PHYSIO-CHEMICAL ANALYSIS OF WATER COLLECTED FROM VILLAGES ADOPTED UNDER UNNAT BHARAT ABHIYAN

A

PROJECT REPORT

Submitted in partial fulfilment of the requirements for the award of the degree

of

BACHELOR OF TECHNOLOGY

IN

CIVIL ENGINEERING

Under the supervision

Of

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to

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY

WAKNAGHAT, SOLAN – 173234

HIMACHAL PRADESH, INDIA

MAY – 2019

STUDENT'S DECLARATION

We hereby declare that the work presented in the Project report entitled **"Physio - Chemical Analysis of Water Collected from Villages Adopted Under Unnat Bharat Abhiyan"** submitted for partial fulfillment of the requirements for the degree of Bachelor of Technology in Civil Engineering at **Jaypee University of Information Technology, Waknaghat** is an authentic record of my work carried out under the supervision of **Dr. Saurav .** This work has not been submitted elsewhere for the reward of any other degree/diploma. I am fully responsible for the contents of my project report.

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CERTIFICATE

This is to certify that the work which is being presented in the project report titled **"PHYSIO - CHEMICAL ANALYSIS OF WATER COLECTED FROM VILLAGES ADOPTED UNDER UNNAT BHARAT ABHIYAN"** in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology in Civil Engineering submitted to the Department of Civil Engineering, **Jaypee University of Information Technology, Waknaghat** is an authentic record of work carried out by **Karan Goel (151692) and Shubham Soni (151656)** during a period from August, 2018 to May, 2019 under the supervision of **Dr. Saurav** , Department of Civil Engineering, Jaypee University of Information Technology, Waknaghat.

The above statement made is correct to the best of our knowledge.

Date: May, 2019

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ABSTRACT

Unnat Bharat Abhiyan (UBA) an aspiring project with the support of the Ministry of Human Resource Development, Government of India, was propelled with the aim to use the technological knowledge created by the leading engineering institutes of the nation and apply it in the rural milieu. To this end, JUIT led Participatory Rural Appraisals (PRAs) in five villages.

Five villages were hen picked based on statistic qualities, territory, availability and degree of urbanization in July, 2018. Wakna, a village in district Solan, which lies around 5 km from JUIT, was among the five picked villages, A group of 2 students led a full scale level and smaller scale level study on the villages. The Mission of Unnat Bharat Abhiyan is to empower higher educational institutions to work with the rural population of country India in distinguishing advancement challenges and developing appropriate solutions for accelerating sustainable growth and development. It also aims to make an idealistic cycle among society and a comprehensive scholastic framework by giving learning and practices for emerging professions and to upgrade the capabilities of both people in public and the private segments in reacting to the advancement needs of rural India.

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DO	Dissolved Oxygen
pH	Power of Hydrogen
TDS	Total Dissolved Solids
UBA	Unnat Bharat Abhiyan

CHAPTER - 1

INTRODUCTION

1.1 Project Description

The western culture, in view of innovations and urbanization, has offered ascend to significant issues like expanding imbalance and environmental change because of fast biological degradation. To eliminate these issues, it is important to advance improvement of provincial regions, in light of neighborhood assets and utilizing eco-accommodating innovation with the goal that the fundamental needs of garments, Food, cover, vitality, human services, work, sanitation, transportation, and training can be met.

The idea of Unnat Bharat Abhiyan began with the activity of a gathering of devoted employees of Indian Institute of Technology (IIT) Delhi working in the region of country improvement and suitable innovation.

The Vision of Unnat Bharat Abhiyan is transformational change in rustic advancement forms by utilizing information establishments to help fabricate the engineering of an Inclusive India.

Mission

The Mission of Unnat Bharat Abhiyan is to empower higher instructive establishments to work with the general population of rural India in recognizing improvement challenges and developing proper answers for quickening supportable development. It expects to make a virtuous cycle among society and a comprehensive scholastic framework by giving learning and practices to rising callings and to update the capacities of both the general population and the private areas in responding to the improvement needs of rural India.

Water Management

Water is getting to be alarm with time both in the rural regions just as the urban regions. This is generally a direct result of terrible administration and wrong misuse of water assets. Drinking water is an issue even in urban zones as is the situation in rural areas including water for irrigation. India has enough rains. The vast majority of that water streams down into the ocean taking with it the fertile top soil. It doesn't permeate down and therefore the ground water is additionally exhausting quick, the water table going further and further down all over. There are advancements accessible, both in the modern sector as well as in the traditional sector for better water management.

Water resource management is the activity of arranging, creating, disseminating and dealing with the ideal utilization of water resources. Much exertion in water resource management aims at utilization of water and in limiting the ecological effect of water use on the natural environment. The perception of water as an indispensable part of the biological system depends on incorporated water resource management, where the amount and nature of the environment help to decide the idea of the natural resources.

In Unnat Bharat Abhiyan (UBA), Village Development Program is initiated and in this program different processes are involved. Five villages have been adopted by Jaypee University of Information & Technology Under this scheme as follow :-

1. CHAUVSA
2. DOMEHAR
3. BISHA
4. WAKNA
5. RICHANA

1.2 Need For Quality Test

During our visit to all the five villages adopted by the University , when we did our survey and asked the people of village about their challenges, the most common answer that we got was they don’t have satisfactory results regarding the quality of water.

Although they have filled a application to the Health Department regarding the same and requested government to take effective measures and take this issue on a serious note.

So upon equating to their challenges, we collected different water samples from these five villages in different seasons. We performed certain physio-chemical analysis and portability check to test the water quality.

Also, the report has been sent to Ministry of Human Resource Development (MHRD).

1.3 How UBA Works

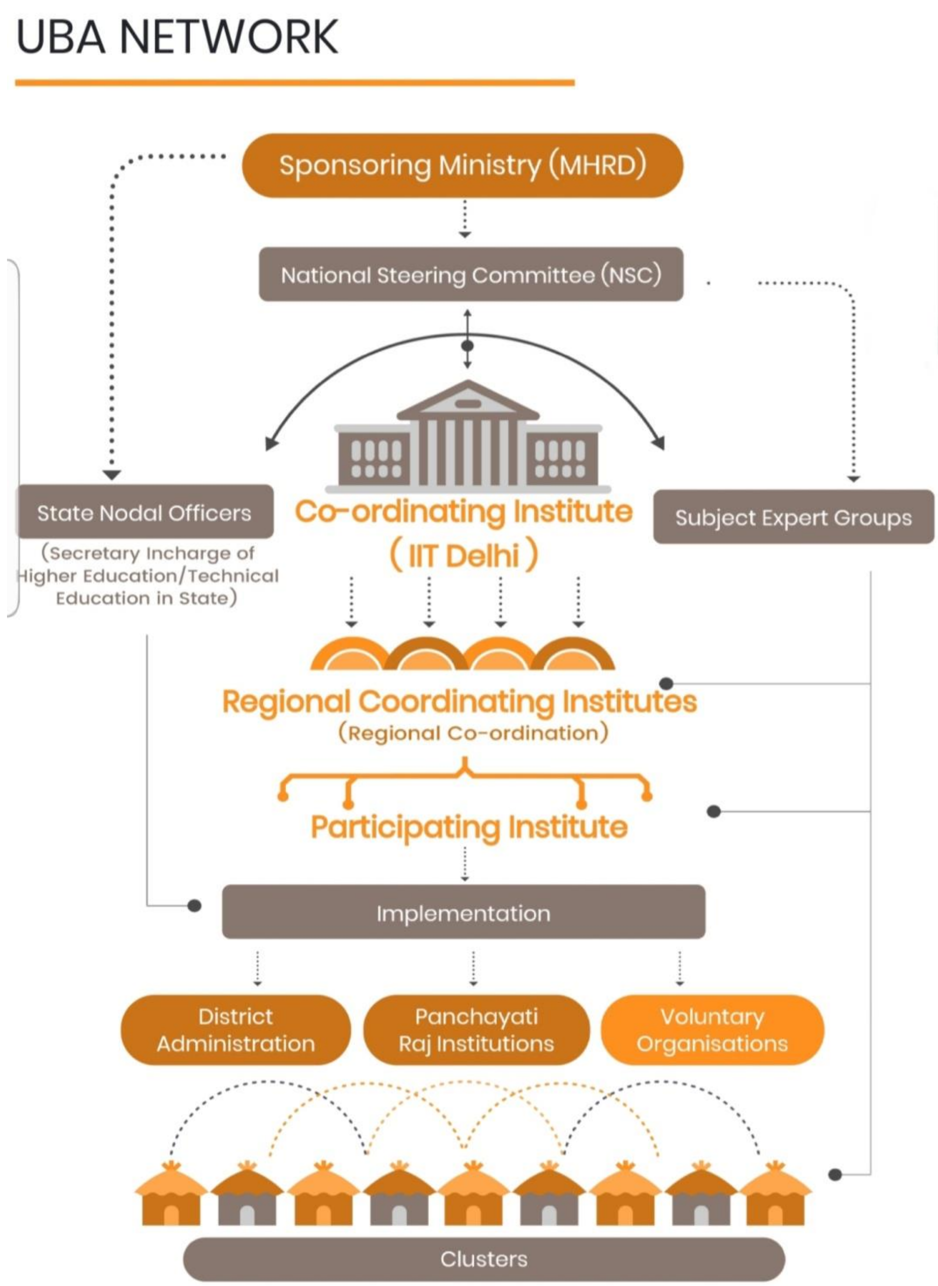


Fig. 1.1: Working of UBA

CHAPTER - 2

LITERATURE REVIEW

- **Sharma S., [1]** analysed the household drinking water in 39 localities of Kathmandu valley and found ranging from 4 to 460 cfu per 100 mL.

- **DISVI [2]** conducted a study on the quality of drinking water of Kathmandu valley by taking 472 samples at 58 sampling points, 44 water taps, 7 storage, and 7 water treatment plants which showed existence of bacterial contamination in most of the sampling points.

- **Pandey B., [3]** Dissected the drinking water quality of Central Development district, Nepal, He investigated the total of 243 examples, 130 from ground water source and 113 from springs. 20 of the groundwater tests surpassed WHO standards. Moreover, We inferred that the greater part of the springs and groundwater sources were intensely tainted with fecal coliform microbes.

- **Ribeiro A., et al [4],** analysed water quality from various sources in Portugal. The objectives of this study were to analyse the seasonal fluctuations of fungal contamination, and to trace the origin of the contaminating fungal populations with molecular biology techniques in a bottle water company. He analysed water from water tank, water filter and bottled water twice monthly for fungal growth and found significant fungal contamination. The dominant fungal genera in order of highest numbers isolated were: Penicillium, Cladosporium and Trichoderma followed by Aspergillus, Paecilomyces and others. He also observed that fungal contamination increased during the warmer seasons, especially May and June.

- **Bittner A., et al [5]** carried out a study on the quality of drinking water. Samples were taken from various sources like well, stream and treatment plants, all of which showed contamination. Hence it was concluded that most drinking water supplies are microbiologically contaminated.

- **Prasai T., et al [6]** analysed a total of 132 water samples collected from various sources. Among the total samples, 49 were from tube wells, 57 from wells, 17 from taps and 9 from stone spouts. The analysis was carried out for various water quality parameters. The results showed that 82.6% of drinking water samples crossed WHO standards. During the study, 238 isolates of enteric bacteria were identified, of which 26.4 % were Escherichia coli.

- **Pokhrel S.R., [7]** analysed 42 samples of bottled water from 7 companies for physio-chemical as well as microbiological parameters. He found that the physio-chemical parameters were under the acceptable limit whereas, bacterial count up to 162 was found in Total Plate Count. In addition to this, yeast as well as coliform was also detected.

- **Gyawali R., [8]** conducted a study on Microbial and chemical quality of water available in Kathmandu with 6 samples of tap and river from Sundarighat upstream and found that the physio-chemical parameters were below WHO standards except chloride. Also, bacteriological contamination was 900cfu/100 mL in average.
- **Thakuri B.M., [9]** conducted a study on the quality of bottled water taking 10 different brands of bottled water available in the valley and found that most of the physio-chemical parameters were under the limit of WHO (1994). Microbial analysis showed that most brands had satisfactory quality though few numbers of coliforms were present.

- **Rak A., [10]** Progressively more extensive utilizations of artificial neutral networks (ANN) in exploration and study of unit and mechanical procedures identified with the water treatment was a reason of making ANN model for foreseeing of treated water turbidity in recently working water treatment innovation for surface and retention water in 'Sosnowka' water reservoir . For displaying of water turbidity amid water treatment process for the chose innovative framework, the accompanying project was connected Flexible Bayesian Models on Neutral Networks (FBM). There was a model made which permits to gauge turbidity of water pre-treated through a particular technological framework and the premise of which are data turning out from checking of physio chemical parameters of water drawn from the particular water bodies just as from observing procedure parameters of water treatment system theoretical ought to condense the content of the paper.

- **Sorlini S., [11]** Risky drinking water is one of the primary worries in creating nations. So as to manage this issue, a participation venture was set up by the ACRA Foundations in the

Logone valley (Chad-Cameroon). Water supplies were inspected all through the villages of this territory for the most part from boreholes, open wells, streams and lakes just as some funnelled waters. The examples were examined for their physical-chemical and microbiological quality so as to recognize the contamination issues and recommend suitable solutions. Raised lead levels were recognized both in aquifers and in surface waters, affirming that further examinations of the event of lead pollution in the Logone valley are justified. Likewise, numerous groundwater sources are contrarily affected by parameters of tasteful concern, for example, turbidity, iron and manganese. Despite the fact that they don't influence human well-being, raised dimensions of these parameters cause consumers to abandon improved water supplies, regularly for surface water sources that are micro-biologically contaminated. The utilization of alternate sources, Improvement of water structures and water treatment are conceivable solutions to improve the quality of drinking water in the Logone.

- **Gorde S.P. and Jadhav M.V., [12]** Water is the most significant in forming the land and managing the atmosphere. It is a standout amongst the most significant compound that crucially impact life. The nature of water is normally depicted by its physical, chemical and organic qualities. Quick industrialisation and unpredictable consumption of synthetic humus and pesticides in agribusiness are causing substantial and changed contamination in amphibian condition prompting weakening of water quality and consumption of sea-going biota. Due of consumption of sullied water, human encounters water borne contaminations. It is along these lines important to check the water quality at customary interim of time. Parameters that may be attempted to consolidate temperature, pH , Turbidity , Saltiness, Nitrates and phosphates. An appraisal of the aquatic macro invertebrates can likewise give indication of water quality.

- **Miseviciene S., [13]** Researched on the rural areas for their surface water quality. It was discovered that the organization's surface wastewater is for the most part contaminated by suspended solids, in light of the fact that amid the exploration time frame, the normal contamination in the water from the organization's domains was resolved to be 28.2 mg. Be that as it may, after the treatment arranges, the suspended solids diminished by 61%, i.e. to 11.1 mg. This fixation conforms to the natural necessities for the surface wastewater that is released into the environment. BOD concentration in water discharge is very low and did not reach maximum allowable instantaneous concentrations.

- **Altansukh O., [14]** Assessed for Surface Water quality of Tuul river, Mongolia. Cold period contrarily influences the self cleansing capacity and procedures of the river. Another reason is that releases from toxin sources are in the period more noteworthy than river discharges.

CHAPTER - 3

METHODOLOGY

3.1 Analytic methods

We have water samples collected from 15 different sources from different sources from different villages in different seasons. For these kind of water sources, there are distinctive fundamental parameters considered based on the sort of water sources. Since it is the water supply that we are progressively concerned about, We will compare the parameters of only consumable water for different seasons. Millions of water quality tests are carried out daily to fulfil regulatory requirements and to maintain safety.

So thusly, we have considered only those fundamental parameters which are given in the Table3.1 beneath.

Table 3.1: Methodological Details

S.No.	Parameters	Apparatus	Method
1	Alkalinity	Titration	Titrimetric
2	Acidity	Titration	Titrimetric
3	Chloride Content	Titration	Titrimetric
4	pH	pH Strips and pH Meter	Instrumental
5	Dissolved Oxygen	HQD portable meter	Instrumental
6	Hardness	Titration	Titrimetric
7	Total Dissolved Solids	TDS meter	Instrumental
8	Conductivity	Conductivity Meter	Titrimetric
9	Turbidity	Turbidity Meter	Instrumental

3.2 Parameters tested and Procedures

There are certain parameters which are physical, chemical, biological that categorizes water into various streams and water is analyzed accordingly**.**

a) Alkalinity

Alkalinity is characterized as a proportion of the buffering capacity of water to neutralize strong acid . This limit is credited to bases that are available in regular waters including OH^{-}, HCO_{3-}, and CO_2^{-3}. Greater alkalinity in your water test implies additionally buffering capacity of your water test.

Alkalinity is huge for fish and maritime life since it guarantees or supports against rapid pH changes. Living structures, especially amphibian life, works best in a pH Range of 6.0 to 9.0.

Reagents Used :

- CO_2 free distilled water.
- 0.02 N standard H_2SO_4
- Phenolphthalein Indicator
- Methyl Orange Indicator

Procedure :

- Collect 50ml water sample, add 3 drops of phenolphthalein indicator, titrate the sample with 0.02N sulphuric acid and estimate the quantity of phenolphthalein indicator.
- Phenolphthalein indicator will change the color from pink to clear.
- If not, there must be presence of minerals itself.
- Take the same sample and ad 2-3 drops of methyl orange indicator.
- Titrate the sample until it turns to brick Red.
- Record the volume of acid used for the titration.

Model Calculations :

$$\text{Alkalinity} = \frac{\text{Volume of indicator} \times \text{Normality of } H_2SO_4 \times 1000 \times 50}{\text{Volume of sample taken}}$$

b) Acidity

The acridity of water is its quantitative ability to react with a strong base to assigned pH or it very well may be characterized as the base neutralizing capacity.

Hydrogen particles present in a sample as a result of dissociation hydrolysis of solutes is neutralized by titration with standard alkali. The acidity therefore relies upon endpoint pH or indicator utilized CO_2 is normally a noteworthy acidic component of unpolluted surface water.

Reagents Used :

- CO_2 free distilled water.
- 0.02 N standard NaOH.
- Phenolphthalein Indicator
- Methyl Orange Indicator

Procedure :

- Collect 50ml water sample, add 3 drops of methyl orange indicator, titrate the sample with 0.02N standard NaOH and estimate the quantity of methyl orange indicator.
- Methyl orange indicator will change the color from orange-red to yellow.
- If not, there must be presence of minerals itself.
- Take the sample again and add 2-3 drops of phenolphthalein indicator.
- Titrate the sample until it turns to faint pink.
- Record the volume of acid used for the titration.

Model Calculations :

$$\text{Acidity} = \frac{\text{Volume of NaOH} \times 1000}{\text{Volume of Sample Taken}}$$

c) pH

Testing the pH of water reveals how acidic or basic the water is at the time of testing. Unadulterated, unpolluted water typically has a pH level of 7, which is neutral (neither acidic nor basic). The pH level of water can provide data on potential contamination, and can be a significant insurance for securing the health of people, animals and vegetation.

pH can be tried utilizing a pH meter or pH strips. Refer Fig 3.1 and Fig 3.2.

pH Strips :

pH strips contain a progression of indicator bars that will all change color after introduction to a solution. The strength of the acids and bases on each bar varies. After they change, the color patterns of the bars can be coordinated to the precedents that accompany the pack. Collect a sample of the water in a clean container.

Dip a test strip into your sample. Only a couple of moments of introduction will do the suffice. The different color bars on the paper will start changing color inside a couple of minutes. Contrast the test strip and the color diagram that accompanied the paper. The color(s) on the outline should coordinate the color(s) of your test strip. The chart should correlate color patterns to pH levels.

pH Meter :

- Rinse the probe with double deionized water before utilizing it. Get it dry with a spotless tissue.
- Gather a sample of the water in a spotless container.
- Adjust the meter to coordinate the sample temperature.
- Put the probe into the sample. Wait for the meter to come to equilibrium.
- Read the pH measurement of the Sample. Your pH meter ought to give a reading on the size of 0-14. In the event that the water is unadulterated, it should peruse near 7.

Fig 3.1: pH Strips

Fig. 3.2: pH Meter

d) Dissolved Oxygen (DO)

Aquatic creatures need dissolved oxygen to live. Fish, spineless creatures, plants, and vigorous microscopic organisms all require oxygen for breath. Oxygen breaks up promptly into water from the climate until the water is immersed. When broken down in the water, the oxygen diffuses all around gradually and circulation relies upon the development of the circulated air through water. Oxygen is created by aquatic plants, algae, and phytoplankton as a by-product of photosynthesis. The measure of oxygen required differs as indicated by species and phase of life. Broken down Oxygen levels underneath 3 ppm are unpleasant to most aquatic creatures. Broken down Oxygen levels beneath 2 or 1 ppm won't support fish. Levels of 5 to 6 ppm are normally required for growth and activity.

Procedure :-

- Rinse the Water Sampling Bottle with the sample water.
- Remove the top and enable the container to fill.

- Tap the sides of the container to remove any air bubbles.
- Tightly top the jug, and submerge it to the ideal depth.
- Replace the top while the bottle is as yet submerged.
- Retrieve the bottle and ensure that no air bubbles are caught inside.
- Using DO meter, check the precise reading. Refer Fig 3.3.

Fig. 3.3: DO Meter

e) Hardness

The ions involved with water hardness, for example Ca^{2+}(aq) and Mg^{2+}(aq), can be determined by titration with a chelating operator, ethylene diaminetetra acetic acid (EDTA), for the most part as disodium salt . Erichrome Black T is usually used as indicator for the titration. At pH 10, Ca^{2+}(aq) ions firsts edifices with the marker as CaIn+(aq) which is wine red. As the more grounded ligand EDTA is incorporated, the Caln+(aq) complex is supplanted by the CaY^{2-}aq) complex which is blue. The end reason for titration is appeared by a sharp color change from wine red to blue. Titration using Erichrome Black T as indicator decides absolute hardness due to

Ca^{2+} (aq) and Mg^{2+}(aq) particles. Hardness because of Ca^{2+}(aq) particles is directed by a separate titration at a higher pH, by including NaOH solution for precpitate Mg $(OH)_2$,

Reagents Used :

- EDTA (disodium salt)
- NaOH solution (If required)
- Erichrome Black T Indicator

Procedure :

- Take 50ml water sample which needs to be titrated.
- Add 1 ml of buffer solution to balance the pH of the sample.
- Add 2-3 drops of Erichrome Black T indicator.
- Titrate with 0.01M EDTA until the solutions turn from wine red to sky blue with no existence of red.
- Repeat the titration for concordant observations. Refer Fig 3.4.

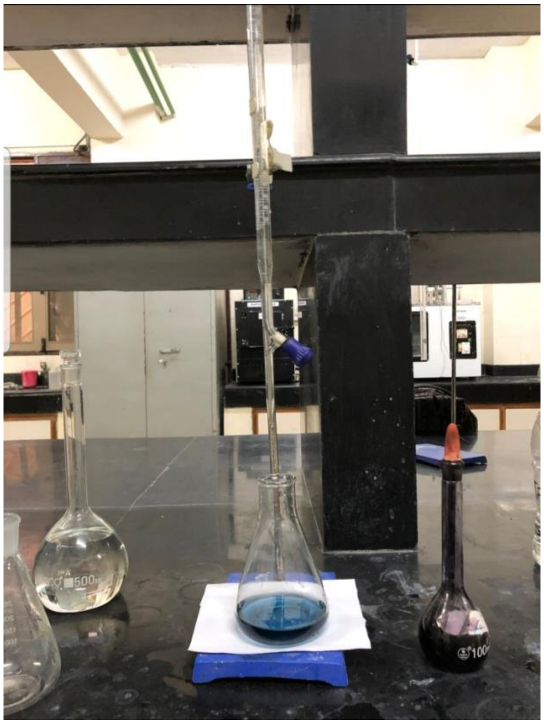


Fig. 3.4: Titration for determining Hardness

f) Chloride content

Chlorides are broadly disseminated in nature as salt of Sodium (NaCl), Potassium (KCl), and Calcium ($CaCl_2$).

The taste limit of a chloride anion in water is reliant on the associated cation. Taste limit for Sodium chloride and Calcium chloride in water are in the range 200 - 300 mg/l. The flavor of espresso is influenced in the event that it is made with water containing a chloride grouping of 400 mg/l as Sodium chloride or 530 mg/l as Calcium chloride.

Sodium chloride is broadly utilized in the generation of Industrial chemicals, for example, Caustic Soda, Chlorine, Sodium Chloride and sodium hypoclorite. Sodium chloride and Calcium chloride are broadly utilized in snow and ice control. Potassium Chloride is utilized for the generation of Fertilizers.

Chloride in water might be significantly expanded by treatment process in which chlorine or chloride is utilized, For instance, Treatment with 40 g of chlorine for every m3 and 0.6 mole of Iron chloride per liter, required for the decontamination of ground water containing huge measure of Iron, or surface water contaminated with colloids has been accounted for to result in chloride convergence of 40 and 63 mg/l, separately in the completed water.

Chloride focus in overabundance of around 250 mg/l can offer ascent to discernible preference for water, yet the limit relies on the associated cations. Purchasers can anyway wound up acclimated with concentration more than 250 mg/l. No health based rule esteem is proposed for chloride in drinking water.

Reagents Used :

- Potassium chromate indicator solution
- Standard Silver Nitrate

Procedure :

- Take 50 ml of solution in a conical flask.
- Add 1ml of potassium Chromate indicator.

- Titrate with Standard Silver Nitrate solution to pinkish yellow end point.
- Note down the amount of Standard Silver Nitrate used.

Model Calculations :

$$\text{Chloride Content} = \frac{\text{Volume of titrant used} \times \text{Normality of Silver Nitrate} \times 35.5 \times 1000}{\text{Volume of sample taken}}$$

g) TDS

Consumable Water ought to be of such quality that it delivers no impression of taste and odour. An estimation of total dissolved solids give statistics on the genuine quality of water utilized in fish handling companies.

The minerals dissolved in water will generally gather in the focal part of ice blocks and gives a shady appearance in the inside which is undesirable.

The test give you the procedure to evaluate the total dissolved solids in water which ought not surpass 300 ppm**.**

Fig. 3.5: TDS Meter

h) Conductivity

Conductivity is a proportion of water's capacity to pass electrical flow. This capacity is straightforwardly identified with the centralization of particles in the water. These conductive particles originate from dissolved salts and inorganic materials, for example alkalis, chlorides, sulfides and carbonate compounds. Compounds that disintegrate into ions are called as electrolyte. The more ions that are available, the higher the conductivity of water. In like manner, the less ions that are in the water, the less conductive it is.

Distilled or deionized water can go about as a insulator because of its extremely low conductivity value. Sea water, then again, has a high conductivity.

Ions conduct electricity because of their positive and negative charges. At the point when electrolyte dissolve in water, they split into cations and anions. As a dissolved substances split in water, the cluster of every positive and negative charge remains equivalent. This implies despite the fact that the conductivity of water increment with added ions, it remains electrically neutral.

e) Turbidity

Turbidity is the cloudiness of haziness of a fluid brought about by suspended solids that are generally imperceptible to the unaided eyes. The estimation of Turbidity is a significant test when attempting to decide the quality of water. It is a total optical property for the water and does not distinguish in individual substance, it simply state something is there. Refer Fig. 3.6 to have a preferable look on how a Turbidity meter looks like.

Water quite often contains suspended solids that comprise of a wide range of particles of varying size. Some of the particles are sufficiently extensive and sufficiently overwhelming to in the end settle to the bottom of the container if a sample is left standing. The littler particles will possibly settle gradually if by any means. It's these particles that makes water look turbid.

The term Turbidity can likewise be connected to transparent solids like plastic and glass.

In drinking water the higher the level of turbidity, the higher the possibility that those utilizing it could create gastrointestinal illnesses. Contaminants like infections and pathogenic microbes can join themselves to the suspended solids. These solids at that point interferes with sanitization. Numerous things can influence the quality of drinking water, so the administration guidelines set the dimension of turbidity that is admissible. Typically utilities endeavor to keep up a turbidity level of about 0.2 NTU.

Fig. 3.6: Turbidity Meter

CHAPTER - 4

RESULTS AND DISCUSSIONS

Following results are obtained and data has been analyzed

4.1 Results of Chauvsa (Village 1)

Season 1 (August - September)

The Table 4.1 underneath displays the assessed parameters of the water sample collected from Village Chauvsa between the months of August and September and the results are compared with Indian and Foreign standards.

Table 4.1 - Results of Season 1

Parameters	Source	Storage	Tap	WHO	EU	BIS
Alkalinity (mg/l)	52	33	28	20 - 200	20 - 180	20 - 200
Acidity (mg/l)	38	10.5	9	< 50	< 60	< 50
Chloride Content (mg/l)	23.89	6.97	7.17	200	200	250
pH	6.54	6.67	6.67	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
DO (mg/l)	5.12	7.10	8.22	> 4	> 4	> 4
Hardness (mg/l)	189	123	87	500	500	300
TDS (ppm)	58	62	60	< 600	< 600	< 500
Conductivity (mhos/cm)	97.3	139.6	134.3	--	--	--
Turbidity (NTU)	0	0	0	5	4	5

Fig. 4.1: Village Council Chauvsa

4.2 Results of Chauvsa (Village 1)

Season 2 (October - November)

The Table 4.2 underneath displays the assessed parameters of the water sample collected from Village Chauvsa between the months of October and November.

Table 4.2 - Results of Season 2

Parameters	Source	Storage	Tap	WHO	EU	BIS
Alkalinity (mg/l)	55	38	31	20 - 200	20 - 180	20 - 200
Acidity (mg/l)	37	9.4	8.6	< 50	< 60	< 50
Chloride Content (mg/l)	22.9	7.57	8.39	200	200	250
pH	6.58	6.7	6.71	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
DO (mg/l)	5.36	6.78	7.83	> 4	> 4	> 4
Hardness (mg/l)	191	124	85	500	500	300
TDS (ppm)	66	70	79	< 600	< 600	< 500
Conductivity (mhos/cm)	127.1	159.3	154.1	--	--	--
Turbidity (NTU)	0	0	0	5	4	5

Fig. 4.2: Source site of Chauvsa

4.3 Results of Chauvsa (Village 1)

Season 3 (January- February)

The Table 4.3 underneath displays the assessed parameters of the water sample collected from Village Chauvsa between the months of January and February.

Table 4.3 - Results of Season 3

Parameters	Source	Storage	Tap	WHO	EU	BIS
Alkalinity (mg/l)	64	51	46	20 - 200	20 - 180	20 - 200
Acidity (mg/l)	34	8.6	7.4	< 50	< 60	< 50
Chloride Content (mg/l)	20.3	6.12	6.79	200	200	250
pH	6.64	6.77	6.77	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
DO (mg/l)	5.91	7.18	8.47	> 4	> 4	> 4
Hardness (mg/l)	200	136	93	500	500	300
TDS (ppm)	51	56	53	< 600	< 600	< 500
Conductivity (mhos/cm)	96.3	138.7	113.5	--	--	--
Turbidity (NTU)	0	0	0	5	4	5

Fig. 4.3: Storage tank of Chauvsa

4.4 Results of Chauvsa (Village 1)

Season 4 (March - April)

The Table 4.4 underneath displays the assessed parameters of the water sample collected from Village Chauvsa between the months of March and April.

Table 4.4 - Results of Season 4

Parameters	Source	Storage	Tap	WHO	EU	BIS
Alkalinity (mg/l)	55	48	43	20 - 200	20 - 180	20 - 200
Acidity (mg/l)	36	16	13	< 50	< 60	< 50
Chloride Content (mg/l)	24.14	8.94	9.65	200	200	250
pH	6.72	6.67	6.68	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
DO (mg/l)	6.06	6.71	6.61	> 4	> 4	> 4
Hardness (mg/l)	184	127	90	500	500	300
TDS (ppm)	207	101	114	< 600	< 600	< 500
Conductivity (mhos/cm)	410	241	238	--	--	--
Turbidity (NTU)	0	0	0	5	4	5

Fig. 4.4: A Random Tap in Chauvsa

Also we performed tests against bacteria culture on Tap water, Basically known as potable water to check the presence of pathogenic bacteria for different seasons.

We performed following tests twice every week for better and exact outcomes. Upon equating the following parameters, we compared the TAP water of Village 1 (Chauvsa) across different seasons to check the variations where 1,2,3 and 4 represents Season 1, Season 2, Season 3 and Season 4 respectively.

4.5 Figures of Tap water

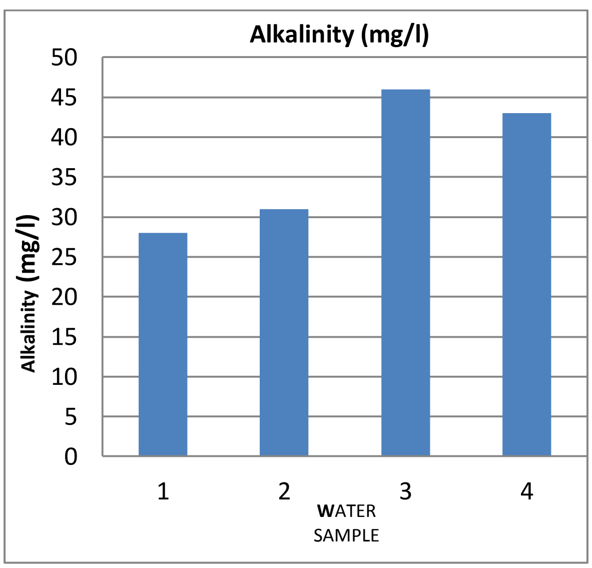


Fig. 4.5.a

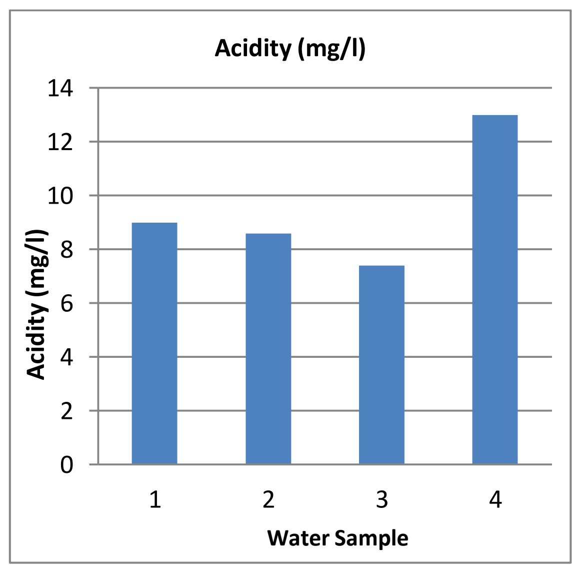


Fig. 4.5.b

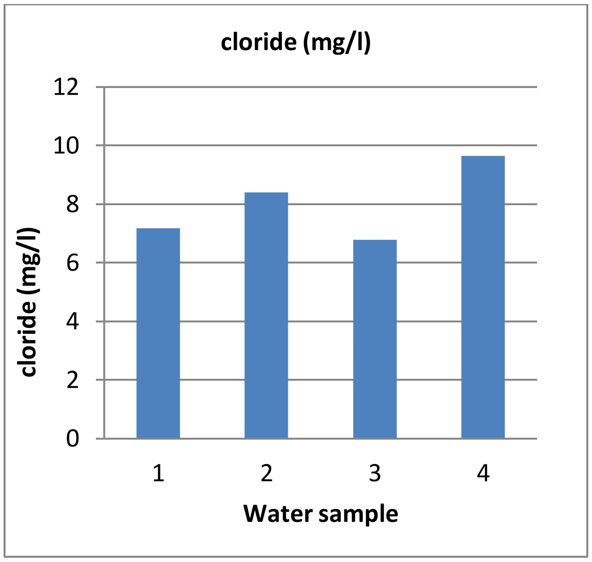


Fig. 4.5.c

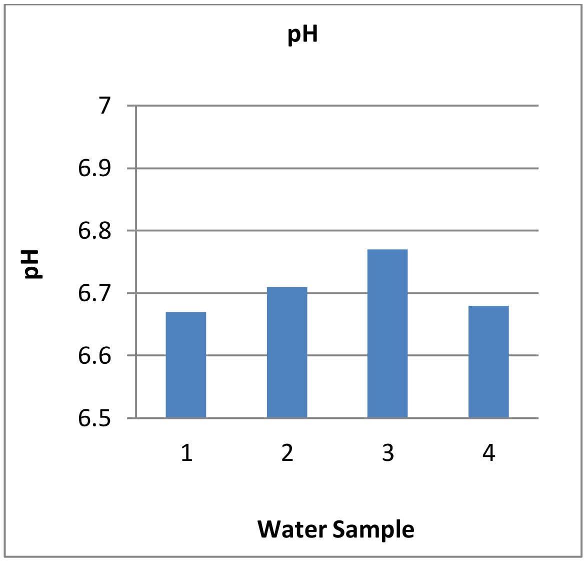


Fig. 4.5.d

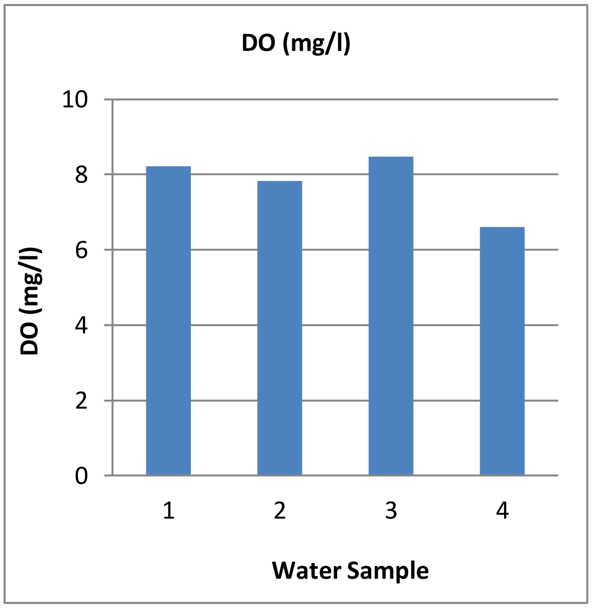


Fig. 4.5.e

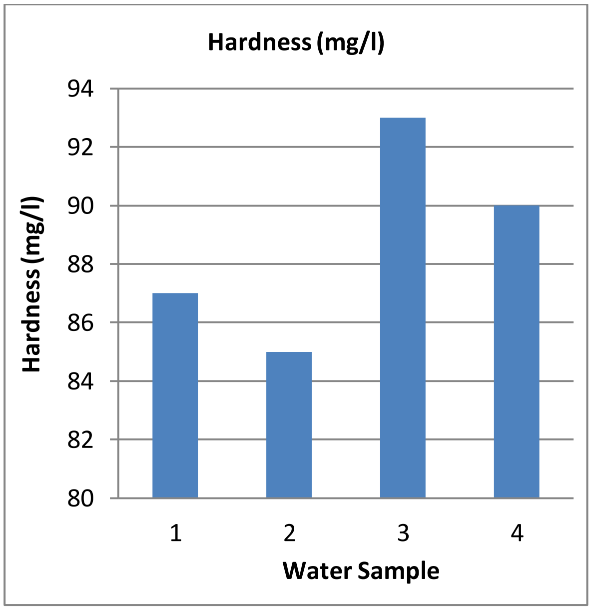


Fig. 4.5.f

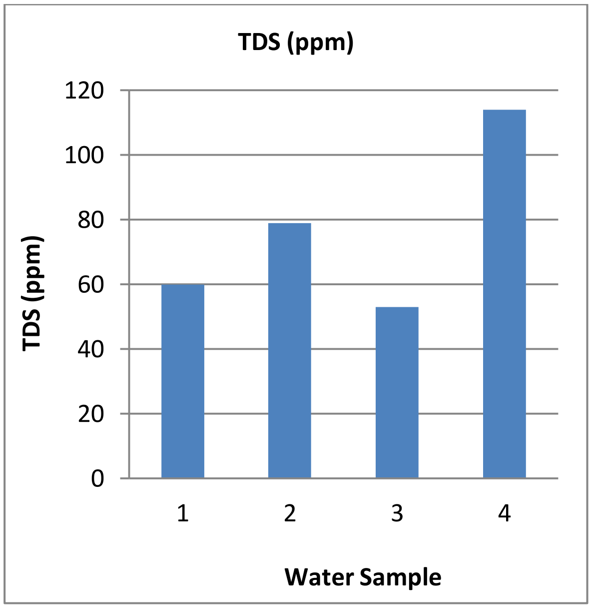


Fig. 4.5.g

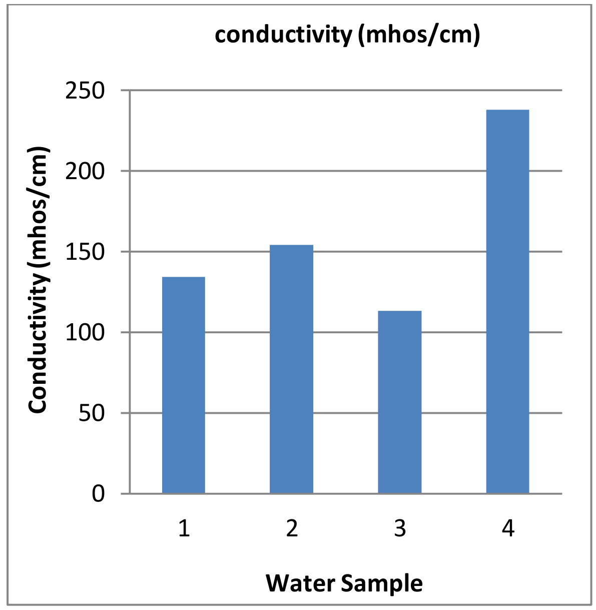


Fig. 4.5.h

4.6 Results of Domehar (Village 2)

Season 1 (August - September)

The Table 4.5 underneath displays the assessed parameters of the water sample collected from Village Domehar between the months of August and September and the results are compared with Indian, WHO and European standards.

Table 4.5 - Results of Season 1

Parameters	Source	Storage	Tap	WHO	EU	BIS
Alkalinity (mg/l)	48	37.5	29	20 - 200	20 - 180	20 - 200
Acidity (mg/l)	29	9	6.5	< 50	< 60	< 50
Chloride Content (mg/l)	19.9	6.76	6.93	200	200	250
pH	6.58	6.56	6.55	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
DO (mg/l)	5.75	7.37	8.38	> 4	> 4	> 4
Hardness (mg/l)	129	111.5	93	500	500	300
TDS (ppm)	67	68	65	< 600	< 600	< 500
Conductivity (mhos/cm)	84	117.9	114.3	--	--	--
Turbidity (NTU)	0	0	0	5	4	5

Fig. 4.6: Source water of Domehar

4.7 Results of Domehar (Village 2)

Season 2 (October - November)

The Table 4.6 underneath displays the assessed parameters of the water sample collected from Village Domehar between the months of October and November and compare the parameters with Bureau of Indian Standards, WHO and European Standards.

Table 4.6 - Results of Season 2

Parameters	Source	Storage	Tap	WHO	EU	BIS
Alkalinity (mg/l)	50	38.4	31	20 - 200	20 - 180	20 - 200
Acidity (mg/l)	28	9.6	6.3	< 50	< 60	< 50
Chloride Content (mg/l)	21.1	7.23	7.63	200	200	250
pH	6.58	6.55	6.55	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
DO (mg/l)	5.93	7.41	7.64	> 4	> 4	> 4
Hardness (mg/l)	146	123.9	102	500	500	300
TDS (ppm)	78	87	85	< 600	< 600	< 500
Conductivity (mhos/cm)	113	216.3	203.9	--	--	--
Turbidity (NTU)	0	0	0	5	4	5

4.8 Results of Domehar (Village 2)

Season 3 (January- February)

The Table 4.7 underneath displays the assessed parameters of the water sample collected from Village Domehar between the months of January and February and compare the parameters with Bureau of Indian Standards, WHO and European Standards.

Table 4.7 - Results of Season 3

Parameters	Source	Storage	Tap	WHO	EU	BIS
Alkalinity (mg/l)	56	42.5	38	20 - 200	20 - 180	20 - 200
Acidity (mg/l)	24	8.3	5.9	< 50	< 60	< 50
Chloride Content (mg/l)	16.8	5.36	5.87	200	200	250
pH	6.57	6.65	6.65	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
DO (mg/l)	6.93	7.83	8.90	> 4	> 4	> 4
Hardness (mg/l)	197	164.9	132	500	500	300
TDS (ppm)	74	75	71	< 600	< 600	< 500
Conductivity (mhos/cm)	79	116.7	112.4	--	--	--
Turbidity (NTU)	0	0	0	5	4	5

4.9 Results of Domehar (Village 2)

Season 4 (March - April)

The Table 4.8 underneath displays the assessed parameters of the water sample collected from Village Domehar between the months of March and April and compare the parameters with Bureau of Indian Standards, WHO and European Standards.

Table 4.8 - Results of Season 4

Parameters	Source	Storage	Tap	WHO	EU	BIS
Alkalinity (mg/l)	41	37	33	20 - 200	20 - 180	20 - 200
Acidity (mg/l)	30	14	11	< 50	< 60	< 50
Chloride Content (mg/l)	16.33	7.96	8.23	200	200	250
pH	6.64	6.59	6.62	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
DO (mg/l)	6.79	6.97	6.72	> 4	> 4	> 4
Hardness (mg/l)	180	156	128	500	500	300
TDS (ppm)	217	161	193	< 600	< 600	< 500
Conductivity (mhos/cm)	321	305	368	--	--	--
Turbidity (NTU)	0	0	0	5	4	5

We also performed tests for bacteria culture on Tap water, especially used for drinking purposes to check the presence of pathogenic bacteria for different seasons.

We performed following tests twice every week for better and exact outcomes. Upon equating the following parameters, we compared the TAP water of Village 2 (Domehar) across different seasons to check the variations where 1,2,3 and 4 represents Season 1, Season 2, Season 3 and Season 4 respectively.

4.10 Figures of Tap water

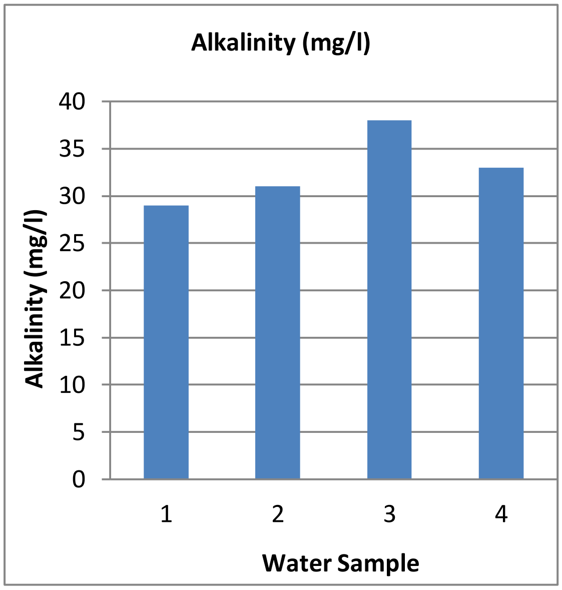


Fig. 4.10.a

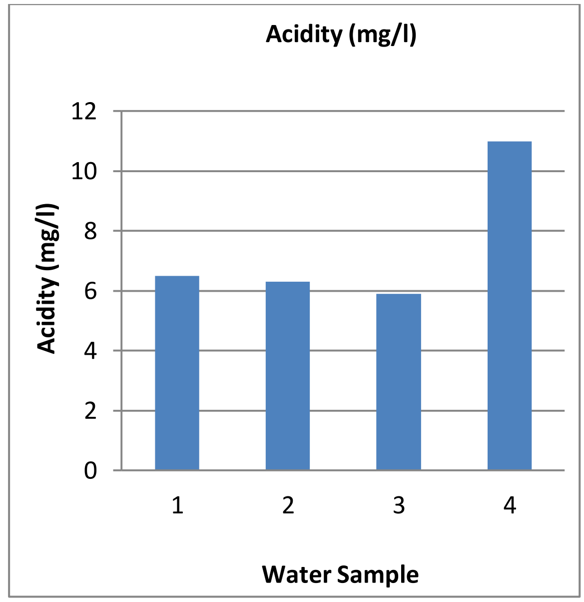


Fig. 4.10.b

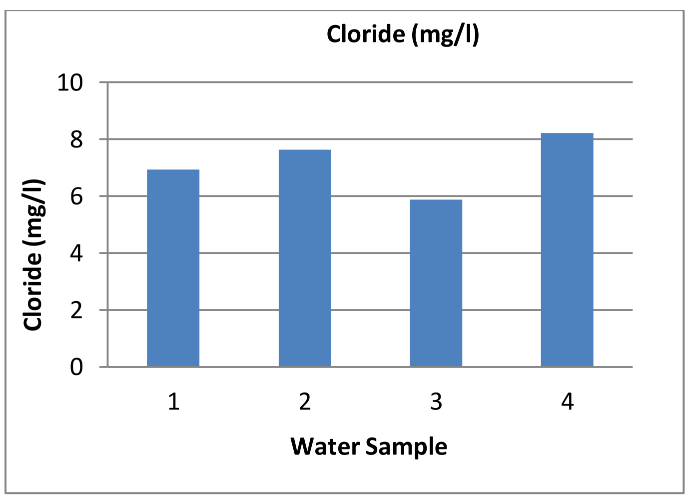


Fig. 4.10.c

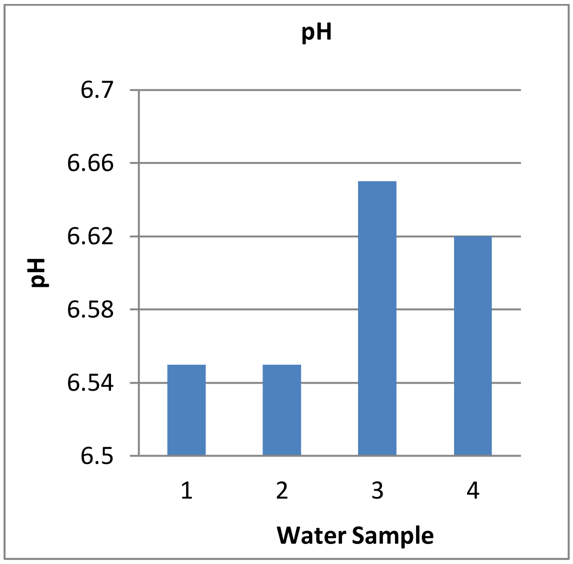


Fig. 4.10.d

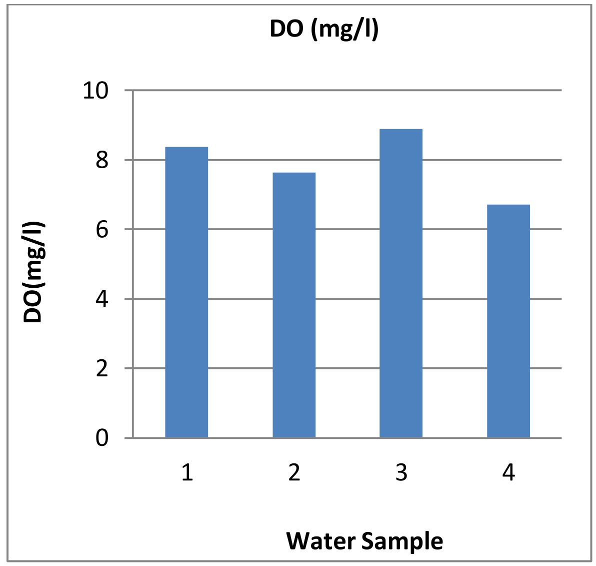


Fig. 4.10.e

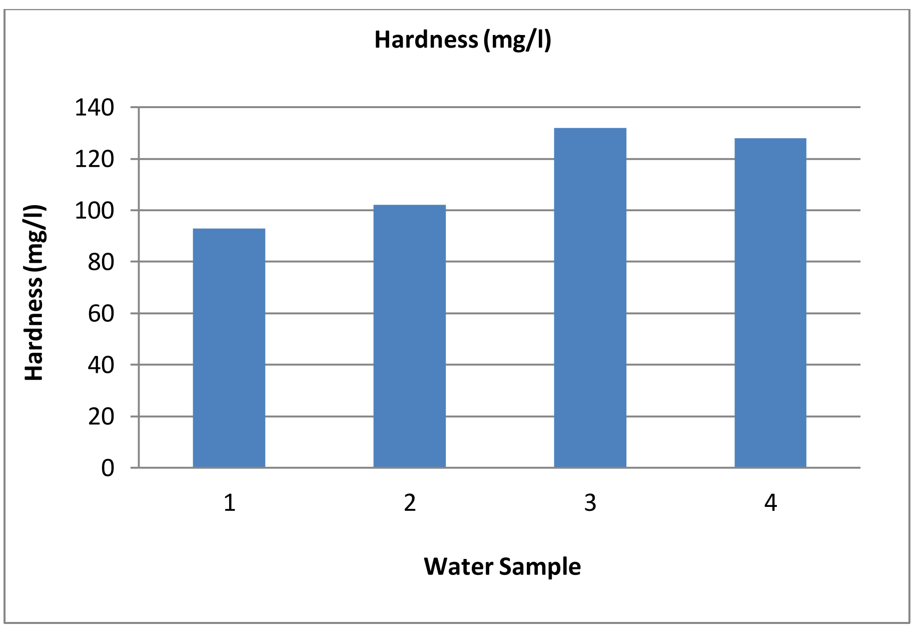


Fig. 4.10.f

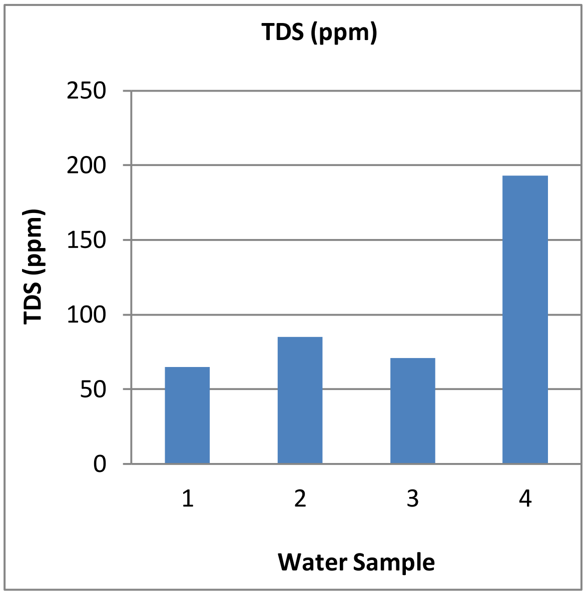


Fig. 4.10.g

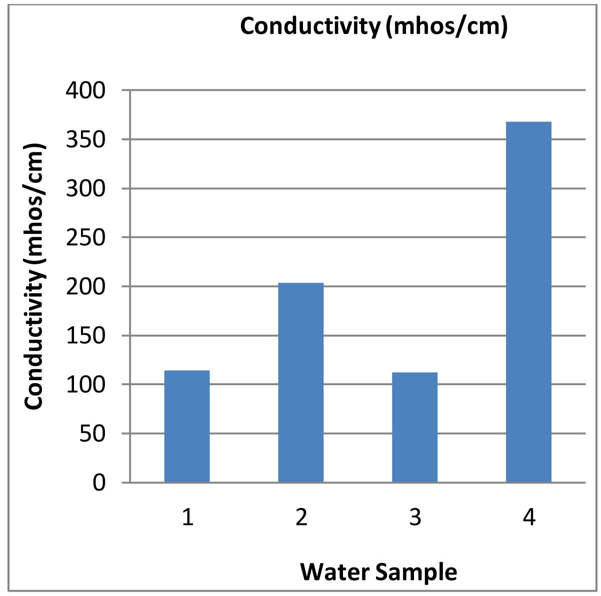


Fig. 4.10.h

4.11 Results of Bisha (Village 3)

Season 1 (August - September)

The Table 4.9 underneath displays the assessed parameters of the water sample collected from Village Bisha between the months of August and September and the results are compared with Indian, WHO and European standards.

Table 4.9 - Results of Season 1

Parameters	Source	Storage	Tap	WHO	EU	BIS
Alkalinity (mg/l)	46	33	29	20 - 200	20 - 180	20 - 200
Acidity (mg/l)	31	8.7	7.2	< 50	< 60	< 50
Chloride Content (mg/l)	20.87	3.87	3.56	200	200	250
pH	6.58	6.77	6.74	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
DO (mg/l)	5.83	7.57	8.37	> 4	> 4	> 4
Hardness (mg/l)	156	113.5	89	500	500	300
TDS (ppm)	57	60	61	< 600	< 600	< 500
Conductivity (mhos/cm)	79.1	114	112.6	--	--	--
Turbidity (NTU)	0	0	0	5	4	5

Fig. 4.11: Collecting Source water of Bisha

4.12 Results of Bisha (Village 3)

Season 2 (October - November)

The Table 4.10 underneath displays the assessed parameters of the water sample collected from Village Bisha between the months of October and November and compare the parameters with Bureau of Indian Standards, WHO and European Standards.

Table 4.10 - Results of Season 2

Parameters	Source	Storage	Tap	WHO	EU	BIS
Alkalinity (mg/l)	43	32	27	20 - 200	20 - 180	20 - 200
Acidity (mg/l)	30.8	9.1	7.4	< 50	< 60	< 50
Chloride Content (mg/l)	19.32	3.88	3.42	200	200	250
pH	6.58	6.78	6.74	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
DO (mg/l)	5.85	7.41	7.79	> 4	> 4	> 4
Hardness (mg/l)	163	115.9	83	500	500	300
TDS (ppm)	56	60	62	< 600	< 600	< 500
Conductivity (mhos/cm)	98.7	112.9	121.7	--	--	--
Turbidity (NTU)	0	0	0	5	4	5

Fig. 4.12: Stored Water of Bisha

4.13 Results of Bisha (Village 3)

Season 3 (January- February)

The Table 4.11 underneath displays the assessed parameters of the water sample collected from Village Bisha between the months of January and February and compare the parameters with Bureau of Indian Standards, WHO and European Standards.

Table 4.11 - Results of Season 3

Parameters	Source	Storage	Tap	WHO	EU	BIS
Alkalinity (mg/l)	52	37	32	20 - 200	20 - 180	20 - 200
Acidity (mg/l)	28.7	8.2	6.7	< 50	< 60	< 50
Chloride Content (mg/l)	16.47	2.56	3.18	200	200	250
pH	6.67	6.86	6.85	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
DO (mg/l)	5.91	7.76	8.71	> 4	> 4	> 4
Hardness (mg/l)	171	126.2	101	500	500	300
TDS (ppm)	52	54	55	< 600	< 600	< 500
Conductivity (mhos/cm)	76.3	110.7	109.6	--	--	--
Turbidity (NTU)	0	0	0	5	4	5

Fig. 4.13: Open Storage Tank of Bisha

4.14 Results of Bisha (Village 3)

Season 4 (March - April)

The Table 4.12 underneath displays the assessed parameters of the water sample collected from Village Bisha between the months of March and April and compare the parameters with Bureau of Indian Standards, WHO and European Standards.

Table 4.12 - Results of Season 4

Parameters	Source	Storage	Tap	WHO	EU	BIS
Alkalinity (mg/l)	40	30	26	20 - 200	20 - 180	20 - 200
Acidity (mg/l)	23	14	16	< 50	< 60	< 50
Chloride Content (mg/l)	15.68	3.13	4.26	200	200	250
pH	6.61	6.73	6.75	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
DO (mg/l)	6.98	7.25	6.88	> 4	> 4	> 4
Hardness (mg/l)	160	119	92	500	500	300
TDS (ppm)	61	58	58	< 600	< 600	< 500
Conductivity (mhos/cm)	123	131	138	--	--	--
Turbidity (NTU)	0	0	0	5	4	5

We performed tests against bacteria culture on Tap water, especially used as potable water to check the presence of pathogenic bacteria for different seasons.

We performed following tests twice every week for better and exact outcomes. Upon equating the following parameters, we compared the TAP water of Village 3 (Bisha) across different seasons to check the variations where 1,2,3 and 4 represents Season 1, Season 2, Season 3 and Season 4 respectively.

4.15 Figures of Tap water

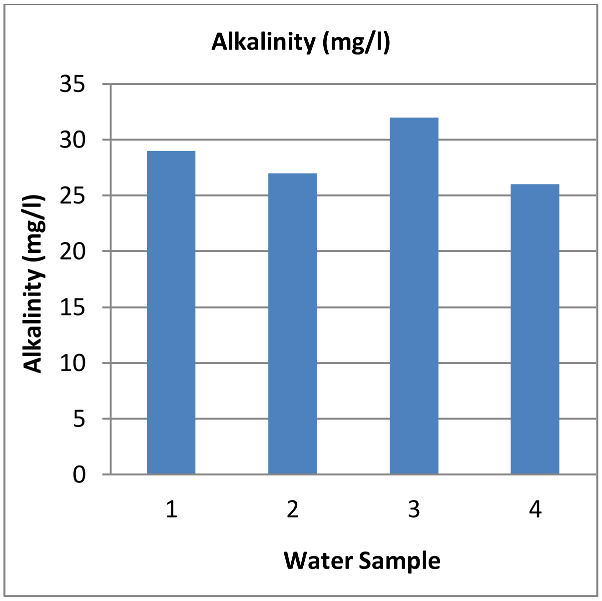


Fig. 4.15.a

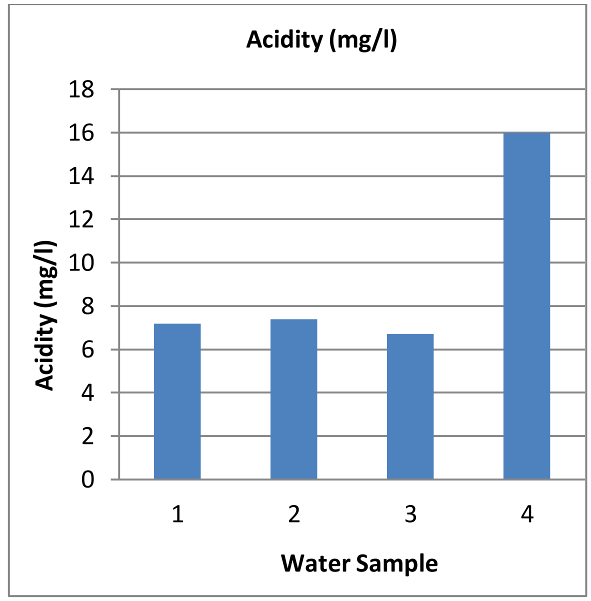


Fig. 4.15.b

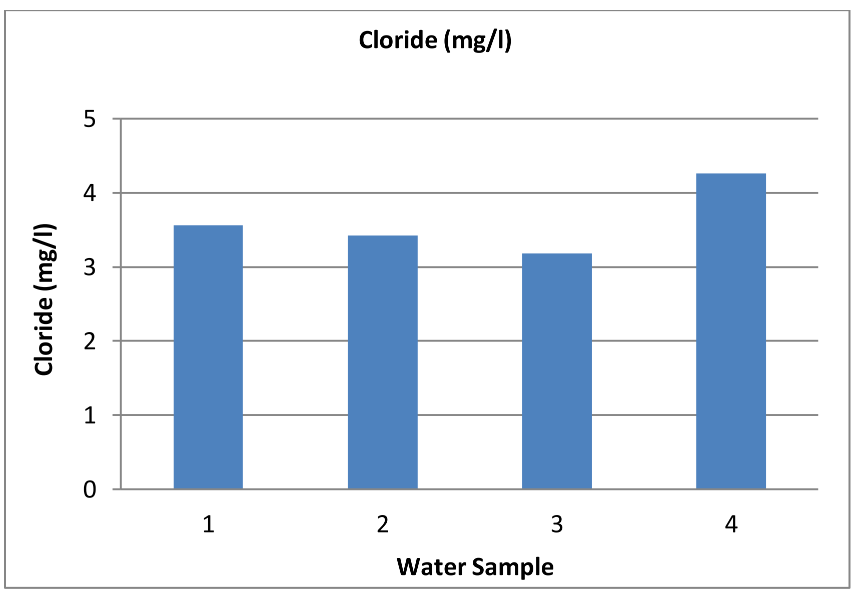


Fig. 4.15.c

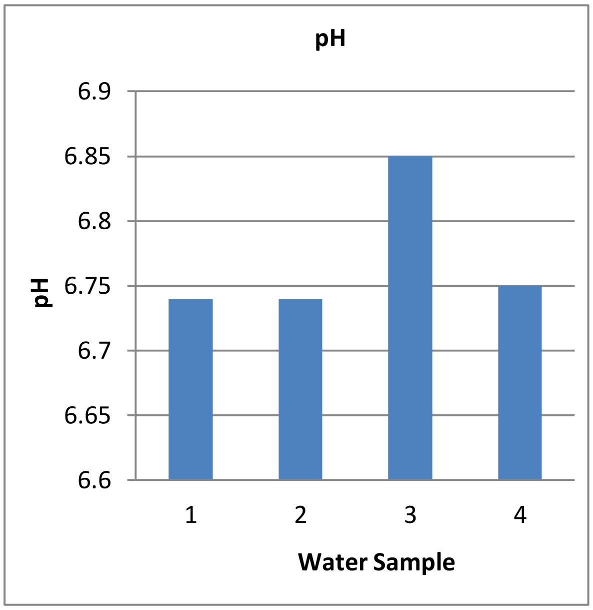


Fig. 4.15.d

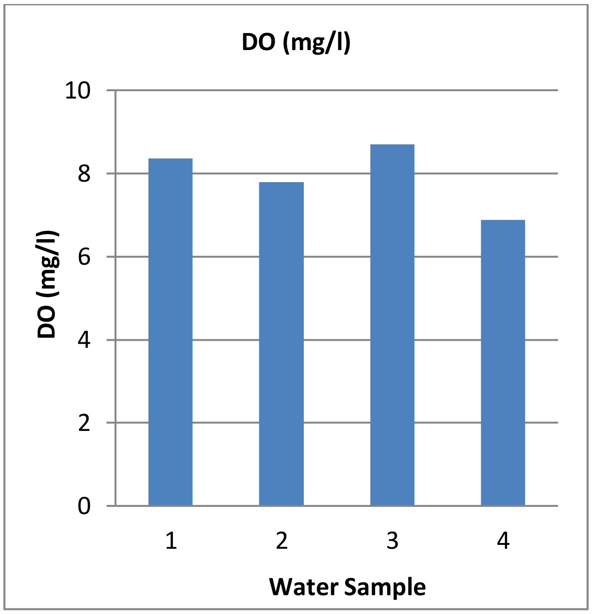


Fig. 4.15.e

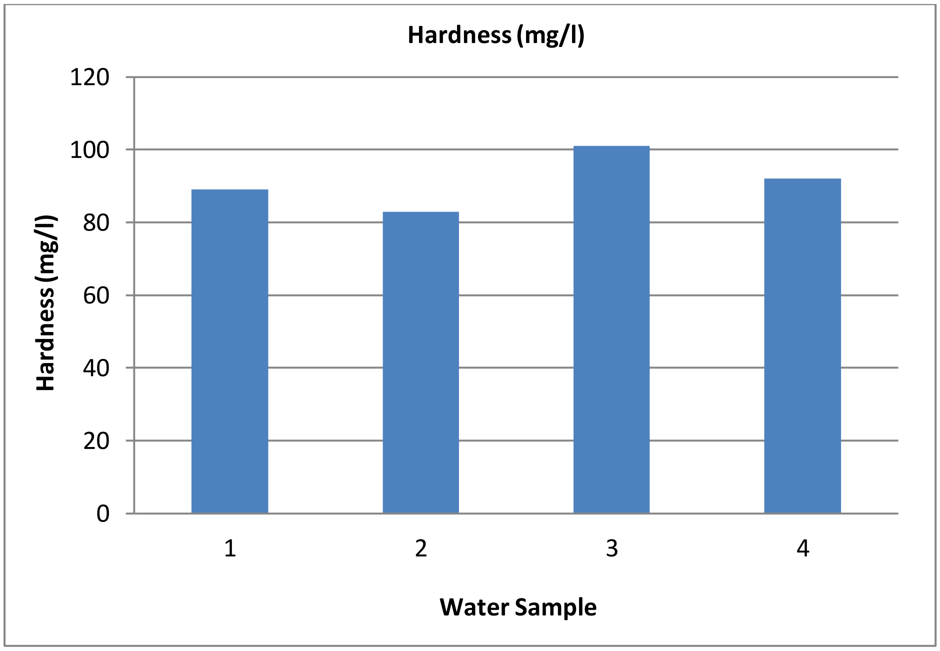


Fig. 4.15.f

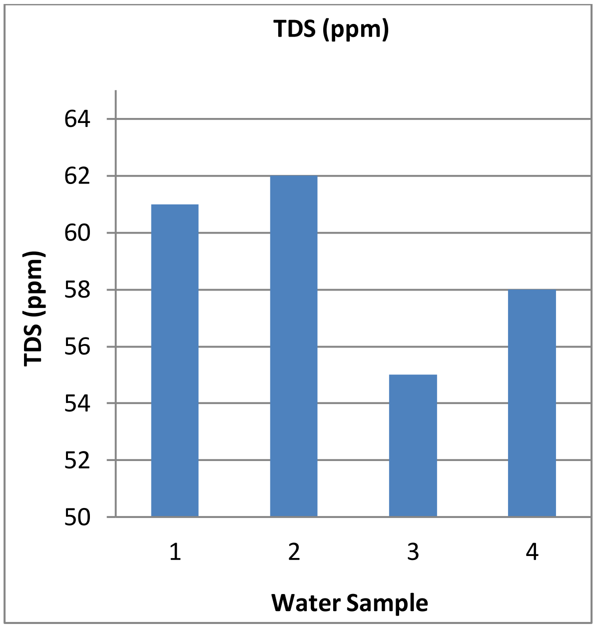


Fig. 4.15.g

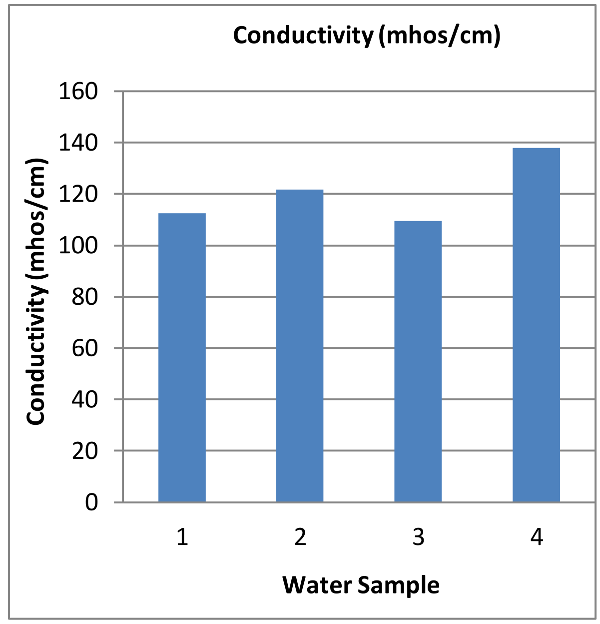


Fig. 4.15.h

4.16 Results of Wakna (Village 4)

Season 1 (August - September)

The Table 4.13 underneath demonstrates the assessed parameters of the water sample collected from Village Wakna between the months of August and September and the results are compared with Indian and Foreign standards.

Table 4.13 - Results of Season 1

Parameters	Source	Storage	Tap	WHO	EU	BIS
Alkalinity (mg/l)	50	31	27	20 - 200	20 - 180	20 - 200
Acidity (mg/l)	34	9.6	7.8	< 50	< 60	< 50
Chloride Content (mg/l)	20.19	6.23	7.16	200	200	250
pH	6.76	6.80	6.81	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
DO (mg/l)	5.52	7.56	8.35	> 4	> 4	> 4
Hardness (mg/l)	173	110	82	500	500	300
TDS (ppm)	60	64	61	< 600	< 600	< 500
Conductivity (mhos/cm)	145.6	151.1	149.6	--	--	--
Turbidity (NTU)	0	0	0	5	4	5

Fig. 4.16: Collecting Sample from Source Site of Wakna

4.17 Results of Wakna (Village 4)

Season 2 (October - November)

The Table 4.14 underneath represents the assessed parameters of the water sample collected from Village Wakna between the months of October and November.

Table 4.14 - Results of Season 2

Parameters	Source	Storage	Tap	WHO	EU	BIS
Alkalinity (mg/l)	52	30	25.5	20 - 200	20 - 180	20 - 200
Acidity (mg/l)	35.2	9.4	8.1	< 50	< 60	< 50
Chloride Content (mg/l)	19.87	7.08	7.82	200	200	250
pH	6.77	6.81	6.82	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
DO (mg/l)	5.61	7.59	8.41	> 4	> 4	> 4
Hardness (mg/l)	175	129	89	500	500	300
TDS (ppm)	69	83	67	< 600	< 600	< 500
Conductivity (mhos/cm)	143.8	149.7	151.2	--	--	--
Turbidity (NTU)	0	0	0	5	4	5

Fig. 4.17: Storage Tank of Wakna

4.18 Results of Wakna (Village 4)

Season 3 (January- February)

The Table 4.15 underneath displays the assessed parameters of the water sample collected from Village Wakna between the months of January and February.

Table 4.15 - Results of Season 3

Parameters	Source	Storage	Tap	WHO	EU	BIS
Alkalinity (mg/l)	55	33.8	31.7	20 - 200	20 - 180	20 - 200
Acidity (mg/l)	27.8	7.6	6.9	< 50	< 60	< 50
Chloride Content (mg/l)	18.16	5.59	5.93	200	200	250
pH	6.81	6.83	6.84	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
DO (mg/l)	5.77	7.70	8.63	> 4	> 4	> 4
Hardness (mg/l)	194	155	119	500	500	300
TDS (ppm)	54	60	58	< 600	< 600	< 500
Conductivity (mhos/cm)	138.3	144.1	143.5	--	--	--
Turbidity (NTU)	0	0	0	5	4	5

Fig. 4.18: Collecting Tap Water from Wakna

4.19 Results of Wakna (Village 4)

Season 4 (March - April)

The Table 4.16 underneath displays the assessed parameters of the water sample collected from Village Wakna between the months of March and April.

Table 4.16 - Results of Season 4

Parameters	Source	Storage	Tap	WHO	EU	BIS
Alkalinity (mg/l)	44	27	20	20 - 200	20 - 180	20 - 200
Acidity (mg/l)	24	19	10	< 50	< 60	< 50
Chloride Content (mg/l)	17.04	7.81	8.32	200	200	250
pH	6.71	6.80	6.79	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
DO (mg/l)	6.27	7.14	8.25	> 4	> 4	> 4
Hardness (mg/l)	220	152	112	500	500	300
TDS (ppm)	72	99	76	< 600	< 600	< 500
Conductivity (mhos/cm)	144	163	154	--	--	--
Turbidity (NTU)	0	0	0	5	4	5

We even performed tests against pathogenic bacteria on Tap water, generally used as drinkable water, to check the presence of bacteria culture for different seasons.

We performed following tests thrice for better and exact outcomes. On equating the above parameters, we compared the TAP water of Village 4 (Wakna) across different seasons to check the variations where 1,2,3 and 4 represents Season 1, Season 2, Season 3 and Season 4 respectively.

4.20 Figures of Tap water

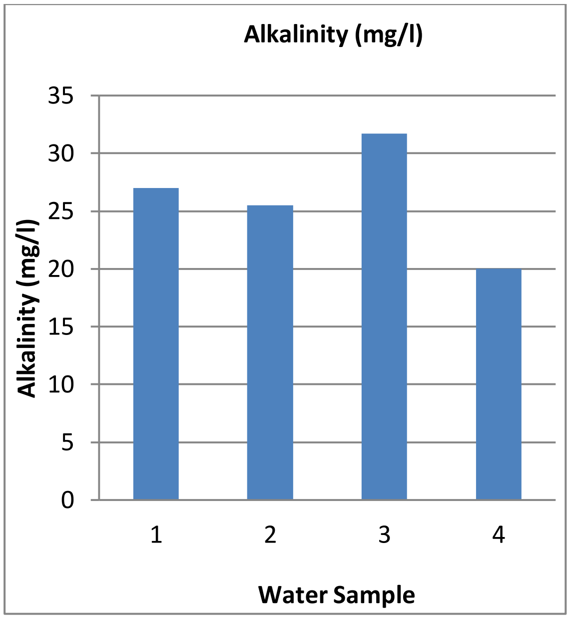


Fig. 4.20.a

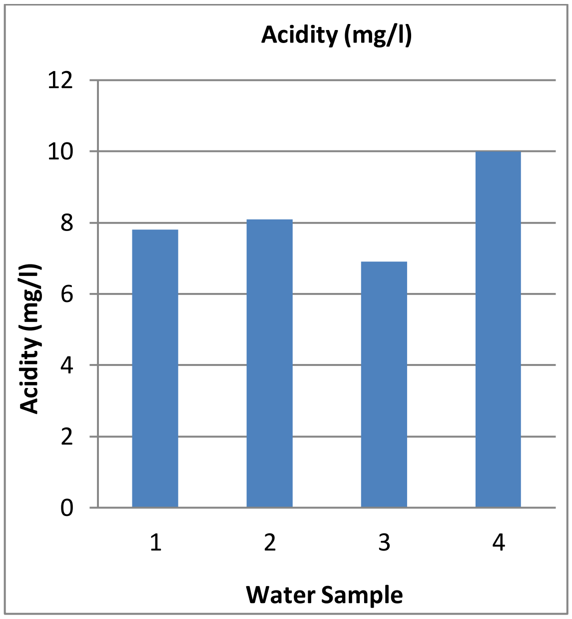


Fig. 4.20.b

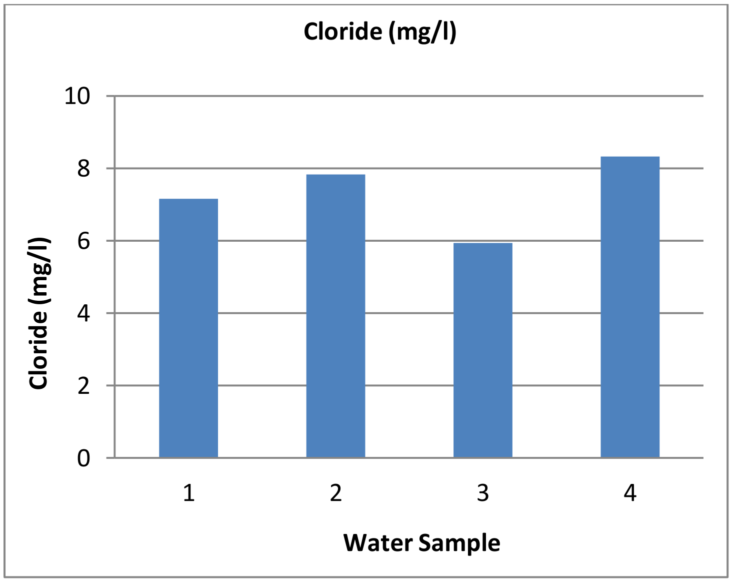
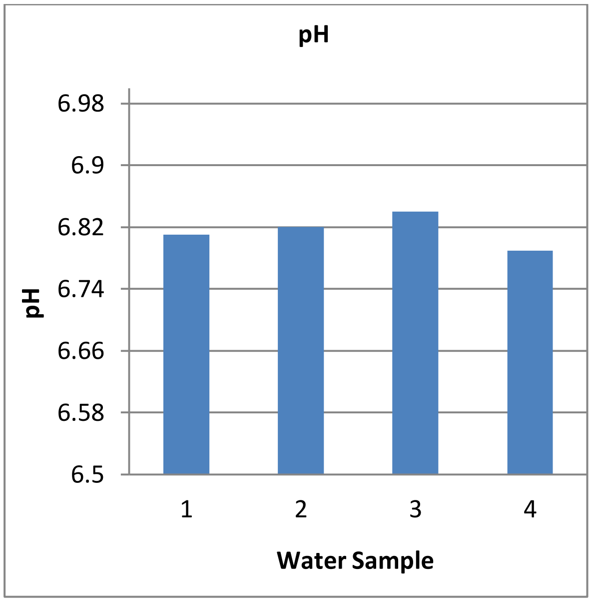


Fig. 4.20.c



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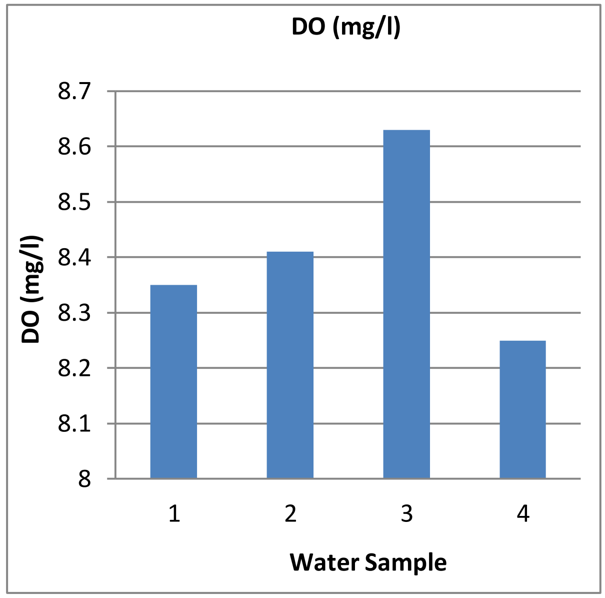

Fig. 4.20.e

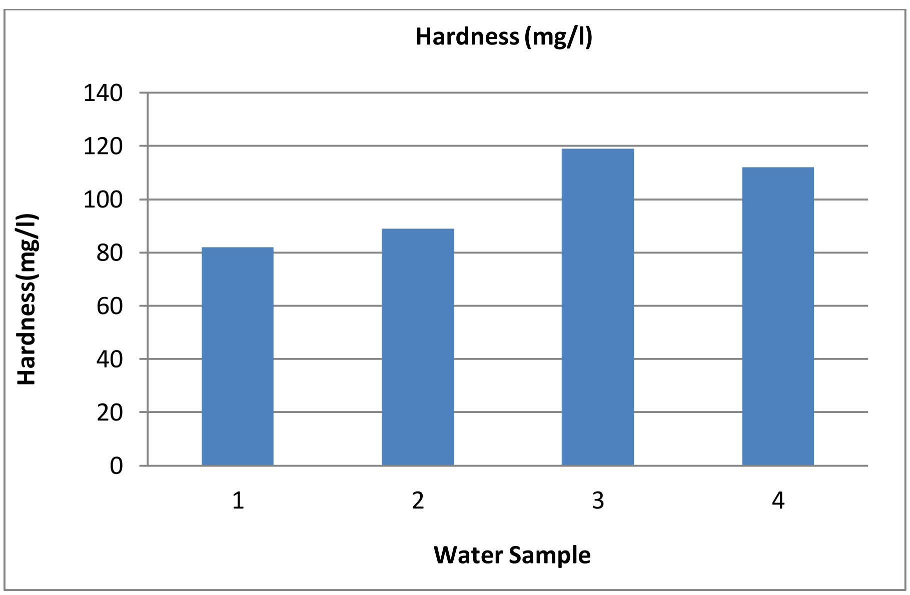

Fig. 4.20.f

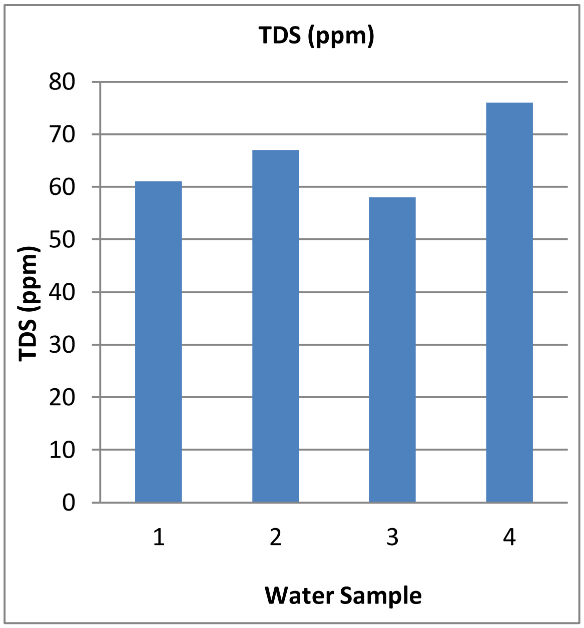

Fig. 4.20.g

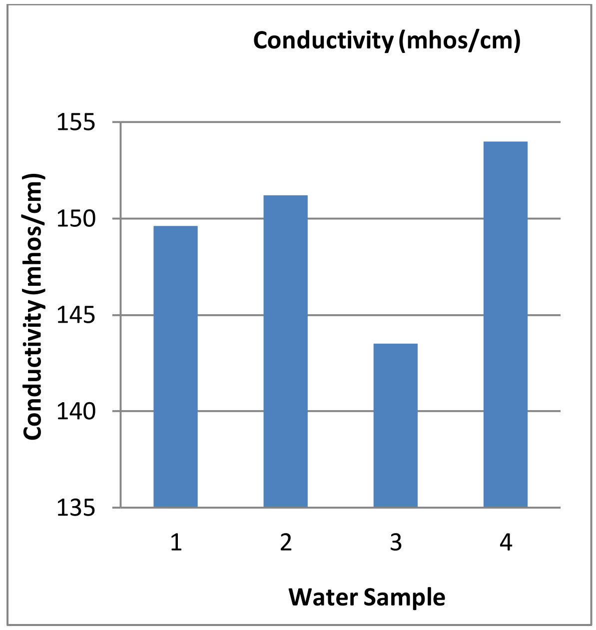

Fig. 4.20.h

4.21 Results of Richana (Village 5)

Season 1 (August - September)

The Table 4.17 underneath demonstrates the assessed parameters of the water sample collected from Village Richana between the months of August and September and the results are compared with Indian and Foreign standards.

Table 4.17 - Results of Season 1

Parameters	Source	Storage	Tap	WHO	EU	BIS
Alkalinity (mg/l)	51	32	29	20 - 200	20 - 180	20 - 200
Acidity (mg/l)	31	9.5	8.6	< 50	< 60	< 50
Chloride Content (mg/l)	20.58	7.66	8.18	200	200	250
pH	6.58	6.65	6.65	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
DO (mg/l)	5.88	7.56	8.27	> 4	> 4	> 4
Hardness (mg/l)	179	113	77	500	500	300
TDS (ppm)	89	97	106	< 600	< 600	< 500
Conductivity (mhos/cm)	244	248	260	--	--	--
Turbidity (NTU)	0	0	0	5	4	5

Fig. 4.21: Collecting Sample from Source Site of Richana

4.22 Results of Richana (Village 5)

Season 2 (October - November)

The Table 4.18 underneath represents the assessed parameters of the water sample collected from Village Richana between the months of October and November.

Table 4.18 - Results of Season 2

Parameters	Source	Storage	Tap	WHO	EU	BIS
Alkalinity (mg/l)	53	33	30	20 - 200	20 - 180	20 - 200
Acidity (mg/l)	32	10.8	10.4	< 50	< 60	< 50
Chloride Content (mg/l)	20.15	8.26	8.47	200	200	250
pH	6.57	6.67	6.67	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
DO (mg/l)	5.99	7.23	7.33	> 4	> 4	> 4
Hardness (mg/l)	181	112	78	500	500	300
TDS (ppm)	116	113	134	< 600	< 600	< 500
Conductivity (mhos/cm)	258	266	292	--	--	--
Turbidity (NTU)	0	0	0	5	4	5

4.23 Results of Richana (Village 5)

Season 3 (January- February)

The Table 4.19 underneath displays the assessed parameters of the water sample collected from Village Richana between the months of January and February.

Table 4.19 - Results of Season 3

Parameters	Source	Storage	Tap	WHO	EU	BIS
Alkalinity (mg/l)	64	44	42	20 - 200	20 - 180	20 - 200
Acidity (mg/l)	23	8.4	7.9	< 50	< 60	< 50
Chloride Content (mg/l)	19.23	7.12	6.78	200	200	250
pH	6.61	6.72	6.72	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
DO (mg/l)	6.18	7.87	8.58	> 4	> 4	> 4
Hardness (mg/l)	188	118	84	500	500	300
TDS (ppm)	82	89	98	< 600	< 600	< 500
Conductivity (mhos/cm)	223	227	233	--	--	--
Turbidity (NTU)	0	0	0	5	4	5

4.24 Results of Richana (Village 5)

Season 4 (March - April)

The Table 4.20 underneath displays the assessed parameters of the water sample collected from Village Richana between the months of March and April.

Table 4.20 - Results of Season 4

Parameters	Source	Storage	Tap	WHO	EU	BIS
Alkalinity (mg/l)	65	40	41	20 - 200	20 - 180	20 - 200
Acidity (mg/l)	22	19	17	< 50	< 60	< 50
Chloride Content (mg/l)	21.3	7.49	9.23	200	200	250
pH	6.67	6.64	6.64	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
DO (mg/l)	6.97	7.18	6.77	> 4	> 4	> 4
Hardness (mg/l)	200	132	81	500	500	300
TDS (ppm)	131	134	170	< 600	< 600	< 500
Conductivity (mhos/cm)	274	271	341	--	--	--
Turbidity (NTU)	0	0	0	5	4	5

Also We even performed tests against bacteria culture on Tap water to check the presence of pathogenic bacteria for different seasons.

We performed following tests thrice for better and exact outcomes. On equating the above parameters, we compared the TAP water of Village 5 (Richana) across different seasons to check the variations where 1,2,3 and 4 represents Season 1, Season 2, Season 3 and Season 4 respectively.

4.25 Figures of Tap water

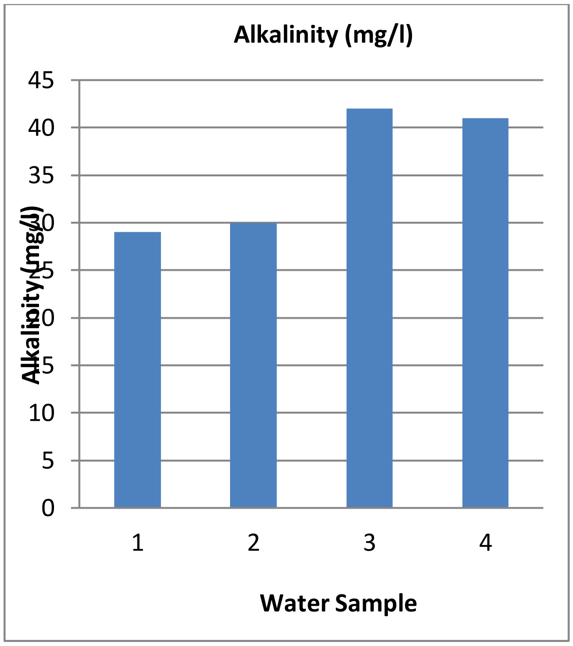

Fig. 4.25.a

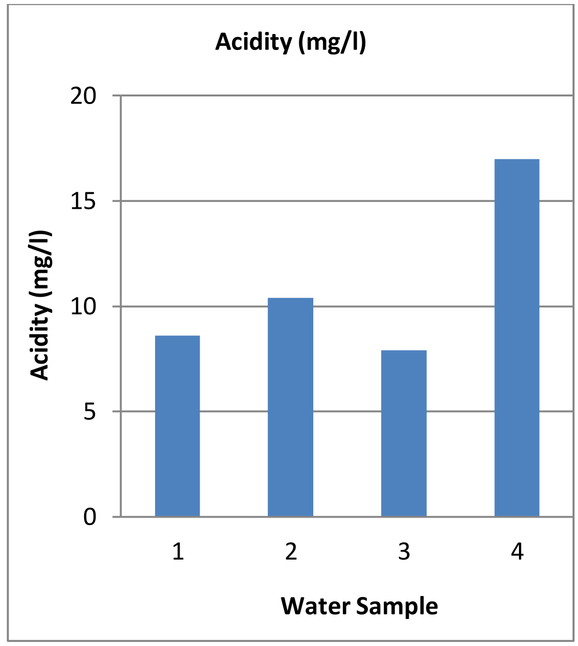

Fig. 4.25.b

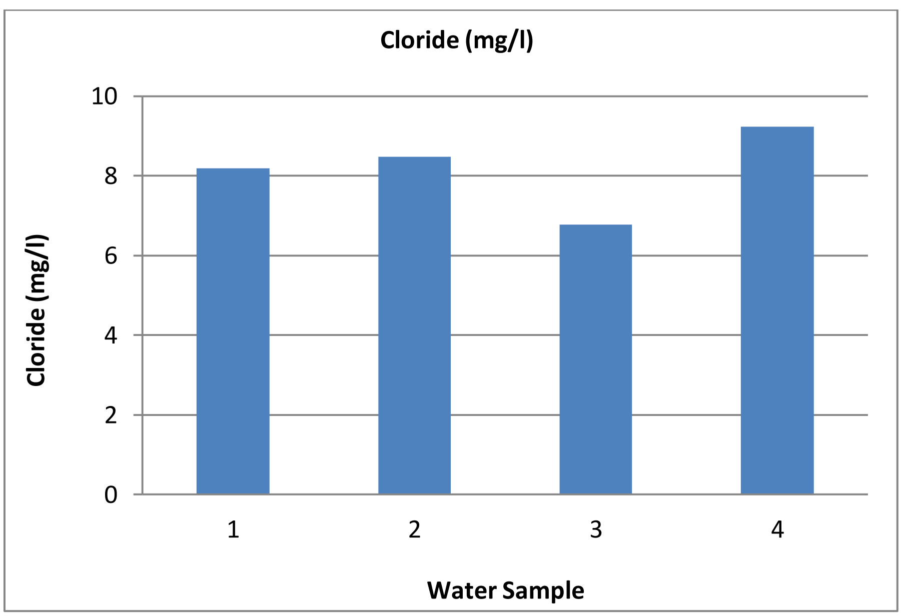

Fig. 4.25.c

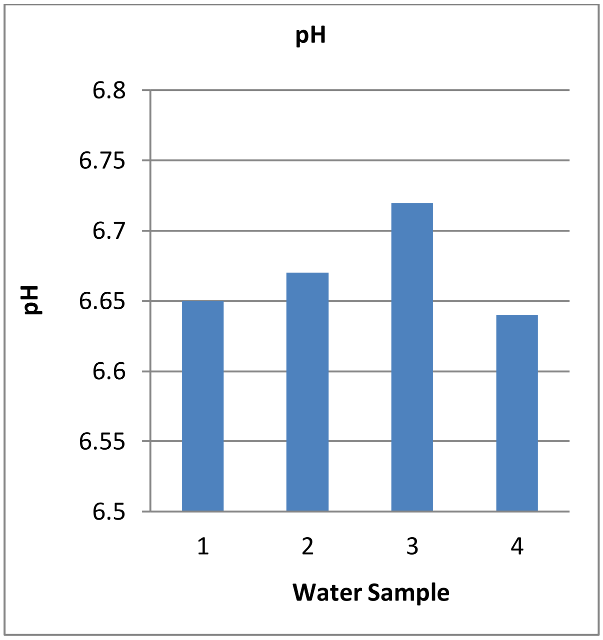

Fig. 4.25.d

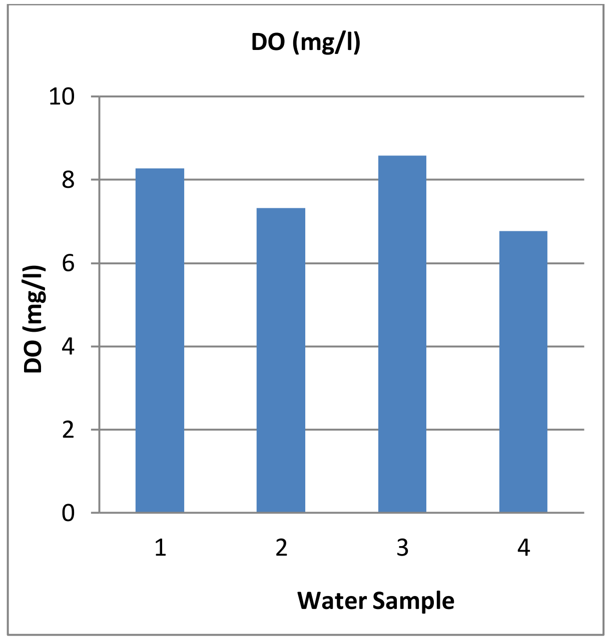

Fig. 4.25.e

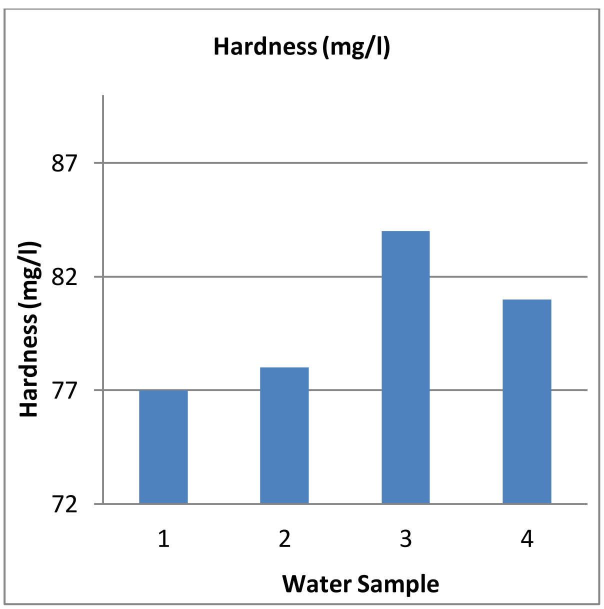

Fig. 4.25.f

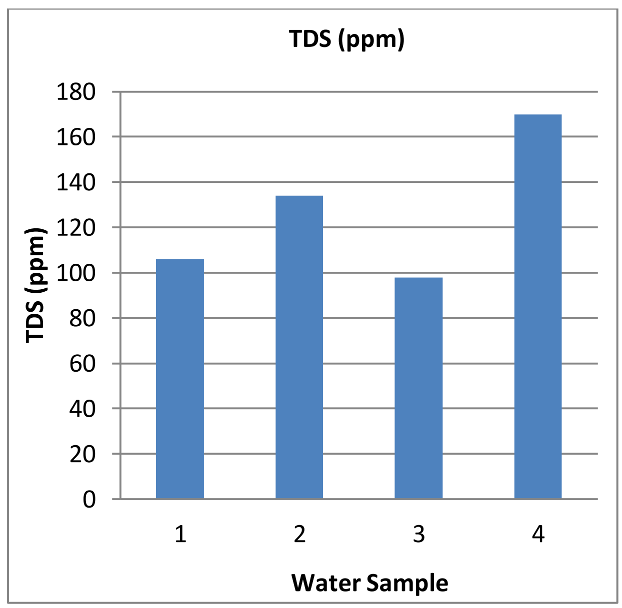

Fig. 4.25.g

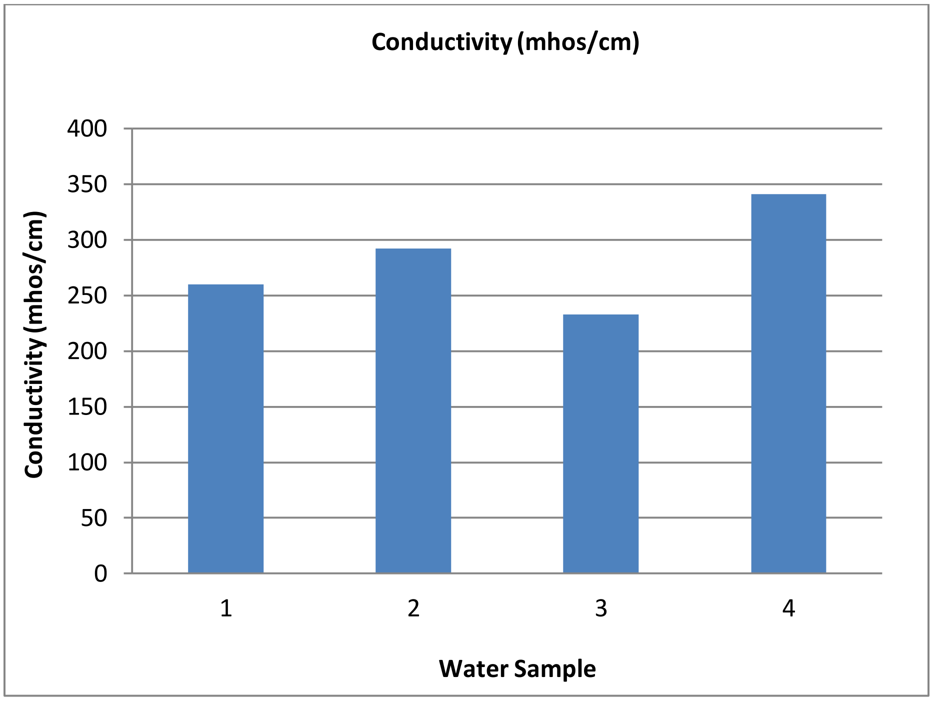
Conductivity (mhos/cm)
Conductivity (mhos/cm)
400
350
300
250
200
150
100
50
0
1
2
3
4
Water Sample

Fig. 4.25.h

CHAPTER - 5

CONCLUSION

After analyzing the water samples of all the five villages, We herby conclude that resultant parameters are not deviating the desirable limits stated by Bureau Of Indian Standards, WHO and European Standards.

There are not much significant variations in the evaluated results.

- Less content of chlorides are present in the samples collected from the villages, when compared to the plain region.
- pH is found under permissible limit, i.e. close to neutral.
- Conductivity has the highest flow peak in the spring season, i.e. March & April due to dissociation of ions.
- Turbidity is almost negligible in all the samples.
- Increase in hardness in the month of January & February resulting in the increment of salts of calcium and magnesium.
- The change in dissolved oxygen (DO) is mainly due to temperature differences. As the temperature decreases, solubility of oxygen increases.
- Alteration of acidity is noticed due to temperature variation.
- Due to temperature descend, bit of a rise in witnessed in the value of alkalinity.

The water which the residents of all the five villages are consuming is uncontaminated & unadulterated and is squeaky clean for consumption. Slight changes are observed in comparison with different seasons but none of them bears any toxic outcomes.

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