SUMMER INTERNSHIP REPORT

ON

WATER AND SOIL ANALYSIS IN THE PARTS OF KANIHA BLOCK, DISTRICT ANGUL, ODISHA

SUBMITTED

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ACKNOWLEDGEMENTS

My sincere thanks to Prof. D.C.Nainwal, Head of Geology Department and the Principle, Govt. P.G College, Rishikesh and Prof. Pankaj pant for providing facilities of the Department.

It is my privilege to express my respect and sincere gratitude to Dr. S.P Rai, Scientist-E, Hydrological Investigation Division, National Institute of Hydrology, Roorkee for his valuable guidance and supervision.

I am extremely thankful to Er. Raj Dev Singh, Director, NIH, Roorkee for granting permission to carry out the summer training in NIH, Roorkee. I express my deep sense of gratitude to Dr. Sudhir Kumar, Scientist-G and Head of Hydrological Investigation Division, Roorkee and Mr. Ravi Saini, Neeraj Pant (SRF) National Institute of hydrology. Also sincere thanks to my friends, Sandeep Singh and Vinod Kumar for providing support and keeping my moral high during the tough time.

Above all I am indebted to my parents, and Brother, who have always supported me and provided me with the best facilities available in their Command to carry out this work. I gratefully acknowledge their efforts in making me complete the work in the present form.

Last but not the least, I would like to express my sincere thanks to all of them who helped me directly or indirectly towards the making of this work. I acknowledge their help with a sense of gratitude.

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CANDIDATE'S DECLARATION

I, hereby, certify that the report entitled " **WATER AND SOIL ANALYSIS IN THE KANIHA BLOCK, DISTRICT ANGUL, ODISHA"** This work, during the period of **10th June 2016** to **23 August 2016**, is a record of my own work under the supervision of **Dr S.P Rai**, Scientist 'E', Hydrology Investigation Division, National Institute of Hydrology (NIH), Roorkee (Uttarakhand).

(ARTI GAMTHIYAL)
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This is to certify that the above statement made by the candidate is correct to the best of my knowledge.

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CONTENTS

ABSTRACT

The water and soil analysis in Kaniha block, district Angul, Odisha is an important aspect in understanding the behavior of soil and water and what can they be used for. The two essential properties of soil are soil texture and soil structure. Apart from being a natural filter, it enables plants and wildlife to grow. Ash pond area around Kaniha, district Angul, Odisha have been studied. This study gives us a valuable information on the general properties of soil such as soil texture, and water quality parameters like pH, electrical conductivity, TDS, Bicarbonate, Sulfate, Nitrate, chloride etc. of the study area. Three locations were decided for soil sampling. For the water analysis seventeen locations were decided. The soil samples were analyzed in the Soil and Water laboratory of National institute of hydrology, Roorkee for soil texture. The result of the particle size distribution along different depth at particular location shows that there was much variation in the grain size. Loam and Silty clay loam, clay loam and clay are the major soil texture of the study area. Water samples were analyzed at the water quality lab. NIH, Roorkee for pH, electrical conductivity and total dissolved solids. pH of river varied from 7.64 to 8.21. In case of pond the value of pH varied from 7.03 to 7.84. The pH of groundwater varied from 7.18 to 7.4 and pH of ash pond varied from 7.66 to 8. The electrical conductivity (EC) of river's sample falls from 130.8µmho/cm to 341µmho/cm. EC of pond's sample varied between 139.3µmho/cm and 888µmho/cm In case of ground water it varied from 307µmho/cm to 1042µmho/cm. The overall total dissolved solids in water of study area varied from 71mg/l to 1369mg/l.The range of Fluoride in water of study area varied from 0.05mg/l to 5.46mg/l. it is concluded that value of fluoride has more than acceptable range. Overall the range of the Chloride in water of the study area tend to falls between 4.02mg/l to 265.94mg/l. Sulfate of all the water samples that were collected from the study area have ranged from 3.16mg/l to 106.07mg/l.

The range of the Bicarbonate of all the water samples varied from 42mg/l to 610mg/l. It was concluded that that the water standard of study area is good according to BIS (IS: 10500-1991), except some parameters such as Fluoride, Nitrate, and Sulfate etc. the type of soil in the study area supports crop cultivation and facilitates groundwater recharge. Groundwater of the study area is suitable for drinking purpose, except for few locations and it is also suitable for the irrigation. The study can be helpful in improving the management of land use cover and method of irrigation. The results from this study can be further used in modeling studies such as estimation of ground water recharge.

CHAPTER 1
INTRODUCTION

1.1 GENERAL

India is blessed with a rich and vast diversity of natural resources, water being one of them. Water is Mother Earth's most wonderful, abundant and useful compound. There are many essential elements for the survival of living beings such as water and soil. Water is rated to be of the greatest importance. Water is not only essential for the lives of animals and plants, but also occupies a unique position in industries. Groundwater is an important source of water supply throughout the world. Groundwater occurs almost everywhere beneath the earth surface not in a single widespread aquifer but in thousands of local aquifer systems and compartments that have similar characters. Knowledge of the occurrence, replenishment, and recovery of groundwater has special significance in arid and semi-arid regions due to discrepancy in monsoonal rainfall, insufficient surface waters and over drafting of groundwater resources. (Mahananda et al., 2010).The demand for water has increased over the years, which has led to the water scarcity in many parts of the country. The situation is further aggravated by the problem of water pollution or contamination. India is heading towards a freshwater crisis mainly due to improper management and environmental degradation of surface and ground water resources.

1.2 IMPORTANCE OF WATER AVAIBILITY AND QUALITY

Water is a clear liquid that has no color, taste or smell and have its own chemistry that has fall from cloud as rain and Form Rivers, lakes and seas. It is an essential element for the survival of living beings. With two third of earth's surface covered by water and human body consisting of 75% of it, it is evidently clear that water is one of the prime elements responsible for life on earth. Water existing in the soil strata is known as subsurface water and can be separated into soil water and groundwater. The soil water occurs in unsaturated zone, and groundwater occurs in saturated zone. Groundwater is an important source of water supply throughout the world. Groundwater occurs almost everywhere beneath the earth surface not in a single widespread aquifer but in thousands of local aquifer systems and compartments that have similar characters. Water from beneath the ground has been exploited for domestic use, livestock and irrigation since the earliest times. It is however common for the dominant role of groundwater in the freshwater part of hydrological cycle to be overlooked. Groundwater is easily the most important component and constitute about two third of fresh water resources of the world and, if the polar ice caps and glaciers are not considered, Groundwater accounts for nearly 90% all usable freshwater. even if the consideration is further limited to only the most active and accessible groundwater bodies (estimated by Lvovitch 1972 at 4× 106 km^3) then they constituent 95% of the total freshwater. Lakes and rivers account for only 1.5 per cent (Freeze and cherry 1979). So it is our responsibility to protect and save the groundwater from the harmful effects that has come from the industrial wastes brought by rivers for our basic needs.

Ground water quality is important to humans. Therefore it is important to ensure its quality is high at all time so that the consumer health is not compromised. Groundwater resources are affected mainly by three major activities: (i) excessive use of fertilizers and pesticides in agricultural areas, (ii) untreated/partially treated wastewater to surface water bodies, and excessive pumping and improper management of groundwater resource. Solid waste disposal in open un-engineered landfill is the one of the factor that causes ground water pollution due to lack of pollution control interventions such as water proof layer, leachate treatment pond, monitoring wells, etc (Mohamad et al., 2007). Groundwater pollution also occurs due to disposal of toxic wastes, especially from industries, or undetected leakage from pipes, waste storage containers, or underground tanks. According to WHO, about 80% of all the diseases in human beings are caused by water Groundwater once contaminated, its restoration to actual state requires prolonged time and decontamination is not possible by just stopping the ingress of pollutants from the source. Contamination of groundwater by domestic, industrial effluents and agricultural pollutants is a serious problem being faced by developing countries. The industrial waste water, sewage sludge and solid waste materials are currently being discharged directly into the environment indiscriminately. These materials enter subsurface aquifers resulting in the pollution of irrigation and drinking water. High rates of mortality and morbidity due to water borne diseases are well known in India. Therefore, access to safe drinking water supply remains an urgent necessity, as 30% of urban and 90% of rural households still depend completely on untreated surface or ground water (Palanisamy et al., 2007).

The quality of water is defined in terms of its physical, chemical and biological parameters. Its development and management plays a vital role in agriculture production, poverty reduction, environmental sustenance and sustainable economic development (Hiremath et al., 2011). In some areas of the world, people face serious drinking water shortage because of the ground water pollution. Thus, evaluation of groundwater quantity and quality is important for the development of further civilization and to establish database for planning future water resources development and management strategies. The quality of water may depend on geology of particular area and also vary with depth of water table as well as seasonal changes and is governed by the extent and composition of the dissolved salts depending upon the subsurface environment.

1.3 SOIL AND ITS IMPORTANCE

Soil is a natural body engaged in dynamic interactions with the atmosphere above and the strata below, that influences the planet's climate and hydrological cycle and that serves as a growth medium for a versatile community of living organisms. In addition, the soil plays a major environmental role as a bio-physico-chemical reactor that decomposes waste products and recycles them into nutrients for the continual regeneration of life on earth (Hillel, 1999). Soil is composed of inorganic solid particles of various sizes and irregular shapes. The origins of these particles are weathered rocks, erupted materials, and sediment in ocean, lakes, marshes, and rivers. The pore space in between soil particles are termed as soil pores. When soil pores are filled with liquid-phase material, the soil is termed saturated; when gas-phase material is contained in the pore spaces, the soil is termed unsaturated.

Soil properties are important for any hydrological study. One such property is soil texture which is an essential for understanding the behavior of soil. Soil texture refers to the proportion of the soil "separates" that make up the mineral component of soil. These separates are called sand, silt, and clay. According to United States Department of Agriculture, these soils separated based on the following size ranges (Miyazaki, 2006).

• Gravel	larger than 2.0 mm
• Coarse sand	between 2.0 and 0.2 mm
• Fine sand	between 0.2 and 0.02 mm
• Silt	between 0.02 and 0.002 mm
• Clay	smaller than 0.002 mm

1.4 OBJECTIVES

The present study was carried out to complete the following objectives:-

- Evaluation for the drinking water purposes.
- Study of soil texture.

CHAPTER 2

STUDY AREA

2.1 GENERAL

2.1.1 LOCATION

Kaniha is located 32Km towards North from the District headquarters Angul. The state of Orissa is endowed with vast natural resources including strategic minerals. This has led to intensive industrial development. The Angul district which has been carved put from earlier Dhenkanal district is one such area in which various industries are located. The district is named after the district headquarter town of Angul. Angul district was formed out of the former undivided Dhenkanal district on April 1, 1993. The district lies between 20° 31 N and 21° 40 N latitude and 84° 15 E and 85° 23 E longitude. The altitude lies between 564 and 1,187 meters. The name Angul is said to be a corruption of Anugola, named after Anu, the last Khond Tribal Chief who was deposed by means of a gol, which literally means battle.

The district has a total area of 6,232 sq. km. with a population of 11, 39,341 as per the 2001 Census (males: 586,903, females: 552,438) and a population density of 179 per sq.km. There are 1,922 villages in the district, out of which 1,635 are inhabited and 287 are uninhabited. The total rural population of the district is 980,954 and the total urban population is 158,387. Angul is the 11th largest district among 30 districts of Orissa. It is bounded by Dhenkanal and Cuttack districts in the east, Debagarh, Kendujhar and Sundargarh in the north, Sambalpur and Sonepur in the west and Boudh and Nayagarh in the south.

Angul is abundant in natural resources, which ultimately helps it to contribute the maximum amount of revenues to the State government. Although a new district, it is strategically the most advanced, owing to its vast coal mines that earn large revenues for the State. The district is also rich in flora and fauna. It boasts of several unique wildlife habitats such as Satakosia Gorge Sanctuary, Malyagiri, Bulajhar, Panchadhara and Mahanadi river system, which are all of tremendous biological diversity.

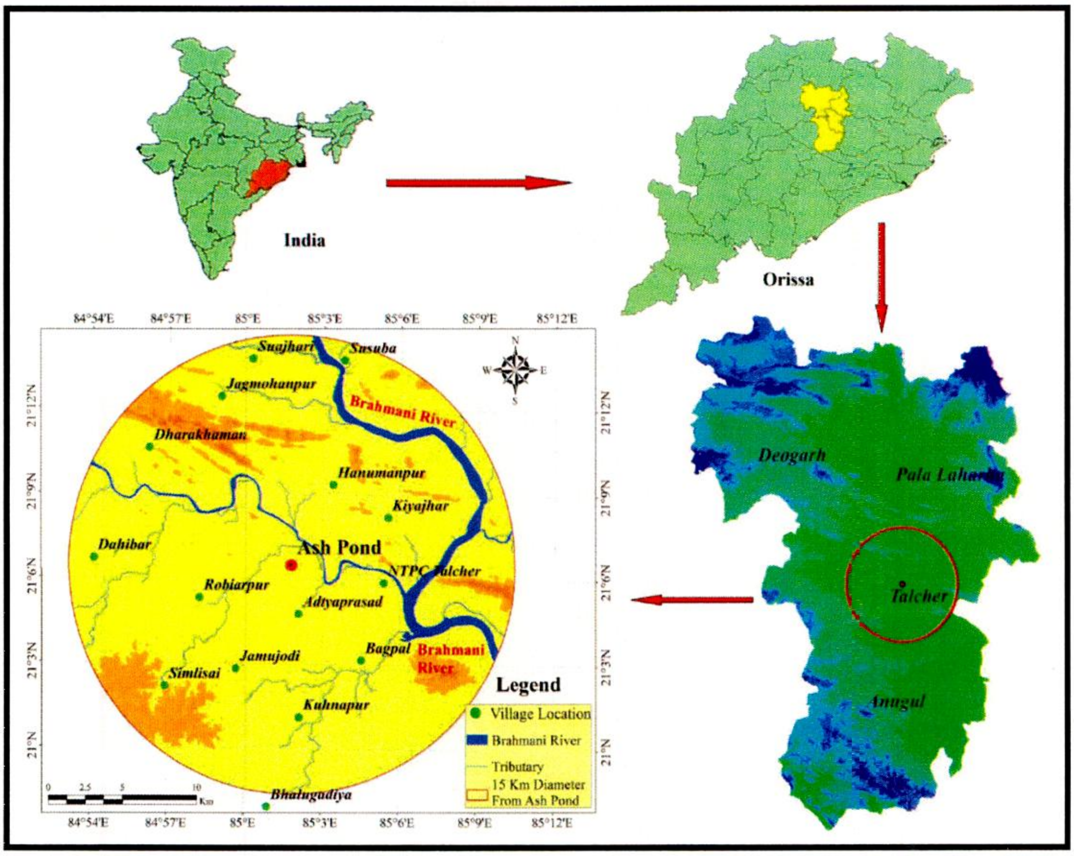

Figure 1: Location Map of the study area Kaniha, District Angul.

2.1.2 GEO-MORPHOLOGICAL SET UP

The Physiography of the district is marked by three major regions. The South and Western part comprises ranges of the Eastern Ghat Super Group and the Older Metamorphic Group. The Central portion is represented by sediments deposited in the Satpura-Mahanadi graven defined by pronounced NW-SE trending lineaments on a Precambrian platform, almost separating the Eastern Ghat Mobile Belt and Orissa Carton. The northern boundaries of Talcher basin are faulted. Situated at the heart of Orissa, the district of Angul is an integral part of the State contributing towards its rich culture, tradition and socio-economic development. Most of the forests of the district are deciduous in nature. The Angul Forest Division covers forest areas of Angul and Talcher civil sub-division of Angul district. Established in 1885, the Angul Forest Division is the oldest Forest Division in the State. The major part of the Angul district falls between two major river systems of Orissa State i.e. river Brahmani flows in the north east and river Mahanadi which forms the south-south western boundary of the district. The altitude and physiographic set of the area divides the whole district into two distinct catchment, the streams joining the river Mahanadi flows in south-west direction where the streams joining the river Brahmani from the central plains flow in north-east direction. The drainage pattern is mostly dendritic and parallel in hills. These rivers have been harnessed to meet the focal water need for irrigation by constructing bunds and medium dams. The main source of surface water is Derange reservoir in the area which is located 3km east of Angul town.

2.1.3 SOIL AND LAND USE

The district is dominated by tropical wet and dry climate and locally it has been put under Arid Central Table Land. The district is consisted of mainly three type of soil, namely Alfi Soil, Ulti Soil and Verti Soil. Alfi soil comprises of red sandy soils, red loamy soils and mixed red and black soils. The red loamy and red sandy soils cover major parts of the district. The red soils are suitable for cultivation of paddy and other crops. Soil plays an important role in over all the availability of surface water as well as recharge to ground water. The red soil are light textured, usually made of lime Kankar and free of carbonates. Sandy clay is common and these soils are suitable for cultivation of paddy and other crops. Ulti sols are also found in the western extremity of the study area which consist of red and yellow soils and are rich in clay content. The major crop of kharif season, during Rabi season mainly vegetable and oil seeds are grown.

2.1.4 CLIMATE AND RAINFALL

The study area experiences tropical monsoon climate with mild winter and hot summer. There are three distinct season, good rainfall has been observed in the area through south-west monsoon between May to September every year. The Climatological data including the monthly temperature, humidity and rainfall for the period of last eight years from Angul I.M.D station has been analyzed to arrive at the annual normal rainfall of the area and is presented in Table 2.1. The average annual rainfall of the Angul area has been observed as 1266.7 mm, of which major amount are received during the four months extending from June to September.

2.1.5 GEOLOGY:

The district of Angul represents diverse geological sequence, from rocks of Eastern Ghats of Pre-Cambrian age, Iron-ore super group, Gondwana Super group, Laterites to alluvial deposits of Quaternary age. The Gondwana rocks are exposed in the central part of the district covering parts of Talchir, Kaniha, Chendipada and Kishorenagar blocks. The plant area occupies the southern portion of Talchir coalfield and is located north-west of Angul town. Major portion of study area is occupied by Precambrian basement rocks except in extreme north eastern corner where Talchir are present.

Table 2.1: Climatological Data of IMD Station, Angul

Month	Mean Temperature (°C)		Relative Humidity (%)		Rainfall (mm)
	Max	Min	Morning	Evening	
January	28.85	15.61	80	58	17.0
February	32.41	18.19	75	49	16.8
March	37.34	18.63	67	40	21.3
April	39.31	20.00	67	44	40.4
May	40.21	21.46	67	48	93.6
June	35.18	21.23	75	67	212.1
July	31.78	20.57	81	77	258.2
August	31.86	20.81	83	81	317.3
September	32.99	20.47	81	77	165.7
October	32.64	18.21	82	73	93.7
November	31.17	14.59	77	64	23.3
December	28.63	12.69	79	59	7.3
Average	33.53	18.54	76	61	1266.7

2.1.6 HYDROLOGY

The major part of the total water requirement for domestic, irrigation and industries of the district as well as the study area are met from surface water sources. The district is also dotted with numerous small water bodies which cater to the domestic water needs. The river Mahanadi marks the southern boundary of this district River Brahmani enters the district through Rengali reservoir and passes through Talcher sub-division. Both these great rivers have innumerable tributaries large and small. Pallahara and Talcher sub-division and major portion of Angul sub-division form a part of the

Brahmani basin. The Mahanadi basin is spread over Athamallik and part of Angul sub-divisions. Other rivers of Angul are mountain streams which are torrents in the rains and in summer contain little or no water. Their banks in most part are high, their beds rocky and they are not used for navigational purposes Brahmani basin is the largest basin of the district with 68.02% of the total geographical area and the Baitarani basin is the smallest covering only about0.36% of the total geographical area of Rayaga district. The Mahanadi basin with about 32% area of the district is another prominent basin here.

2.2 WATER SAMPLING LOCATIONS

Groundwater conditions of the study area were studied by carrying out water sampling. Water samples were collected from different sources of the study area such as river, ponds, ash pond and hand pump. Table 2.2

Table 2.2 Water Sample Locations and Source of Water

S. NO.	SAMPLE ID	VILLAGE	SOURCE	LONGITUDE	LATITUDE
1	TL-1	BRAHMANI	RIVER	78.055	28.087
2	TL-2	BARUIN	RIVER	78.041	28.009
3	TL-3	GOHAM	RIVER	78.078	28.028
4	TL-4	TIKIRA	RIVER	78.130	27.979
5	TL-5	AMBAPAL	POND	78.153	27.945
6	TL-6	DERANG	POND	78.098	27.902
7	TL-7	BAUDA BEDA	POND	78.115	28.129
8	TL-8	EK GHARIA	POND	78.037	27.957
9	TL-9	NTPC KANIHA	ASH POND WATER (1) STAGE I	78.202	27.958
10	TL-10	NTPC KANIHA	ASH POND SEEPAGE WATER (2) STAGE I	78.237	27.999
11	TL-11	NTPC KANIHA	ASH POND SEEPAGE WATER (4) STAGE II	78.267	28.150
12	TL-12	NTPC KANIHA	ASH POND EFFLUIENT L-I STAGE II	78.178	28.103
13	TL-13	NTPC KANIHA	ASH PONF EFFLUIENT RECIRCULATOR WATER	78.127	28.048
14	TL-14	NTPC KANIHA	RAW (MAKE UP) WATER	78.175	28.019
15	TL-15	AMBAPAL	HAND PUMP	78.059	28.099
16	TL-16	AMBAPAL	HAND PUMP	78.116	28.129
17	TL-17	DAUNDSINGH	HAND PUMP	78.178	28.011

2.3 SOIL SAMPLING LOCATIONS

Soil samples were collected for analyzing its different properties. Soil samples were collected from 3 different sites (Kaniha, Derang and Takua) of the study area and are listed below in table 2.3.

Table 2.3 Soil Sampling Location and Depth

S. No.	Sampling site no.	Depth (m)		Sample code/ ID	Date of collection	Location/Village	Long	Lat
		From	To					
1	NTPC/Soil-1	0.00	0.80	STL-1	6/6/2016	Kaniha	85.04122	21.1002
2	NTPC/Soil-1	0.80	1.00	STL-2	6/6/2016	Kaniha	85.04122	21.1002
3	NTPC/Soil-1	1.00	1.60	STL-3	6/6/2016	Kaniha	85.04122	21.1002
4	NTPC/Soil-1	1.60	2.40	STL-4	6/6/2016	Kaniha	85.04122	21.1002
5	NTPC/Soil-2	0.00	0.70	STL-5	6/6/2016	Derang	84.9999	21.1006
6	NTPC/Soil-2	0.70	1.70	STL-6	6/6/2016	Derang	84.9999	21.1006
7	NTPC/Soil-2	1.70	2.00	STL-7	6/6/2016	Derang	84.9999	21.1006
8	NTPC/Soil-3	0.00	1.20	STL-8	6/6/2016	Takua	85.0336	21.1199

CHAPTER 3

METHODOLOGY

3.1 GENERAL

The Physico-chemical analysis is performed as per the standard methods (APHA, 1992). To check the results of laboratory analysis, ionic balance has also been done. A total number of eleven water quality parameters were selected. The details of various water quality parameters, analytical methods and equipment's are given in Table 3.1

Table 3.1 Details of Analytical Methods and Equipments

S. No.	Parameter	Method	Equipment
1	pH	Electrometric	pH Meter
2	Conductivity	Electrometric	Conductivity Meter
3	TDS		Conductivity/TDS Meter
4	Bicarbonate	Titration by H_2SO_4	Titration
5	Sulphate	Turbid metric	Turbidity Meter
6	Chloride	Titration by $AgNO_3$	Titration
7	Iron	Spectrophotometer	Spectrophotometer
8	Calcium	Titration by EDTA	Titration
9	Magnesium	Titration by EDTA	Titration
10	Sodium	Flame Emission	Flame Photometer
11	Hardness	Titration by EDTA	Titration

3.2 METHODOLOGY FOR WATER QUALITY PARAMETERS.

In the present study, various water quality parameters as given in Table 2.2 are described in detail as follows:

3.2.1 pH

pH value is a measure of hydrogen ion concentration and is the negative exponent of the logarithm of the hydrogen ion concentration. A low pH solution has a high hydrogen ion concentration and is therefore, acidic while high pH solution is low in hydrogen ion concentration and is alkaline (pH 7 being neutral).

The pH value of natural water is an important index of acidity or alkalinity and is the resulting value of the acidic/basic interaction of a number of its mineral and organic components. In pure or slightly polluted water, the value of pH is determined mainly by the correlation between the concentrations of free carbon dioxide, bicarbonate and carbonate ions. This correlation, in turn depends substantially on the intensity of the process of photosynthesis and the biochemical oxidation of organic substances as well as on chemical conversions of some mineral substances. pH of most natural waters range from 4 to 9 and are often slightly basic due to the presence of carbonates and bicarbonates.

A major deviation from the normal pH for given water indicates the industrial wastes. Practically every phase of water supply and wastewater treatment, e.g., acid- base neutralization, water softening, precipitation, coagulation, disinfection and corrosion control, is pH dependent.

PROCEDURE:-

i) For detailed instructions, follow manufacturer's manual, Standardize the pH meter by immersing the electrode in buffer solution of known pH. Read the pH and correctly, adjust with the control until the meter indicates the correct value for pH of buffer solution.

ii) Remove electrodes from first buffer, rinse thoroughly with distilled water, blot dry with a soft tissue, and immerse in second buffer, the reading should be within 0.1 unit for the pH of the buffer. If the response shows a difference greater than 0.1 pH unit from expected value, look for trouble with the electrode or pH meter.

iii) Rinse the electrodes in distilled water and immerse them in the sample. Let the reading stabilize. Read the pH value.

3.1.2 ELECTRICAL CONDUCTIVITY (EC)

Conductivity is a measurement of water's capacity for conveying electrical current and is directly related to the concentrations of ionized substance in the water. Solutions of most inorganic acids, bases and salts are relatively good conductors. Conductivity measurements are commonly used to determine the purity of demineralized water and total dissolved solids in boiler and cooling tower water. Electrical conductivity is generally measured in terms of μS/cm.

REAGENTS:-

i) **Conductivity water:** Pass distilled water through a mixed bed deionizer and discard first liter. Conductivity should be less than 1µmho/cm.

ii) **Standard potassium chloride solution, 0.01 N:** Dissolve 745.6 mg anhydrous KC1 in conductivity water and dilute to 1000 ml at 25°C. This is the standard reference solution, which at 25°C has a conductivity of 1413 µmho/cm. It is satisfactory for most samples when the cell has a constant between 1 and 2.

PROCEDURE:-

i) For detailed instructions, follow manufacturer's manual, Standardize the EC meter by immersing the electrode in distilled water of known EC. Read the EC is 0, Remove electrodes from distilled water and immerse in KCL EC meter read 1413 µmho/cm.

ii) Remove electrodes from KCL, rinse thoroughly with distilled water, and blot dry with a soft tissue. Immerse them in the sample. Let the reading stabilize. Read the EC value.

3.1.3 TOTAL DISSOLVED SOLIDS (TDS)

Solids refer to matter suspended or dissolved in water or waste water. Solids may affect water or effluent quality adversely in a number of ways. Waters with high dissolved solids generally are of inferior palatability and indices an unfavorable physiological reaction in the transient consumer. For these reasons, a limit of 500 mg/L is desirable for drinking water. A well-mixed sample is filtered through a standard glass fiber filter, and the filtrate is evaporated to dryness in a weighed dish and dried to constant weight at 180°C. The increase in dish weight represents the total dissolved solids (TDS). Total dissolved solids are determined using the equation given below and are expressed in terms of mg/L.

3.1.4 BICARBONATE

Bicarbonate is a major element in our body. Bicarbonates are naturally produced by the gastric membrane in the stomach. This production will be low in alkaline conditions and will rise in response to acidity. In healthy individuals this adaptive mechanism will control the pH perfectly. Bicarbonate is measured in terms of mg/L.

$$Bicarbonate = Alkalinity \times 1.22$$

3.1.5 ALKALINITY:

REAGENTS:-

- **Methyl orange indicator:** Dissolve 0.5 g of methyl orange in 1 L of distilled water.
- **Phenolphthalein indicator:** Dissolve 5.0 g phenolphthalein in 1 L of 5.0% ethyl alcohol. Neutralize the solution with 0.02 N NaOH solutions.
- **Sulfuric acid, 0.02 N:** Prepare stock H_2SO_4 solution (approximately 0.1N) by diluting 3 ml H_2SO_4 to 1 L of distilled water. Dilute 20 mL of the 0.1 N stock solutions to 1 L with distilled water. Standardize the 0.02 N acids against 0.02 N sodium carbonate solutions.

PROCEDURE:-

1. Take 100 ml sample in a conical flask and add 2-3 drops of phenolphthalein indicator and swirl to mix.

2. Add 2-3 drops methyl orange indicator to the titrated solution and swirl to mix. Continue titration with sulfuric acid standard solution, 0.02 N, yellow to a pink color or pH comes down to 4.5. Note the volume of sulfuric acid used.

$$\text{Alkalinity, as } CaCO_3 \text{ (mg/L)} = \frac{A \times 1000}{\text{Volume of sample, ml}}$$

Where, A = volume of sulfuric acid used.

3.1.6 SULPHATE

Sulphate appears in natural waters in a wide range of concentrations. Mine waters and industrial effluents frequently contain large amounts of sulphate from pyrite oxidation and the use of sulfuric acid. Sodium and magnesium sulphate exert cathertic action and hence its concentration above 250 mg/L in potable water is objectionable. Sulphate causes a problem of scaling in industrial water supplies, and problem of odour and corrosion in wastewater treatment due to its reduction to hydrogen sulphide. Sulphate is measured in terms of mg/L.

REAGENTS:-

Buffer Solution: Dissolve 30 g magnesium chloride, $MgC1_2.6H_20$, 5 g sodium acetate, $CH_3COONa.3H_2O$, 1 gm. potassium nitrate, KNO_3, and 20 ml acetic acid, CH_3COOH (99%), in 500 ml distilled water and make up to 1000mL.
Barium chloride crystals: 20 to 30 mesh.

PROCEDURE:-

1. Take 100 mL sample, or suitable portion made up to 100 ml, into a 250 ml flask. Add 20 ml buffer solution and mix in stirring apparatus. Add barium chloride crystals while stirring. Continue stirring for 1 minute after addition of barium chloride.

2. Measure the turbidity developed after five minutes on colorimeter at 420 mm.

3. Prepare standard curve by carrying standard Sulphate solution through entire procedure. Space standards at 5 mg/L increment in the 0 to 40 mg/L range. Above 40 mg/L accuracy decreases and barium Sulphate suspension loss stability.

4. Read the concentration of Sulphate present in the sample from the standard curve.

3.1.7 CHLORIDE

Chloride is one of the major inorganic anions in water and wastewater. Chlorides are present in all potable water supplies and in sewage, usually as a metallic salt. When sodium is present in drinking water, chloride concentrations in excess of 250 mg/L give a salty taste. If the chloride is present as calcium or magnesium salt, the taste detection level may be as high as 1000 mg/L. Chloride is measured in terms of mg/L.

Chloride is essential in the diet and passes through the digestive system unchanged to become one of the major components of raw sewage. The wide use of zeolite in water softeners also contributes a large amount of chloride to sewage and waste waters. High chloride concentrations in water are not known to have toxic effects on human, though large amounts may act corrosively on metal pipes and be harmful to plant life. The maximum allowable chloride concentration of 250 mg/L in drinking water has been established for reasons of taste rather than as a safeguard against physical hazard.

REAGENTS

(i) Potassium chromate indicator: Dissolve 50 g of potassium chromate in a small quantity of distilled water. Add $AgNO_3$ solution to produce a light red precipitate. Allow to stand overnight and filter. Make up to 1 L.

(ii) N/35.5 Silver nitrate solution: Dissolve 4.78 g of silver nitrate in 1 L of distilled water. Standardized with standard sodium chloride solution.

PROCEDURE:-

(I) Take 100 ml sample in a conical flask. If the sample is highly colored, add 3 ml aluminum hydroxide suspension, mix well and allow to settling and filtering. If sulphide, sulphite or thiosulfate is present, add 1 ml hydrogen peroxide and stir for 1 minute.

(II) Adjust the pH of sample between 7.0 and 10.0 if it is not in this range and add 1.0 mL of potassium chromate indicator solution.

(III) Titrate with standard silver nitrate solution, N/35.5, to a pinkish yellow end point. Note the volume of silver nitrate solution used. Place the same quantity of chloride free distilled water in another flask and establish reagent blank value by the titration method outlined above. A view of pinkish to yellow color for chloride analysis.

$$\text{Chloride mg/l} = \frac{(A - B) \times 1000}{\text{Volume of Sample, mL}}$$

A = Volume of $AgNO_3$, used for sample, ml, and

B = Volume of AgNO3 used for blank, ml,

3.1.8 IRON

Iron in drinking water can be objectionable because it gives a rusty color to laundered clothes and may affect taste. Frequently found in water due to large deposits in the earth's surface, iron can also be introduced into drinking water from iron pipes in the water distribution system. In the presence of hydrogen sulfide, iron causes a sediment to form that may give the water a blackish color.

The Illinois Environmental Protection Agency (IEPA) has established a maximum concentration for iron in drinking water of 1.0 mg/L. Iron, as it exists in natural groundwater, is in the soluble (ferrous) state but, when exposed to oxygen, is converted into the insoluble (ferric) state with its characteristic reddish brown or rusty color. If allowed to stand long enough, this rusty sediment will usually settle to the bottom of a container; however, it is difficult to use this type of settling to remove the iron. Iron is measured in terms of mg/L.

REAGENT:-

1) Ferro Zine® Iron Reagent Solution Pillow.

PROCEDURE:-

(i) Operate the Spectrophotometer Press STORED PROGRAMS.

(ii) Fill a clean 25-mL graduated mixing cylinder to the 25-mL mark with sample.

(iii) Prepared Sample: Add the contents of one Ferro Zine® Iron Reagent Solution Pillow to the mixing cylinder. Press TIMER>OK. A five-minute reaction period will begin. A purple color will develop if iron is present

(iv) Blank Preparation: Fill a square sample cell with 10 mL of sample. When the timer expires, pour 10 mL of the prepared sample into a second clean square sample cell. Insert the blank into the cell holder with the fill line facing right. Press ZERO. The display will show: 0.000 mg/L Fe.

(v) Insert the prepared sample into the cell holder with the fill line facing right. Press READ. Results are in mg/L Fe.

3.1.9 CALCIUM

The ion Ca^{2+} is also the fifth-most-abundant dissolved ion in sea water by both molarity and mass, after sodium, chloride, magnesium, and sulfate. Water, described as "hard", is high in dissolved minerals, specifically calcium and magnesium. Hard water is not a health risk, but a nuisance because of mineral build-up on fixtures and poor soap and/or detergent performance. Calcium is measured in terms of mg/L.

REAGENT:-

1. Sodium hydroxide 2N: Dissolve 80 g NaOH and dilute to 1 L.
2. Standard EDTA solution, 0.01 M: Dissolve 3.723g EDTA sodium salt and dilute to 1000 ml. Standardize against standard calcium solution, 1 mL=1mg $CaCO_3$.

PROCEDURE:-

1. Take 100 ml water sample in a conical flask and add to1 ml sodium hydroxide solution to raise the pH to 12.0 and a pinch of murex indicator.

2. Titrate with standard EDTA solution, 0.01M, till pink color changes to purple. Note the volume of EDTA used.

$$\text{Calcium Hardness, mg/l} = \frac{B \times C}{\text{Volume of sample, ml}}$$

B = Volume of EDTA solution used with murex indicator, ml, and,
C = mg $CaCO_3$ equivalent to 1.0 ml EDTA

3.1.10 MAGNESIUM

Magnesium is a chemical element with symbol "*Mg*" and atomic number 12.Magnesium is the fourth most abundant cation in the human body and the second most abundant cation in intracellular fluid. It is a cofactor for some 350 cellular enzymes, many of which are involved in energy metabolism. It is also involved in protein and nucleic acid synthesis and is needed for normal vascular tone and insulin sensitivity. Low magnesium levels are associated with endothelial dysfunction, increased vascular reactions, elevated circulating levels of reactive protein and decreased insulin sensitivity. Low magnesium status has been implicated in hypertension, coronary heart disease, type 2 diabetes mellitus and metabolic syndrome. Magnesium is measured in terms of mg/L.

Magnesium Hardness, mg/l = [Total Hardness – Calcium Hardness] × 0.243

3.1.11 SODIUM

Sodium ranks sixth among the elements in order of abundance and is present in most natural waters. Relatively high concentrations may be found in brines and hard water softened by the sodium exchange process. The ratio of sodium to total cations is important in agriculture and human pathology. Soil permeability can be harmed by a high sodium ratio. Persons afflicted with certain diseases require water with low sodium concentration. A limiting concentration of 2 to 3 mg/L is recommended in feed water destined for high-pressure boilers. When necessary, sodium can be removed by the hydrogen-exchange process or by distillation.

Sodium compounds are used in many applications, including caustic soda, sat fertilizers and water treatment chemicals, and represent the total dissolved solids. Sodium is measured in terms of mg/L.

PROCEDURE:-

Pre-treatment of polluted water and wastewater samples: Filter the sample passing through 0.45μm membrane filter.

Direct-intensity measurement: Prepare a blank and sodium calibration standards in stepped amounts in any of the following applicable ranges: 0 to 1.0, 0 to 10, or 0 to 100 mg/L. Starting with the highest calibration standard and working toward the most dilute, measure emission at 589 nm. Repeat the operation with both calibration standards and samples enough times to secure a reliable average reading for each solution. Construct a calibration curve from the sodium standards. Determine sodium concentration of sample from the calibration curve. Where a large number of samples must be run routinely, the calibration curve provides sufficient accuracy.

Internal-standard measurement: To a carefully measured volume of sample (or diluted portion), each sodium calibration standard and a blank, add with a volumetric pipette, an appropriate volume of standard lithium solution. Measure the intensity directly.

Bracketing approach: From the calibration curve, select and prepare sodium standards that immediately bracket the emission intensity of the sample. Determine emission intensities of the bracketing standards (one sodium standard slightly less and the other slightly greater than the sample) and the sample as nearly simultaneously as possible.

Repeat the determination on bracketing standards and sample. Calculate the sodium concentration by the equation formed by standard calibration curve.

3.1.12 TOTAL HARDNESS

The Hardness of water was originally defined in terms of its ability to precipitate soap. Calcium and magnesium ions are the principle causes although iron, aluminum, manganese, strontium, zinc and hydrogen ions are capable of producing the same effect. High concentrations of the latter ions are not commonly found in natural waters. In conformity with current practice, total hardness is defined as characteristic of water which represents the total concentration of calcium and magnesium expressed as their calcium carbonate equivalent. Hardness is measured in terms of mg/L.

Temporary hardness is caused by the presence of bicarbonates of calcium and magnesium. Permanent hardness is mostly due to Sulphate. When the total hardness has a value greater than total alkalinity, the amount of hardness equivalent to the alkalinity is called carbonate hardness and the excess amount is non-carbonate hardness. When total hardness is equal or less than the total alkalinity, there is no carbonate hardness.

REAGENT :-

1. Inhibitor: Dissolve 4.5 g hydroxyl amine hydrochloride in 100 ml 95% ethyl alcohol. Eriochrome block T indicator: Mix 0.5 g dye with 100 g NaCl to prepare dry powder or dissolve 0.19 of Eriochrome black T in 20 mL of ethyl alcohol.

2. Sodium hydroxide 2N: Dissolve 80 g NaOH and dilute to 1 L.

3. Standard EDTA solution, 0.01 M: Dissolve 3.723g EDTA sodium salt and dilute to 1000 ml. Standardize against standard calcium solution, 1 mL=1mg $CaCO_3$.

PROCEDURE:-

1. Take 100 ml water sample in a conical flask and add to it 1-2 mL buffer solution followed by 1 mL inhibitor.

2. Add 2 drops Eriochrome black T indicator and titrate with standard EDTA solution, 0.01 M, till wine red color changes to blue. Note the volume of EDTA used.

3. In another flask take 100 mL sample ad add 1 ml sodium hydroxide solution to raise the pH to 12.0 and a pinch of murex indicator.

4. Titrate with standard EDTA solution, 0.01M, till pink color changes to purple. Note the volume of EDTA used.

$$\text{Total Hardness, mg/l} = \frac{A \times C}{\text{Volume of sample, ml}}$$

$$\text{Calcium Hardness, mg/l} = \frac{B \times C}{\text{Volume of sample, ml}}$$

A = Volume of EDTA solution used with Eriochrome black T indicator.
B = Volume of EDTA solution used with murex indicator, ml, and,
C = mg $CaCO_3$ equivalent to 1.0 ml EDTA titrate.

Magnesium Hardness, mg/l = [Total Hardness – Calcium Hardness] × 0.243

3.3 METHODOLOGY FOR SOIL ANALYSIS\

Particle Size Distribution

Particle size distribution means different grain sizes on the soil that makes a given soil mass. Soil has three main parts such as sand, silt and clay. These parts determine the soil texture.

(i) Sand is the largest of the mineral particles. Sand particles create large pore spaces that improve aeration. Water flows through the large pore spaces quickly. Soils with a high percentage of sand are generally well drained. Sandy soils lack the ability to hold nutrients and are not fertile. Sandy soils also feel gritty to the touch

(ii) Silt is the mid-size soil particle. Silt has good water-holding ability and good fertility characteristics. It feels like flour when dry and smooth like velvet when moist.

(iii) Clay is the smallest size soil particle. Clay has the ability to hold both nutrients and water that can be used by plants. It creates very small pore spaces, resulting in poor aeration and poor water drainage. Clay forms hard clumps when dry and is sticky when wet. All three soil's types have their own characteristics, which shown in below Table 3.2

Table 3.2 Characteristics of Sand, Silt and Clay

CHARACTERISTICS	SAND	SILT	CLAY
Looseness	Good	Fair	Poor
Air space	Good	Fair to Good	Poor
Drainage	Good	Fair to Good	Poor
Ease of working	Good	Fair to Good	Poor
Moisture-holding ability	Poor	Fair to Good	Good
Fertility	Poor	Fair to Good	Fair to Good

Soil texture describes the proportion of three sizes of soil particles and the fineness or coarseness of a soil. Soil texture may be determined in one of two ways. The percentages of sand, silt, and clay may be tested in the lab. Once tested, the textural classes of the soil can be determined by referring to the textural triangle (fig.3.1) by United State Department of Agriculture (Shukla *et al.* 1995)

Soils with different amounts of sand, silt, and clay are given different names. For instance, a soil containing 40 percent sand, 40 percent silt, and 20 percent clay is called loam soil. The other classes of soil describe by textural triangle described in Table 3.3 by USDA (Shukla *et al.* 1995).

Table 3.3 Soil Textural Classes

CLASS OF SOIL	SAND	SILT	CLAY
Sand	85-100%	0-15%	0-10%
Loamy Sand	70-90%	0-30%	0-15%
Sandy Loam	43-85%	0-50%	0-20%

CLASS OF SOIL	SAND	SILT	CLAY
Loam	23-52%	28-50%	7-27%
Silt loam	0-50%	50-88%	0-27%
Clay loam	20-45%	15-53%	27-40%
Silt clay loam	0-20%	40-73 %	27-40 %
Sandy clay loam	45-80%	0-28%	20-35%
Clay	0-45%	0-40%.	40-100%

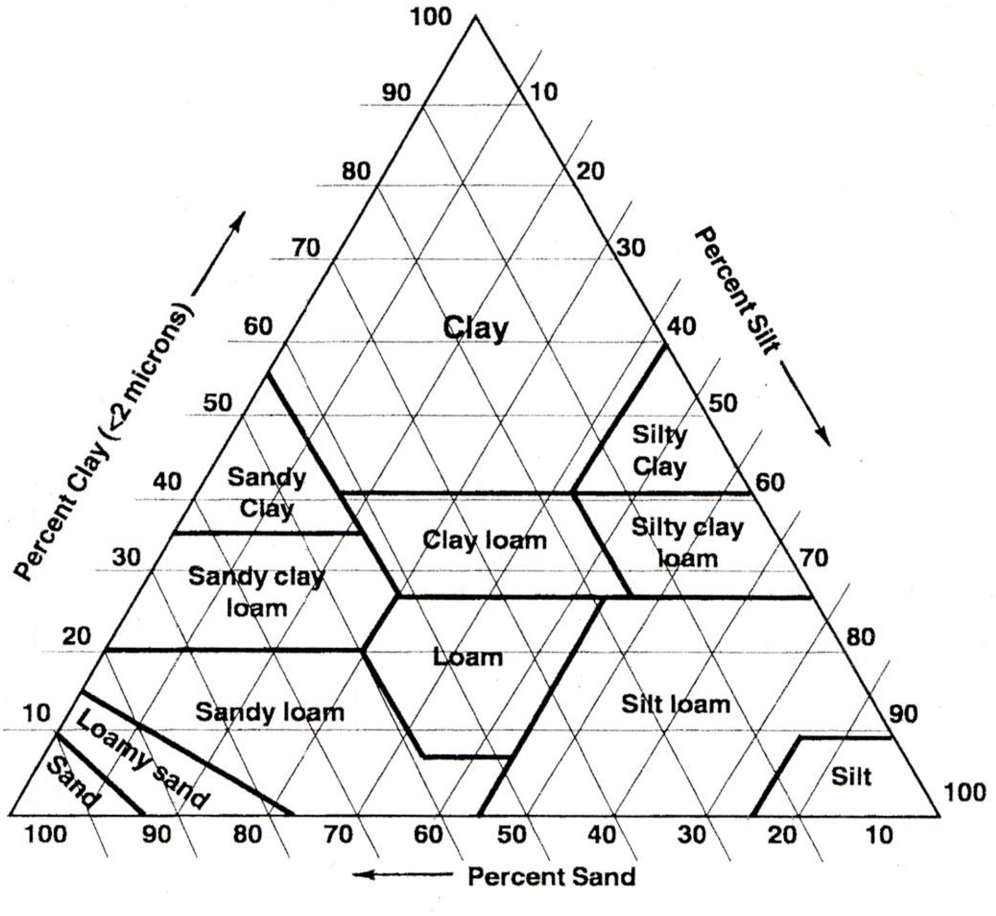

Figure. 3.1: **Soil Texture Triangle by USDA (Shukla *et al.* 1995)**

The particle's diameter present in the soil makes the soil to be coarse, medium and fine. Table 3.4 shows the textural class names of soil as per particle diameter by international society of soil science, soils are classified by a particle size into five classes.

Table 3.4 Textural Classification as Per Particle Diameter By ISSS

MATERIAL	DIAMETER(mm)
Gravel	Larger than 2.0
Coarse sand	Between 2.0 – 0.2
Fine sand	Between 0.2 – 0.02
Silt	Between 0.02 – 0.002
Clay	Less than 0.002

In the Indian standard (IS: 460-1662), the sieves are designated by the size of aperture in mm, whereas in BS (410-1962) and ASTM (E11-1961) standards, the sieve sizes are given in the terms of the number of openings per inch. (Seth. 1990)

The sieving process does not provide information on the shape of the soil grains. It only gives the information of grains that can pass through rectangular sieve opening of a certain size.

The results are presented in the graph of percent passing versus the sieve size. On the graph the sieve size scale is logarithmic.

Procedure for Particle Size Distribution

1. Oven dried soil sample weighing 500gm was taken and soaked in water for 24 hours.
2. Soil samples then washed through sieve no.200 (75μ). For washing distilled Water was used
3. After washing, the above 75μm soil sample (coarse particles) was collected in beaker and below 75μm soil sample (fine particles) was collected in tray. These were then kept in oven for 24 hours.

Sieve analysis for particle of size above 75 μm

4. Above 75μm soil sample were processed through the process of sieve analysis. The soil samples were passed through different sieve number such as 4 (4.750 mm), 10 (2mm), 14 (1.400 mm), 20(0.850 mm), 40 (0.425), 60 (0.250 mm), 70 (0.212 mm), and 200 (0.075 mm). The sieving was performed for 30 minutes with mechanical sieve shaker (Fig. 4.2).

5. The stack of sieves was removed from sieve shaker. Than weight of the particles were weighed, one by one from different sieve number. The percentage of total soil sample retained on each sieve was also calculated.
6. The calculation was started with 100% and subtracting the percentage retained on each sieve as cumulative procedure as given by.
7. **% passing = % arriving - % retained**

CHAPTER 4

RESULT AND DISCUSSIONS

4.1 WATER ANALYSIS

Water samples were collected for analyzing the different parameters at the nuclear laboratory in NIH, Roorkee. The result of water quality parameters are described below;-

4.1.1 pH

The overall pH varied from7.03 to 8.21 in the study area. Among all the samples of water of different sources, river water pH ranged from 7.64 to 8.21, pond water pH varied from 7.03 to 7.84 while in the samples of ash pond pH varied from 7.66 to 8 and 7.18 to 7.4 in the samples of ground water. According to BIS (IS: 10500-1991) the pH value within the 6.5 to 8.5 is suitable for a drinking water. The pH of samples of all type of water is within the BIS prescribed limit therefore it appears that the water is suitable for drinking water purposes.

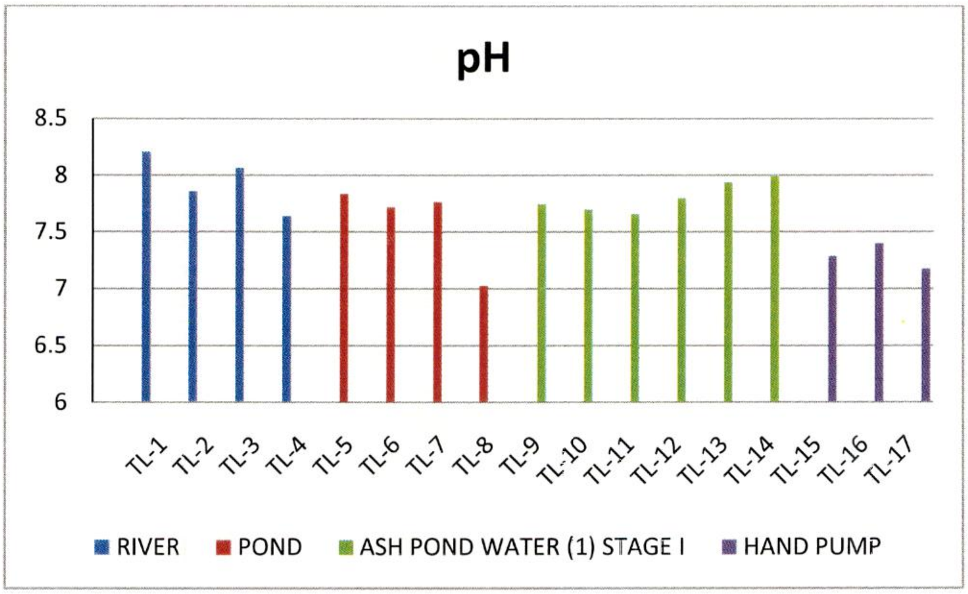

Figure 4.1: Value of ph at Different Sites

4.1.2 ELECTRICAL CONDUCTIVITY (EC)

The overall range of the electrical conductivity varied between 130.8µmho/cm and 1042µmho/cm in all the collected samples of water (Fig.4.2) which includes the sources such as river, pond, ash pond and groundwater. EC ranged from 130.8µmho/cm to 341µmho/cm in the river water while in pond water it ranges about139.3µmho/cm to

888μmho/cm. In ash pond water EC ranged from 133.4μmho/cm to 514μmho/cm and 307μmho/cm to 1042μmho/cm in groundwater. The EC values are found higher in the groundwater than that of other sources.

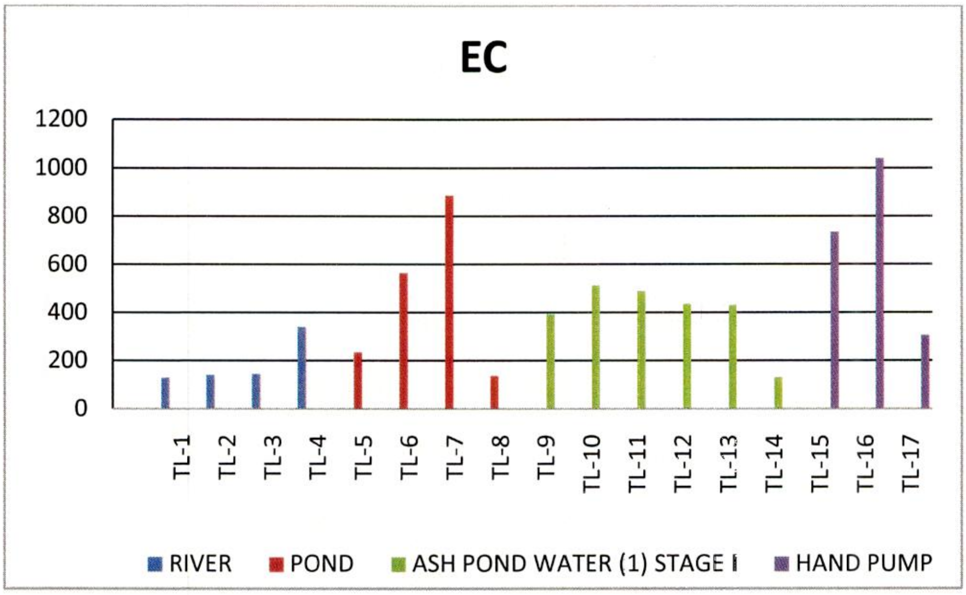

Figure 4.2: Value of EC at Different Sites

4.1.3 TOTAL DISSOLVED SOILDS (TDS)

Figure 4.3 show the ranges of the TDS were found in overall study area between 71mg/l to 1369mg/l. Samples of water comprised of different sources such as river, pond, ash pond and ground water. In the samples of River water the value of TDS ranged from 101mg/l to 228mg/l, 71mg/l to 1369mg/l in pond water, 96mg/l to 613mg/l in ash pond water and 285mg/l to 742mg/l in ground water. All the river samples show lower TDS content than pond samples. According to BIS (IS: 10500-1991) the agreeable value of TDS is 500mg/l and maximum is 2000 which is suitable for a drinking water. The samples that we have taken from different sites of our study area having a TDS less than its permissible value therefore it is quite visible that the water is suitable for drinking water purposes.

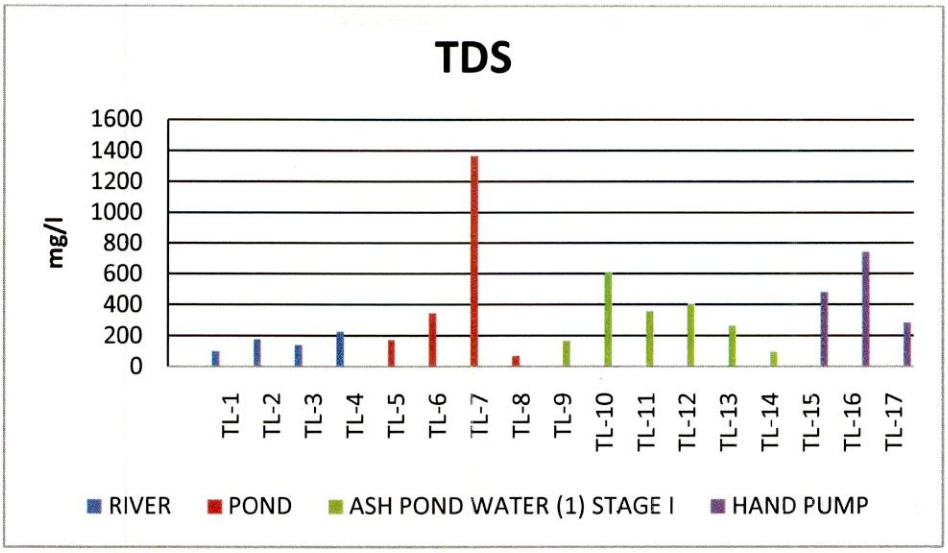

Figure 4.3: Value of TDS at Different Sites

4.1.4 FLUORIDE

In the present study the overall range of Fluoride were observed from 0.05mg/l to 5.46mg/l. Samples that were collected from river water having a value of Fluoride ranged from 0.29mg/l to 1.88mg/l. Samples those were comprises of pond water containing a value of Fluoride ranges about 0.44mg/l to 2.59mg/l (figure 4.4). In the samples of ash pond the value of Fluoride varied from 0.33mg/l to 5.46mg/l and Samples of ground water having a value of Fluoride ranged from 0.05mg/l to 1.53mg/l. According to BIS (IS: 10500-1991) the agreeable value of Fluoride with in 1mg/l and maximum is 1.5 which is suitable for a drinking water. In most of the groundwater and surface water samples the fluoride values were low and are within permissible limit while in the samples of pond water and ash pond water the value of fluoride is much higher than its permissible limit. Hence the water may be used for drinking water purposes.

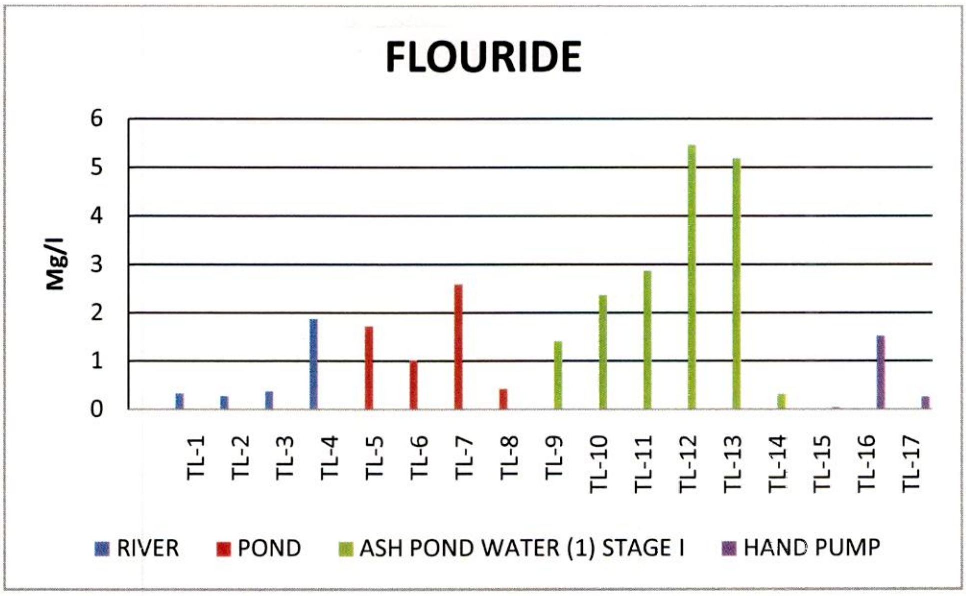

Figure 4.4: Value of fluoride at different sites.

4.1.5 CHLORIDE

The overall range of the Chloride (figure 4.5) of all the water samples those were collected from different sites of our study area tend to falls between 4.02mg/l to 265.94mg/l. Samples that were collected from river having a value of Chloride ranged from 4.30mg/l to 18.88mg/l. Samples those were comprised of pond containing a value of Chloride ranged from 4.11mg/l to 265.94mg/l. Value of Chloride varied from 0.4mg/l to 27.62mg/l in ash pond samples and 9.81mg/l to 54.46mg/l in samples of groundwater.

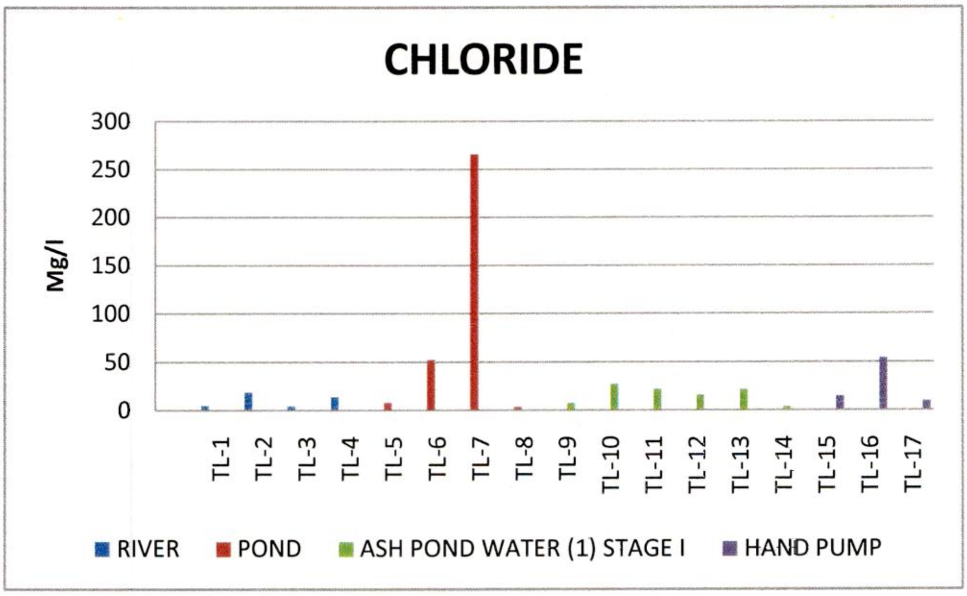

Figure 4 5: Value of Chloride at Different Site

According to BIS (IS: 10500-1991) the agreeable value of Chloride with in 250mg/l which is suitable for a drinking water. Range of Chloride in overall water have been found less than its desirable limit except one pond water sample, so that the water may be used for drinking water purposes.

4.1.6 BICARBONATE

In figure 4.6 the range of the Bicarbonate is shown, of all the water samples extended from 42mg/l to 610mg/l. Samples that were collected from River water having a value of Bicarbonate ranged from 60mg/l to 108mg/l while in the samples of pond water it ranged from 42mg/l to 610mg/l, 60mg/l to 284mg/l in the samples of ash pond water and 176mg/l to 425mg/l in the samples of ground water.

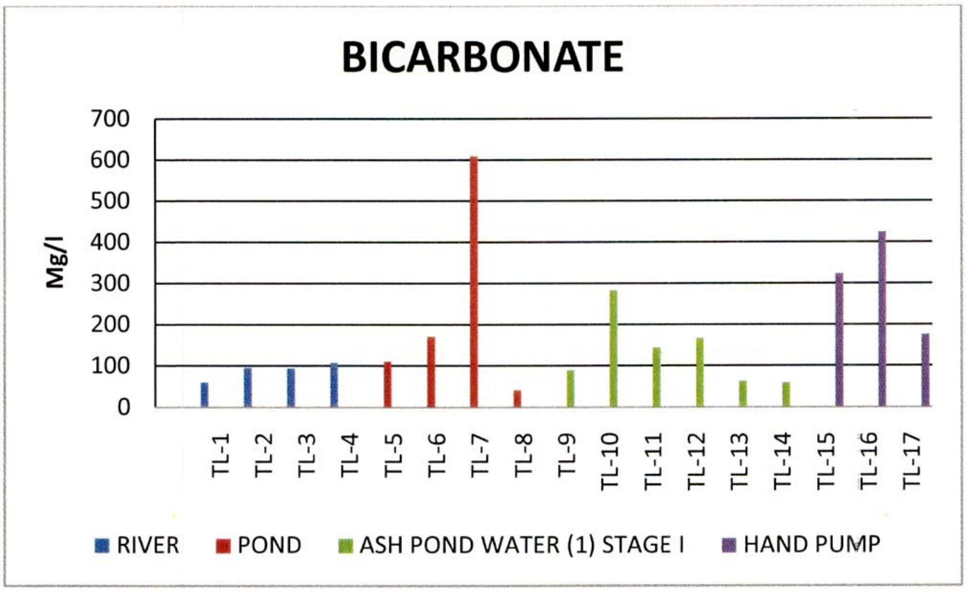

Figure 4.6: Value of Bicarbonate at Different Sites

4.1.7. SULFATE

Figure 4.7 reveals that concentration of Sulfate in all the water samples that were collected from the study area have ranged from 3.16mg/l to 106.07mg/l. Among all the Samples of different sources such as river, pond, ash pond and groundwater in river water sample the value of sulfate ranged from 4.84mg/l to 37.80mg/l, while in the samples of pond water sulfate value ranges about 3.16mg/l to 31.40mg/l. In the samples of ash pond water sulfate value ranged from 6.64mg/l to 106.07mg/ and 11.41mg/l to 29.23mg/l in the samples of ground water. According to BIS (IS: 10500-1991) the agreeable value of Chloride with in 200mg/l which is suitable for a drinking water. Samples that were collected from different sites of our study area having a value of Chloride less than its desirable value Hence the water is usable for drinking water purposes.

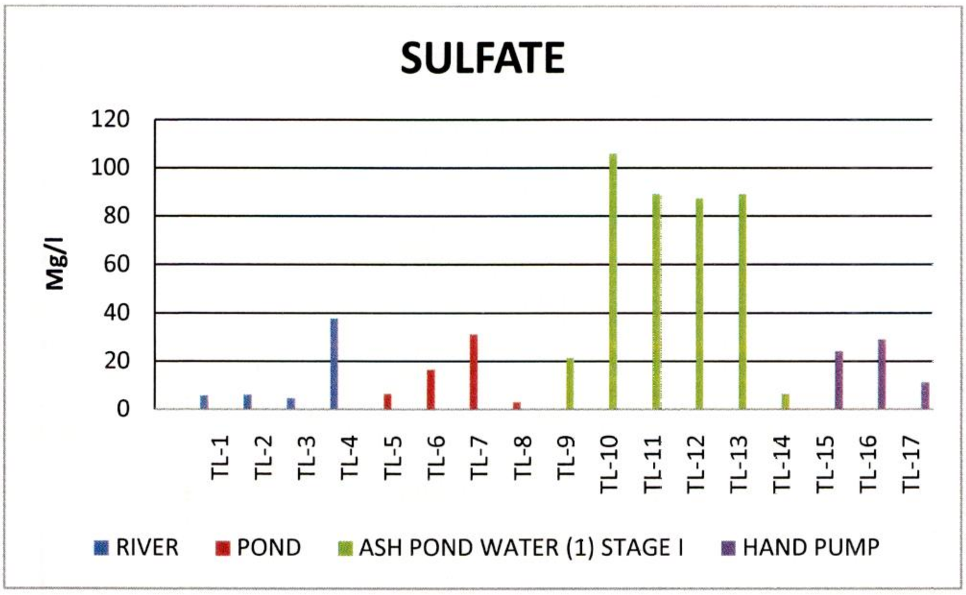

Figure 4.7: Value of Sulfate at Different Sites

4.1.8. NITRATE

In figure 4.8 overall Nitrate concentrations varied from 0.14mg/l to 15.00mg/l in the study area. Among, all the samples the River water sample shows Nitrate ranged from 2.38mg/l to 3.29mg/l, 0.14mg/l to 12.09mg/l in pond water, 0.47mg/l to 13.54mg/l in ash pond water and 0.18mg/l to 15.00mg/l in ground water. According to BIS (IS: 10500-1991) the agreeable value of Nitrate within 50mg/l which is suitable for a drinking water. The value of Nitrate that was found in all the collected samples from different sites of study area are within the desirable value therefore the water is suitable for drinking water purposes.

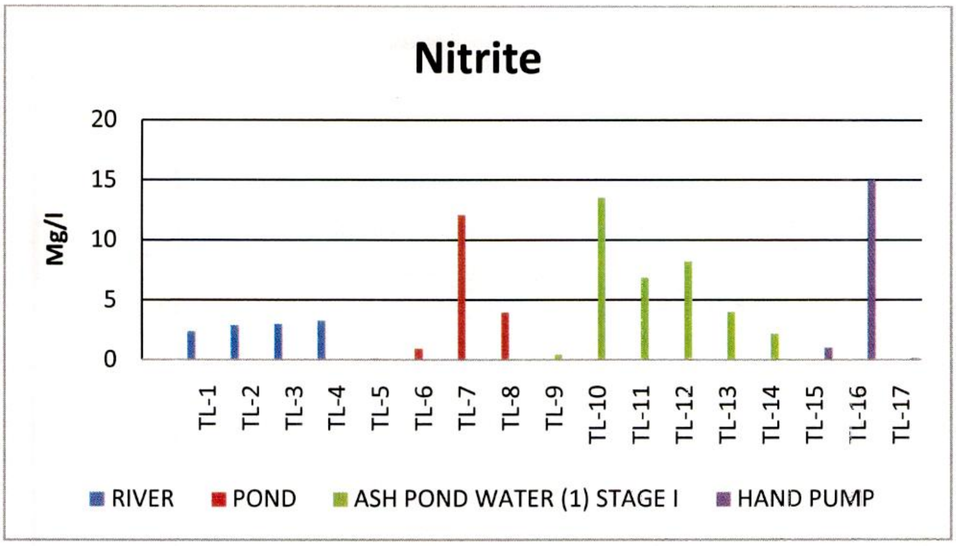

Figure 4.8: Value of Nitrate at Different Sites

4.1.9. CALCIUM

The range of the Calcium in all the water samples varied from 9.89mg/l to 141.68mg/l. Samples including River, pond, ash pond and ground water. In river water calcium ranged from 13.87mg/l to 38.37mg/l while in pond water it varied from 9.89mg/l to 141.68mg/l, 11.27mg/l to 132.79mg/l in ash pond and 63.85mg/l to 68.80mg/l in ground water. According to BIS (IS: 10500-1991) the agreeable value of Calcium is 75mg/l and maximum value is 200. According to desirable value and permissible value the range of allover samples falls under the permissible value. Hence it is quite visible that water is suitable for drinking purposes.

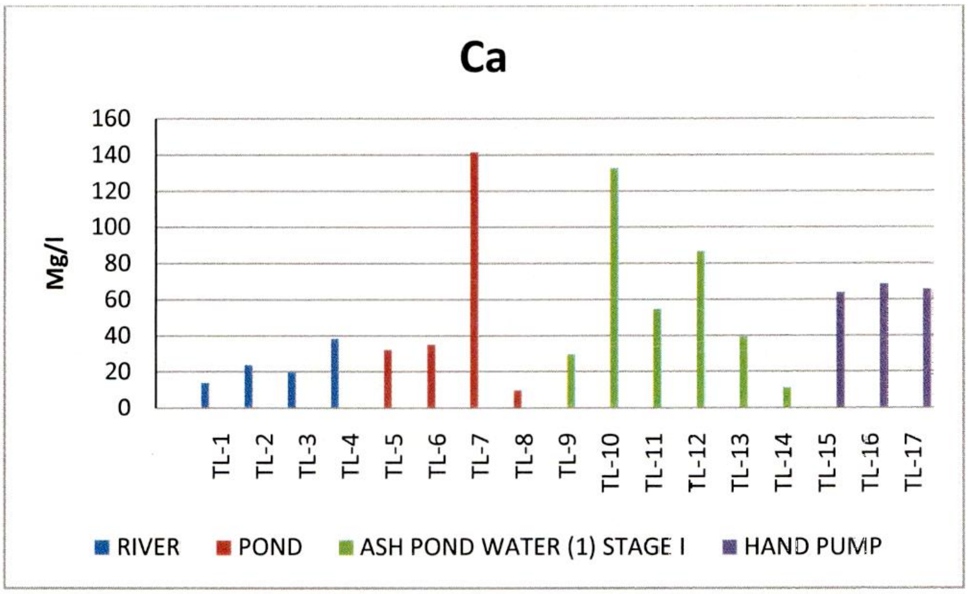

Figure 4.9: Value of Calcium at Different Sites

4.1.10. MAGNESIUM

In figure 4.10 the range of the Magnesium of all the water samples varied from 2.18mg/l to 35.49mg/l. Samples that were collected from River having a value of Magnesium ranged from 4.12mg/l to 8.05mg/l. Samples those were collected from pond containing a value of Magnesium ranged from 2.18mg/l to 18.24mg/l. In the samples of ash pond the value of Magnesium varied from 3.87mg/l to 17.46mg/l and Samples of ground water having a value of Magnesium ranged from 11.16mg/l to 35.49mg/l. According to BIS (IS: 10500-1991) the agreeable value of Magnesium with in 30mg/l, except one sample of groundwater sources the range of allover samples falls under its prescribed limit therefore it appeared that the water is suitable for drinking purposes.

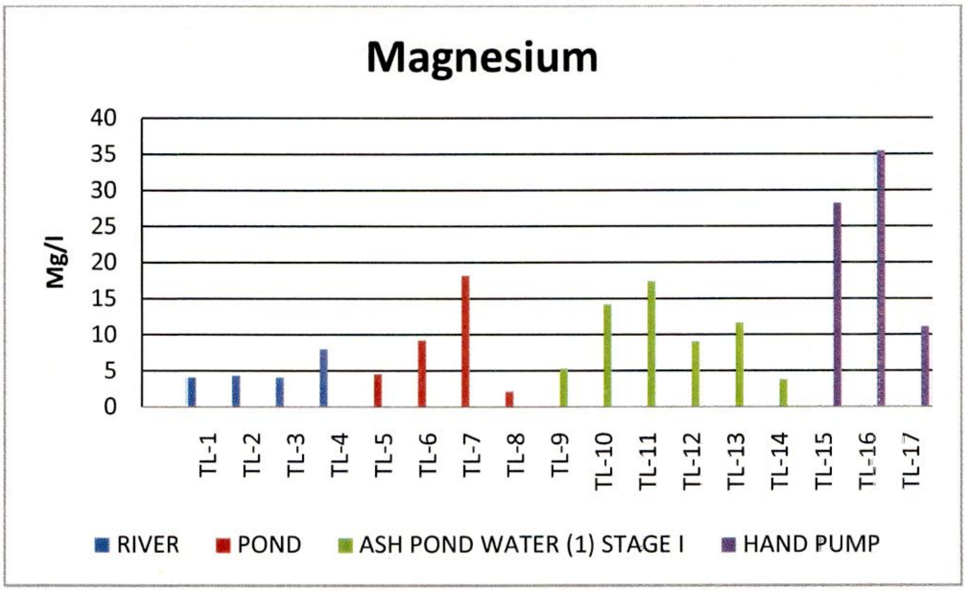

Figure.4.10: Value of Magnesium at Different Sites

4.1.11 SODIUM

This is from figure 4.11 range of overall Sodium varied from 3.96mg/l to 244.09mg/l. Samples that were collected from River have value of Sodium ranged from 6.70mg/l to 16.27mg/l. Samples those were collected from pond water containing a value of Sodium ranged from 3.96 mg/l to 244.09mg/l. In the samples of ash pond the value of Sodium varied from 5.09mg/l to 18.84mg/l and in ground water Sodium value ranged from 6.28mg/l to 109.55mg/l.

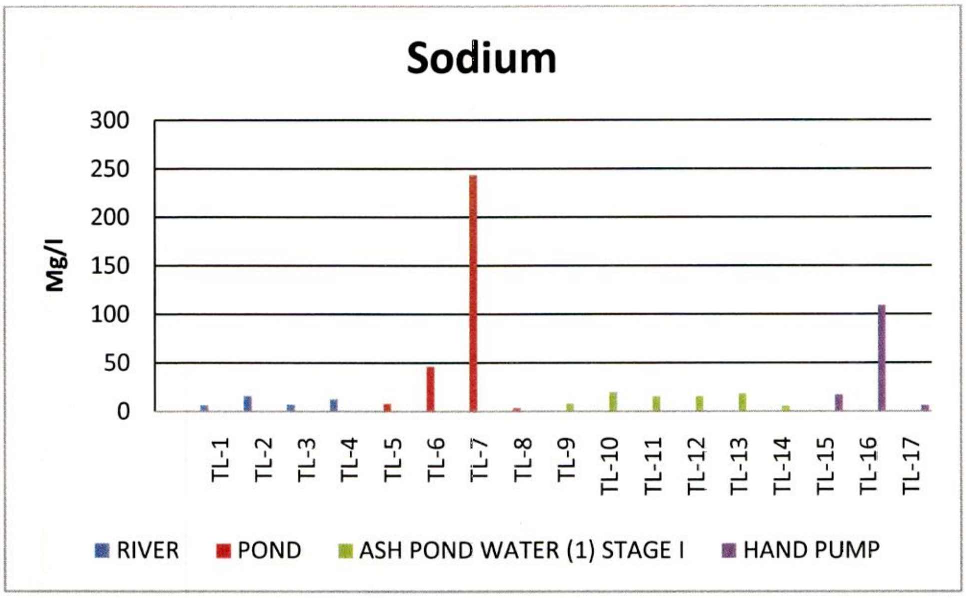

Figure 4.11: Value of Sodium at Different Sites

4.1.12. POTASSIUM

According to this figure 4.12 the range of the Potassium in overall water varied from1.02mg/l to 42.58mg/l. Samples comprises of different sources like river, pond, ash pond and ground water. Range of potassium varied from 2.30mg/l to 8.98mg/l in river, 1.02mg/l to 42.58mg/l in pond, 1.69mg/l to 12.45mg/l in ash pond and 3.62mg/l to 8.17mg/l in ground water.

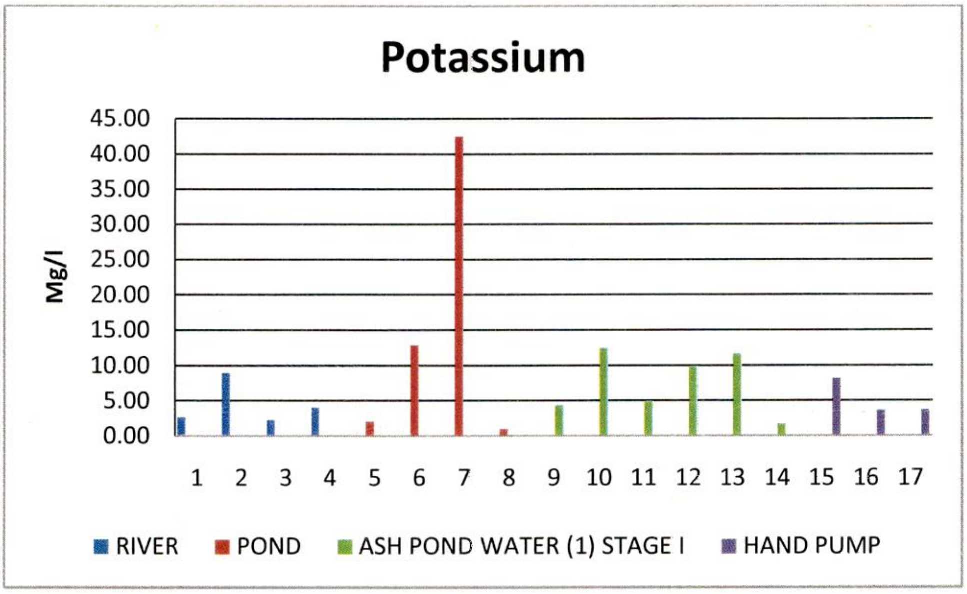

Figure 4.12: Value of Potassium at Different Sites

4.2 SOIL ANALYSIS

The soil sample were collected from the various location at kaniha area, undisturbed soil sample were taken upto 3.0m depth with the help of auger. These soil samples were analyzed for different soil properties at the Soil and Water laboratory, NIH, Roorkee. Analyses are described in subsequent sections. Sieving is a main concern here. Sieving has done in these samples.

The result of sieve analysis (particle size > 0.75mm) determine by the percentages of sand, silt, clay and gravel in each soil sample. Table 4.1 lists the results of sand, silt and clay percentages of different locations in the study area. Making use of U.S. Department of Agriculture (Shukla *et al.* 1995) method for naming soils, the textural classification of soil samples was done. Results show that the presence of gravel content in the soil samples lies from 0.49 to 33.92 percent. The variation of sand content in soil samples ranges from 14.53 to 42.61 percent. The percentage of silt contents in soil sample lies from 20.54 to 45.78 percent. The presence of clay contents was seen less and is found varying from 9.91 to 40.9 percent.

Based on textural classification of soil samples, the soil of the study area could be classified into four major groups: Loam, clay, Silty clay loam and Clay loam. Figure 4.1 to 4.8 show the variation in total percentage of sand, silt, clay and gravels

Table 4.1 Soil Type of the Soil Samples

S. NO.	SAMPLING SITE NO.	DEPTH (M)		SAMPLE CODE/ ID	DATE OF COLLECTION	LOCATION / VILLAGE	SOIL TYPE
		From	To				
1	NTPC/Soil-1	0.00	0.80	STL-1	6/6/2016	Kaniha	Loam
2	NTPC/Soil-1	0.80	1.00	STL-2	6/6/2016	Kaniha	Loam
3	NTPC/Soil-1	1.00	1.60	STL-3	6/6/2016	Kaniha	Loam
4	NTPC/Soil-1	1.60	2.40	STL-4	6/6/2016	Kaniha	Clay
5	NTPC/Soil-2	0.00	0.70	STL-5	6/6/2016	Derang	Silty clay loam
6	NTPC/Soil-2	0.70	1.70	STL-6	6/6/2016	Derang	Clay loam
7	NTPC/Soil-2	1.70	2.00	STL-7	6/6/2016	Derang	Clay loam
8	NTPC/Soil-3	0.00	1.20	STL-8	6/6/2016	Takua	Clay loam

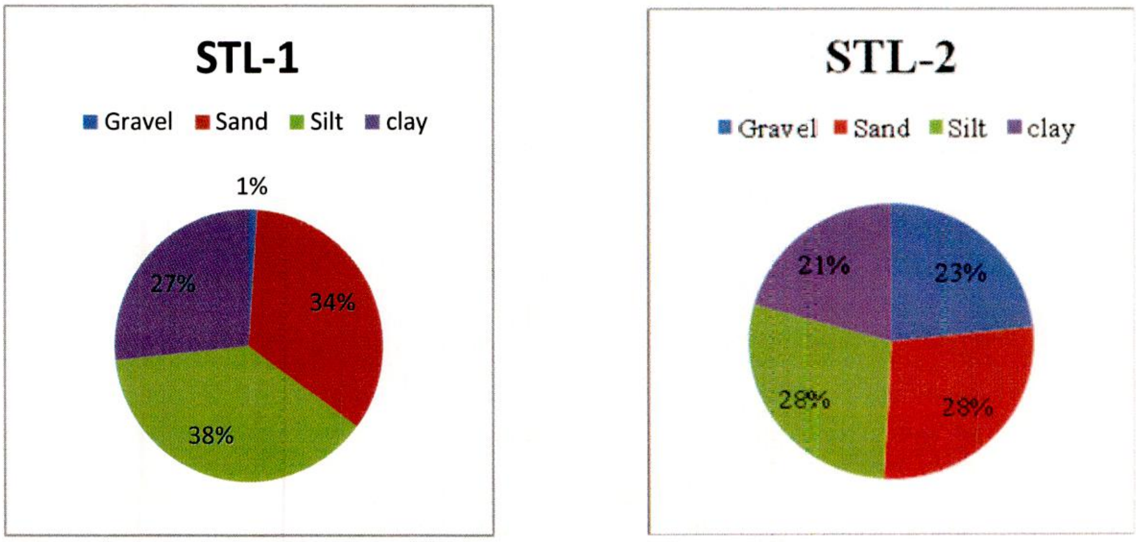

Figure 4.1 & 4.2: Percentage of Gravel Sand Silt and Clay of Sample 1& 2

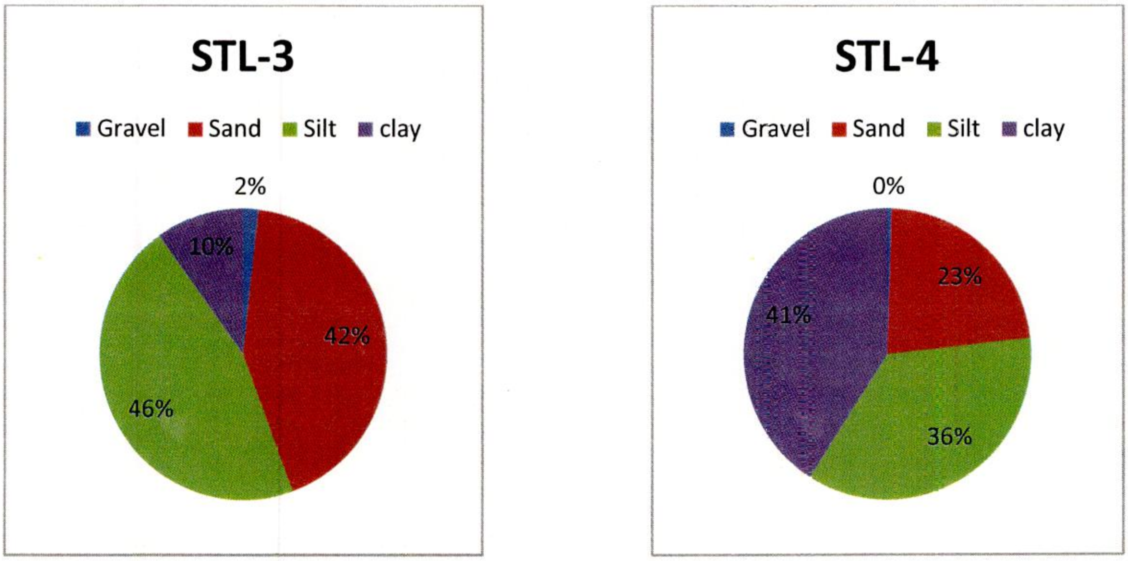

Figure 4.3 & 4.4: Percentage of Gravel Sand Silt and Clay of Sample 3 &4

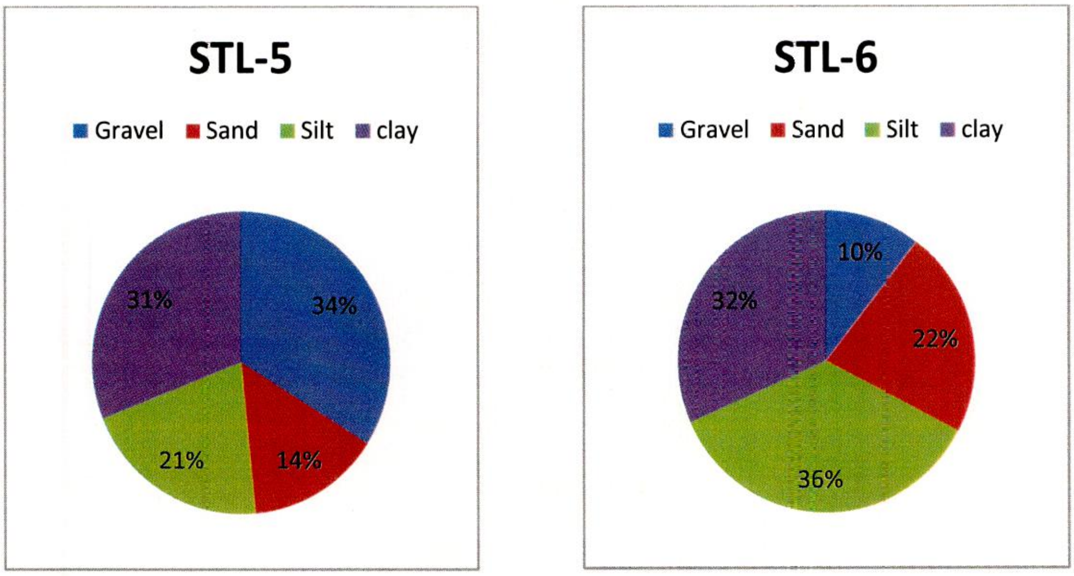

Figure 4.5 & 4.6: Percentage of Gravel Sand Silt and Clay of Sample 5 &6

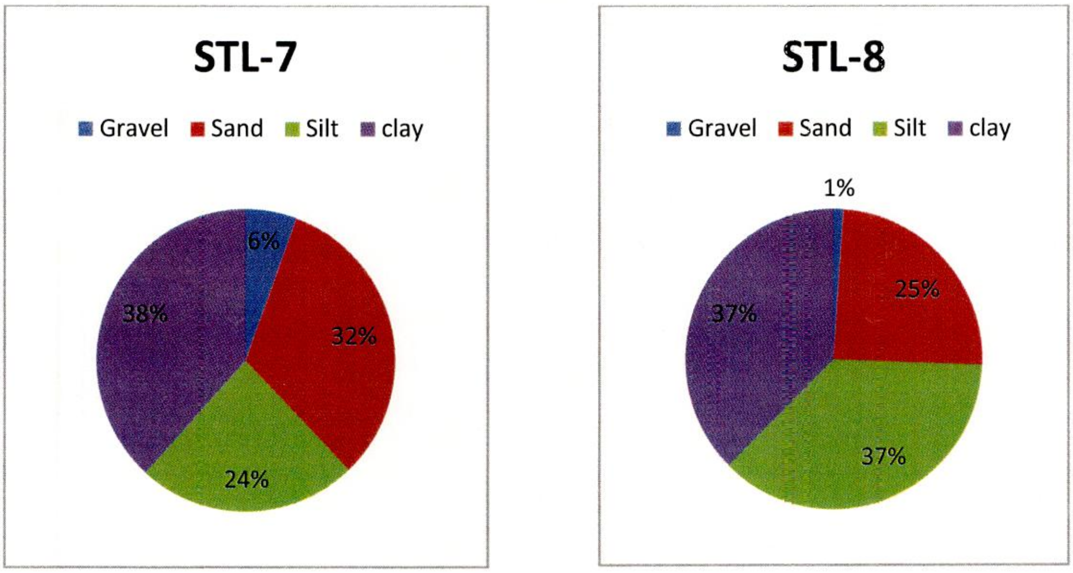

Figure 4.7 & 4.8: Percentage of Gravel Sand Silt and Clay of Sample 7 & 8

CHAPTER 5

CONCLUSION ✓

5.1 GENERAL

The analysis of water is very vital for understanding the allocation and management water resources in an area. Water analysis constitutes basic information for carrying out studies related to groundwater, irrigation and drainage. The major conclusion from this study and the scope of future work are presented in the following section.

5.2 CONCLUSIONS

The following conclusions are made based on the experimental result:

- The different sources (river, hand pump, pond and ash pond) of water have different water qualities.

- The pH of river varied from 7.64 to 8.21. In case of pond the value of pH ranged from 7.03 to 7.84. The pH of groundwater varied from 7.18 to 7.4 and pH of ash pond varied from 7.66 to 8. It is concluded that the pH of water of study area is suitable for drinking purpose.

- The electrical conductivity (EC) of river water sample falls from 130.8µmho/cm to 341µmho/cm. EC of pond water sample varied between 139.3µmho/cm to 888µmho/cm. In case of ash pond water EC varied from 133.43µmho/cm to 514µmho/cm and 307µmho/cm to 1042µmho/cm in groundwater samples.

- The overall total dissolved solids in water of study area varied from 71mg/l to 1369mg/l. According to BIS standard the water of the study area has suitable for drinking purpose as well as it is also suitable for irrigation.

- The range of Fluoride in overall water of study area varied from 0.05mg/l to 5.46mg/l. It is concluded that value of fluoride has more than acceptable range.

- Overall the range of the Chloride in water of the study area varied between 4.02mg/l to 265.94mg/l. it means that except one sample of pond water overall range of all the water samples within its desirable limit.

- The range of the Bicarbonate of all the water samples extended from 42mg/l to 610mg/l.

- Sulfate of all the water samples that were collected from the study area have ranged from 3.16mg/l to 106.07mg/l.

- The range of the Calcium in all the water samples varied from9.89mg/l to 141.68mg/l. Samples including River, pond, ash pond and ground water

- The overall conclusion of this study is that the water standard of study area is good according to BIS (IS: 10500-1991), except some parameters such as Fluoride, Nitrate, and Sulfate etc.

- The variation of sand content in soil samples ranges from 14.53 to 42.61 percent

- The presence of gravel content in the soil samples lies from 0.49 to 33.92 percent.

- The percentage of silt contents in soil sample lies from 20.54 to 45.78 percent

- The presence of clay contents was found less and varying from 9.91 to 40.9 percent.

- The soil of the study area could be classified into four major groups: Loam, clay, Silty clay loam and Clay loam.

5.3 Future Scope of Study

The physical parameters of the water in the study area (Talchir Kaniha) can be used to study the ground water characteristics monitoring in the study area in near future. The study can be helpful in improving the management of land use cover and method of irrigation. The understanding of the water analysis in study area can be used for developing the water quality index as well as management of ground water quality for irrigation purpose.

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