RESEARCHERID
THOMSON REUTERS

[I-CONCEPTS-18]

ISSN 2348 – 8034
Impact Factor- 5.070

GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES

WATER QUALITY AND SUSTAINABILITY ASPECTS OF RURAL WATER SUPPLY & SANITATION SOURCES, KISTAPUR, MEDCHAL DISTRICT, TELANGANA, INDIA

M. Venkateshwarlu[1]*, R. Janaiah[2], M. Narsi Reddy[1], T. Rohini Reddy & A. P. Ravi Chandra[1]

[1]Professor Department of Civil Engg.,CMRCET, Kandlakoya, Hyderabad-501401. T.S., India

[2]Department of Geology, Osmania University, Hyderabad-500007. T.S., India

ABSTRACT

Access to safe drinking water remains an urgent necessity in the world as it is directly related to health. Groundwater account for more than 80% of the rural domestic water supply in India. The main aim and objective of present research study is on applicability of satellite remote sensing techniques for sustainability of rural water supply sources of Kistapur, Medchal district .The integrated ground water prospects maps are preferred by using different thematic layers like geology. Geomorphology, structures, Hydrology etc. Drinking water quality data of Rural Water supply sources situated in Medchal district is studied for the parameter like Fluoride, Total Dissolved solids, Total Hardness, Alkalinity, PH and Chlorides to assess the spatial distribution of Ground quality in terms of portable or non-portable, satellite remote sensing and GIS studies are employed by making use of other of data. Well inventory data and Rural Water supply data are incorporated. Groundwater quality data required are spatially interpolated using inverse distance weighted (IDW). The plan includes proposing water harvesting structures to either dilute the areas where the water quality problems is there or to increase the Groundwater reserves through artificial recharge in areas where there is a sustainability problem .

Keywords: *ph, EC, TDS, Dissolved Oxygen, BOD, COD, Total Hardness*.

I. INTRODUCTION

Water is the most precious natural resource that exists on our planet. It occupies over 70% of the Earth's surface. Life on the Earth without water would have been non-existent. India is the second most populous country with a population more than 1.03 billion. Potable water is provided to 200 million people in this country by 58,000 community water supplies. With 15% of the total population, India has access to about 4% of the total water availability (European Community, 1980).

It is the estimated that approximately one third of the world's population use groundwater for drinking (Nickson, 2005). The increased demand for the water due to agriculture expansion, growing population and urbanization, so water resources management has become very important. The interaction of the natural and anthropogenic factors leads to various water types. According to Hamzaoui-Azaza (2011), the increased knowledge of the geochemical evolution of water quality could lead to effective management of water resources. In India and various parts of the world, numerous studies have been carried out to assess the geochemical characteristics of groundwater (Ahmad and Qadir, 2001; Alexakis, 2011; Aghazadehm, 2010; Jeevanandam, 2006; Laluraj, 2005; Subramani, 2005; Sujatha, 2003).

Water is required by humans for agricultural, industrial, household, recreational and environmental activities. Virtually for all of these human uses require fresh water. Only 2.5% of water on the Earth is fresh water, and over two thirds of this is frozen in glaciers and polar ice caps. With growing needs, water demand is gradually exceeding in many parts of the world (Gleick, 1998).

ISSN 2348 – 8034
Impact Factor- 5.070

II. STUDY AREA

Study area near to Medchal (M) location at kistapur (vi) The area lies between north16°35' to 116˚45′ latitudes and east 78˚25′ to 78˚30′ longitude. Medchal is a northern suburb of Hyderabad, India. It used be as kistapur village and one of the rural area mandals in Rangareddy district of Telangana, India

Fig 01: Location map of the study area

III. GEOLOGY OF THE AREA

The study area comprises crystalline rocks of Achaean age consisting of essentially granites. They are hard and compact and range in texture from fine to coarse, least intergranular porosity. However alteration of minerals composition and structure tend to modify this condition. Geological map of Ranga Reddy district is given here (Fig No. 1).

The granites are primarily two type's namely pink and gray granites. They owe their color to the presence of characteristic of mineral. It is rather difficult to demarcate between the two granites. The gray granite is conspicuously banded with light bands being rich in quartz and feldspar and dark bands are mainly mica and hornblende. Pink granites consist of quartz microcline or orthoclase and acid plagioclase, some hornblende. Pink granites consist of quartz, microcline or orthoclase and acid plagioclase, some hornblende, mica and epidote. Pink granites grade into porphyritic varieties. The colour of the pink granite is mainly due to the presence of orthoclase feldspar, and gray is mainly due to the presence of orthoclase feldspar, and the grey is mainly due to the presence of typically light colored feldspar.

IV. GRAY GRANITES

These rocks exhibit low relief. These are fine to medium grained. They show all enclaves of mafic minerals are hornblende and Biotite ranging in size 2 to 3 mm. this cluster is arranged in parallel plains and constitute lineation and this is responsible for the pronounced gneissic banding the mafic enclaves are about 5cm long and 2-3 cm wide. The light grey and the blue colour quartz grains are mainly responsible for the rock. The potash feldspar crystals have a light brown colour and the plagioclase grains are white or light gray colour. Hence they are called grey granites. The rock is jointed quartz and epidote veins have traversed the rock. The ramifications of quartz-feldspathic veins are also observed. The grey granites are also occur as even grained and which case these rocks are mostly equi granular in texture expect for a few patches of coarse and find texture here and there. The find grained

ISSN 2348 – 8034
Impact Factor- 5.070

rocks are relatively dark in colour. The feldspars are white or grayish white in colour and sometimes light pink collared feldspar also observed. The quartz is gray, smoky or light green in colour. The feldspar occurs as irregular crystals.

Pink granites:

The pink granites are common in this area. The pink granites are heterogeneous group of rocks whose common character is the pink colour. It is also shown that there is no difference in texture and mineralogy between these granites and the gray equivalents. The only criteria are pink colour which is due to pink or flesh colour feldspar, which forming dominant constituent. Some of them are brick red to light pink. The grain size varies from fine to coarse. There are generally coarse and porphyritic. The rock is grades into adjacent county rocks in the fields. It is generally weathered and the feldspar crystals are conspicuous

Rainfall and Climate

The average annual rainfall of the district is 833 mm, which ranges from nil rainfall in January and December to 190 mm in July. July is the wettest months of the year. The mean seasonal rainfall distribution is 652 mm in southwest monsoon (June-September), 114 mm in northeast monsoon (Oct-Dec), 4 mm rainfall in Winter (Jan-Feb) and 63 mm in summer (March – May). The percentage distribution of rainfall, season-wise, is 78.3% in southwest monsoon, 13.7 % in northeast monsoon, 0.5 percentage in winter and 7.6 % in summer. The mean monthly rainfall distribution is given in Fig. 2 the annual and seasonal rainfall distribution with its departure from mean along with percentage distribution year-wise is given in Table.1. The data is presented in Fig.2. The annual rainfall ranges from 516 mm in 2011 to 1110 mm in 2010. The annual rainfall departure ranges from -38 % in 2011 to 33 % in 2010. The southwest monsoon rainfall contributes about 78 % of annual rainfall. It ranges from 428 mm in 2002 to 927 mm in 2010. The year 2002 and 2011 experienced drought conditions in the district as the annual rainfall recorded in these two years is 27 % and 19 38% less than the long period average (LPA) respectively. The cumulative departure of annual rainfall from LPA is presented in Fig.3. It indicates that, the rainfall departure as on 2011 is negative i.e. -64%, showing rainfall deficit. The peak temperature recorded in the year 2010 was 40.9o C in the month of April and the lowest temperature of 15.1o C was recorded in December. Relative humidity of 46% and 85% was observed in April and September respectively. Recorded in these two years is 27 % and 38% less than the long period average (LPA) respectively. The cumulative departure of annual rainfall from LPA is presented in Fig.3. It indicates that, the rainfall departure as on 2011 is negative i.e. -64%, showing rainfall deficit. The peak temperature recorded in the year 2010 was 40.9o C in the month of April and the lowest temperature of 15.1o C was recorded in December. Relative humidity of 46% and 85% was observed in April and September respectively.

Geomorphology

The present-day landforms in the district are the products of different geomorphic processes such as erosion, deposition, crustal movements coupled with climatic changes operating on the surface. The specific geomorphic groups are (i) Residual hills the present day landforms in the district are the products of different geomorphic processes such as erosion, deposition, crustal movements coupled with climatic changes operating on the surface. The specific geomorphic groups are (ii) Plateau the present-day landforms in the district are the products of different geomorphic processes such as erosion, deposition, crustal movements coupled with climatic changes operating on the surface. The specific geomorphic groups are the present day landforms in the district are the products of different geomorphic processes such as erosion, deposition, crustal movements coupled with climatic changes operating on the surface. The specific geomorphic groups are the present day landforms in the district are the products of different geomorphic processes such as erosion, deposition, crustal movements coupled with climatic changes operating on the surface. The specific geomorphic groups are (Deccan traps) (iii) Pediment Isenberg complex (IV) Pedi plain 20 and the present day landforms in the district are the products of different geomorphic

ISSN 2348 – 8034
Impact Factor- 5.070

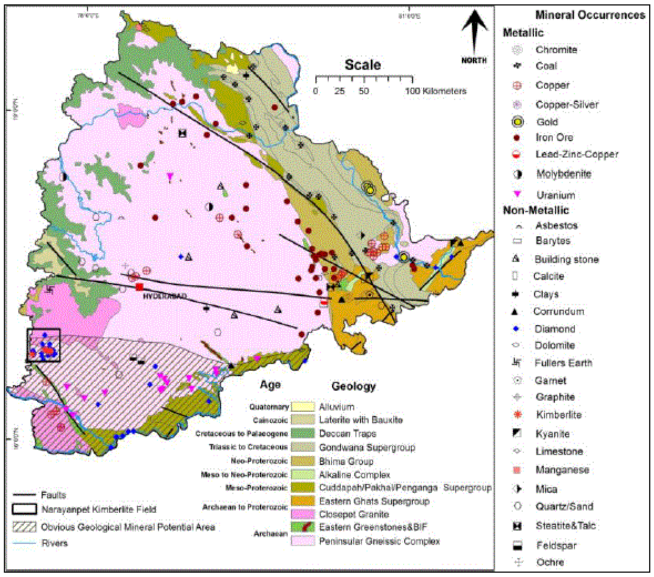

Fig 2: Geomorphology

Ground water occurs under phreatic conditions in weathered zone and under semi-confined to confined conditions in the fractured zones. The piezo metric elevations in northern part vary from 500 to 563 m alms with steep gradient in NE direction. Geomorphology which is indicate all things and what are the parameter Ground water occurs under phreatic conditions in weathered zone and under semi-confined to confined conditions in the fractured zones. The piezo metric elevations in northern part vary from 500 to 563 m alms with steep gradient in NE direction. Geomorphology which is indicate all things and what are the parameter. On the map various point which is representation all water quality parameter alms with steep gradient in NE direction. Geomorphology which is indicate all things and what are the parameter. On the map various point which is representation all water quality parameter alms with steep gradient in NE direction. Geomorphology which is indicate all things and what are the parameter. On the map various point which is representation all water quality parameter

Hydrogeology

Ground water occurs under phreatic conditions in weathered zone and under semi-confined to confined conditions in the fractured zones. The piezo metric elevations in northern part vary from 500 to 563 m alms with steep gradient in NE direction. In southern part, the piezo metric elevation is between 470 and 520 m alms with gentle gradient towards. Ground water was exploited through shallow, large diameter dug wells until 1970 to meet domestic and irrigation requirements. Presently ground water is being exploited through shallow and deep bore wells with depth ranging from 100-300 m.

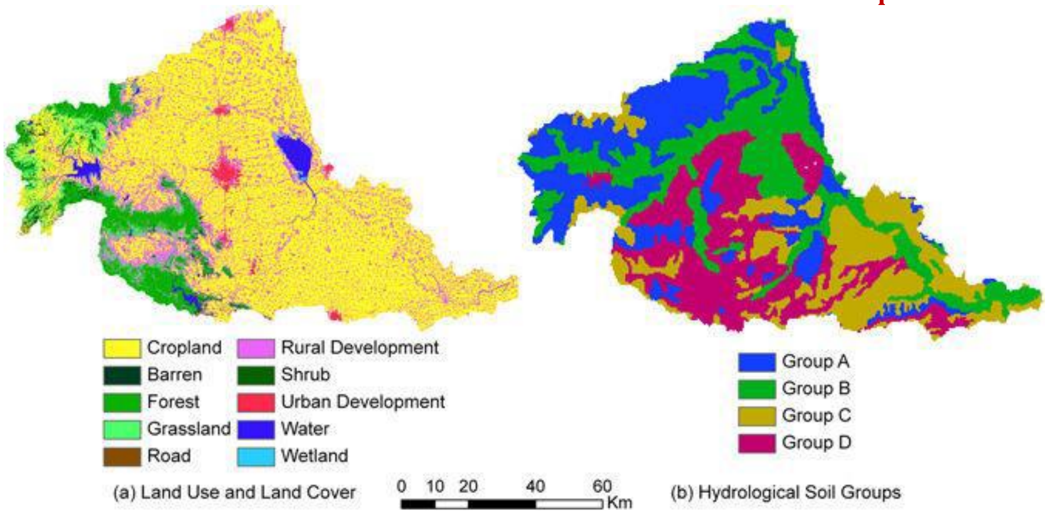

Fig-3 Land use and Land cover at Kistapur area

V. EXPERIMENT

The sampling bottles soaked in 1:1 HCL for 24h were rinsed with distilled water followed by deionized water. At the time of sampling, the bottles were thoroughly rinsed two or three times, using the groundwater to be sampled. The chemical parameters viz. pH and electrical conductivity (EC) were collected in 1000-ml polyethylene bottles from hand pump/bore holes in the study area. The bottles were labeled, tightly packed, transported immediately to the laboratory, and stored at 4˚C for the chemical analyses. The samples were analyzed for Electrical conductivity (EC) and pH were measured by conductivity meter (Systronics, 304) and digital pH meter (Systronics, 802) respectively. Estimation of chloride (Cl), by Titration (Mohr's Method) in the laboratory. Samples were maintained at 4˚C after sampling and analyzed within a few hours (<3h) of collection. The BOD5 was measured respirometrically using the oxitop method with means of replicates used for statistical analysis. Nitrification was suppressed by the addition of 0.5mg L-1 allythiourea.

VI. RESULTS AND DISCUSSION

The pH of water is easily measured in the field and must be measured in-situ to achieve accuracy. When groundwater is exposed in to the atmosphere, dissolved CO2 escapes and the pH rises. The combination of CO2 with water forms carbonic acid, which affects of the pH in the water. The pH in the groundwater is varied from 8 to 10 in all the groundwater samples of the study area and is within safe limit.

Pure water contains low electrical conductance of around 0.1µS/cm (Jeff Lewis, 2010). Ionic species dissolved in the water, then increase the conductivity, but conductance measurements cannot be used to estimate ionic concentrations, natural water contain a variety of dissolved species in various amounts. The value of EC is between 0.89 and 2.8µS/cm .The Ec is a measure of a materials ability to conduct an electric current so that the higher Ec indicates the enrichment of salts in groundwater.

Calcium and Magnesium are the principle ions responsible for total hardness. The observed value of TH in the groundwater is between 72.56 and 915.82 mg/L. The TH can be classified as soft, if the TH is less than 75 mg/L; moderately hard, if the TH is varied from 75 to 150 mg/L; hard, if the TH is between 150 and 300 mg/L; and very hard, if the TH is more than 300 mg/L (Sawyer, 2003). According to the classification of TH, approximately 90% of the groundwater comes under the hard category and the remaining 10% of the groundwater fall in the very hard category.

ISSN 2348 – 8034
Impact Factor- 5.070

Bicarbonate is a major element in human body, which is necessary for digestion. When ingested, for example, with mineral water, it helps buffer lactic acid generated during exercise and also reduces acidity of dietary components. It has a prevention effect on dental cavities (Subba Rao, 2011). The concentration of HCO3- is observed from 79.313 to 292.84 mg/L. The Cl− plays an important role in balancing level of electrolytes in blood plasma, but higher concentration can develop hypertension, risk of stroke, left ventricular hypertrophy, osteoporosis, renal stones, and asthma (McCarthy, 2004). The concentration of Cl− is between 52 and 316 mg/L. 50% of groundwater is within the desirable limit of 250 mg/L (Table-2). This is the second largest ion, after HCO3- ion. In fact, the Cl− is derived mainly from the non-litho logical source and its solubility is generally high and the groundwater is caused by the influences of poor sanitary conditions, irrigation-return flows and chemical fertilizers.

The concentration of Na+ is varied from 15 to 53 mg/L than that of the recommended limit of 200 mg/L for safe water and all groundwater samples are within the safe limit. Generally, the concentration of K+ is less than 10 mg/L in the drinking water. It maintains fluids in balance stage in the body. The K+ is observed between 2 and 26mg/L, which is below the prescribed limit. The Ca2+ is an important element to develop proper bone growth. The concentration of Ca2+ is between 80.2 and 195 mg/L. 50% of groundwater has below the standard limit of 75 mg/L, while that of the concentration of Mg2+ is varied from 36 to 108 mg/L.. Although, Mg2+ is an essential ion for functioning of cells in enzyme activation, but at higher concentration, it is considered as laxative agent (Garg, 2009). The range of alkalinity in the area of study is 20-128 mg/l and the average value is 95 mg/l. alkalinity is within the permissible limit in this region lake water is slightly higher than the permissible limit. The average value of BOD in this area is 99.3 mg/l. the water is suitable for discharge in to streams and rivers. Range of this area is 6.0 to 22.7mg/l. all the area has sufficient DO and is suitable for aquatic life.

COD ranges of this area 50.53 to 260.20 mg/l. the average value of COD is 156.60 mg/l. the water is suitable for discharge in to rivers etc. Turbidity ranges of this area are 2.0 to 18.0 NTU. The average value is 3.5 NTU. Turbidity is within the limit. In some areas turbidity is exceed permissible limit due various industries waste water release in to surrounding lakes. In kistapur villages lake water not suitable for any purpose, these exceed the all the water quality water parameter.

VII. CONCLUSION

The groundwater sources in and around Kistapur area, Medchal district of T.S., have been evaluated for their chemical composition and suitability for drinking and irrigation purposes. In the study area malignity of groundwater samples are within permissible limits prescribed for drinking water. The source of chloride in ground water is more due to the weathering of minerals present in the rocks of the study area. Also the Chloride content in ground water increased due to natural sources, domestic sewage and industrial effluents. The BOD/COD found in all cases as less than 0.50, which indicate the poor biodegradability of the waste, need more attention in the treatment processes and to be treated before its final disposal.

VIII. ACKNOWLEDGMENTS

We express our thanks to Ch. Gopal Reddy, Secretary, CMRGI, Principal and HOD, CMR College of Engineering & Technology Hyderabad, for help and encouragement to publish this paper.

REFERENCES

1. *Aghazadeh N and Mogassem A (2010), Environmental Monitoring and Assessment,doi:10.1007/S10661-0101574-4*
2. *Ahmad Z and Qadir A (2011), Environmental Monitoring and Assessment, 175(1-4), pg. no.9.*
3. *Alexakis D(2011), Environmental Monitoring Assessment, doi:10.1007/S10661-011-1884-2*
4. *APHA (1992), Standard Methods for the Examination of Water and Wastewater, Washington D.C: American Public Health Association, 326.*
5. *BIS (2003), Drinking water Specification, Bureau of Indian Standards, New Delhi IS: 10500, 11.*

ISSN 2348 – 8034
Impact Factor- 5.070

6. *Craig, E. and Anderson, M.P. (1979): The effect of Urbanization on Groundwater Quality – A case study. Groundwater, Vol.17, No.5, pp.456-462*
7. *Davis S.N. and Dewiest R.J.M.1966), Hydrogeology, New York, Wiley, 463*
8. *Eaton E.M.(1950), Soil Science ,69, 123.*
9. *European Community, (1980):"Council directive of 15 July 1980 relating to the quality of water intended for human consumption". Official Jour. Eur. Community, Brussels, Belgium 23 (1229), 11-23.*
10. *Garrers ,R.M.(1967),Genesis of some ground waters from igneous rocks .In: Ahelson pH(ed)Researches in Geochemistry, Wiley ,New York ,405*
11. *Gupta S.K. and Gupta I.C.(1987), Management of Saline Soils and Water, Oxford and IBH Publication. Co. New Delhi ,India ,399*
12. *Gustafson, D.L. (1993): "Pesticides in drinking water," Van Hosfrand Reinhold, New York, pp.241.*
13. *Hamzaoui- Azaza F., Ketata M., Bouhlia R., Gueddari M., and Riberio L. (2011), Enviornmental Monitoring and Assessmet 174,283.*
14. *Hem, J.d., (1991) study and interpretation of the chemical characteristics of natural water (3rd ed., p.263). Jodhpur, India: United States Geological survey professional paper 2254, scientific pub.*
15. *Karanth, K.R. (1987): Groundwater Assessment, Development and Management, Tata Mc Graw Hill Public Co. Ltd, New Delhi.*
16. *Mccarthy M.f. (2004), Medical Hypothesis, 63,138.*
17. *Patil. P.N, Sawant. D.V. Deshmukh. R.N., 2012. Physico-chemical parameters for testing of water a review. International journal of environmental sciences Vol 3, (3) 1194-1207.*
18. *Saxena V.K., and Ahmed S., (20001), Enviorn geol, 40(8), 1084.*
19. *WHO (2004). Guidelines for drinking water quality. Geneva: world Health Organization.*
20. *WHO (1983). Guidelines for drinking water quality. Geneva: world Health Organization*