EVALUATION OF WATER QUALITY OF GROUND WATER AND SURFACE WATER AT MANGALDAI AREA IN DARRANG DISTRICT ASSAM

A dissertation
submitted in the partial fulfillment of the requirement for the Award of the Degree of

MASTER OF TECHNOLOGY
In
CIVIL ENGINEERING
(*With specialization in Geotechnical Engineering*)
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DECLARATION

I hereby declare that the work presented in this report entitled "**EVALUATION OF WATER QUALITY OF GROUND WATER AND SURFACE WATER AT MANGALDAI AREA IN DARRANG DISTRICT ASSAM"** in the partial fulfillment of the requirement for the award of the degree of Master of Technology in Civil Engineering with specialization in Geotechnical Engineering submitted in the Department of Civil Engineering, Assam Engineering -College, Jalukbari, Guwahati-13 under Assam science and Technology University, is a real record of my work carried out in the said college for twelve months under the supervision of Dr Abinash Mahanta, Associate Professor, Department of Civil Engineering, Assam Engineering College, Jalukbari, Guwahati-13, Assam.

Do hereby declare that this project report is solemnly done by me and is my effort and that no part of it has been plagiarized without citation.

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CERTIFICATE

This is to certify that the work presented in this report entitled "**EVALUATION OF WATER QUALITY OF GROUND WATER AND SURFACE WATER AT MANGALDAI AREA IN DARRANG DISTRICT ASSAM**" is carried out by Partha Pratim Saharia, Roll No: PG/C/23/12, a student of M. Tech 3rd semester, Department of Civil Engineering, Assam Engineering College, under my guidance and supervision and submitted in the partial fulfillment of the requirement for the award of the Degree of Master of Technology in Civil Engineering with specialization in Geotechnical Engineering under Assam Science and Technology University.

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CERTIFICATE FROM HEAD OF THE DEPARTMENT

This is to certify that the project report entitled "**EVALUATION OF WATER QUALITY OF GROUND WATER AND SURFACE WATER AT MANGALDOI AREA IN DARRANG DISTRICT ASSAM**" has been submitted by Partha Pratim Saharia, bearing Roll No: PG/C/23/12, a student of M.Tech 3rd Semester, Geotechnical Engineering (Civil Engineering Department), Assam Engineering College, in partial fulfillment of the requirements for the award of the degree of Master of Technology in Geotechnical Engineering of Assam Science & Technology University.

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ABSTRACT

Water quality is a critical aspect of environmental sustainability, public health, and socio-economic development. This research thesis aims to evaluate the water quality of both groundwater and surface water sources, utilizing a comprehensive approach that incorporates the Water Quality Evaluation technique to assess the overall health and suitability of water for domestic, industrial, and agricultural use. The study was conducted in a Mangaldai area in Darrang district in Assam to represent variations in water quality across different landscapes and human activities. Sample was collected from two groundwater and three surface water sites, focusing on key physicochemical parameters such as PH, TDS, Turbidity, Electronic Conductivity, Chloride, Total Alkalinity, Sulphate, Total hardness, Total Iron, Fluoride, and Nitrate. Each parameter was analyzed using standard methodologies, and the results were compared against BIS Standard and Indian Standard (IS 10500:2012). The findings of the study highlight significant regional variations in water quality, with groundwater in hand pump showing higher levels of total Iron concentration. River water in the region is comparatively of better quality, with lower levels of contaminants, making it suitable for domestic use. This thesis underscores the importance of ongoing water quality monitoring and the adoption of sustainable water uses practices to protect water sources. The use of the Water Quality Evaluation technique in this research provides a useful tool for decision-makers to prioritize areas for intervention and improve water quality management strategies, ensuring safe and adequate water for all sectors of society.

CHAPTER 1

INRODUCTION

1.1 GENERAL

Water is one of the most vital resources for sustaining life, driving ecosystems, and supporting economic activities across the globe. As populations grow and industrialization accelerates, the demand for clean and accessible water is rising, leading to significant concerns about water quality, availability, and sustainability. Most human activities involve the use of water in one way or other. It may be noted that man's early habitation and civilization sprang up along the banks of rivers. Although the surface of our planet is nearly 71% water, only 3% of it is fresh. Of these 3%, about 75% is tied up in glaciers and polar icebergs, 24% in ground water and 1% is available in the form of fresh water in rivers, lakes and ponds suitable for human consumption. Due to increasing industrialization on one hand and exploding population on the other, the demands of water supply have been increasing tremendously. More over considerable part of this limited quantity of water is polluted by sewage, industrial waste, and a wide range of synthetic chemicals. Fresh water which is a precious and limited vital resource needs to be protected, conserved, and used wisely by man. But unfortunately, such has not been the case, as the polluted lakes, rivers and streams throughout the world testify. According to the scientists of National Environmental Engineering Research Institute, Nagpur, India, about 70% of the available water in India is polluted. In many regions, water bodies face increasing pressure from various factors, including pollution, over-extraction, climate change, and land use changes. These challenges not only affect the environment but also pose threats to human health, agriculture, and economic stability. Consequently, accurate water assessment is vital for developing effective management strategies and policies that ensure water resources are used sustainably, preserved for future generations, and remain accessible for all.

Mangaldai is a place in north-eastern India. It is situated in the Darrang district of Assam state. The average altitude is 37 meters. The climate is humid and congenial, while the relative humidity is around 82%. The annual rainfall is around 2,000 mm. Mangaldai is a Municipal Board city in district of Darrang, Assam. The Mangaldai city is divided into 10 wards for which elections are held every 5 years. The Mangaldai Municipal Board has population of 25,989 of which 13,362 are males while 12,627 are females as per report released by Census India 2011.The remaining majority are in villages of Darrang district, and the population there was 85616 (43562 males and 42054 females). The primary river Mangaldai River, flowing near

Mangaldai town in Assam, India, is a small but significant waterway that frequently causes flooding issues due to its tendency to change course and overflow its banks, particularly during monsoon season.

1.2 OBJECTIVE OF THE STUDY

- To find the concentration of the physio-chemical parameters available in both ground water and surface water near Mangaldai river.
- To assess overall water quality of Mangaldai area in Darrang district.

CHAPTER 2

LITERATURE REVIEW

2.1 GENERAL

Water is essential for existence of life. it seems to be in abundance on the earth. Nevertheless, its 97.5 percent is saline whereas the fresh water just make 2.5 percent. Water has a profound influence on human health. At a very basic level, a minimum amount of water is required for consumption on a daily basis for survival and therefore access to some form of water is essential for life. The water demand is continuously increasing mainly due to population growth and raising needs in agriculture, industrial uses and domestic services. Integrated water management has a strong impact on long-term protection and sustainability. For survival of human beings' clean water is an essential commodity whereas contamination in drinking water threatens to mankind.

2.2 REVIEW ON LITERATURE:

Tyagi et al., (2010) conducted a research work for analysis of moveable water by Water quality index (WQI) which deliver whole water quality grade and also help for suitable remediation methods for related problems. However, WQI labels the combined impression of different drinking water quality parameters and connection water quality statistics to the governmental and community decision makers. The current study also brings thought towards the progress of a worldwide and novel accepted "Water Quality Index" in a relaxed form.

Memon et al., (2011) conducted a study that particularly young children in developing countries, unsafe drinking water is a major cause of the diseases. Pathogens which are present in drinking water including many bacterial and viral agents caused about 2.5 million deaths from prevalent diarrheal disease each year (M. Kosek et al., 2010). Major health problems were stated as gastroenteritis (40%-50%), dysentery (28%-35%), diarrhoea (47%-59%), hepatitis A (32%-38%), hepatitis C (6-7%) and hepatitis B (16%-19%) by respondents (Khan et al., 2015). In Sindh, water related diseases such as diarrhoea, gastroenteritis, vomiting, dysentery, and kidney problem are caused by polluted drinking water.

Pavender et al., (2011) conducted work to analyse biological and physiochemical parameter of moveable water in India. From digging well water samples were collected. Firm water and open well were analysed. Well water was contaminated with huge level of total hardness, total dissolved solid, while in bore well results large amount of fluorides water result shown that microbial contagion of water samples of study area and unhealthy for drinking purpose.

Jadhav et al. (2012) have explained, in order to understand the water quality of Triveni Lake, physicochemical parameters were studied and analyzed for the period of one year i.e., December 2010 to November 2011. Various physicochemical parameters, such as water temperature, air temperature, pH, humidity, conductivity, free Co2, total solid, dissolved oxygen, Total alkalinity, Total hardness, $CaCo_3$, Ca^{2+}, Mg^{2+} were studied. The results revealed that there was significant seasonal variation in some physicochemical parameters and most of the parameters were in normal range and indicated better quality of lake water. It has been found that the water is best for drinking purpose in winter and summer seasons.

Khalik (2013) a methodical study was done to assess the change in physiochemical characteristics of water with respect to period. For this purpose, from Bertram rivers six localities were selected Cameron highland for sample collection. Specific locations were nominated where human activities are high. Water Sampling was completed in months of august to November 2012. Following parameters were selected. Ph, temperature, salinity, electrical conductivity, total dissolved solid, total suspended solids, hardness, ammonia nitrogen, biochemical, biological oxygen demand nitrate phosphate. Results are showed and associate with Malaysian national standard for drinking water quality NSDWQ Category II.

Sorlini et al., (2013) designed a research work by ACRA foundation of logon valley to define the impacts on health and aesthetic beauty and the water quality. through bore wells, open holes, river and piped water samples were collected. Results showed that most of these parameters had thoughtful concern with health and aesthetic. Negatively impact on the health from ground water contamination was due to high level of turbidity, iron, and manganese. By installing water treatment plant and improve and repair water distribution system the problem could be solved.

Shukla et al., (2013) conducted a study to checking the quality of water whether water is suitable for drinking purpose as well as investigate physiochemical features of water and its impact on an ecosystem. Then consequences of all parameters match with permissible limit suggested by WHO. Study was conducted to tell the effect of the biological growth in water in Ahmadabad that changed in physiochemical characteristics.

Singla et al., (2014) conducted research to analyse the physiochemical and biological parameters of bottled and pack water in different markets of Delhi (India). 16 samples of water bottles and 4 samples of sachets water were selected for lab analysis, from different local places in study area and at national test house their lab analysis was done, Ghaziabad. The results revealed that bottled water quality was far way better than sachets water quality. The main values of lead and copper in sachet water was found to surpass from the limits of IS and international standards. The biological analysis results revealed that, for coliform the mean rate for bottles was nil while the mean rate for sachets was 16.75, which revealed that sachet water was dangerous for drinking purposes.

Nagamani (2015) conducted research work for water quality status in 5 locations including urban and rural areas of Bangalore. Samples include, bore water, mineral water and bore well water. Then samples were exposed to physio-chemical parameters include TDS, TSS, pH, hardness specific conductivity, and results associate with permissible limit. TDS, pH, hardness, conductance seems as neutral. Range increases in urban areas in comparision to ruler area.

A. Kumar et al. (2015) Evaluation of water quality of Ganga River using Water Quality Index tool to analyze water samples from five designated locations along the river (Rishikesh to Allahabad) using Weighted Arithmetic WQI Method to measure various physio-chemical parameters and to observe trends in the water quality downstream and correlate these with environmental pollutants to understand how local factors contribute to water quality deterioration. The results point to the significant consequences of mindless anthropogenic activities and poorly regulated industrial discharges along the river. They found that, using WQI calculation the study reports a significant trend of degrading water quality along the downward path of the river which may serve as a guide to planning strategies to control pollution.

Ojo et al., (2016) conducted a research work on chemical and microbial analysis of drinkable water within university Lagos state university campus. It was done in four designated areas and relocation to university lab for chemical and microbial analysis. Outcomes are associated with WHO recommended level. Findings stated that magnesium, iron, and calcium were present in normal concentration but coliform present in water at high rates. So, it's not suitable for drinking. The following Study suggested that fixing of distribution system was necessary to decrease microbial contamination.

Kumar et al., (2017) in this research study samples from different site of central university of Jharkhand campus from surface and ground water were collected for analysis of its physical and chemical parameters. Using titrimetric method laboratory experiments were done, for analysis of various parameters. The results of all parameters are within Indian Standards (IS) expect alkalinity.

The literature on water quality demonstrates that maintaining safe and clean water is a complex and multifaceted issue. The factors influencing water quality, such as pollution, climate change, and human activity, require ongoing research and effective management strategies. As the global population grows and environmental pressures increase, the need for comprehensive water quality assessments and sustainable water management practices will become even more critical. This thesis will contribute to the body of knowledge by providing insights into the current state of water quality in the study area and offering recommendations for improving its sustainability and resilience.

CHAPTER 3
EXPERIMENTAL PROCEDURE

3.1 GENERAL:

To achieve the project's goal, pertinent laboratory experiments was carried out according to Indian standard procedures and the corresponding IS codes. This chapter presents the test programs for the various laboratory tests that are conducted as well as the related findings.

3.2 TEST PROGRAM

The phase of the complete program are as follows

1. Collection of water samples from different stations in the vicinity of the Mangaldai river.

2. Preservation of the samples as per Indian standard.

3. Determination of physical and chemical properties of the samples.

4. Analysis of test results.

3.3 WATER SAMPLING STATIONS

Water samples are collected in the post monsoon season in the vicinity of the Mangaldai river.

Table 3.1: Sampling stations with their latitude and longitude:

SI NO	STATIONS	LATITUDE	LONGITUDE
1.	Mangaldai Ghat	26.4535	92.0457
2.	Mangaldai Bridge	26.4655	92.0462
3.	Islampur	26.4468	92.0205
4.	Ground water from Mangaldai Ghat	26.4535	92.0457
5.	Ground water from Islampur	26.4468	92.0205

3.4 WATER SAMPLING PROCEDURE AND ANALYSIS

Water samples were collected by using plastic bottle from different study sites near Mangaldai River i.e. surface and ground water sources of Mangaldai area. Two samples were collected from each location. These bottles were properly washed, dried, and labelled and again rinsed with the river water to be sampled just prior to sampling. The river water samples were taken from the sampling points 1 foot below the surface of the river. Once the bottles were filled, they were securely sealed. Precautions were taken during sampling to avoid aeration. Once collected, the samples were warily transported to the laboratory and analysis was done instantaneously.

Fig 3.1: Sampling near Mangaldai Ghat

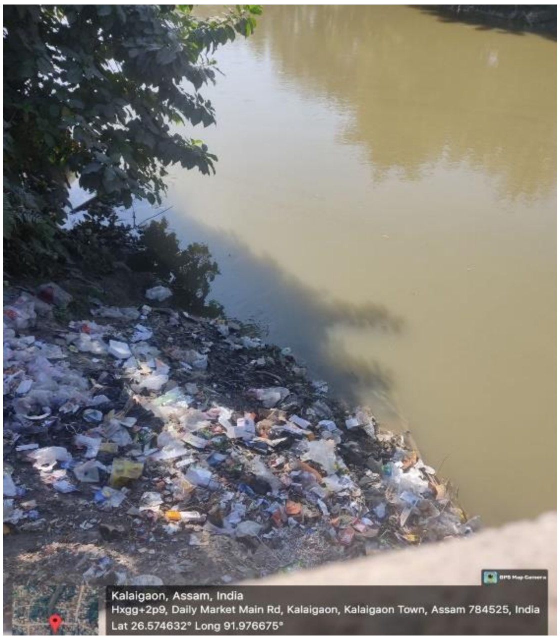

Fig 3.2: Sampling near Islampur

Fig 3.3: Laboratory testing at State Public Health Laboratory

Table 3.2: Determination of physio-chemical parameters

SI No	Parameter	Units	Methods of test ref. to
1.	pH	No unit	IS 3025 (Part 11):1983
2.	TDS	ppm	IS 3025 (Part 16) : 2023
3.	Turbidity	NTU	IS 3025 (Part 10) :2012
4.	Electronic conductivity	mg/l	IS 3025 (Part 14) :2012
5.	Chloride	mg/l	IS 3025 (Part 32) :2012
6.	Total Alkalinity	mg/l	IS 3025 (Part 23) :2012
7.	Sulphate	mg/l	IS 3025 (Part 24) :1986
8.	Total Hardness	mg/l	IS 3025 (Part 21) :1983
9.	Total Iron	mg/l	IS 3025 (Part 53) :2003
10.	Floride	mg/l	IS 3025 (Part 60) :2012
11.	Nitrate	mg/l	IS 3025 (Part 34) :2012

Table 3.3: Standard drinking water quality parameters (as per IS 10500: 2012)

SI No	Parameter	Units	Acceptable limit	Permissible limit
1.	pH	No unit	6.5-8.5	No relaxation
2.	TDS	ppm	500	2000
3.	Turbidity	NTU	1	5
4.	Electronic conductivity	mg/l	NA	NA
5.	Chloride	mg/l	250	1000
6.	Total Alkalinity	mg/l	200	600
7.	Sulphate	mg/l	400	No relaxation
8.	Total Hardness	mg/l	200	600
9.	Total Iron	mg/l	0.3	No relaxation
10.	Floride	mg/l	1	1.5
11.	Nitrate	mg/l	45	No relaxation

3.5 MATERIALS AND METHODS

3.5.1 METHODOLOGY FOR MEASUREMENT OF pH VALUE

The pH of a solution is a measure of its acidity or alkalinity, defined as the negative logarithm of the hydrogen ion concentration ($[H^+]$) in a solution. The pH scale ranges from 0 to 14, with values less than 7 indicating acidic conditions, values greater than 7 indicating alkaline conditions, and a value of 7 representing a neutral solution. Determining the pH of water or any solution is an essential task in water quality analysis, environmental monitoring, and industrial processes.

The pH value is determined by measurement of the electromotive force of a cell consisting of an indicator electrode (an electrode responsive to hydrogen ions such as a glass electrode) immersed in the test solution and a reference electrode (usually mercury/calomel electrode), Contact between the test solution and the reference electrode is usually achieved by means of a liquid junction, which forms part of the reference electrode. The electromotive force is measured with a pH meter, that is, a high impedance voltmeter calibrated in terms of pH. Several types of electrodes have been suggested for electrometric determination of pH value. Although the hydrogen gas electrode is recognized as primary standard the glass: electrode in combination with calomel electrode is generally used with reference potential provided by saturated calomel electrode. The glass electrode system is based on the fact that a change, of 1 pH 13 unit produces an electrical change of 59.1 mV at 25°C. The active element of a glass electrode is a membrane of a special glass. The membrane forms a partition between two liquids of differing hydrogen ion concentration and a potential is produced between the two sides of the membrane which is proportional to the difference in pH between the liquids.

Apparatus used:

1. pH meter with glass and reference electrode (saturated calomel), preferably with temperature compensation.
2. Thermometer With least Count Of 0.5°C

Sample handling and preparation:

1. Samples should be analysed as soon as possible, preferably in the field at the time of sampling.
2. High purity water and water not at equilibrium with the atmosphere (ground water or lake water collected at depth) are subject to changes when exposed to the atmosphere, Therefore the sample containers should be filled completely and kept sealed prior to analysis.

Procedure:

After required warm-tip period, standardize the instrument with a buffer solution of pH near that of the sample and check electrode against at least one additional buffer of different pH value. Measure the temperature of the water and if temperature compensation is available in the instruments adjust it accordingly. Rinse and gently wipe the electrodes with solution. If field measurements are being made, the electrodes may be immersed directly in the sample stream to an adequate depth and moved in a manner to ensure sufficient sample movement across the electrode sensing element as indicated by drift free readings (< 0.1 pH unit). If necessary, immerse them into the sample beaker or sample stream and stir at a constant rate to provide homogeneity and suspension of solids. Rate of stirring should minimize the air transfer rate at the air-water interface of the sample. Note and record sample pH and temperature However, if there is a continuous drift, take a second reading with the fresh aliquot of sample without stirring and report it as the pH value.

Fig 3.4.: A pH meter

3.5.2 METHODOLOGY TO DETERMINE TOTAL DISSOLVED SOLIDS (TDS)

Total Dissolved Solids (TDS) refers to the combined content of all inorganic and organic substances dissolved in water. These substances include minerals, salts, metals, cations, and anions that are present in the water in a dissolved state. TDS is often measured in milligrams per liter (mg/L) or parts per million (ppm). High TDS levels can indicate pollution or contamination, while low levels might suggest very pure or distilled water. Here, TDS have been found using 'thermo scientific' TDS meter. A TDS meter is an electronic device that measures the electrical conductivity of water and directly provides a TDS reading in ppm or mg/L. It is an efficient and widely used method for quick on-site measurements.

Fig3.5: A TDS meter

3.5.3 METHODOLOGY TO DETERMINE TURBIDITY

Turbidity measurement is crucial for assessing water quality in India, particularly for ensuring safe drinking water and monitoring environmental conditions. The method involves using a turbidimeter to measure the amount of suspended particles that scatter light, with results reported in NTU. The process is standardized and ensures that water treatment processes are functioning effectively, in line with national and international water quality standards. The procedure for determining the turbidity of water typically involves using a **turbidimeter** or **nephelometer** to measure the scattering of light caused by suspended particles in the water. It is based on comparison of the intensity of light scattered by the sample under defined conditions with the intensity of light scattered by a standard reference suspension under the same conditions. Turbidity measurement is crucial for assessing water quality in India, particularly for ensuring safe drinking water and monitoring environmental conditions. The method involves using a turbidimeter to measure the amount of suspended particles that scatter light, with results reported in NTU. The process is standardized and ensures that water treatment processes are functioning effectively, in line with national and international water quality standards.

Fig 3.6: A Microprocessor Turbidity Meter

3.5.4 METHODOLOGY TO DETERMINE ELECTRONIC CONDUCTIVITY

Electrical conductivity (EC) is a measure of the water's ability to conduct electricity, which is directly related to the concentration of dissolved ions (such as salts, acids, and bases) in the water. The EC is an important water quality parameter and can be used to estimate the Total Dissolved Solids (TDS) in water. Measuring the electrical conductivity of water is a quick and reliable method to assess water quality, especially for understanding the concentration of dissolved ions. It is widely used in various fields, including environmental monitoring, industrial processes, and water treatment. Regular calibration and maintenance of the conductivity meter are essential for obtaining accurate and consistent results.

Fig 3.7: A conductivity meter

3.5.5 METHODOLOGY TO DETERMINE CHLORIDE

Chloride can be titrated with mercuric nitrate because of the formation of soluble, slightly dissociated mercuric chloride. In the pH range 2.3 to 2.8. diphenyl carbazone indicates the end point by the formation of a purple complex with excess mercuric ions. Use a 100 ml sample that the chloride content is less than 10 mg. Add 1.0 ml indicator acidifier reagent. For highly alkaline or acid waters, adjust pH to about 8 before adding indicator-acidifier reagent. Titrate with 0.41 1 N mercuric nitrate to a definite purple end point. The solution turns from green blue to blue a few drops before the end point. Determine the blank by titrating 100 ml distilled water containing IO mg of sodium bicarbonate.

Calculation:

$$\text{Chloride, mg/L} = [(V_1 - V_2) \text{ X } N \text{ X } 35450]/V_3$$

Where,

V_1= volume in ml of silver nitrate used by the sample,

V_2 = volume in ml of silver nitrate used in the blank titration,

V_3 = volume in ml of sample taken for titration and

N = Normality of silver nitrate solution.

3.5.6 METHODOLOGY TO DETERMINE TOTAL ALKALINITY INDICATOR METHOD

Total alkalinity (TA) refers to the capacity of water to neutralize acids. It is an important parameter in water chemistry, especially in pools, aquariums, and natural water systems. Alkalinity is primarily contributed by bicarbonates, carbonates, and hydroxides, which act as buffers to stabilize pH levels. A proper level of alkalinity helps maintain a stable pH, preventing sharp changes that could harm aquatic life, cause corrosion, or affect the effectiveness of chemicals used in water treatment.

Procedure:

- Take 50 ml sample in a 100 ml conical flask.
- If the pH of the sample is over 8.3 then add 2 to 3 drops of phenolphthalein indicator and titrate with standard 0.02 N Sulphuric acid (H_2S0_4) solution till the pink colour observed by indicator just disappears.
- Record the volume of 0.02 N standard sulphuric acid solution from the burette.
- If pH of the sample is below 8.3 then eliminating the step 2 and 3, Add 2-3 drops of mixed indicator (Bromocresol green-Methyl Red indicator) solution. The colour of sample changes to Blue.
- Titrate with 0.02 N Sulphuric Acid solution (Colour changes from Blue to Pink)

Calculation:

$$\text{Total alkalinity (as } CaCO_3\text{), in mg/L} = (A \times N \times 5000) / V$$

Where,

A = ml of standard sulphuric acid used to titrate to pH 8.3

N = normality of Standard acid used, and

V = volume in ml of sample taken for test.

3.5.7 METHODOLOGY TO DETERMINE SULPHATE

Sulphate is a naturally occurring compound, primarily found in water as **sulphate ions (SO_4^{2-})**, which come from various sources such as natural mineral deposits, industrial discharge, and agricultural activities. In water, sulphates can be dissolved as salts, most commonly as calcium sulphate (gypsum) or sodium sulphate. Sulphates are not usually harmful in low concentrations but can impact water quality and taste when present in higher amounts. In India, the presence of sulphate in water is of particular concern, especially in regions with high industrial activity or mining operations. In India, sulphate contamination in water is a growing concern, especially in regions with high industrial, agricultural, or mining activities. While sulphates at low concentrations are generally not harmful, high levels can affect the taste of water and pose health risks, particularly for infants and individuals with sensitive digestive systems. Monitoring and managing sulphate levels through water treatment and regulation are essential to maintaining safe water quality standards across the country. Here, we have used UV-VIS Spectrophotometer for finding Sulphate.

Procedure: SULPHATE TURBIDITY METHOD (IS 3025 PART 24)-1986, Reaffirmed 1992

- Filter the sample through 0.45 µm , membrane filter, if there is any turbidity.
- Take 20 ml sample in a 100 ml conical flask
- Add 1 ml Hydrochloric acid solution and 1 ml conditioning reagent and mix well for 30 sec.
- Add a spoonful or 3 gm of $BaCl_2$ (Barium Chloride) crystals and stir at constant speed for 1 min.
- Read Absorbance at 420 nm.

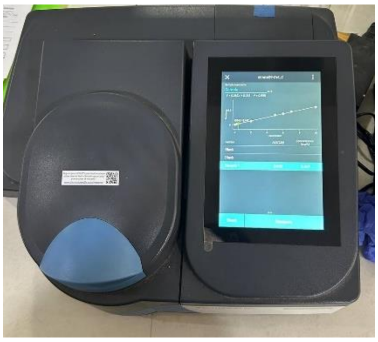

Fig3.8: A UV-VIS Spectrophotometer

3.5.8 METHODOLOGY TO DETERMINE TOTAL HARDNESS

Total hardness refers to the concentration of dissolved minerals in water, primarily calcium (Ca^{2+}) and magnesium (Mg^{2+}) ions, which are responsible for the water's hardness. The hardness of water is typically measured in terms of calcium carbonate ($CaCO_3$) equivalents. Hard water is characterized by a higher concentration of these minerals, and its presence can have both beneficial and adverse effects on water systems, appliances, and health. Total hardness is commonly measured in terms of milligrams per liter (mg/L) or parts per million (ppm) of calcium carbonate ($CaCO_3$). The hardness level can be determined by Titration method, where The water sample is titrated with a standard solution of a known concentration, often using a reagent like EDTA (ethylenediaminetetraacetic acid) that binds with calcium and magnesium ions to determine their concentration.

Procedure:

- Take 25 ml sample in a 250 ml conical flask.
- Add 1 ml Hydroxylamine hydrochloride solution.
- Adjust the pH in between 10-10.1 by adding 1-2 ml Buffer Solution.
- Add 1/2 drops of EBT (Eriochrome Black T) indicator (Colour changes to wine red)
- Titrate with 0.02N EDTA solution (Colour changes from wine red to
- Note down the end point from the burette
- Blank titration is carried out in a similar way

Calculation:

$$\text{Total Hardness} = [\ 1000 \text{ X } (V_1 - V_2) \text{ X CF }] / V_3$$

where,

V_1= Volume of EDTA std solution used in the titration for sample

V_2= Volume of EDTA std solution used in the titration for the blank sample

V_3 = Volume of the sample taken for the test

X_1 = Volume of std Calcium solution taken for standardization

X_2 = Volume of EDTA solution used in the titration

Correction Factor (CF) = X1/X2

3.5.9 METHODOLOGY TO DETERMINE TOTAL IRON

Iron is one of the most common elements found in groundwater and surface water in India. It is typically present in water in its dissolved form as ferrous ions (Fe^{2+}) or in its oxidized state as ferric ions (Fe^{3+}). The presence of iron in water can have both beneficial and detrimental effects depending on its concentration and the form in which it exists. In India, iron contamination in drinking water is a widespread concern, especially in rural and semi-urban areas. The Indian Standard (IS 10500:2012) sets the permissible limit for iron concentration in drinking water at 0.3 mg/L (milligrams per litre), but many regions across the country exceed this limit.

Procedure:

- Take 50 ml sample in a 125 ml Erlenmeyer flask
- Add 2 ml Conc. Hydrochloric Acid
- Add 1 ml Hydroxylamine Hydrochloride ($NH_20H.HCl$)

- Add few glasses bead and heat to boiling. To ensure dissolution of all the iron, continue boiling until volume is reduced to 15-20 mL
- Cool to room temperature
- Transfer to a 50- or 100-mL volumetric flask
- Add 10 ml Ammonium Acetate ($NH_4C_2H_30_2$) buffer solution
- Add 4 ml Phenanthroline solution and dilute to mark with distilled water
- Mix thoroughly and allow a minimum of 10 min for maximum colour development
- Read Absorbance at 510 nm

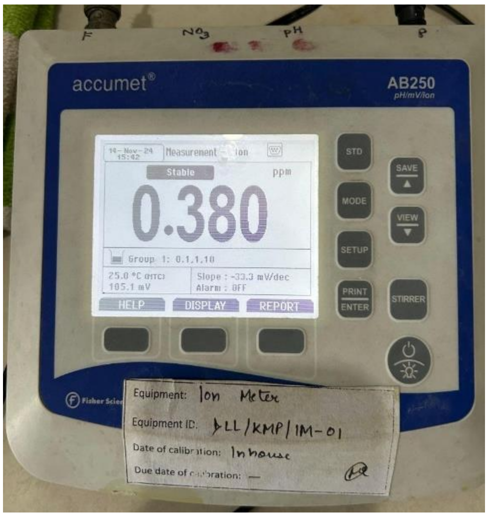

Fig3.9: Total Iron

3.5.10 METHODOLOGY TO DETERMINE FLUORIDE

Fluoride is a naturally occurring mineral that can be found in soil, water, and various types of rock formations. In water, fluoride typically exists in the form of **fluoride ions (F^-)**. Fluoride concentrations in water can vary significantly depending on the geographical region, geological conditions, and local sources of contamination. While fluoride is beneficial in small amounts, particularly for dental health, excessive fluoride in drinking water can cause several health issues. In India, fluoride contamination in drinking water has become a major public health concern in several states, especially in rural areas. Fluoride contamination in drinking water is a major public health issue in several parts of India, particularly in rural areas where groundwater is the primary source of water. While fluoride is beneficial for dental health at low concentrations, excessive levels of fluoride in water can lead to serious health problems such as dental and skeletal fluorosis. Addressing this issue requires effective water treatment methods, increased awareness, and the implementation of policies to ensure safe drinking water for the affected populations.

Here, we have used Fluoride Ionomeric Method to determine Fluoride in water sample .(IS 3025 part 60: 2008)

Procedure:

- Calibrate 0.1 ppm, 1 ppm, 10 ppm standard solution in ion meter
- Take 10 ml sample in a flask
- Add 1 mi TISAB III
- Record the readings displayed against respective standards

3.5.11 METHODOLOGY TO DETERMINE NITRATE

Nitrate (NO_3^-) is a chemical compound that naturally occurs in the environment, primarily in soil, water, and plants, as part of the nitrogen cycle. However, when nitrate concentrations in drinking water exceed safe levels, it can pose significant health risks to humans and animals. Nitrate contamination in drinking water is a significant environmental and public health issue, primarily due to agricultural runoff, wastewater discharge, and improper waste management. High levels of nitrates in water pose serious health risks, especially for infants, and can contribute to long-term health issues such as cancer and thyroid dysfunction. It is essential to monitor and regulate nitrate levels in drinking water sources to ensure safe water for communities. Implementing sustainable agricultural practices, improving wastewater treatment, and using effective water treatment technologies are critical steps in mitigating nitrate contamination and protecting public health. Here we have used Nitrate UV Screening Method to determine the Nitrate in water sample.

Procedure:

- Pipette 50 ml sample in a dry 100 ml Volumetric flask
- Add 1 ml 1M HCl
- Read Absorbance

CHAPTER 4
RESULTS AND DISCUSSION

4.1 GENERAL

The water quality assessment for the Mangaldai region reveals significant insights into the status of local water resources. Various parameters such as pH, dissolved oxygen, turbidity, and levels of major ions were evaluated to understand the suitability of water for both human consumption and ecological balance. The results indicate a mixture of conditions, with certain water bodies exhibiting high levels of contaminants, while others maintain relatively good water quality. This section discusses the findings in detail, interpreting the implications of these parameters on public health, agriculture, and the environment, while also exploring potential sources of pollution and recommending strategies for improvement.

4.2 VALUE OF DIFFERENT PARAMETER

4.2.1 pH Value

The pH is a measure of the intensity of acidity or alkalinity and measures the concentration of hydrogen ions in water. It has no direct adverse effect on health, however, a low value, below 4.0 will produces our taste and higher value above 8.5 shows alkaline taste. A pH range of 6.5–8.5 is normally acceptable as per guidelines suggested by IS code 10500:2000. In the present study, the fluctuation of pH in the samples is from 7.46 to 8.15.

Table 4.1: pH values of samples

SI No	Location	pH
1.	Mangaldai Ghat	7.72
2.	Mangaldai Bridge	7.46
3.	Islampur	8.15
4.	Ground water from Mangaldai Ghat	7.6
5.	Ground water from Islampur	7.5

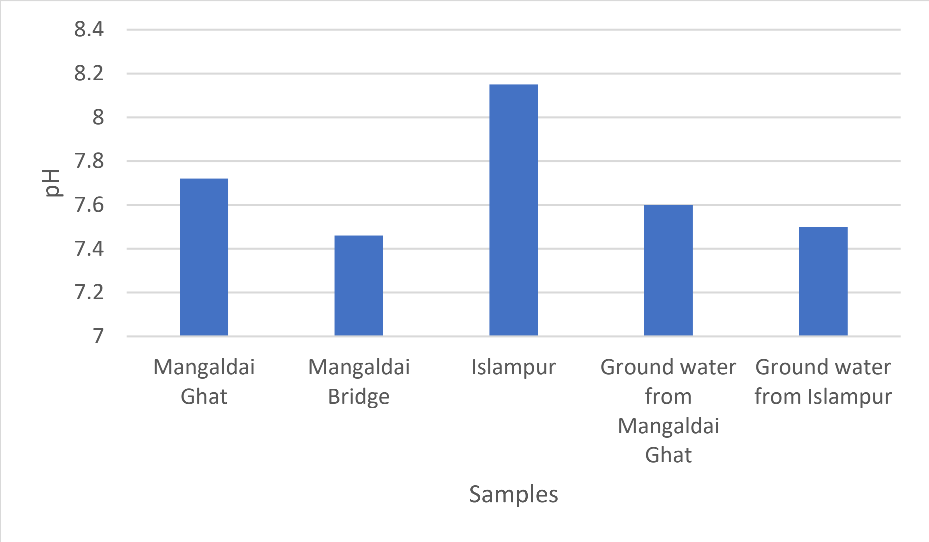

Fig 4.1: Graph showing the pH values of all samples

4.2.2 Total Dissolved Solids (TDS)

Table 4.2: Values of TDS of samples

SI No	Location	TDS
1.	Mangaldai Ghat	95
2.	Mangaldai Bridge	75
3.	Islampur	125
4.	Ground water from Mangaldai Ghat	210
5.	Ground water from Islampur	165

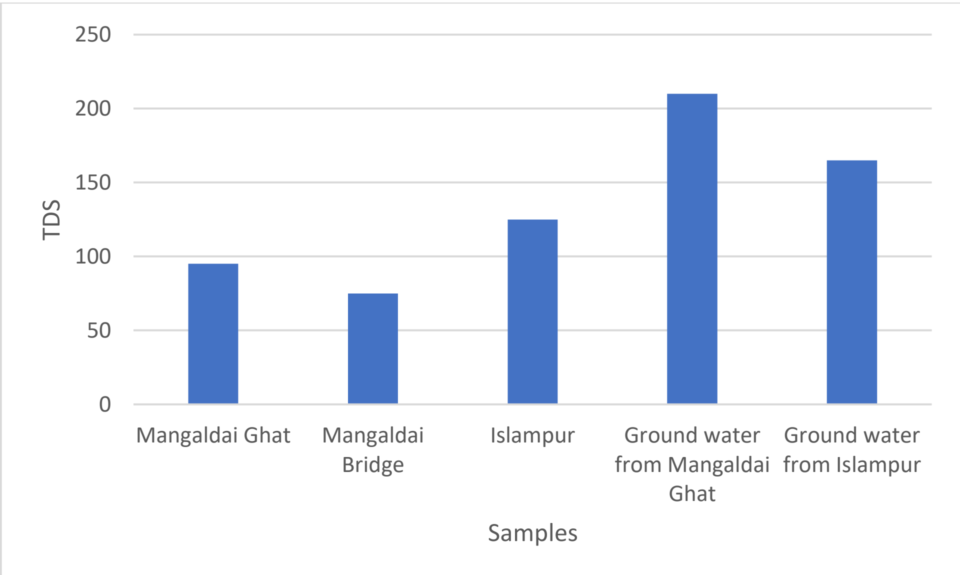

Fig 4.2: Graph showing TDS values of samples

4.2.3 Turbidity

Table 4.3: Values of turbidity of samples

SI No	Location	Turbidity
1.	Mangaldai Ghat	1.2
2.	Mangaldai Bridge	2.5
3.	Islampur	2.3
4.	Ground water from Mangaldai Ghat	6.5
5.	Ground water from Islampur	7.9

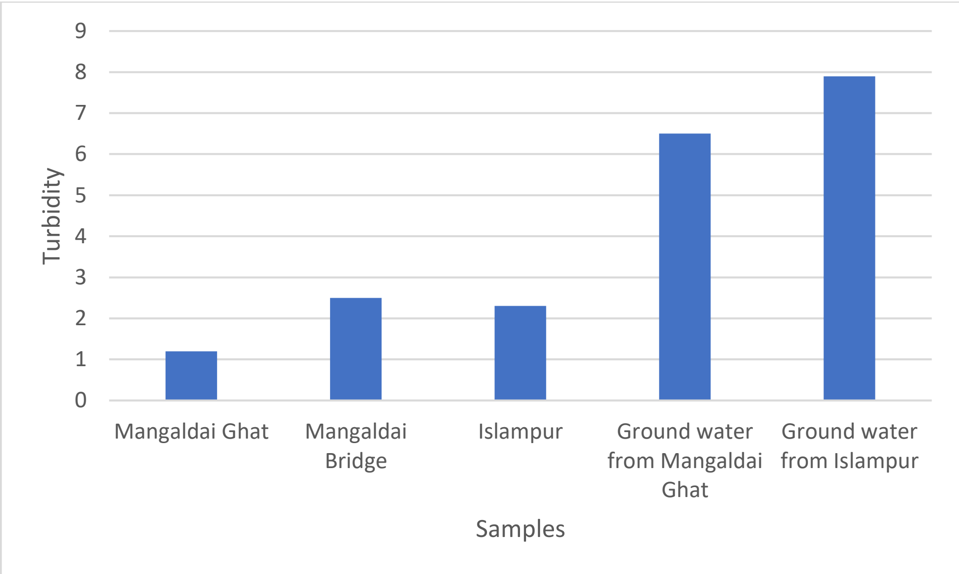

Fig 4.3: Graph showing Turbidity values of samples

4.2.4 Electronic conductivity

Table 4.4: Values of electronic conductivity of samples

SI No	Location	EC
1.	Mangaldai Ghat	103.1
2.	Mangaldai Bridge	120.4
3.	Islampur	149.5
4.	Ground water from Mangaldai Ghat	350
5.	Ground water from Islampur	319

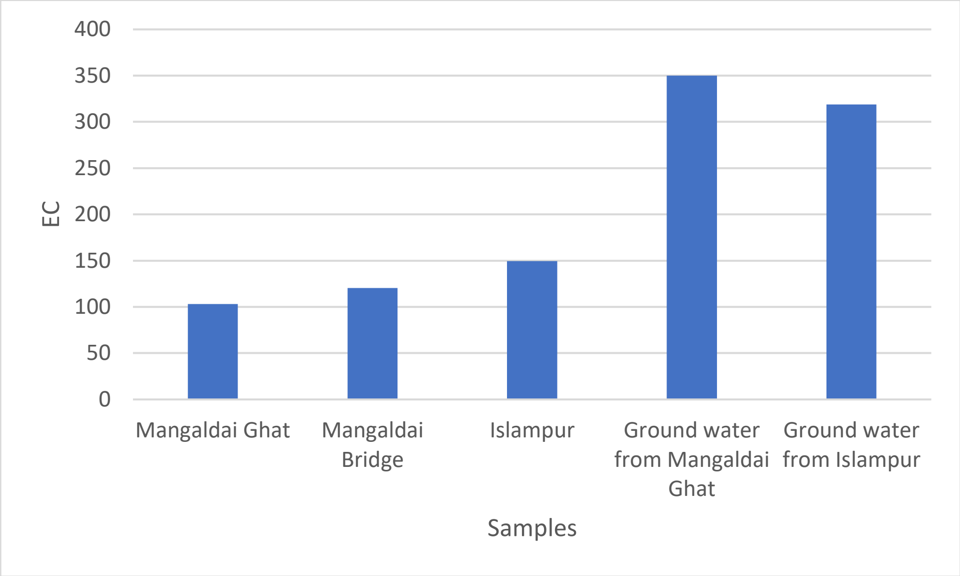

Fig 4.4: Graph showing electronic conductivity values of samples

4.2.5 Chloride

Table 4.5: Values of chloride of samples

SI No	Location	Chloride
1	Mangaldai Ghat	55.33
2	Mangaldai Bridge	60.67
3	Islampur	79.45
4	Ground water from Mangaldai Ghat	26.51
5	Ground water from Islampur	20.59

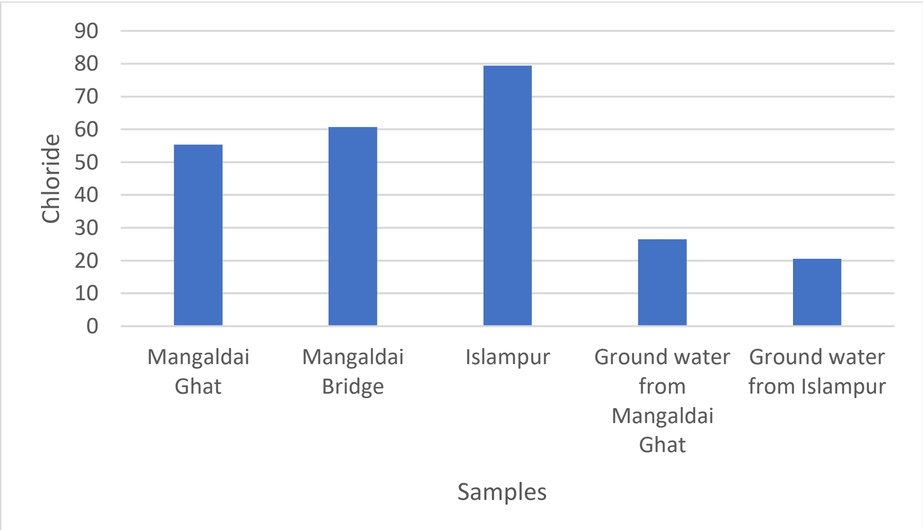

Fig 4.5: Graph showing chloride values of samples

4.2.6 Total alkalinity

Table 4.6: Values of total alkalinity of samples

SI No	Location	Total Alkalinity
1	Mangaldai Ghat	10.5
2	Mangaldai Bridge	16.8
3	Islampur	8.4
4	Ground water from Mangaldai Ghat	21
5	Ground water from Islampur	18.5

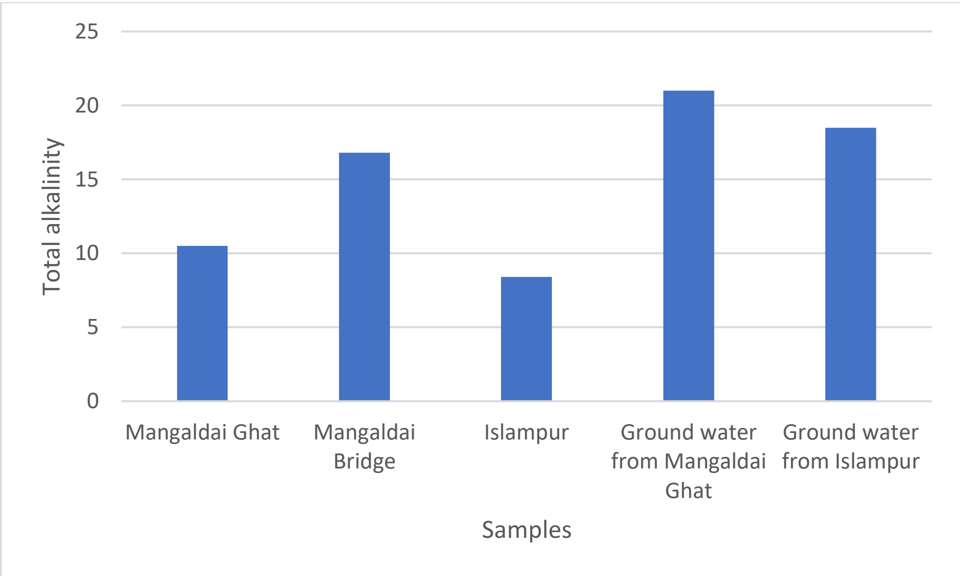

Fig 4.6: Graph showing Total alkalinity values of samples

4.2.7 Sulphate

Table 4.7: Values of total sulphate of samples

SI No	Location	Sulphate
1	Mangaldai Ghat	9.39
2	Mangaldai Bridge	16.2
3	Islampur	11.5
4	Ground water from Mangaldai Ghat	20.43
5	Ground water from Islampur	29.5

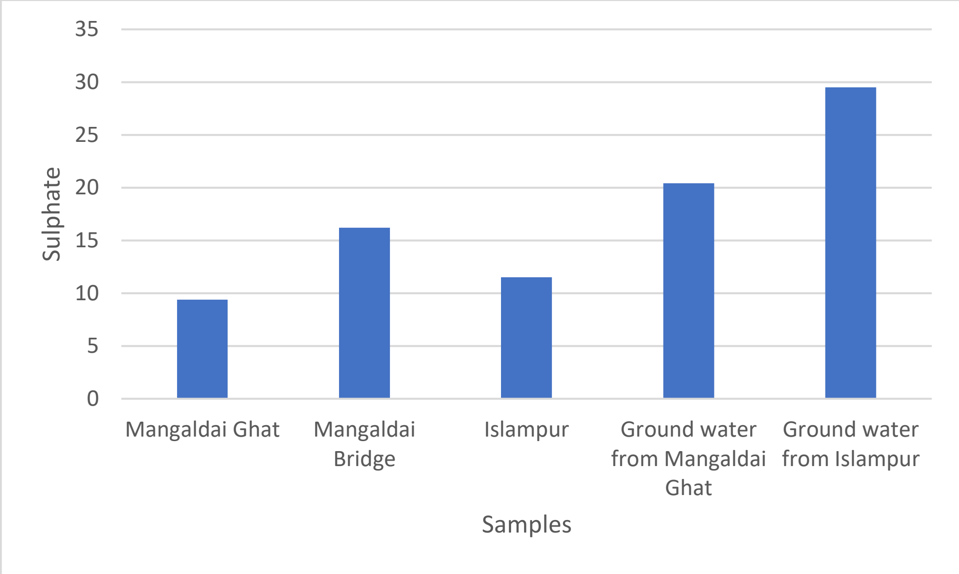

Fig 4.7: Graph showing sulphate values of samples

4.2.8 Total hardness

Table 4.8: Values of total hardness of samples

SI No	Location	Total Hardness
1	Mangaldai Ghat	29.4
2	Mangaldai Bridge	79.8
3	Islampur	46.2
4	Ground water from Mangaldai Ghat	130.2
5	Ground water from Islampur	117.6

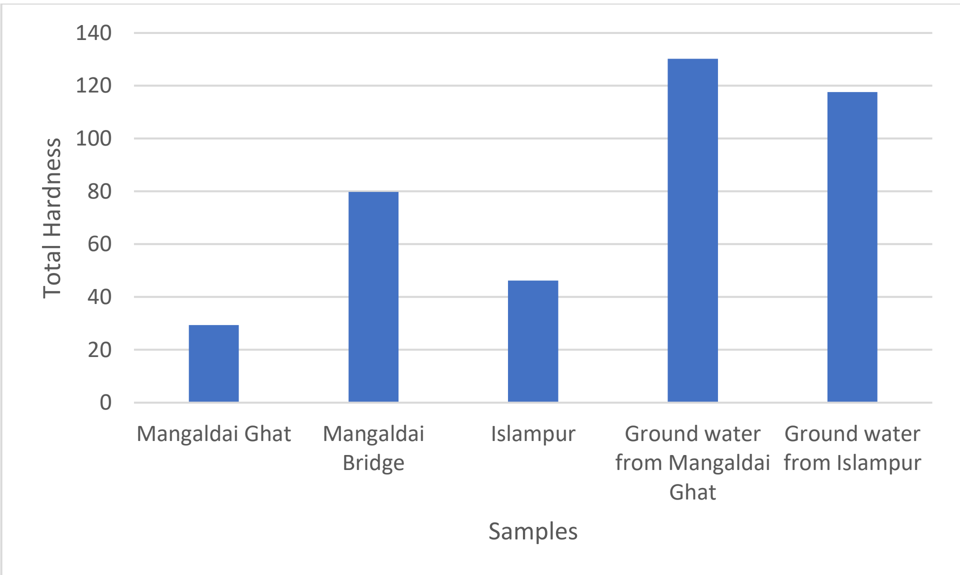

Fig 4.8: Graph showing total hardness values of samples

4.2.9 Total Iron

Table 4.9: Values of total iron of samples

SI No	Location	Total Iron
1	Mangaldai Ghat	2.71
2	Mangaldai Bridge	1.53
3	Islampur	1.93
4	Ground water from Mangaldai Ghat	2.51
5	Ground water from Islampur	1.62

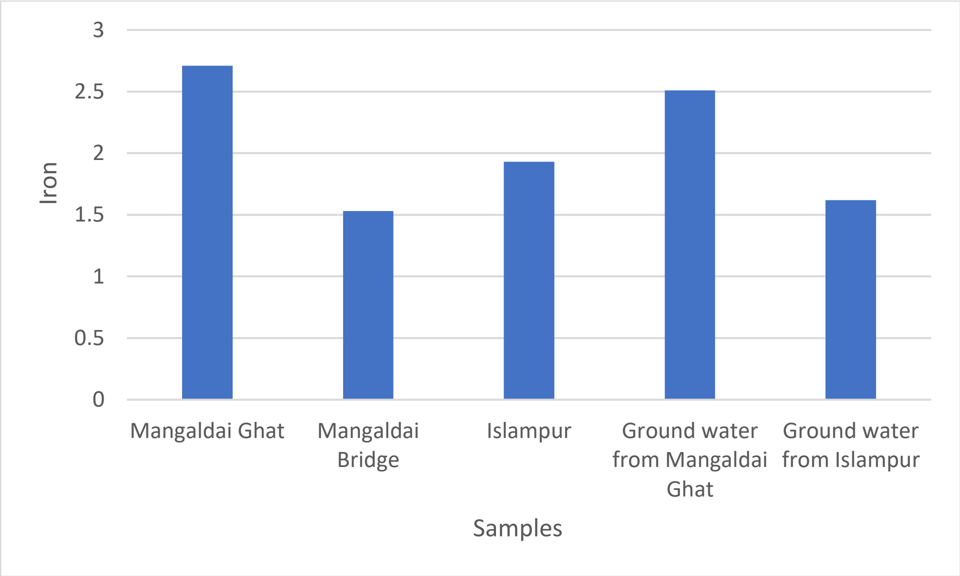

Fig 4.9: Graph showing total iron values of samples

4.2.10 Fluoride

Table 4.10: Values of fluoride of samples

SI No	Location	Fluoride
1	Mangaldai Ghat	0.38
2	Mangaldai Bridge	0.39
3	Islampur	0.41
4	Ground water from Mangaldai Ghat	0.147
5	Ground water from Islampur	0.21

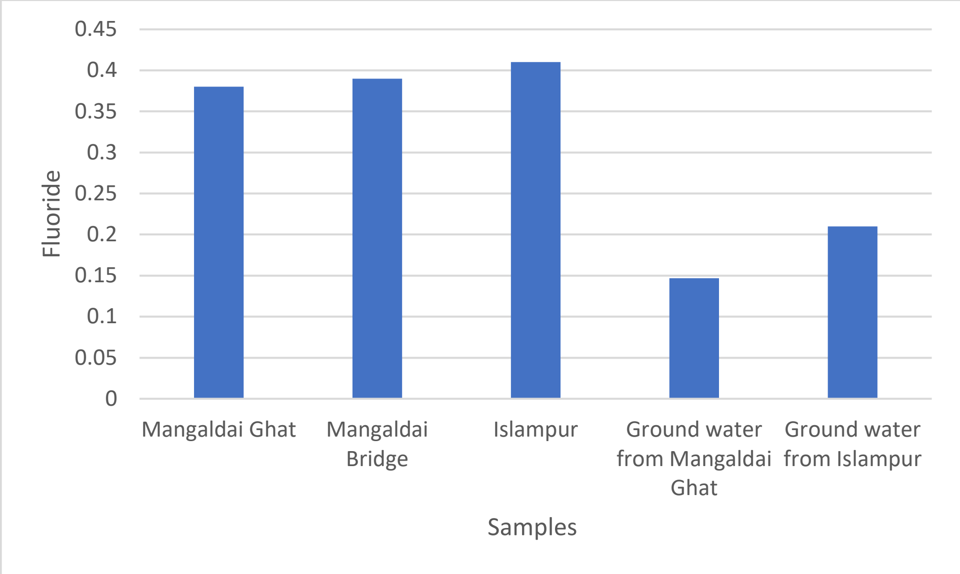

Fig 4.10: Graph showing fluoride values of samples

4.2.11 Nitrate

Table 4.11: Values of nitrate of samples

SI No	Location	Nitrate
1	Mangaldai Ghat	3.68
2	Mangaldai Bridge	4.51
3	Islampur	3.97
4	Ground water from Mangaldai Ghat	2.63
5	Ground water from Islampur	1.62

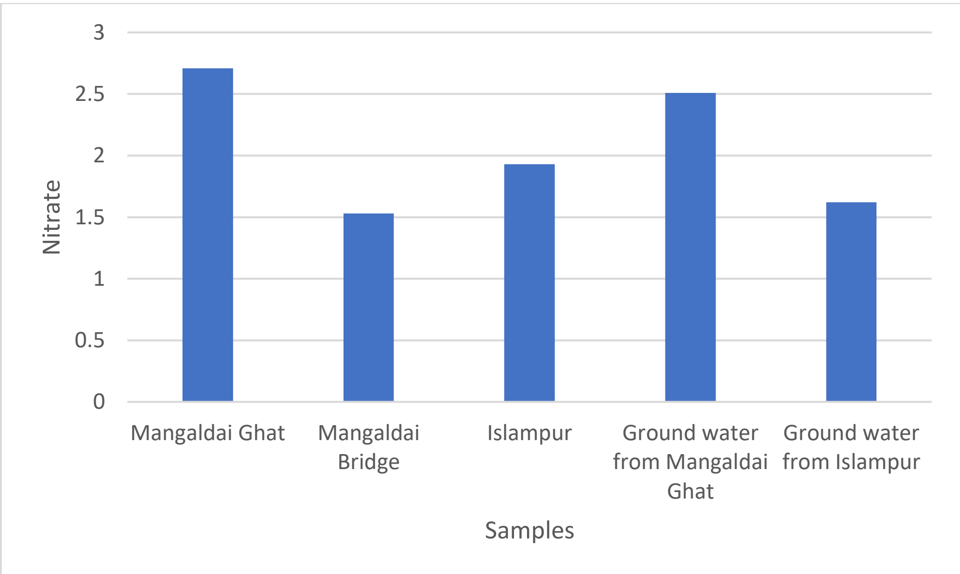

Fig 4.11: Graph showing nitrate values of samples

CHAPTER 5

CONCLUSIONS

5.1 GENERAL

This research highlights the critical importance of monitoring and assessing water quality to ensure safe and sustainable water resources for both groundwater and surface water. The study demonstrated significant differences in water quality across diverse regions, emphasizing the role of human activities such as agriculture, industrialization, and urbanization in shaping water contamination levels.

5.2 CONCLUSIONS

In conclusion, the water quality assessment conducted in the Mangaldai area highlights significant differences between ground water and river water, with implications for public health and water usage practices. The study found that ground water in the region has elevated levels of iron. This high iron content can lead to a range of health concerns, such as staining of teeth and potentially affecting the liver over long-term consumption. Therefore, ground water in the Mangaldai area is not considered ideal for direct consumption without proper filtration and treatment to reduce the iron levels to acceptable standards.

On the other hand, the river water in the region is comparatively of better quality, with lower levels of contaminants, making it suitable for domestic use. The river water could be further purified through filtration and appropriate treatment methods, enabling it to be used safely for drinking purposes as well. This suggests that river water, with proper management, could serve as a sustainable and accessible source of clean water for the community. These findings underline the need for targeted interventions to improve the quality of ground water, particularly by addressing the high iron content through filtration technologies. Additionally, promoting the use of river water for drinking after proper treatment could offer a safer alternative for the local population. Future studies should focus on monitoring water quality trends over time and exploring cost-effective treatment methods, ensuring that both ground and surface water sources meet the required standards for health and safety. By implementing these measures, the Mangaldai area can secure a more reliable and healthier water supply for its residents.

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