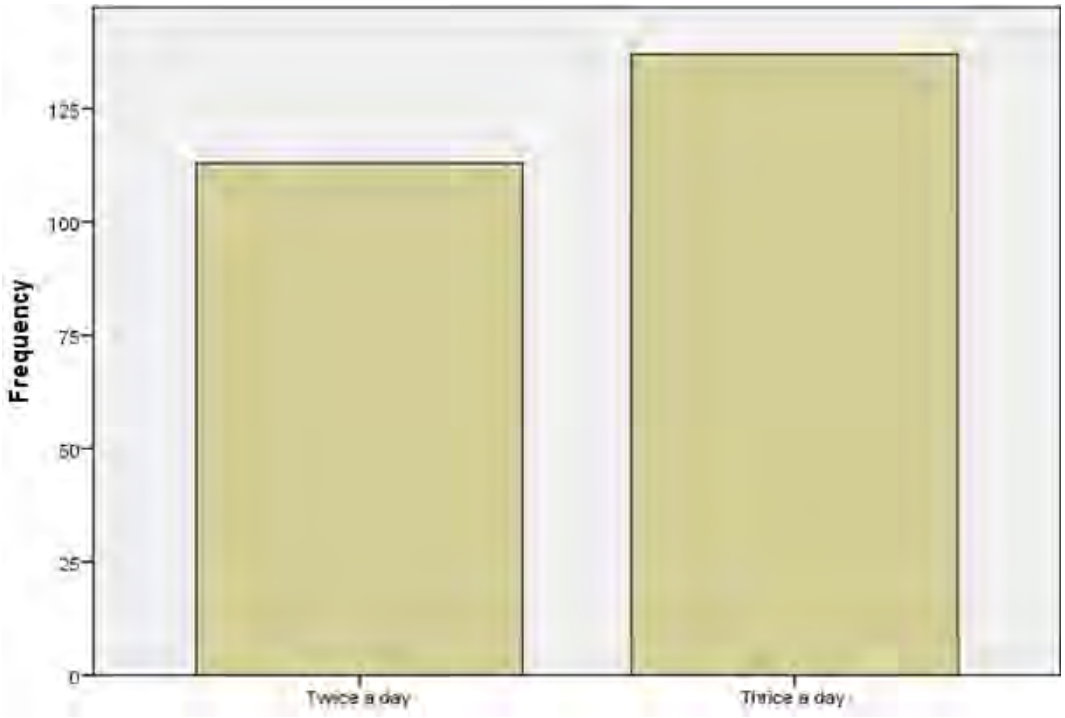


**Figure 9: Frequency of collecting water every day by women**

**Table 12: Frequency of collecting water every day by women**

| | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Twice a day | 113 | 45.2 | 45.2 | 45.2 |
| Thrice a day | 137 | 54.8 | 54.8 | 100.0 |
| Total | 250 | 100.0 | 100.0 | |

People face various problems while collecting the water. 60.8% people said that they have to quarrel for collecting water and that causes a huge time loss. 26% people said that they have to quarrel for collecting the water and about 13% said that collecting water from the source is a huge time loss.

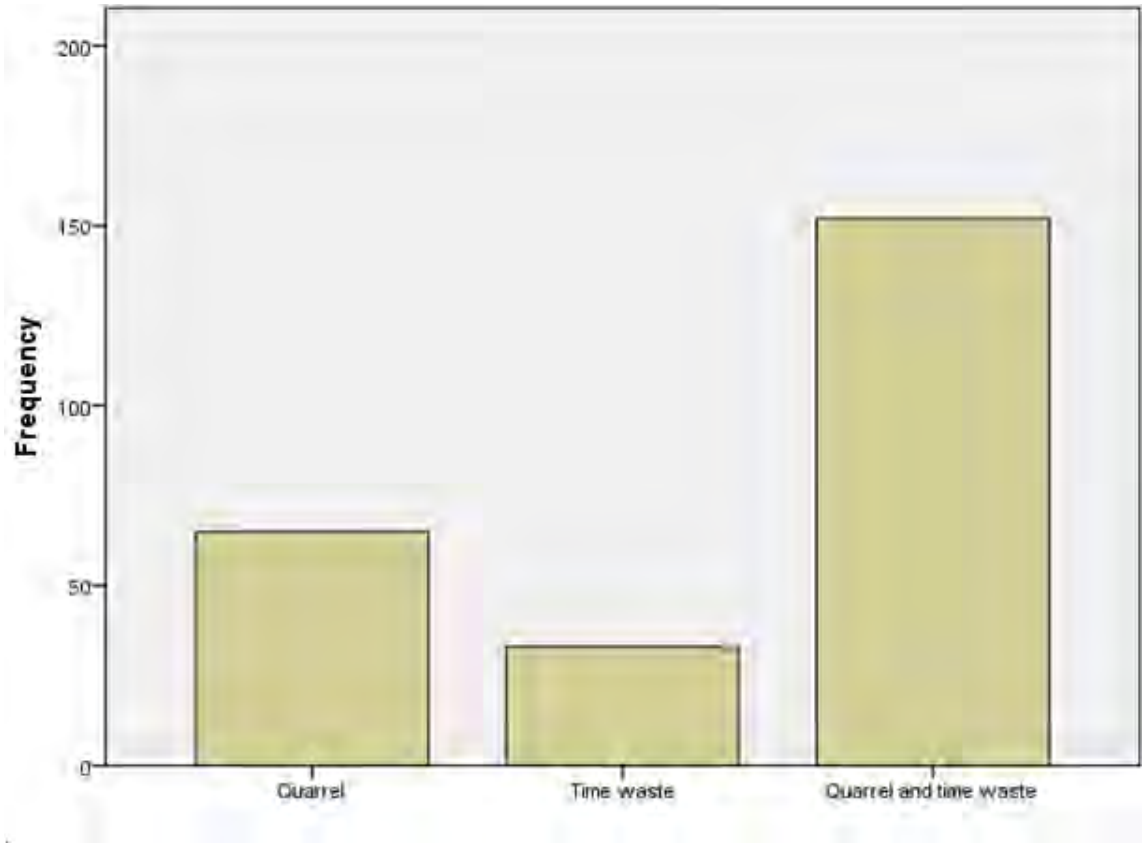


**Figure 10: Troubles that people face while collecting water**

**Table 13: Troubles that people face while collecting water**

| | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Quarrel | 65 | 26.0 | 26.0 | 26.0 |
| Time waste | 33 | 13.2 | 13.2 | 39.2 |
| Quarrel and time waste | 152 | 60.8 | 60.8 | 100.0 |
| Total | 250 | 100.0 | 100.0 | |

People said that they found a lot of unusual materials from the source. 4% people said that they found bad odor, 5.6% people said that source contains excessive iron and so on. 42.4% people said that they found excessive iron, bad odor and muddy in the drinking water source. 10% said that they found salty drinking water.

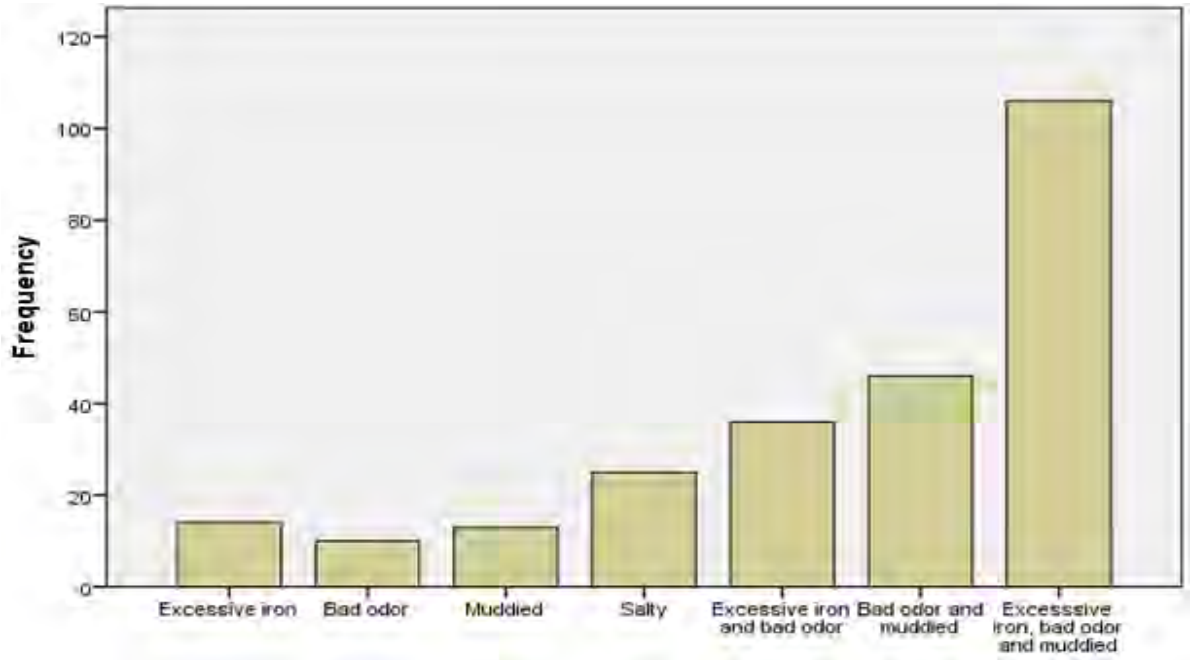


**Figure 11: People found excessive unusual material from the source**

**Table 14: People found excessive unusual material from the source**

| | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Excessive iron | 14 | 5.6 | 5.6 | 5.6 |
| Bad odor | 10 | 4.0 | 4.0 | 9.6 |
| Muddied | 13 | 5.2 | 5.2 | 14.8 |
| Salty | 25 | 10.0 | 10.0 | 24.8 |
| Excessive iron and bad odor | 36 | 14.4 | 14.4 | 39.2 |
| Bad odor and muddied | 46 | 18.4 | 18.4 | 57.6 |
| Excessive iron, bad odor and muddied | 106 | 42.4 | 42.4 | 100.0 |
| Total | 250 | 100.0 | 100.0 | |

We asked people that any government or non-government organization helped them to solve their problem regarding safe drinking water. 80% said yes and rest of the people said no. various government organization as well as a lot of non-governmental organizations like: Asa, Prodipon, LDB also helped them to establish water source in their locality.

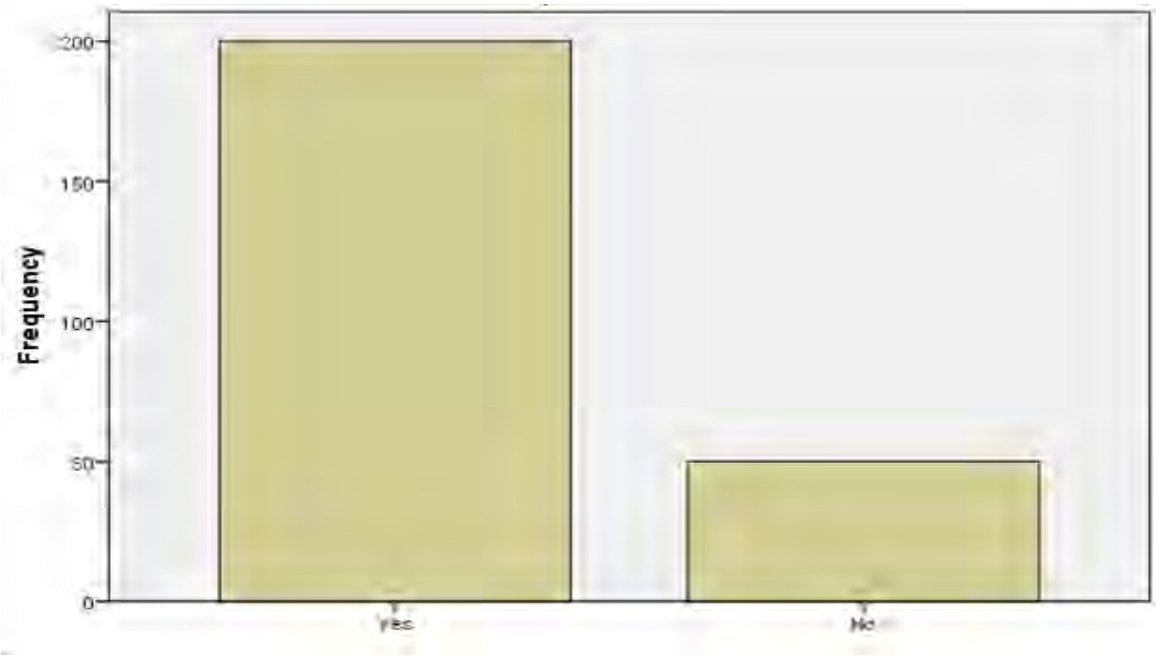


**Figure 12: Government or NGO worked to solve drinking water problems**

**Table 15: Government or NGO worked to solve drinking water problems**

| | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Yes | 200 | 80.0 | 80.0 | 80.0 |
| No | 50 | 20.0 | 20.0 | 100.0 |
| Total | 250 | 100.0 | 100.0 | |

82.8% said that they use water for drinking, bathing and cooking and the rest of the people said that they use this water only for drinking and cooking. So it is clear that, maximum families do their day to day household activities by using the same water source. A few are found who use river water for bathing.

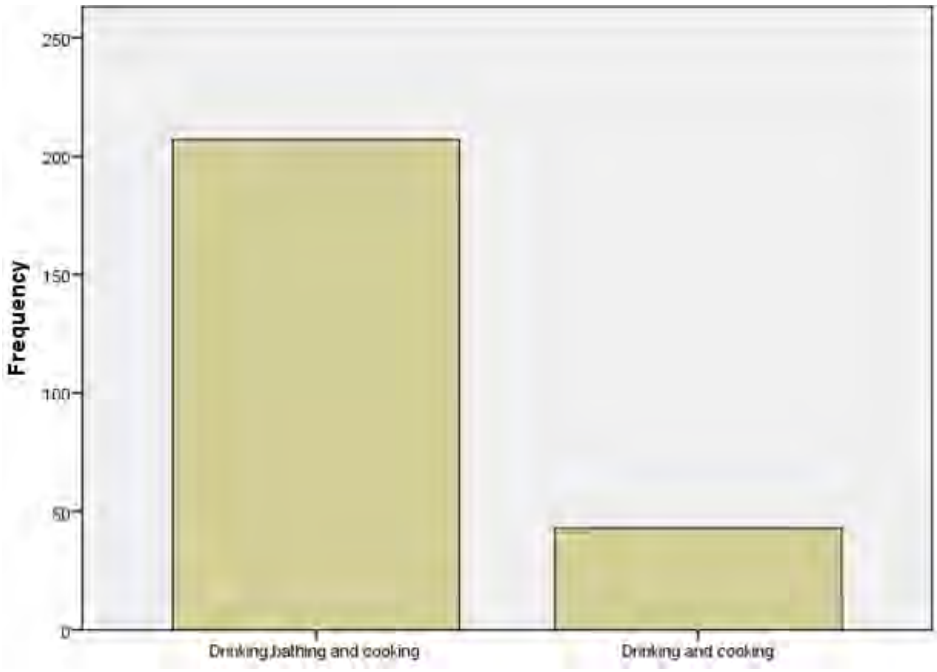


**Figure 13: Purposes you using water mostly**

**Table 16: Purposes you using water mostly**

| | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Drinking, bathing and cooking | 207 | 82.8 | 82.8 | 82.8 |
| Drinking and cooking | 43 | 17.2 | 17.2 | 100.0 |
| Total | 250 | 100.0 | 100.0 | |

They also said that they face other water related problems too. 6% people said that they found reddish stain under the glass, about 74% said that they found they found reddish stain under the glass and pot, 10% people said that they found tangled hair in the water.

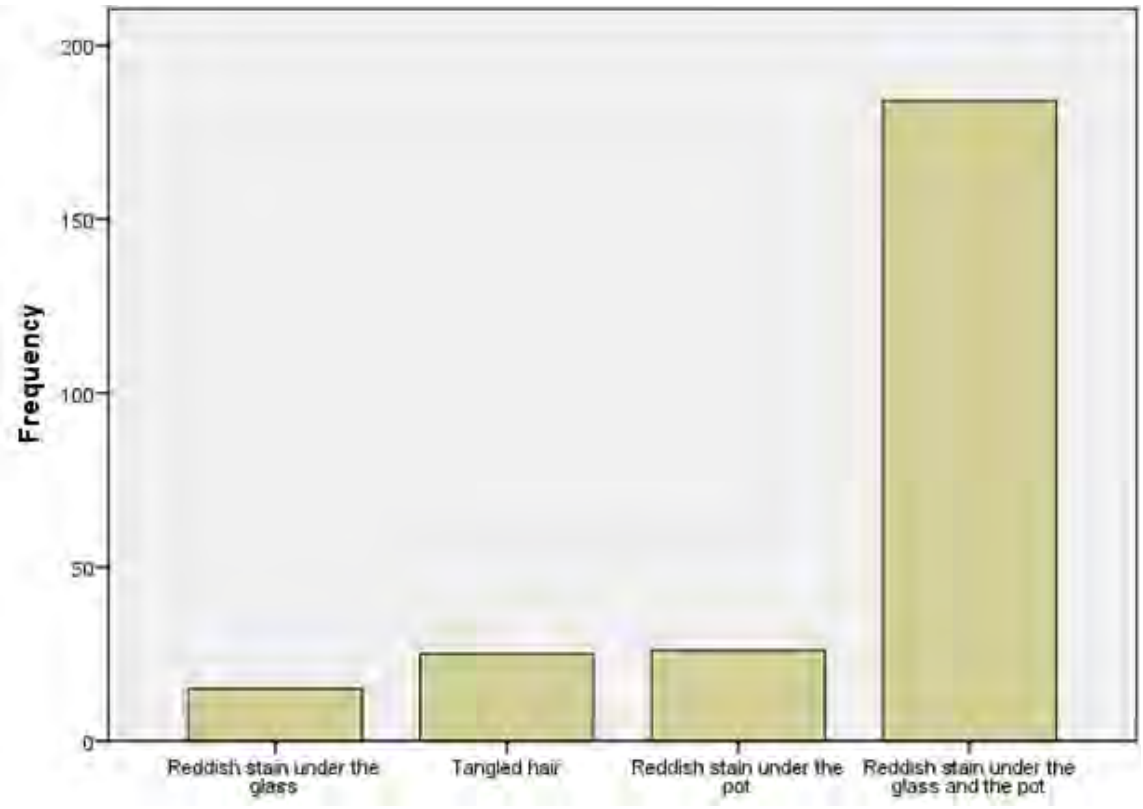


**Figure 14: Do you have any other water related problems in your house?**

**Table 17: Do you have any other water related problems in your house?**

| | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Reddish stain under the glass | 15 | 6.0 | 6.0 | 6.0 |
| Tangled hair | 25 | 10.0 | 10.0 | 16.0 |
| Reddish stain under the pot | 26 | 10.4 | 10.4 | 26.4 |
| Reddish stain under the glass and the pot | 184 | 73.6 | 73.6 | 100.0 |
| Total | 250 | 100.0 | 100.0 | |

In the question related with the diseases they face, they said they face diarrhea and dysentery mostly. 23.2% people said that they face diarrhea. 35% and 10% people said that they have diarrhea and dysentery respectively in the last one year. After asking them is there any problem regarding arsenic pollution? All of the people said that they did not face any arsenic problem in this locality.

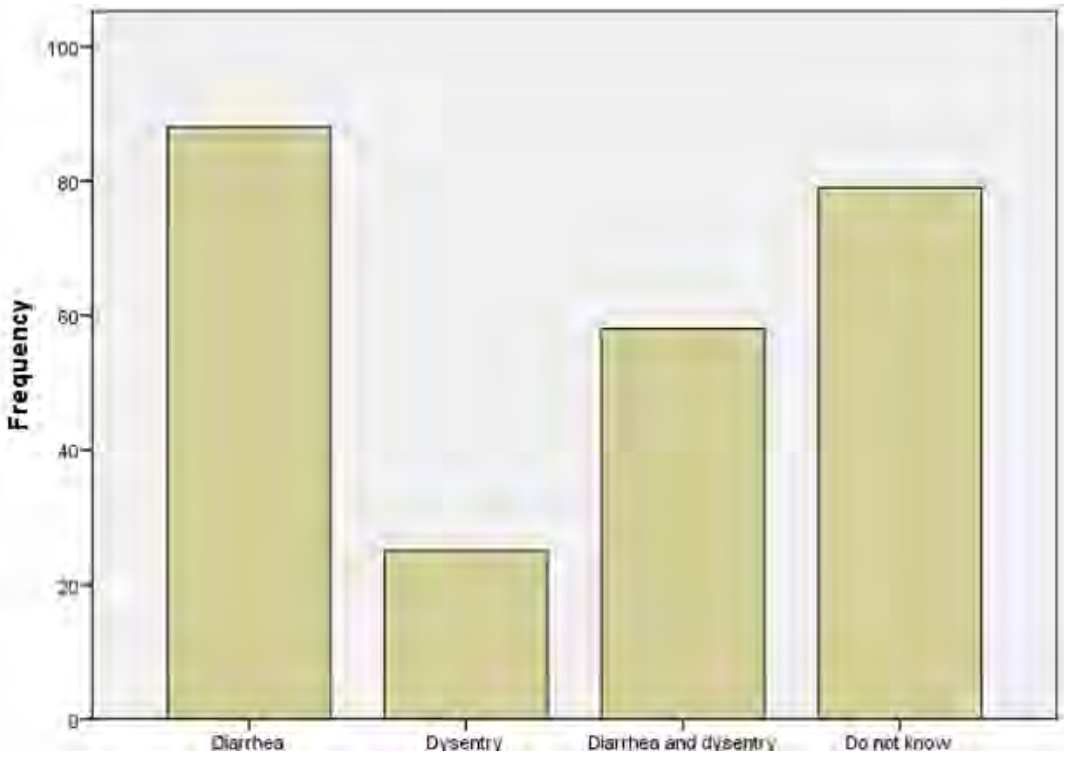


**Figure 15: Mention waterborne diseases in your house for last one year**

**Table 18: Mention waterborne diseases in your house for last one year**

| | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Diarrhea | 88 | 35.2 | 35.2 | 35.2 |
| Dysentery | 25 | 10.0 | 10.0 | 45.2 |
| Diarrhea and Dysentery | 58 | 23.2 | 23.2 | 68.4 |
| Do not know | 79 | 31.6 | 31.6 | 100.0 |
| Total | 250 | 100.0 | 100.0 | |

To treat these diseases, about 90% people said that they go to government hospital when they face severe problem and the rest of the people said that also go to the paramedic doctor. Almost all of the people complained about the government hospital. Since it should be free of cost for the poor people, the hospital takes not only the medicine charge but also treatment charge which is difficult for those people to bear.

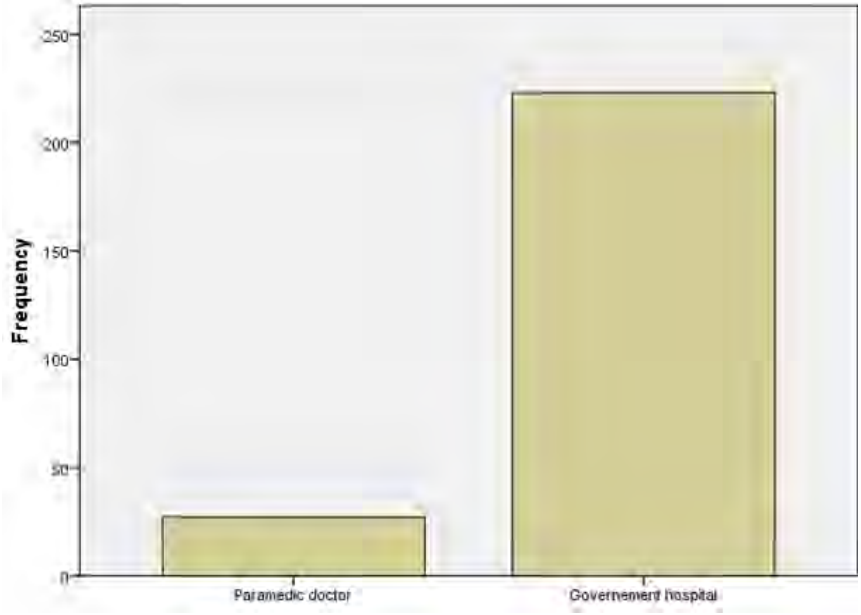


**Figure 16: What kind of measures you have taken to get rid of these diseases?**

**Table 19: What kind of measures you have taken to get rid of these diseases?**

| | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Paramedic doctor | 27 | 10.8 | 10.8 | 10.8 |
| Government hospital | 223 | 89.2 | 89.2 | 100.0 |
| Total | 250 | 100.0 | 100.0 | |

After asking them about them method of water purification and they 78.4% said that they use water sieve for water purification only when drinking and the rest of the people did not use any other precautions to treat disease.

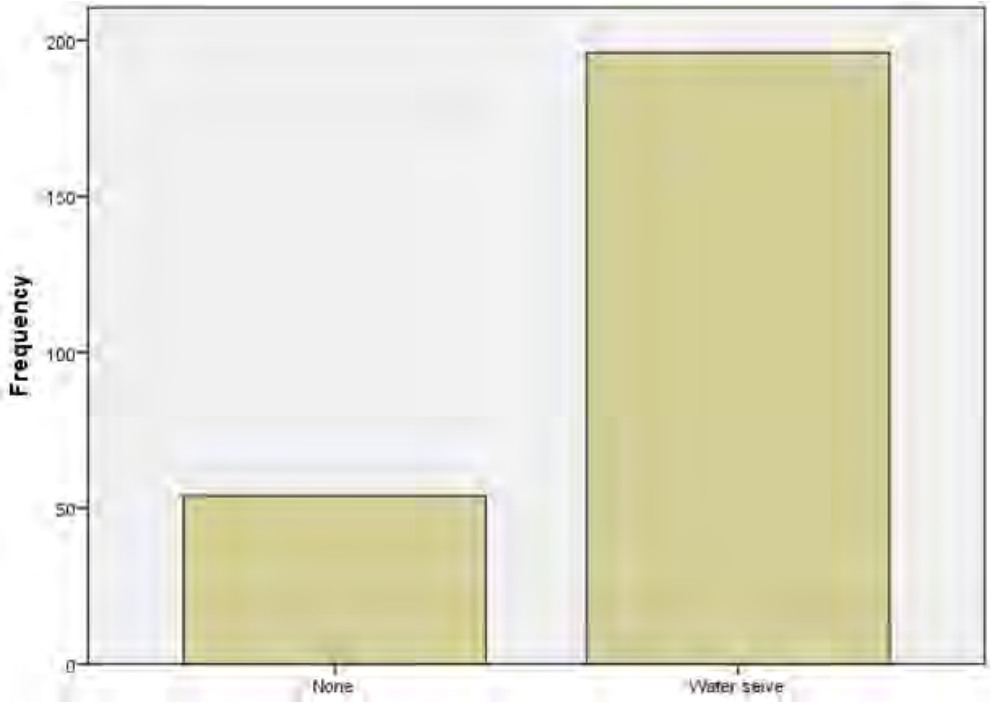


**Figure 17: Method use for water purification**

**Table 20: Method use for water purification**

| | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| None | 54 | 21.6 | 21.6 | 21.6 |
| Water Sieve | 196 | 78.4 | 78.4 | 100.0 |
| Total | 250 | 100.0 | 100.0 | |

60% people said that they collect rain water for use this in various purposes and about 40% people said that they did not collect rainwater. They also said that they collect rain water in silver ever and silver pot. They use this rainwater for cooking and drinking.

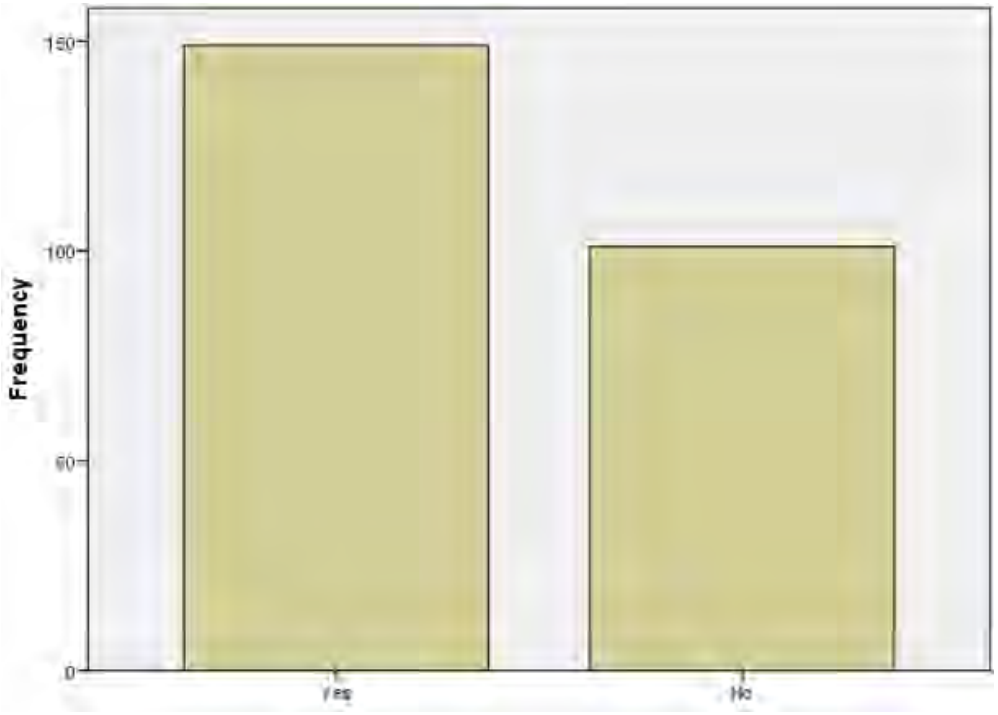


**Figure 18: People collect rain water to use it for different purposes**

**Table 21: People collect rain water to use it for different purposes**

| | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Yes | 149 | 59.6 | 59.6 | 59.6 |
| No | 101 | 40.4 | 40.4 | 100.0 |
| Total | 250 | 100.0 | 100.0 | |

After asking “What kind of natural disaster they face in their locality? 21.2% said that they face water logging, 68.8% said that they face flood and water logging and 10% said that water logging and salty water.

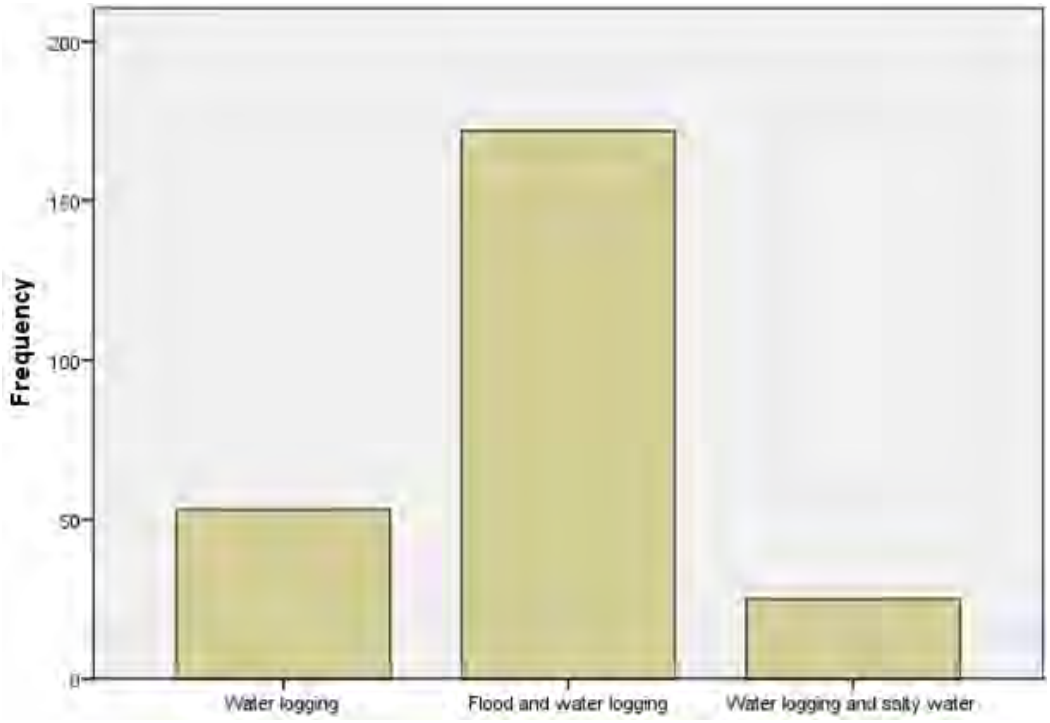


**Figure 19: Kind of environmental problems are associated with the water in their area**

**Table 22: Kind of environmental problems are associated with the water in their area**

| | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Water logging | 53 | 21.2 | 21.2 | 21.2 |
| Flood and water logging | 172 | 68.8 | 68.8 | 90.0 |
| Water logging and salty water | 25 | 10.0 | 10.0 | 100.0 |
| Total | 250 | 100.0 | 100.0 | |

During natural disaster 90% people collect water from pipe water and rest of the people collect water from tube well. Though they faced a lot of problem while collecting water during natural disaster such as: salty water, polluted water, bad odor, mixture of waste in water but they have to collect it as they have no other options.

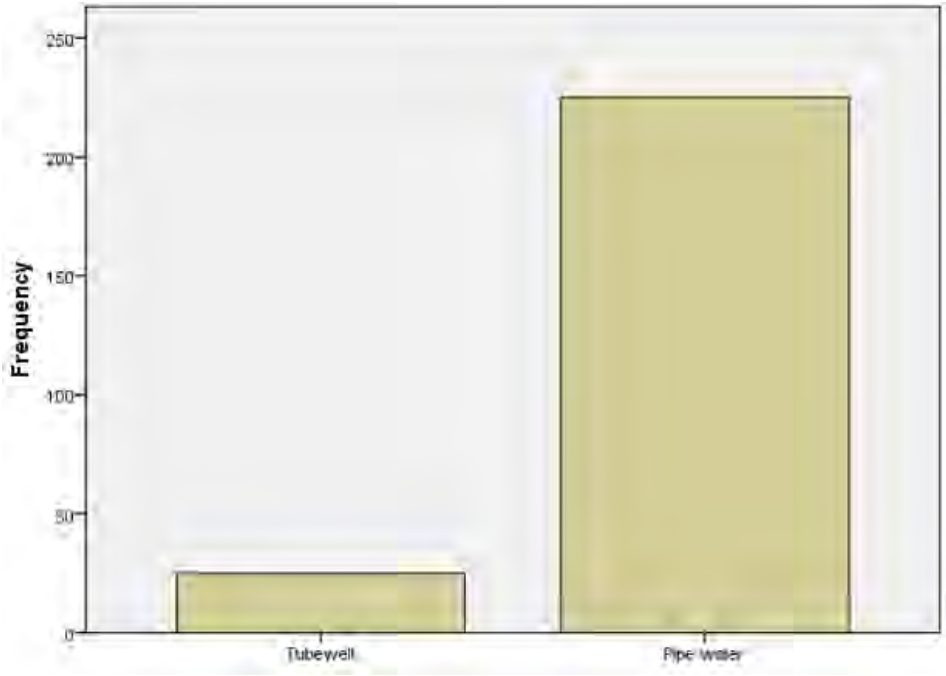


**Figure 20: Source of collecting water during natural disaster**

**Table 23: Source of collecting water during natural disaster**

| | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Tube well | 25 | 10.0 | 10.0 | 10.0 |
| Pipe water | 225 | 90.0 | 90.0 | 100.0 |
| Total | 250 | 100.0 | 100.0 | |

# CHAPTER 4

# CONCLUSION

Consumption of contaminated water can be a significant threat to human health all over the world. This study was a small attempt to reflect the demographic characteristics of the study area which will provide a better understanding of the inhabitants as well as there are different sources of water and precautions and measures can be taken for ensuring the availability of safe water. It may not asses the uncountable losses occurring each and every second throughout our planet due to consuming unhealthy and polluted water, but we can plainly observe the consequences of it and take necessary steps to overcome these losses to build a healthy community around the globe and ensure safety of lives (Zhu and Yang, 2014).

After analyzing the responses to the questions it is found that there are 52.4% of the respondents are using pipe water as drinking water source using silver ewer. But 90% respondents reproached about the source of water as unsafe. Moreover, it is to be observed that the water has excessive iron, muddied as well as bad odor and sometimes the water becomes salty. So it can surely be a confirmation of the heavy presence of waterborne diseases (e.g. Diarrhea, Dysentery etc.) in the area but there are 31.6% respondents have no clear knowledge about the diseases caused by drinking water.

Access to safe drinking water for all has been a major challenge especially in the industrial areas of Bangladesh and the impact has been more disastrous continuously. Maintaining water quality for drinking and household purposes is very much important as well as tough task to do. But to ensure safety of public health and security of our daily lifestyle, it should be well managed and safe water should be accessible to the people all around the world. Including the rural areas, contaminated water should be marked as avoidable substance and necessary actions should be taken and monitored strictly. Government and high officials in collaboration with the researchers and scientists are digging into the problems to come out with eco-friendly solutions to these and help recover the present situation to save the world that consists mostly of water (Zhu and Yang, 2014) Some possible measures can be taken in order to increase the availability of safe drinking water and reduce the harmful health impacts.

# CHAPTER 5

# **RECOMMENDATION**

Water quality can be controlled through the proper knowledge of water sources among the world and using the appropriate guidelines for diminishing the leading causes of water contamination. Solutions to the contamination of water are hugely followed nowadays, but still, there is a long way that is yet to be discovered (Lautenberg, 2016).

- It is essential to focus on the water that is being supplied and to bring them up for storage, with sheer care to avoid further deterioration of water before consumption.
- As global citizens, everyone should be conscious about anything that has to do with the water resources throughout the world.
- Everyone should be attentive while cleaning our household items and throwing any kind of waste material into the water.
- Instead of having a cellar drain or sump pump it should be prepared in a way that the sanitary sewer system does not drained into it.
- After consuming any kind of solid or liquid medicines, wrapping it up with dry wastes is important. For it can cause great hazard if gets mixed with the water flow and can be a reason for further complexities.
- Minimizing the use of pesticides, herbicides, fertilizers must be done and disposal of these chemicals, motor oil, or other automotive fluids into the sanitary sewer or storm sewer systems should be stopped. Both of them end at the river.
- Necessary medications in terms of safe usage of household water to avoid having any kind of heavy metals on it as well as carcinogenic effects must be used.
- Boiling water properly before using it as drinking water, is very much necessary to ensure safety of health.
- It is crucial for people to gather proper knowledge about the usage of water every time they use toilet as well as, before and after eating.

# CHAPTER 6

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# CHAPTER 7

# **ANNEX**

# Annex

১। উত্তরদাতা ও পরিবার সংক্রান্ত তথ্য

১.১উত্তরদাতারনাম

১.২ঠিকানা

১.৩মোবাইলনম্বর

১.৪পেশা

১.৭ আপনার পরিবারের মাসিক আয় কত

১.৮ আপনার পরিবারের মাসিক খরছ কত

২। উত্তরদাতার খাবার পানির উৎস ও তার দূরত্ব

২.১ আপনার খাবার পানি কোথায় থেকে সংগ্রহ করেন

ক) টিউবয়েল খ) কূপ গ) পুকুর ঘ)গভীর নলকূপ ঙ) অন্যান্য

২.২ সেই পানির উৎস কি নিরাপদ ? হ্যাঁ - না - জানি না-

২.৩ পানি আনার ক্ষেত্রে আপনি ব্যাবহার করেন?

১) কলসি (মাটি) ২) কলসি (ধাতব) ৩) বোতল ( প্লাস্তিক) ৪) বোতল (কাচ)

৫) পাতিল (মাটি) ৬)পাতিল (ধাতব) ৭) অন্যান্য

২.৪ প্রতিদিন গড়ে কত বার পানি আনতে হয়?

| | সকাল | দুপুর | বিকাল | রাত |
|---|---|---|---|---|
| পুরুষ | | | | |
| মহিলা | | | | |
| শিশু | | | | |

২.৫ পানি সংগ্রহ করার সময় আপনি কি কি ধরনের অসুবিধার সম্মুখিন হন

১) নিরাপত্তা ২) ঝগড়া ৩) সময়ের অপচয় ৪) কাদাময় রাস্তা

৫) মালিকের অনীহা ৬) অন্যান্য

৩। পানি সংগ্রহ ও পরিশোধন ঃ

৩.১ আপনার বাড়ীতে কি ধরনের পাত্রে পানি সংগ্রহ করেন?

১) কলসি (মাটি ) ২) কলসি ( ধাতব ) ৩) পাতিল ( মাটি ) ৪) পাতিল ( ধাতব ) ৫) ড্রাম ৬) অন্যান্য

৩.২ কয়টি পাত্রে পানি সংগ্রহ করে রাখেন ?

৩.৩ খাবার পানি টিউবয়েল অথবা অন্য কোন উৎস থেকে সংগ্রহেরকতদিন / ঘণ্টা পর তা ব্যাবহার করেন?

দিন = ঘণ্টা=

৩.৪ আপনারা পানি বিশুদ্ধকরনের কোন পদ্ধতি বেবহার করেন?

ক) ফুটিয়ে খ) ফিটকারী দিয়ে গ) ট্যাবলেট দিয়ে ঘ) কোনটাই না ঙ) অন্যান্য

৩.৫ আপনাদের গ্রামে সম্মিলিত উদ্যোগে পানি সংরক্ষণের কোন ব্যবস্থা আছে ? হ্যাঁ - না –

উত্তর হ্যাঁ হলে –

১) পুকুর ২) খাল ৩) কুয়া ৪) গভীর নলকূপ ৫)টিউবয়েল ৬) অন্যান্য

৩.৬ পানি সংরক্ষণের ব্যাপারে আপনারা কখনো কি কোন উদ্যোগ নিয়েছেন ? হ্যাঁ - না –

৩.৭ আপনারা কি বৃষ্টির পানি সংগ্রহ করেন না করতেন ? হ্যাঁ - না –

৩.৮ উত্তর হ্যাঁ হলে কোথায় সংগ্রহ করেন?

১) কলসি ( মাটি ) ২) কলসি (ধাতব) ৩) পাতিল (মাটি) ৪) পাতিল (ধাতব) ৫) ড্রাম ৬) অন্যান্য

৩.৯ এ পানি কি কাজে ব্যাবহার করেন /

১) খাবার পানি ২) রান্নার কাজে ৩) গোসলের জন্য ৪) অন্যান্য

৪। পানির গুনগত মান

৪.১ আপনাদের গ্রামে আর্সেনিক এর কোন সমস্যা আছে কি? হ্যাঁ - না –

৪.২ এ সমস্যা সমাধানে কোন সংস্থা কি ব্যবস্থা নিয়েছে? বিস্তারিত লিখুন –

ক) সরকারি উদ্যোগ

খ) এনজিও উদ্যোগ

গ) কমিউনিটি উদ্যোগ

ঘ) ব্যক্তিগত উদ্যোগ

৪.৩ এ সমস্যার সমাধান কিভাবে করা যেতে পারে বলে আপনি মনে করেন ?

৪.৪ আপনাদের বাড়ীতে পানি জনিত অন্যান্য সমস্যা হয় কি? ( টিক চিহ্ন দিন )

ক) গ্লাসের তলা লালচে হয়ে যাওয়া

খ) মাথার ছুলে জট

গ) দাঁতে দাগ পড়া

ঘ) পাত্রে পানি রাখলে তলায় লালচে দাগ পড়া

ঙ) অন্যান্য

৪.৫ আপনাদের বাড়ীতে গত এক বছরে পানিবাহিত রোগ গুলোর নাম উল্লেখ করুন

| রোগের নাম | পরিবারের সদস্য সংখ্যা | বছরে আক্রান্ত হওয়ার সংখ্যা |
|---|---|---|
| ক) ডায়রিয়া / কলেরা প্রাদুর্ভাব | | |
| খ) চর্মরোগ | | |
| গ) টায়ফয়েড | | |

৪.৬ রোগ থেকে মুক্তি পেতে আপনারা কি বেবস্থা নিয়ে থাকেন?

১) কবিরাজ ২) প্যারামেডিক ডাক্তার ৩) সরকারী হাসপাতাল ৪) অন্যান্য

৪.৭ পানির গুনগত মান পরীক্ষা করতে কি কোন সংস্থা এসেছিল ? হ্যাঁ - না –

৪.৮ উত্তর হ্যাঁ হলে সংস্থাটির নাম বলুন –

৪.৯ আপনার এলাকায় খাবার পানি সরবারাহের জন্য কোন সংস্থা কাজ করছে? হ্যাঁ - না –

৪.১০ উত্তর হ্যাঁ হলে সংস্থাটির নাম বলুন

৪.১১উত্তর হ্যাঁ হলে সংস্থাটি কি ধরনের কাজ করছেন?

১) টিউবয়েল স্থাপন ২) পাইপ ওয়াটার ৩)পিএসএফ ৪) জার ওয়াটার ৫) অন্যান্য

৫। দুর্যোগ ও পানির ব্যাবহার –

৫.১ দুর্যোগের সময় আপনি কোথা থেকে খাবার পানি সংগ্রহ করেন?

১) টিউবয়েল ২) পুকুর ৩) খাল ৪) পাইপ ওয়াটার ৫) বিচ্ছিন্ন সংস্থা হতে ৬) অন্যান্য

৫.২ পানি সংগ্রহের সময় আপনি কি কোন সমস্যার সম্মুক্ষিন হন?

১) নিরাপত্তা ২)ঝগড়া ৩) সময়ের অপচয় ৪) কাদাময় রাস্তা ৫) অন্যান্য

৫.৩ দুর্যোগের সময় খাবার পানি সরবারাহ করার ক্ষেত্রে কোন সংস্থা কি কাজ করেছিল? হ্যাঁ - না –

৫.৪ উত্তর হ্যাঁ হলে সংস্থা গুলোর নাম বলুন। ক) সরকারী খ) বেসরকারি

৫.৫ উত্তর হ্যাঁ হলে তারা কি ধরনের কাজ করেছিল?
১)পাইপ ওয়াটার ২) জার ওয়াটার ৩) টিউবয়েল স্থাপন ৪) অন্যান্য

৬.২ আপনি কি মনে করেন, খাবার পানি জনিত কারনে আপনার খুব সমস্যা হচ্ছে ? হ্যাঁ - না –

৬.৩ এ অবস্থা থেকে মুক্তি পেতে কি করা যেতে পারে বলে আপনি মনে করেন?

৬.৪ খাবার পানি সমস্যা সমাধানে এ গ্রামে কোন সরকারী বা বেসরকারি সংস্থা কাজ করছে? হ্যাঁ - না –

৬.৫ উত্তর হ্যাঁ হলে বিস্তারিত লিখুন

সরকারী সংস্থা ----

বেসরকারি সংস্থা ----

## Annex

RQ 1: What is your Gender?

RQ 2: What is your profession?

RQ 3: What is your monthly income?

RQ 4: Where do you collect your drinking water?

1. Tube well 2. Wells 3. Pond 4. Deep tube well 5. Others

RQ 5: Where did you collect water when there was no tube well?

1. Pond 2. Canal 3.River 4.Pipe water 5. Government/community tube well 6. Others

RQ 6: Is water available throughout the year in your tube well? Yes- No-

RQ 7: Is the water safe? Yes- No- Do not know-

RQ 8: What do you use to collect water?

1. Ewer (Clay) 2. Ewer (Silver) 3. Bottle (Plastic) 4. Bottle (Glass) 5. Pot (Clay) 6. Pot (Silver) 7. Others

RQ 9: How many times women collect water every day in average?

| | Morning | Noon | Afternoon | Night |
|---|---|---|---|---|
| Woman | | | | |

RQ 10: What kind of troubles you face while collecting water?

1. Safety 2. Quarrel 3. Time waste 4. Slimy road 5.Apathy of the owner 6. Others

RQ 11: What condition of water or water related problems are found in the water source you use?

Code: Arsenic= 1; Excessive Iron= 2; Bad odor= 3; Muddied= 4; Salty= 5; Oily substances mixed= 6; Clear/good/normal= 7; No problem= 8

RQ 12: Any government or non-governmental organization worked to solve drinking water problems?

Yes- No-

RQ 13: In which purposes you use water?

1. Drinking 2. Bathing 3.Cooking 4.Water for poultry 5.Water for cattle 6. Others

RQ 14: Do you have any other water related problems in your house?

1. Forming reddish stain under the glass

2. Tangled hair

3. Stain in the teeth

4. Reddish stain under the pot containing water

5. Others

RQ 15: Mention waterborne diseases in your house for last one year

| Disease Name |
| --- |
| |
| |
| |

RQ 16: What kind of measures you have taken to get rid of these diseases?

1. Ayurvedic practitioner 2. Paramedic doctor 3. Government hospital 4. Others

RQ 17: Do you use any method of water purification?

1. Boiling 2. Using fitkiri 3. Using tablet 4. None 5. Others

RQ 18: Do or did you collect rain water? Yes- No-

RQ 19: What kind of environmental problems are associated with the water of your area?

Code: Flood= 1; Drought= 2; Water logging= 3; Salty water= 4; Spate=5

RQ 20: Where do you collect water during disaster?

1. Tube well 2. Pond 3.Canal 4.Pipe water 5.From various organization 6. Others