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STUDY ON GROUND WATER QUALITY OF KARWI CITY CHITRAKOOT (U.P.)

A Dissertation report submitted for partial fulfillment for degree of M. Sc. (Environmental Science)

By

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UNDER THE SUPERVISION OF

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CHITRAKOOT, DISTT. - SATNA (M.P.) 485 334

Ref-………

Date……….

CERTIFICATE

This is to Certify that **Mr. Dharam Raj Singh** *has done his dissertation entitled* **"Study on ground water quality of Karwi city Chitrakoot (U.P.)"** at M.G.C.G.V.Chitrakoot under the supervision of me **Dr. S. K. Tripathi** for the partial fulfilment of the award of degree of Master of Science in **ENVIROMENTAL SCIENCE** of Mahatma Gandhi Chitrakoot Gramodaya Vishwavidhyalaya, Chitrakoot, Satna (M.P.). It is further certified that it embodies work of the candidate himself and is up to standard both in respects of its contents and literary presentation for being referred to the examiners.

Date: 17/06/2017

Place: Chitrakoot

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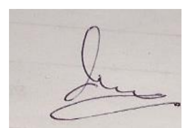
DECLARATION

I am **Mr. Dharam Raj Singh** a bonafide student of M.Sc. in Environmental Science in **Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot, Satna (M.P)** would like to declare that the dissertation entitled **"Study on ground water quality of Karwi city Chitrakoot"** submitted by me in partial fulfillment of the requirements for the award of the Degree of MASTER OF SCIENCE IN ENVIRONMENTAL SCIENCE is my original work.

I further declare that to the best of my knowledge, this report does not contain any part of any work which has been submitted for the award of any degree either in this university or any other university / Deemed university without proper citation



Date: 17/06/2017

Place: Chitrakoot

(Dharam Raj Singh)

M.Sc. (Environmental Science) 4th sem

M.G.C.G.V.,Chitrakoot M.P.

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Date: 17/06/2017

Place: Chitrakoot

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M.Sc. (Environmental Science) 4th sem

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INTRODUCTION

GENERAL INTRODUCTION -

Water as a universal solvent has the ability to dissolve many substance be it organic and inorganic compound. The quality of groundwater depends on various chemical constituents and their concentration. Which are mostly derived from the geological data of the particular regions, Ground water are the major sources of drinking water in both urban and rural areas of India.

Water is an essential constituent for all types of life on earth. About the 60% of the human body is made up of water, and any reduction in this percentage can be disastrous. A man can live without food for about two months, but he can hardly survive for three or four days without water. Water is also essential for food production and many other uses on home and outside. The earth is the only planet where water can exist in all three states (i.e. solid, liquid, and vapour) in substantial quantities. Without water we cannot imagine any kind of life on earth, thus protection of water of water sources is essential for our survival. Most of earth's surface is in the ocean and seas. The high salts content makes its unsuitable for drinking purpose. Only 1% available is fresh water (river, lakes, streams, ground water) for domestic, agriculture, industrial uses. Water is the most precious natural resources expected to be free from pollution. Safe drinking water is essential for life. Access to safe drinking water has improved over the last decades in almost in every part of the world but approximately one billion people still lack access to safe water and over 2.5 billion lack accesses to adequate sanitation. Approximately 70% of the fresh water used by human goes to agriculture

Water is the one of the most significant and precious gift of nature. ¾ parts of our earth are covered by water, but only approximately 1.0% of the total water is fresh and useable for drinking, bathing, irrigation, and other domestic purpose. Water is an essential natural resource and absolute necessity for sustainable life. Water is not only the most valuable constituent of all animals, plants, and other organisms but it is also pivotal for the survivability of the mankind in the biosphere. It is the lifeblood of the environment. Hunan being solely depends upon the availability of fresh water for living and livelihood and in its natural state it is a 'savior of life. One can hardly live without water even for a few days. Today, by ignoring these facts, man is indiscriminately polluting water and unknowingly providing nature a complex situation.

Types of water

1- Surface water-

The quantity of water remaining on the earth's surface after losses due to evaporation, percolation, and transportation, etc. is known as runoff, it forms the sources for all surface water. The most important sources of surface water are lakes, ponds, rivers, and storage reservoirs.

2- Ground water-

The sources of water which supply water from below the earth's surface are known as sub surface or ground water or underground water sources. Rain water or melted snow infiltrate into the ground and its movement below the ground is called as percolation. Ground water is generally clear and colourless and free form bacteria and other organisms as they are filtered out during percolation through sub-soil. Underground water sources are springs, wells, and infiltration galleries.

In India, about 70% of total populations rely heavily on groundwater for drinking purposes

Ground water is generally considered to be much cleaner than surface water. However, several factors such as discharge of industrial, agricultural and domestic wastes, land use practices, geological formation, rainfall patterns and infiltration rate affects the ground water quality and once contamination of ground water in aquifers occurs, its persists for hundreds of years because of very slow movement in them. Ground water often can be used without treatment. However, limited groundwater resources, decreasing level of ground water due to over-abstraction and increasing cost of pumping, are not in tune with the environmental obligations for future generation.

Groundwater is water that accumulates underground. It can exist in spaces between loose particles of dirt and rock, or in cracks and crevices in rocks. Different types of rocks and dirt can contain different amounts of water. The saturation zone is the portion of the soil and rock that is saturated with water, while the unsaturated zone is the portion of the soil and rock that is not saturated. The top of the saturated zone is called the water table. When it rains, the water infiltrates the soil and percolates downwards until it reaches the water table. Some types of soils allow more water to infiltrate than others. Permeable surfaces, such as sand and gravel, allow up to 50 percent of precipitation to enter the soil. Rainwater can take years or even decades to reach the water table. Due to the immense volume of groundwater, once rainwater reaches the water table, it often remains there for an extremely long period of time. Some water that is currently stored in the ground may be rain that fell hundreds or thousands of years ago. Groundwater and surface water use reveal the worldwide importance of groundwater.

Recently the WHO report that 65% of rural and 35% urban Indians were without access to pure drinking water. Ground water is the one of the most useful water sources. Water is second to oxygen as being essential for life. Water is an essential compound of the environment and it sustains life on the earth. Human being depends on water for their survival. Water is also a raw material for photosynthesis and there for in important for the crop production.

Ground water quality depends on the quality of recharged water atmospheric precipitation inland surface water and sub-surface geochemical process. Temporal change in the origin and constitution of the recharged water, hydrologic and human factors may cause periodic change in ground water quality. Water pollution not only affects water quality but also threats human health, economic development and social prosperity. Ground water is a source of drinking and even today more than half of the world population depends on ground water for survival. The assessment of water quality is very important for knowing the suitability for various purposes. Assessment of ground water for drinking and irrigation has become a necessary and important task for present and future ground water quality monitoring and evolution for domestic and agriculture activities around the world. Water is prime need for human survival and industrial development for many rural and small communities ground water is the only sources of drinking water.

Water pollution-

Water pollution may be define as, ‘’alteration in physical, chemical and biological characteristics of water which may cause harmful effects on human, animals, plants, or aquatic biota.”

Ground water Pollution-

- **Domestric**
- **Industrial**
- **Agricultural etc.**

Ground water pollution is occurs when pollutants are released to the ground and make their way down into groundwater. It can also occur naturally due to the presence of a minor and unwanted constituents, contaminant, or impurity in the groundwater, in which case it is more likely referred to as contamination rather than pollution.

Importance of Ground water:

We all know that water is good for us, but often the reasons are a little fuzzy. However, there are some powerful reasons to drink lots of water every day.

- Water is one of the best tools for weight loss.
- Water has no fat, no calories, no carbohydrate and no sugar.
- Drinking a good amount of water control lower our risk of a heart attack
- Drinking water can clear up our skin and people often report a healthy glow after drinking water.
- Water is used by the body to help plush out toxins and waste product from the body.

Surface water occurs in Rivers, ponds, lakes and reservoir where as ground water occurs bellow ground surface under favorable condition. The formation which can hold and yield water is defined as aquifer.

Safe drinking water is essential to sustain life. Therefore, water intended for human consumption should be both safe and whole some i.e. free from pathogenic agents, free from harmful chemical substances, pleasant to the taste (free from color and odor) and usable for domestic purposes (Park, 2007). Water has the ability to dissolve most substances, and all living organisms depend on it in their living whether these organisms are plants or animals (Abdel Magid and EL Hassan, 1986). Most of the world's available freshwater exists as ground water. This ready supply of relatively clean and accessible water has encouraged use of this resource, and in many regions ground water provides drinking water of excellent quality (Chorus and Bartram, 2005).

Groundwater is the cheapest and most practical means of providing water to small communities and it is superior to surface water, because the ground itself provides an effective filtering medium (Park, 2007). Therefore, ground water is generally preferred as source for municipal and industrial water supplies (McGhee, 1991). Wells are drilled to tap underground water supplies, however, not all wells produce enough or good quality water (Reid, 2004). Surface pollutants, dissolved in water, percolate down through the soil. Shallow groundwater that is closest to the surface is most easily contaminated. How much pollutants reach groundwater depends on soil type, pollutant characteristics, and the distance to groundwater? Contamination sources include many types of runoff, Agricultural and urban, chemical and oil spills, and landfill leachate and anything that may percolate through the soil into groundwater. Pathogens, especially viruses can percolate into groundwater. The quality of drinking water in the Sudan has recently received some attention from environmentalists and water scientists. The rural population of the country, constituting about 80% of the total population, uses untreated water coming from traditional surface wells, deep bores, rivers, intermittent rainy season streams (khors), turbid water from natural rain ponds, and artificial rainwater catchments (Hafirs) during most of the year (Abdel Magid et al., 1984).

For groundwater monitoring, of hand pumps are one of the important tool for evaluating ground water quality. Considering these aspects of water pollution the present study of ground water monitoring was undertaken to investigate physic-chemical characteristics of some ground water sample from different location in karwi city chitrakoot

STUDY AREA –

Karwi is a town of district chitrakoot in the state utter Pradesh India. Karwi chitrakoot is geographically located at coordinated $25^{0}20'$ N latitude and $80^{0}55'$ E longitudes. Total area of Chitrakoot Dham Karwi District is 3216 km^2 and population 57402 censuses (2011) of karwi city chitrakoot. Karwi is district head quarters and a municipal board in chitrakoot district in state of utter Pradesh India.

Fig-1 **Map of karwi city, District. Chitrakoot U.P. India**

Objective –

The main objective of this study was:

1. To evaluate the physico-chemical characteristics of water samples collected from different ground water sources in Karwi City.

2. To compare the results with national and international standards

REVIEW OF LITERATURE

The ground water occurs under unconfined condition in phreatic zones and under confined condition in deeper zones. The sediment logical constitution of the subsurface granular zones shows remarkable variation in the depth and the nature of occurrence. Groundwater pollution is one of the most serious crises that we are facing today. Due to the increased urbanization and industrialization surface and groundwater pollution has become a crucial problem .The major problem with the ground water is that once contaminated, it is difficult to restore its quality .A good quality, unpolluted and safe drinking water is the right of citizen, which will ensure better quality of life for the citizens.

Dohare et.al, 2014, analysis of ground water quality parameters: A review showed that most of the water quality parameters slightly higher in the wet season than in the dry season. Correlations the physic-chemical characteristics water pollutants by appropriate statistical method.

Ackah et.al, 2011, studied Assessment of groundwater quality for drinking and irrigation: the case study of taiman –Oyarifa Community, Ga east municipality, Ghana and observed that groundwater in the study area were mostly acidic. Most of the water samples recorded TDs value less than WHO maximum allowable levels. Sodium ion concentration was generally high compared to other cations. The amounts of iron in the water samples were higher than recommended maximum allowable levels, iron is a major component of the entire well and probability originated from the present rock. The measured concentrations of zink in all the water samples were below WHO maximum permissible levels.

Ramakrishnaiah et.al, 2009, reported that Assessment of water quality index for the groundwater in tumkur Taluk, karnatka state,india the water quality index for 269 samples ranges from 89.21 to 660.56. Almost ninety nine percent of the samples exceeded 100, the upper limit for drinking water. The high value of WQI at these stations has been found to be mainly from the higher values of iron, nitrate, TDS, Hardness, Fluoride, Bicarbonate, Chloride, and Manganese in groundwater. About the 63.5% of water samples are poor in quality. In this part, the groundwater quality may improve due to inflow of fresh water of good quality during rainy season. Magnesium and chloride are significantly interrelated and indicates that the hardness of the water is permanent in nature. The analysis reveals that the groundwater of the area needs some degree of treatment before consumption, and it also need to be protected from the perils of contamination.

Dwivedi and Tripathi, 2016, Studied quality assessment of ground water and surface water sample collected from two different zone of central India and showed that the temperature (100C to 400C), pH (6.0to 9.5), turbidity (0.01to 12.8 NTU), total hardness (122 to 960 mg/l), TDS (23.0 to 542.0 mg/l), DO (0.6 to 8.0 mg/l) BOD (1.0 to23.2 mg/l), COD (1.3 to118.0 mg/l), nitrate (0.01 to 17.3), sulphate (0.003 to 200 mg/l) and Phosphate (0.001 to 3.0 mg/l).The temperature of all the water samples of study area were found between100C to 400C , the highest temperature was recorded in summer season in the industrial area of west zone central India.TDS, nitrate and sulphate of all the samples of study area were found below the recommended level. Slightly exceeded value of pH, turbidity, hardness, BOD, COD and phosphate were reported at some locations of study area.

Asheberom et.al, 2016, Obtained from the study have been compared with those labeled on the bottles, Ethiopian and WHO standards, mainly. The pH values of all the samples are close to each other and well within the permissible limits. The conductivity of the samples has been found in the range 14.5µS/cm to 158.2µS/cm. The calculated magnitude of TDS for each sample, though, higher than the company's claimed on the bottle-wrappers but still within the controlled limits of WHO. The concentration of Ca, Mg, Na, K, Cl, SO4 ions were found very low than prescribed by Ethiopian and WHO standards, but to the higher side of reported values on the bottles.

Abdel et.al 2014, Studied assessment of drinking water quality in AL Hawata wadelageili Gadarif state Sudan, and revealed that 97.5% of the samples comply with the permissible drinking water limits set by local, regional and international standards and guidelines, 10% of the samples were found above the upper level (2.3 NTU) set by the SSMO for turbidity. The concentrations of ions (with the exception of Ca^{+2}, Mg^{+2} and Fe^{+2}) were below the upper level set by the various standards and guidelines. Bacteriological analysis indicated that 35% of the drinking water samples examined were contaminated with coliform bacteria, 7.5% of the samples were contaminated with E-coli, indicating the presence of fecal contamination. Some of the obtained data were in good agreement with the respective standards while others are either above, below or do not meet local, regional and international standards and guidelines limit for drinking water quality.

Chaurasia and Gupta 2012 studied that ground water quality for drinking and agriculture use in the Banda district. The ground water samples were analyzed to measure physic-chemical and biological parameters for agriculture and domestic use. The entire ground water samples were from suitable for irrigation purposes based on irrigation quality parameters.

Maruthi et al.2012 reported that water represents the basic elements supporting life and the natural environment, a primary component for industry, a consumer item for humans and animals, and a vector for domestic and industrial pollution. In order to find out the relationship amongst different physico-chemical parameters of water samples, correlation coefficient are worked out and the large number of significant correlations are obtained. The result obtained from 25 water samples were found that though the quality of water in most places in Visakhapatnam is acceptable there are also few places where water needs to properly treat before consumption.

Narsimha.et al. 2012 assessed the suitability of water quality for drinking purpose in the Hanamkonda area by measuring physic-chemical parameters, including major cation and anion compositions, On the basis of nitrate concentration it is illustrated that 61% of samples are suitable for drinking purpose. The chloride content in 27.7% of groundwater samples is above the WHO standard. Chaudhari et al. 2013 studied fifteen water samples from different villages for assessment of ground water.

Nath et al.2013 studied ten different wells around Neyyattinkara Taluk, Kerala. Parameters like pH, EC, TDS, Sulphate and Free carbon-dioxide were measured for a period of four months from March 2012 to June 2012 using standard methods. The parameters like pH, EC, Sulphate and Free carbon-di-oxide were within the permissible limits recommended by WHO.

Kalra et al. 2012 determined water quality in five blocks (Udwantanagar, Tarari, Charpokhar, Piro and Sahar) that lays in southern parts of district Bhojpur district of Bihar, where from each block ten ground water samples are under studied for Physico- chemical status of ground water. In Physico-chemical analysis, also all parameters were compared with ICMR standards of water quality; also in present research paper classification of water samples of five blocks.

Sarala and Ravi 2012 reported that water and environment has become an emotive issue with the people and policy makers. The chief causes for the pollution of water and environment are anthropogenic activities of human beings. The bore wells data is collected from the study area for two seasons i.e., post monsoon and pre monsoon in December 2007 and June 2008. The groundwater contour analysis is done by using Arc GIS software. The study reveals that the concentration of major constituents are well within the permissible limits of IS (10500-1994), except in few cases where total hardness and fluoride concentrations are high. From the analysis it has been observed that the groundwater is polluted in the entire study area. Due to this reason during the monsoon seasons the rainwater drains into the solid waste polluting the land leachate existing in the surrounding areas and in the low lying areas.

Mulla et al. 2011 report the ground water quality of Babalgaon Dist. Latur, the water samples were collected from four sampling sites and their physico-chemical parameters such as pH, conductivity, chloride, sulphate, temperature, turbidity, DO, TDS, COD etc. the water quality was found good in some cases but some of the parameters were above the permissible limit.

Dhakad et al. 2007 deals with the determination of Water Quality Index of ground water (GWQI) of Jhabua town (M.P.) in order to ascertain the quality of water for public consumption. The perusal of the results revealed that the water is safe for drinking and domestic purposes.

Yadav et al. 2013 studied physico-chemical characteristics of Ujjain city water during Jan 2011-Dec 2011. Samples were collected from 15 locations of Ujjain city from various ground water sources for seasonal variations in water quality parameters in rainy, winter and summer seasons. The results indicates excellent status of water during rainy and winter seasons, however very good status was reported during the summer season.

Manjare et al. 2010 studied of the physico-chemical parameters of Tamadalge water tank in Kolhapur District, Maharashtra. Monthly changes in physical and chemical parameters were analyzed for a periods of one year. The results indicate that the tank is non-polluted and can be used for domestic, irrigation and pisciculture.

Longeand Balogun 2010 The current research examined the level of groundwater contamination near a municipal landfill site in Alimosho Local Government Area of Lagos State, Nigeria. Water quality parameters (physico-chemical and heavy metals) of leachate and groundwater samples were analyzed. The results show insignificant impact of the landfill operations on the groundwater resource.

Gupta.et al. 1995 reported that groundwater is precious water resource. There is an acute shortage of surface water in many parts of India. Ground water is a dependable source of water supply for domestic and industrial purposes and is also being subjected to severe pollution.

Ahmad and Mishra 2014 reported that groundwater depends on a large number of individual hydrological, physical, chemical and biological factors. Generally higher proportions of dissolved constituents are found in groundwater than in surface water because of greater interaction of ground water with various materials in geologic strata. The contamination of groundwater by heavy metals has assumed great significance during recent years due to their toxicity and accumulative behavior. These elements, contrary to most pollutants, are not biodegradable and undergo a global eco-biological cycle in which natural waters are the main pathways.

Njoroge, et al. 2014 reported that the borehole and well water in Makuyu Division in Maragua District in central Kenya is not polluted and can be consumed readily. The level of various parameters was low compared to recommended limits. The chemical properties monitoring showed no significant heavy metal pollution in groundwater. The values obtained showed no significant heavy metals pollution in groundwater. The trace metal concentrations in filtered water were below the maximum permissible limits for drinking water as given by the World Health Organization (1993).

Reddy and Prasad 2005 studied the chemistry of groundwater in and around the Tadpatri, Anantapur Distric, The data obtained are used to know hydrochemistry of waters and to determine the quality. The analytical results of the water samples show that Mg, Na, Cl, HCO_3 and SO4 are slightly excess in pre-monsoon period than those found in post-mansoon period.

Naik and Prasad 2004 reported that water samples collected from the bore wells shows that few of the parameters are higher than the maximum permissible limits when compared with the prescribed Indian Standard limits for drinking water.

Sivasankaran et al.2005 studied 42 bore wells in Pondicherry region ,for three seasons during the year 1994-95..The temporal variation in the concentrations of the major ions exhibits an increasing trend towards pre-monsoon and post-monsoon seasons from summer seasons. The study reveals that (i) the water in the alluvial aquifer system has been deteriorated due to sea water intrusion, (ii) the upper layer of the tertiary aquifer is affected to some extent by seawater intrusion and carbonate mineral dissolution and (iii) the characteristics of water in the cretaceous aquifer are mainly due to dissolution of carbonate minerals.

Lalitha et al.2004 The ground water samples were put to physico-chemical and biological analysis and the results were compared with WHO, BIS, and CPHEEO standard values.

MATERIALS AND METHOD

Ground water samples were collected for a period of three months from 20, March to 20, May 2017 from 7 hand pumps of Karwi city. The sample was collected from the hand pumps after drawing water for ten minutes by pumping out. After the collection, the bottles were tightly closed, marked and labeled. The samples were brought to the laboratory for the chemical analysis. The sampling was done at fortnight interval. The water sample was analyzed for physical and chemical parameters. The physical parameter includes temperature, pH, conductivity, TDS, and Turbidity. The chemical parameters include Alkalinity, hardness, calcium hardness, Ca, Mg, Cl^-, NO_3^-, F^-, All the parameters were analyzed as per standard methods APHA, NEERI, AWWA, WPCF 2005 etc.

Details of the sample stations are given in table.

Table-1 details of sampling stations

S.N	Sampling station	Station code	Sources	Location	Longitude/latitude
1.	J.I.C Karwi	**S1**	Hand pump	Sankar Bajar	25° 13.3 N 080° 55.1 E
2.	G.B.I.C Karwi	**S2**	Hand pump	Kasahai road	25° 13.2 N 080° 55.6 E
3.	Govt. Hospital	**S3**	Hand pump	Sonepur	25° 11.7 N 080° 54.7 E
4.	Tahsil Campus	**S4**	Hand pump	Tahsil Campus	25° 12.8 N 080° 55.4 E
5.	Railway Station	**S5**	Hand pump	Station Camp.	25° 13.04 N 080° 55.3 E
6.	S.D. memorial	**S6**	Hand pump	Gokulpuri	25° 13.4 N 080° 55.2 E
7.	Bus stand	**S7**	Hand pump	Bas stand cam.	25° 12.7 N 080° 54.3 E

Temperature pH, conductivity, and turbidity were measured directly by instrumental methods.

Colour:

Pure water exhibits a light blue colour which may be alerted by the presence of organic matter to greenish blue, green, yellow or brown.

Colour is removed to make water suitable for general and industrial application coloured industrial waste water may require colour remove before discharge in to water sources. Colour used here is true colour that is the colour of water from which turbidity has been removed.

Odour
Odour is checked by nose as sensitive organs.

Temperature: Measured by thermometer in degrees Celsius (º C).

pH: Measured by digital pH meter.

Turbidity: Measured by Nephelo-metric turbidity meter in NTU.

Conductivity: Measured by conductivity meter in (umhos/cm) or micro siemens per centimeter

Total solids: TDS was measured by gravimetric method following standard method

ALKALINITY:

Reagents-

1. Standard sulphuric acid (0.02N) - Prepare the 0.1 N H_2SO_4 by diluting 30 ml conc. H_2SO_4 to 1 litre distilled water. Standardized it with standard sodium carbonate Na_2CO_3 0.1N. Dilute appropriate volume of sulphuric acid, approximately 100 ml to 500 ml to obtained standard 0.02N H_2SO_4.
2. Phenolphthalein indicator solution (alcoholic, pH 8.3) - dissolve 5 gm phenolphthalein in 500 ml 95% ethyl alcohol. Add 500 ml distilled water.
3. Methylorange indicator- 0.05 gm methylorange diluted 10 100 ml with distilled water.

Method- Take 100 ml sample in volumetric flask add 2-3 drops of Phenolphthalein indicator. If pink clour develops titrate with 0.02N H_2SO_4 till a colour disappears. Note the volume of sulphuric acid used. Add 2-3 drops of Methylorange indicator to the same flask and continue titration till yellow colour changes to orange. Note the volume of sulphuric acid used.

Formula- Calculate total (T), Phenolphthalein (P) and Methylorange (M) alkalinity as follows and express in mg/l as $CaCO_3$.

Phenolphthalein alkalinity (mg/l as $CaCO_3$) = A x N x 1000/ volume of sample

Total alkalinity (mg/l as $CaCO_3$) = B x N x 1000/ volume of sample

Methylorange alkalinity (mg/l as $CaCO_3$) = (B-A) x 1000/ volume of sample

TOTAL HARDNESS:

Requirements- Volumetric flask, conical flask, burette, pipette, measuring cylinder, burette stand, pipette stand and wash bottle etc.

Reagents-

(a) Buffer solution- Dissolve 16.9 gm NH_4Cl in 143 ml conc. NH_4OH. Add 1.25 gm magnesium salt of ethylenediaminetetraacetate (EDTA) and dilute to 250 ml with distilled water. Store in a plastic bottle stoppered tightly for no longer than one month.

(b) Eriochrome Black T solution (as indicator)- dissolve 0.5 gm dye in 100 ml triethanolamine or 2 ethylene glycol monomethyl ether. The salt can also be used in dry powder form by grinding 0.5 gm dye with 100 gm NaCl.

(c) Standard EDTA titrant (0.01M)- weight 3.723 gm di-sodium salt of EDTA, dehydrate, dissolve in distilled water and dilute to 1000 ml. Store in polyethylene bottle.

(d) Standard calcium solution- weight 1 gm anhydrous $CaCO_3$ in a 500 ml flask. Add 1 + 1 HCl slowly through a funnel till all $CaCO_3$ is dissolved. Add 200 ml distilled water and boil for a few minutes to expel CO2. Cool and adds a few drops of methyl red indicator and adjusts to the intermediate orange colour by adding 3N NH_4OH or 1 + 1 HCl, as required. Transfer quantitatively and dilute to 1000 ml with distilled water, 1 ml-1mg $CaCO_3$.

Method-

Standardize the EDTA titrant against standard calcium solution:

Take 50 ml sample in a conical flask add 2 ml buffer solution and 2 drops EBT indicator solution, wine red colour appears. Titrate with EDTA till the colour changes to blue. Note the volume of EDTA used. Calculate the total hardness by following formula-

Formula- Total Hardness (EDTA) mg/l= A x B x 1000/ volume of sample

Where,A= ml EDTA used, B= mg CaCO3 equivalent to 1 ml EDTA

Ca & Mg Hardness

Reagents-

- **(a)** Buffer solution- Dissolve 16.9 gm NH_4Cl in 143 ml conc. NH_4OH. Add 1.25 gm magnesium salt of ethylenediaminetetraacetate (EDTA) and dilute to 250 ml with distilled water. Store in a plastic bottle stoppered tightly for no longer than one month.
- **(b)** Standard EDTA titrant (0.01M)- weight 3.723 gm di-sodium salt of EDTA, dehydrate, dissolve in distilled water and dilute to 1000 ml. Store in polyethylene bottle.
- **(c)** Standard calcium solution- weight 1 gm anhydrous $CaCO_3$ in a 500 ml flask. Add 1 + 1 HCl slowly through a funnel till all $CaCO_3$ is dissolved. Add 200 ml distilled water and boil for a few minutes to expel CO_2. Cooland adds a few drops of methyl red indicator and adjusts to the intermediate orange colour by adding 3N NH_4OH or 1 + 1 HCl, as required. Transfer quantitatively and dilute to 1000 ml with distilled water, 1 ml-1mg $CaCO_3$.
- **(d)** Sodium hydroxide (1N) - 4 gm NaOH dissolved in 100 ml distilled water.
- **(e)** Murexide (ammonium purpurate) indicator- 75 gm of the indicator is dissolved in 50 gm absolute ethylene glycol.

Method- take 50 ml sample in conical flask raise the pH to 12-13 by adding 2 ml NaOH. Add 1-2 drops of indicator and titrate with EDTA until solution becomes purple from pink.

Calculation- Calcium hardness as $CaCO_3$ (mg/l) =A x B x 100 x 1000/ volume of sample

Where A= ml EDTA used, B= mg $CaCO_3$ equivalent to 1 ml EDTA

Magnesium hardness

Magnesium hardness is determined by subtraction of Ca hardness from the total hardness

Magnesium hardness (mg/l) = total hardness - calcium hardness

Calcium

Calcium is determined by multiplying the Ca hardness by 0.4 i.e. calcium as

Ca (mg/l) = calcium hardness x 0.40

Magnesium

Magnesium is determined by multiplying the magnesium hardness by 0.243 i.e.

Magnesium as Mg (mg/l) = magnesium hardness x 0.243.

CHLORIDE

Reagents-

- **(a)** Potassium chromate indicator solution-
- **(b)** AgNO3

Method- take 100 ml sample in conical flask 1 ml K_2CrO_4 indicator, titrate with $AgNO_3$ and point will be pinkish yellow. Repeat the titration with distilled water blank.

Calculation- Cl (mg/l) = (A-B) x N x 35.45 x 1000/ volume of sample

Where A= ml $AgNO_3$ used for sample B= ml $AgNO_3$ used for blank N= Normality of $AgNO_3$

NITRITE- NITROGEN (Spectrophotometric method)

Reagents-

- **(a.)** Colour reagents- 100 ml 85% phosphoric acid and 10 ml sulphanilamide mix in 800 ml water. After dissolving add 1 gm N-1- naphthylethylenediaminedihydrochloride. Mix to dissolve, then dilute to 1000 ml with distilled water. (Solution is stable for one month when stored in dark in refrigerator).
- **(b.)** Sodium oxalates (0.05N) - Dissolve 3.350 gm $Na_2C_2O_4$ primary standard grade in water and dilute to 1000 ml.
- **(c.)** Stock nitrite- Dissolve 1.232 gm $NaNO_2$ in water and dilute to 1000 ml (1 ml= 250 µg N). Preserve with 1 ml chloroform ($CHCl_3$. Standardize by pipetting in order 50 ml 0.01 M $KMnO_4$, 5 mlconc. H_2SO_4 and 50 ml stock NO_2^- solution in to a glass stoppered flask. Shake well and warm to 70-80^{0}C. Discharge permanganate colour by adding 10 ml portions of 0.025 M sodium oxalate. Titrate excess oxalate with 0.01 M (0.05N) $KMnO_4$ to faint pink end point.

Calculation Nitrite content of stock solution-

A= [(B x C) – (D x E)] x 7 / F

Where A= NO_2^--N/ml in stock solution (mg)

B= total $KMnO_4$ used (ml)

C= normality of $KMnO_4$

D= total oxalate added (ml)

E= normality of oxalate

F= stock nitrite taken for titration (ml)

(d.) Standard nitrite solution- Dilute 10 ml intermediate NO_2^- solution to 1000 ml with water (1 ml = 0.500 µg NO_2^--N, prepare daily).

(e.) Standard potassium permanganate solution (0.05N) - Dissolve 1.6 gm $KMnO_4$ in 1 liter distilled water. Allow ageing for 1 week then decant supernatant. Standardize this solution frequently as follows-

Weigh to nearest 0.1 mg several 100 to 200 mg samples for anhydrous sodium oxalate in beaker. To each beaker add 100 ml distilled water, 10 ml 1+1 H_2SO_4 and heat rapidly to 90 to 95^0C. Titrate with permanganate solution to a slight pink end point that persists to at least 1 min. Do not allow temperature to fall below 85^0C. Run a blank on distilled water +H_2SO_4.

Normality $KMnO_4$ = $Na_2C_2O_4$ (gm) / (A-B) x 0.33505

Where,

A= titrant for sample (ml)

B= titrant for blank (ml)

Average the result of several titrations.

Procedure-

(a.) Add 2 ml colour reagent to 50 ml sample, or to a portion to 50 ml and mix. After this measure absorbance at 543 nm. Wait between 10 minute and 2 hours after addition of colour reagent before measurement. Prepare standard curve by diluting 1, 2, 3, 4 and 5 ml of standard nitrite solution to 100 ml to give 5, 10, 15, 20 and 25 µg/l concentration, respectively.

Fluoride (Spands-Zirconium colorimetric method)

Reagents-

(a.) Zirconyl acid reagents- Dissolve 0.133 gm ($ZrOCl_2.8H_2O$) zirconium oxi chloride in 25 ml distilled water. Transfer in a 500 ml volumetric flask and add 350 ml conc. HCl and dilute to the mark with distilled water keep in refrigerator.

(b.) Spands Reagent- Dissolve 0.958 gm spands in 500 ml distilled water in a volumetric flask 0f 500 ml capacity. Keep in refrigerator.

(c.) Reference solution for setting instruments zero- add 10 ml spands solution to 100 ml distilled water, dilute 7 ml HCl to 10 ml & mix both solutions (total vol. 120 ml). Use this solution for setting instruments zero before analysis.

(d.) Sodium arsenite 0.5% solution- Dissolve 0.50 gm sodium arsenite ($NaAsO_2$) in 100 ml distilled water.

(e.) Concentrate H_2SO_4 1liter (2 x 500 ml)

(f.) Concentrate HCl 1 liter (2 x 500 ml)

(g.) Silver sulphate crystals (Ag_2SO_4)

(h.) Fluoride reference solution- Dissolve 0.221 gm previously dried (105^0C for 2 hours) sodium fluoride (NaF) in 1 liter volumetric flask. Level as stock reference (100 ppm).

(i.) Fluoride working reference solution- Dilute 10 ml of stock refence F^-solution in a 100 ml. volumetric flask dilute to the mark. This will give a solution of 10 ppm fluoride.

Colour Development- Take the sample directly for colour development if sample do not has interferences in higher concentrations and turbidity otherwise sample is distilled after distillation proceed as below-

(1.) Take 50 ml capacity nessler's cylinder with stopper mark on the cylinder as blank 1, 2, 3---- 10.

(2.) Take reference fluoride solution in the cylinders for colour development for preparation of calibration curve as below-

(3.) **B-S=** Blank absorbance – Sample absorbance.

(4.) After taking the volumes of reference solution make up the volume to 50 ml in each cylinder.

(5.) Add 5 ml spands solution and 5 ml zirconyl chloride solution and shake well to mix and let stand for 2 minutes.

(6.) Mean time put on the spectrophotometer for warm up.

(7.) Set instruments 0 with reference solution.

(8.) Now measure the absorbance of blank and note the reading of blank comes in the range of 0.250 to 5.00 absorbance.

(9.) Prepare standard graph (calibration curve) on a graph paper- taking difference of absorbance (B-S) at x-axis and concentration (ppm) at y-axis. The curve comes almost linear.

$$\frac{\text{Conc.ppm}}{\text{absorbance B}-\text{S}} = \text{f (factor)}$$

The concentration of fluoride in the sample = absorbance (B-S) x f (factor) mg/l or ppm.

RESULTS AND DISCUSSION:

The present investigation ground water quality of 7 different hand pumps or different sites of Karwi city, district Chitrakoot. Understanding the ground water quality is important as it is the main factor determining its suitability for drinking; Domestic, Agricultural, and industrial purpose. Table- illustrates the physico-chemical parameters of groundwater in Karwi city, indicating the average values.

Temperature

The temperature value varied from 27.3-28.6. The temperature play important role for quality of water.

Turbidity

Suspension of particles in the water interfering with passage of light is called turbidity. Higher turbidity increases water temperatures because suspended particles absorb more heat. This, in turn, reduces dissolved oxygen (DO) concentrations because warm water holds less DO than cold water. The turbidity was found ranged from 4.4-5.2 NTU. The minimum turbidity was observed 4.4 NTU at S6 and maximum was observed 5.2 NTU at S5. All selected stations were found within the limit prescribed by BIS (10 NTU)

TDS

TDS includes ionized and nonionized matter. The total dissolved solids were found ranged from 511.6-1158.6 mg/l. The minimum value was observed 511.6 mg/l S3 and maximum was observed 1158.6 mg/l at S7. All selected stations were found within the permissible limit prescribed by WHO (2000 mg/l).

pH

The pH were observed ranged from 7.40-7.76. The minimum value was observed 7.40 S4 and maximum was observed 7.76 at S3. All selected stations were found within the permissible limit prescribed by WHO (6.5-8.5). The study showed that the groundwater of the selected station was generally neutral to slightly alkalinity. Althose pH has no direct effect on the human health, it shows close relationship with some parameters of water.

Total Hardness

The total hardness is the measure of the capacity of water to precipitate soap the hardness is more than 50 mg/l cause the RENAL CALCULI formation of kidney store. Hardness levels have a bearing on the toxicity of some metals. In general, these toxic effects are markedly less in waters with significant degree of hardness. The total hardness was found ranged from 125.0-342.6 mg/l. The minimum value was observed 125.0 mg/l S3 and maximum was observed 342.6 mg/l at S2. All selected stations were found within the permissible limit prescribed by BIS (600 mg/l).

Calcium Hardness-

The calcium hardness range was observed 62.0-225.0 mg/l. The minimum value was observed 62.0 mg/l S3 and maximum was observed 225.0 mg/l at S2.

Magnesium-

Magnesium is abundant and a major dietary requirement for humans (0.3-0.5 g/day). It is the second major constituent of hardness. Magnesium sulphate is used medicinally as "Epsom Salts," a laxative.The Magnesium was found ranged from 16.7-56.9 mg/l. The minimum value was observed 16.70 mg/l S7 and maximum was observed 56.9 mg/l at S2. All selected stations were found within the permissible limit prescribed by BIS (35 mg/l) except S2 and S4.

Calcium

Calcium value where observed in the range of 30.2-101.1 mg/l. The minimum value was observed 30.2 at S4 while maximum value was observed 101.1 mg/l at S5. All selected stations were found within the permissible limit prescribed by BIS (200 mg/l)

Chloride

The chloride was found ranged from 81.0-259.5mg/l. The minimum value was observed 81.0 at S1 while maximum value was observed 259.5 mg/l at S7. All selected stations were found within the permissible limit prescribed by BIS (1000 mg/l)

Fluoride

From the health report says that addition of fluoride to water supplies in levels above 0.6 mg/l. Fluoride leads to a reduction in tooth decay in growing children and that the optimum beneficial effect occurs around 1.0 mg/l. It should be noted that fluoride levels in fluoridated public water supplies in Ireland are legally restricted to the range 0.8-1.0 mg/l. The fluoride was found ranged from 0.4-1.2 mg/l. The minimum value was observed 0.4.0 at S6 while maximum value was observed 1.2 mg/l at S5. All selected stations were found within the permissible limit prescribed by BIS (1.5 mg/l). Fluoride is one of the main trace element in ground water, which generally occurs as a natural constituent, (Tiwari et.al, 2014)

Nitrate

Relatively little of the nitrate found in natural waters is of mineral origin, most coming from organic and inorganic sources, the former including waste discharges and the latter comprising chiefly artificial fertilizers. However, bacterial oxidation and fixing of nitrogen by plants can both produce nitrates. Interest is centered on nitrate concentrations for various reasons. Most importantly, high nitrate levels in waters to be used for drinking will render them hazardous to infants as they induce the "blue baby" syndrome (methaemoglobinaemia). Then titrate itself is not a direct toxicant but is a health hazard because of its conversion to nitrite which reacts with blood hemoglobin to cause methaemoglobinaemia. The nitrate was found ranged from 29.7-87.0 mg/l. The minimum value was observed 29.7 at S1 while maximum value was observed 87.0 mg/l at S2. All selected stations were found within the permissible limit prescribed by BIS (100 mg/l)

Alkalinity

The alkalinity of natural water is generally due to the presence of bicarbonates formed in reactions in the soils through which the water percolates. It is a measure of the capacity of the water to neutralize acids and it reflects its so-called *buffer capacity* (its inherent resistance to pH change). Poorly-buffered water will have a low or very low alkalinity and will be susceptible to pH reduction by, for example, "acid rain." At times, however, river alkalinity values of up to 400 mg/l $CaCO_3$ may be found; they are without significance in the context of the quality of the water. The total alkalinity was found ranged from 427.0-713.3 mg/l. The minimum value was observed 427.0 at S6 while maximum value was observed 713.3 mg/l at S4. All selected stations were found within the permissible limit prescribed by BIS (100 mg/l) except S2 and S4.

Electrical Conductivity (EC)

The electric conductivity is the capacity of water to carry an electrical current and varies both with number and types of ions the solution (dohare et.al, 2014). The total EC was found ranged from 390.7-569.3 mg/l. The minimum value was observed 390.0 at S5 while maximum value was observed 569.3 mg/l at S2. All selected stations were found within the permissible limit prescribed by BIS (800 mg/l). Electric conductivity value use can be used to estimate the dissolved solids concentration which may affect the test of water and suitability for various uses. Higher the conductivity value indicates higher the dissolve solid in water (Tiwari et.al, 2014

Table-4: Physico-chemical characteristics of Ground water of Karwi city on 01 March, 2017.

S.N.	Parameter	S1	S2	S3	S4	S5	S6	S7
1.	**Water Temp. ^{0}C**	27	28	27	26	26	28	27
2.	**Colour**	Clean	Clean	Clean	Clean	Clean	Clean	Clean
3.	**Odour**	Odorless	Odorless	Odorless	Odorless	Odorless	Odorless	Odorless
4.	**Turbidity (NTU)**	4.0	4.6	4.0	5.4	3.8	4.2	4.8
5.	**TDS (mg/l)**	635	1130	494	915	820	822	1250
6.	**p^H**	7.8	7.5	7.7	7.3	7.5	7.4	7.4
7.	**T.Hardness (mg/l)**	162	370	114	312	208	140	216
8.	**Ca Hardness (mg/l)**	84	260	56	184	126	74	121
9.	**Mg. (mg/l)**	19.032	55.64	14.64	42.464	20.984	17.08	13.66
10.	**Ca (mg/l)**	67.3	48.9	43.2	25.0	101.20	56.1	64.2
11.	**Cl^- (mg/l)**	75.21	72.5	121.3	115.8	220.5	70	265.2
12.	**F^- (mg/l)**	1.0	0.5	0.2	1.2	1.0	0.3	0.4
13.	**NO_3^- (mg/l)**	25	100	50	65	35	25	10
14.	**Alkalinity (mg/l)**	420	720	520	760	572	400	580
15.	**EC (µ/cm)**	441	616	426	586	466	450	513

Table-5: Physico-chemical characteristics of Ground water of Karwi city on 01 April, 2017.

S. N.	Parameter	S1	S2	S3	S4	S5	S6	S7
1.	**Water Temp. ^{0}C**	28	27	29	28	28	29	27
2.	**Colour**	Clear	Clear	Clear	Clear	Clear	Clear	Clear
3.	**Odour**	Odorless	Odorless	Odorless	Odorless	Odorless	Odorless	Odorless
4.	**Turbidity (NTU)**	5.2	5.4	4.7	5.2	5.0	4.8	5.3
5.	**TDS (mg/l)**	674	1208	527	795	796	764	1168
6.	**p^H**	7.7	7.6	7.8	7.5	7.5	7.6	7.5
7.	**Total Hardness (mg/l)**	164	350	126	295	241	155	225
8.	**Ca Hardness (mg/l)**	82	215	62	192	132	82	132
9.	**Mg (mg/l)**	21.70	39.52	18.71	35.21	17.80	22.86	17.42
10.	**Ca (mg/l)**	62.5	51.7	46.4	33.0	106.8	63.4	75.1
11.	**Cl^- (mg/l)**	85.38	118.5	126.1	135.4	205.9	82.0	261.8
12.	**F^- (mg/l)**	1.2	0.6	0.8	1.0	1.6	0.5	0.7
13.	**NO_3^- (mg/l)**	36	83	57	69	43	35	40
14.	**Alkalinity (mg/l)**	451	716	487	708	577	445	602
15.	**EC (μ/cm)**	346	520	399	512	436	391	482

Table-6: Physico-chemical characteristics of Ground water of Karwi city on 01May, 2017

S.N.	Parameter	S1	S2	S3	S4	S5	S6	S7
1.	**Water Temp. ^{0}C**	29	28	29	30	28	29	28
2.	**Colour**	Clear	Clear	Clear	Clear	Clear	Clear	Clear
3.	**Odour**	Odorless	Odorless	Odorless	Odorless	Odorless	Odorless	Odorless
4.	**Turbidity (NTU)**	4.4	5.2	4.8	5.0	5.0	4.2	5.4
5.	**TDS (mg/l)**	648	1098	514	832	800	732	1085
6.	**p^{H}**	7.8	7.5	7.8	7.4	7.6	7.5	7.4
7.	**Total Hardness (mg/l)**	176	308	135	287	218	157	186
8.	**Ca Hardness (mg/l)**	95	200	68	157	138	85	120
9.	**Mg (mg/l)**	20.47	75.64	17.72	53.07	21.38	20.52	19.21.
10.	**Ca (mg/l)**	57.2	53.6	49.3.	32.6	95.26	48.14	57.24
11.	**Cl^{-} (mg/l)**	82.37	97.2	102.9	150.0	198.1	125	251.6
12.	**F^{-} (mg/l)**	0.8	0.6	1.0	1.4	1.1	0.5	1.2
13.	**NO_3^{-} (mg/l)**	28	78	52	61	57	32	65
14.	**Alkalinity (mg/l)**	418	610	535	672	398	436	614
15.	**EC (µ/cm)**	385	572	537	563	458	474	550

Table-7: Average value of physico-chemical characteristics of Ground water at Karwi city.

S.N.	Parameter	S1	S2	S3	S4	S5	S6	S7
1.	**Water Temp. ^{0}C**	28	27.6	28.3	28	27.3	28.6	27.3
2.	**Colour**	Clear	Clear	Clear	Clear	Clear	Clear	Clear
3.	**Odour**	Odorless	Odorless	Odorless	Odorless	Odorless	Odorless	Odorless
4.	**Turbidity (NTU)**	4.53	5.06	4.5	5.2	4.6	4.4	5.16
5.	**TDS (mg/l)**	652.3	1145.3	511.6	847.3	805.3	772.6	1158.6
6.	**pH**	7.76	7.53	7.76	7.4	7.53	7.5	7.43
7.	**Total Hardness (mg/l)**	167.3	342.6	125	298	222.3	150.6	209
8.	**Ca Hardness (mg/l)**	87	225	62	177.6	132	80.3	124.3
9.	**Mg (mg/l)**	20.40	56.93	17.02	43.58	20.05	20.15	16.76
10.	**Ca (mg/l)**	62.33	51.4	46.3	30.2	101.09	55.88	65.51
11.	**Cl^- (mg/l)**	80.98	96.07	116.76	133.73	208.17	92.33	259.53
12.	**F^- (mg/l)**	1.0	0.56	0.66	1.2	1.23	0.43	0.76
13.	**NO_3^- (mg/l)**	29.66	87	53	65	45	30.66	38.66
14.	**Alkalinity (mg/l)**	429.66	682	514	713.3	515.6	427	598.6
15.	**EC (μ/cm)**	390.66	569.33	454	553.66	453.33	463.66	515

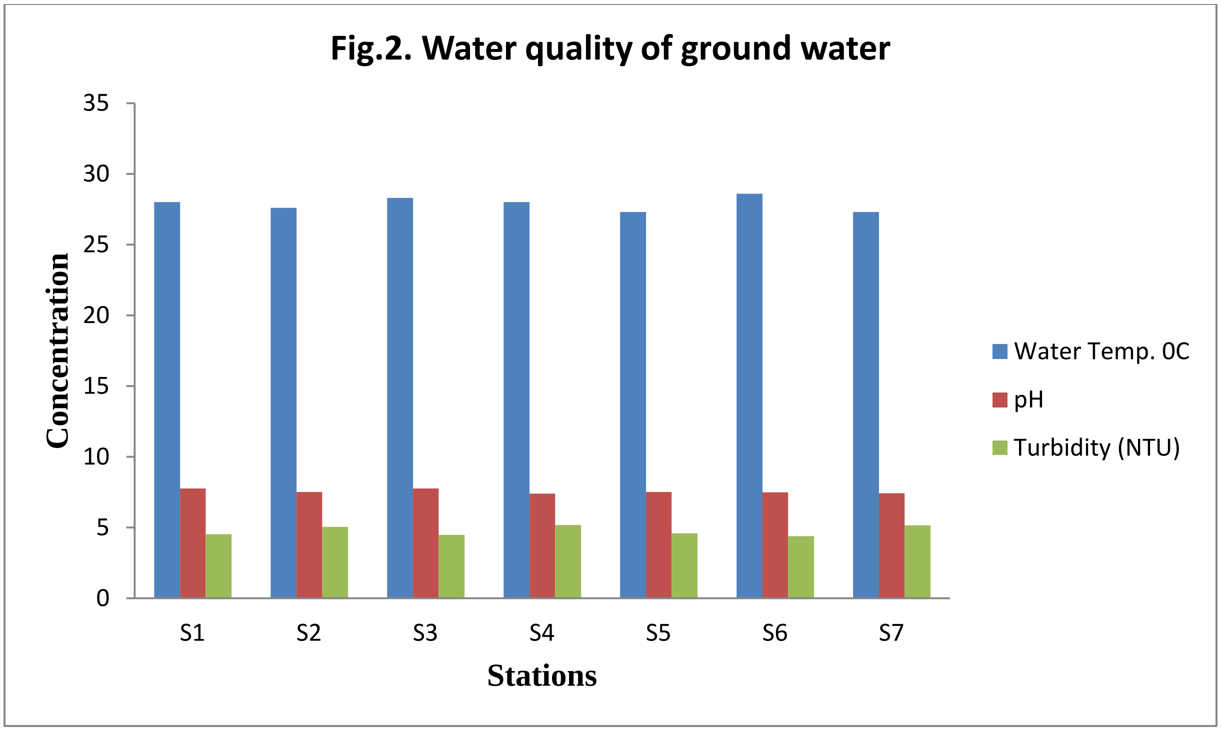


Fig.2. Water quality of ground water
Concentration
35
30
25
20
15
10
5
0
S1
S2
S3
S4
S5
S6
S7
Stations
Water Temp. 0C
pH
Turbidity (NTU)

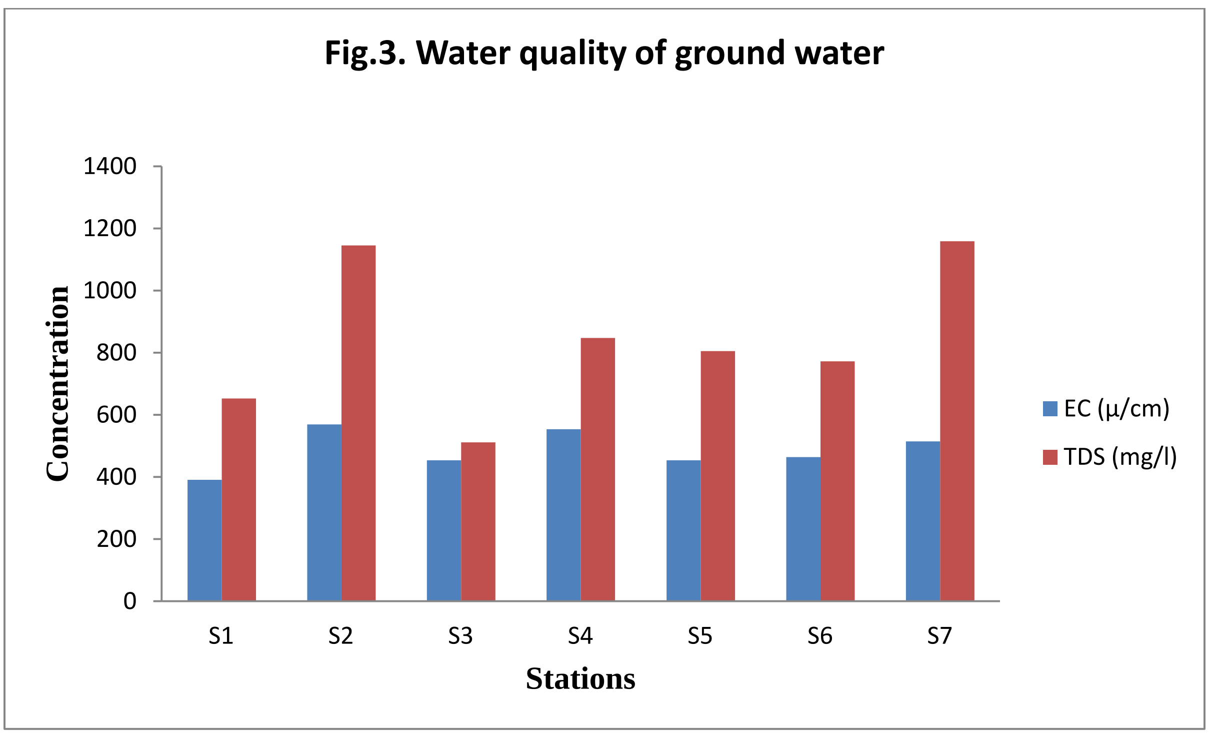


Fig.3. Water quality of ground water
Concentration
1400
1200
1000
800
600
400
200
0
S1
S2
S3
S4
S5
S6
S7
Stations
EC (µ/cm)
TDS (mg/l)

Fig.4. Water quality of ground water

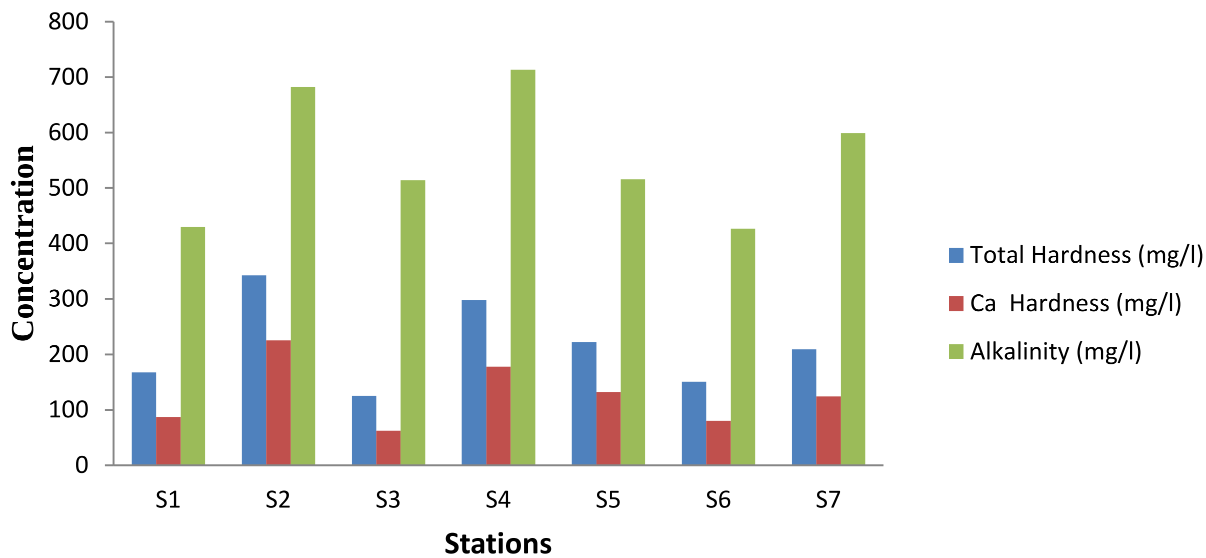
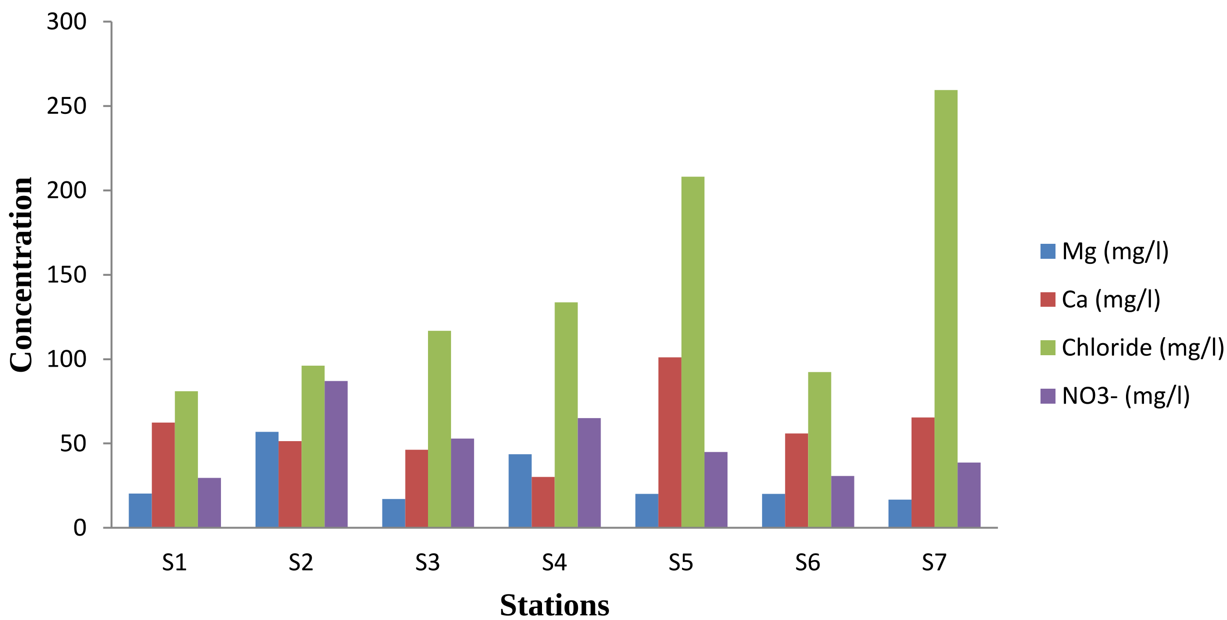


Fig.6. Water quality of ground water



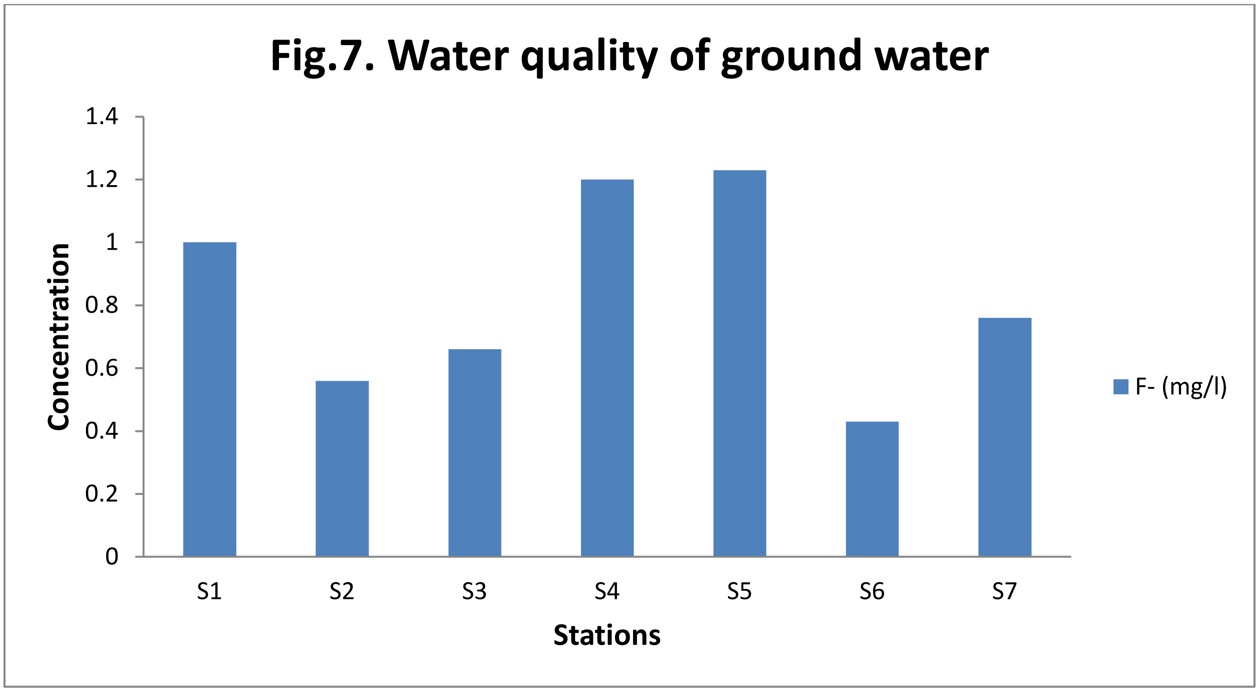


Fig.7. Water quality of ground water
Concentration
1.4
1.2
1
0.8
0.6
0.4
0.2
0
S1
S2
S3
S4
S5
S6
S7
Stations
F- (mg/l)

CONCLUSION

Total seven groundwater sample were selected for study of physico-chemical quality of water at Karwi city. From the study it was conclude that all ground water samples were observed within the limit prescribed by BIS/WHO except Ca hardness at S2 (225.0 mg/l) & S4 (177.6 mg/l) and alkalinity at S2 (682.0 mg/l) & S4 (713.3 mg/l). Hence, these samples of water absolutely fit for drinking propose sum essential treatment needed to Ca hardness & alkalinity to convert in drinkable water.

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