International Journal on Emerging Technologies (Special Issue on ICRIET-2016) **7**(2): 212-216(2016)

ISSN No. (Print) : 0975-8364
ISSN No. (Online) : 2249-3255

Groundwater Quality Assessment for Belur, Heggeri and Neeralkatti Area and its Suitability for Industries and Irrigation uses

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(Received 16 September, 2016 Accepted 19 October, 2016)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Ground water pollution has become a growing threat to human society and natural ecosystems from the past two decades. Assessment of Seasonal changes in water quality is very important in management of the available resources. The consequence of urbanization and industrialization leads to degradation of ground water quality. Groundwater is being explored in rural areas due to non availability of steam flow and canal in the vicinity. The study area falls under the similar categories. Especially in the last decade, it is observed that the ground water has been polluted drastically because of increased anthropogenic activities. The present study has been conducted to evaluate factors regulating groundwater quality and its suitability for industries and irrigation uses.

Key Words: Groundwater, Hydrochemistry, SAR, USSL, RSC, Piper Diagram, Belur, Heggeri & Neeralkatti Karnataka India.

I. INTRODUCTION

Water quality analysis is one of the important tools used in water resources development and it provides information for its management. The quality of the ground water highly involves the dynamic interaction of physical, chemical, biological and also the social systems. Generally the ground water quality has relevance to the quality of the environment. In the natural ecosystem men has played a vital role of remover, destroyer, and improver which leads to disturbance in the ecological balance of the ecosystem.

The term "Quality" as applied to the water is the combination of the physical, chemical and biological characteristics. Activities of the living organisms are directly or indirectly related to the water and its quality.

Water never found in its pure state in the nature. It contains substances derived from the natural environment and sometimes the waste generated by the human activities. The quality of the ground water is determined analytically measuring the concentration of the various components and their effects caused by the presence of these substances in the ground water. Water quality changing parameters require the water technologist to be in constant touch with many segments of the scientific world. The biologist, chemist, bacteriologist and toxicologist are making advance in the quantization of the water quality parameters. Man himself is multiplying and his range is increasing day by day. The ground water quality has become an era of increasing environmental concern contrasted with surface water pollution. Ground water is difficult to detect, even more difficult to control and may persist for decades.

II. LITERATURE REVIEW

Lingaraj Shastri and V.B Chimkod in their paper entitled-"Evaluation of groundwater quality of Yadgir city, Karnataka state" they have studied the groundwater quality of Yadgir city of Karnataka state is extensively monitored for two years of study period from June 2010 to May 2012. Twelve different sampling stations were selected for the study purpose in the city. The study revealed that the water sources in the areas are exceeding the permissible limits during all the seasons are total hardness, alkalinity other parameters have shown distinctive variation in different stations and season. Most of these parameters are correlated with one another. Statistical analysis of the data is presented in this study area.

Sameer V, Yamakanamardi, Hampannavar. U.S, Purandara.B.K Civil Engineering Department, in their paper entitled "Assessment of chloride concentration in groundwater: A case study for Belgaum City" they have studied the concentration of Chlorides and detecting the contamination of groundwater by sewage. The groundwater in Belgaum city was analyzed for their chloride content and other related parameters in January and May month during the year 2010. In present study twenty five groundwater samples collected from open wells and analyzed for chloride content. The chloride concentration varied from 34.86 mg/l to 333.05 mg/l during the month of January and 31.77 mg/l to 297.86 mg/l during the month of May. High concentration of chloride was observed downstream of Lendhi nala. High coefficient of variance indicates a great variability of chloride concentration in groundwater.

Rajkumar V. Raikar, Sneha, M. in their paper entitled-"Water quality analysis of Bhadravathi taluk using GIS" they have studied the water quality analysis carried out at the Bhadravathi Taluk, Karnataka, India. Twelve physico-chemical parameters were considered in the analysis. Geographic information system (GIS) is used to represent the spatial distribution of the parameters and raster maps were created. The analysis was carried for pre-monsoon and post-monsoon seasons. The water quality index indicated that most of the sampling locations come under good category indicating the suitability of water for human use. Due to the industrialization and agricultural disposal some of the sampling locations became unfit.

Nosrat Aghazadeh, Asghar Asghari Mogaddam in their paper entitled-"Assessment of Groundwater Quality and its Suitability for Drinking and Agricultural Uses in the Oshnavieh" they have studied the groundwater resources are developed for water supply and irrigation purposes. In order to evaluate the quality of groundwater in study area, 31 groundwater samples were collected and analyzed for various parameters. Physical and chemical parameters of groundwater such as electrical conductivity, pH, and total dissolved solids, Na, K, Ca, Mg, Cl, HCO_3, CO_3, SO_4, NO_3, NH_3, PO_4, Fe, F were determined. Chemical index like percentage of sodium, sodium adsorption ratio, and residual sodium carbonated, permeability index (PI) and chloroalkaline indices were calculated. Based on the analytical results, groundwater in the area is generally fresh and hard to very hard.

Nosrat Aghazadeh, Asghar Asghari Mogaddam in their paper entitled "Assessment of groundwater quality & its suitability for drinking & Agricultural uses in the Oshnavieh Area. Northwest of Iran" they have studied the groundwater suitability and the interpretation of hydrochemical analysis reveals that the groundwater in the study area is fresh, hard to very hard and the analytical data illustrates that the groundwater samples fall under medium salinity and low sodium water in Northwest of Iran.

K.L. Prakash & R.K. Somashekar in their paper entitled "Groundwater Quality Assessment on Anekal Taluk, Bangalore Urban district, India" the study revealed that the physicochemical & biological results have been subjected to statistical analysis and compared with Bureau of Indian Standards (BIS- 10500 : 1991) . The samples show the considerable variation in the quality of groundwater. Generally this happens due to irregular distribution of rocks or due to variation in the depth of the sample points.

III. DISCRIPTION OF STUDY AREA

About two-third of the surface of the earth is covered by water. Its usability depends upon its quality. Hence the quality of the water is the deciding factor for its use and it is more so in case of groundwater. Groundwater quality is one of the important sectors in water resource studies and it is mainly controlled by recharge, nature of the rocks as well as solid waste management.

It is known fact that the quality of the life depend on the quality of the environment in the natural ecosystem. Man has played a role of destroyer, remover and improver of various components which causes lot of disturbance in the ecological balance. Water pollution becomes not only an aesthetic problem, but an economic as well as medical problem too. Water is never found in its pure state in the nature. The utilization of water from ages has led to its over exploitation coupled with the growing population and industrialization along with improved standard of living as a consequence of technological innovations.

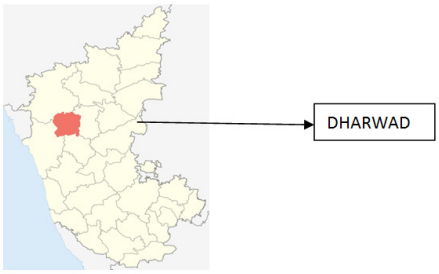

Fig. 1. Location Map.

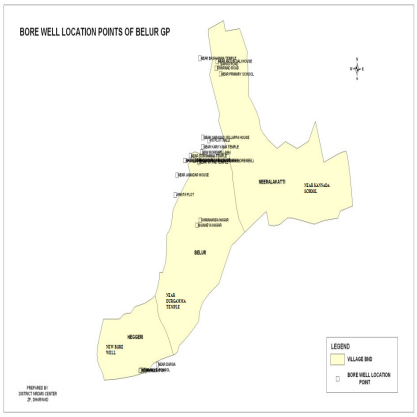

Fig. 2. Bore Well Location Points.

Table 1: Details of Different Sampling Points.

GW1	Nagalavi road
GW 2	Near kannada school
GW 3	Near durgamma temple
GW 4	Near boguravar house
GW 5	Near jamadar house
GW 6	Near vittal temple
GW 7	New borewell-NH4
GW 8	Anjaneya nagar
GW 9	Shiwananda nagar
GW 10	Janata plot
GW 11	Near water tank
GW 12	Near garagad yellappa house
GW 13	Dharwad road
GW 14	Garag road
GW 15	Near kariyamma temple
GW 16	Near arjun gali house

IV. METHODOLOGY

The groundwater collected from the bore wells have been tested for its physio-chemical and biological characteristic parameters by the standard methods. The characteristic of ground water were for the period from November 2013 to February 2014. The sampling points are selected to cover the entire area of study. Out of the 16 sampling points chosen 10 bore well points have been fitted with hand pumps.

The Fig. 2 indicates the position of sampling positions. Samples were collected in morning time only.

A. Analysis of Ground Water

Piper Analysis. The results were plotted on a Piper-tri-linear diagram for pre-and post-monsoon period. The Piper diagram is used to infer hydro-geochemical facies. The diagram is formed of an equilateral triangle. These plots include two triangles, one for plotting cations and the other for plotting anions. Three variables are placed at the apexes. The cations and anion fields are combined to show a single point in a diamond-shaped field. These tri-linear diagrams are useful in bringing out chemical relationships among groundwater samples. The diagram reveals the analogies, dissimilarities and different type of water in the study area, which are identified and listed in the table below.

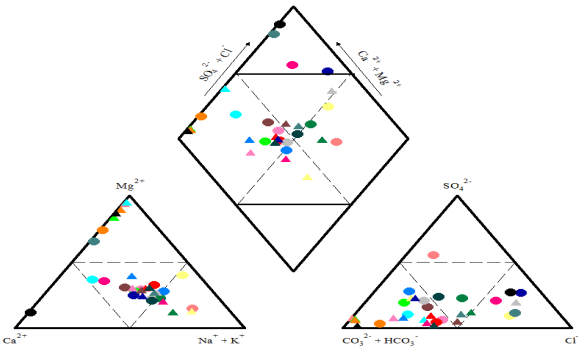

Fig. 3. Piper Diagram for Study Area.

Hychem Analysis. Hychem analysis is the method which has been widely used in geochemical applications. This technique is designed to analyze the interrelationships within a set of variables.

Table 2: Sodium Hazard Classes Based On USSL Classification.

Sodium Hazard class	**SAR in Equivalents per mole**	**Remark on quality**	**Pre monsoon samples**	**Post monsoon samples**
(Alkalinity)				
S1	10	excellent	14	13
S2	10-18	good	02	03
S3	18-26	doubtful		
S4 & S5	>26	unsuitable		

Table 3: Groundwater Quality Based on RSC (Residual Sodium Carbonate).

RSC (epm)	**Remark on quality**	**Pre-monsoon samples**	**Post-monsoon samples**
<1.25	Good	16	14
1.25-2.5	Doubtful	-	-
>2.5	unsuitable	-	02

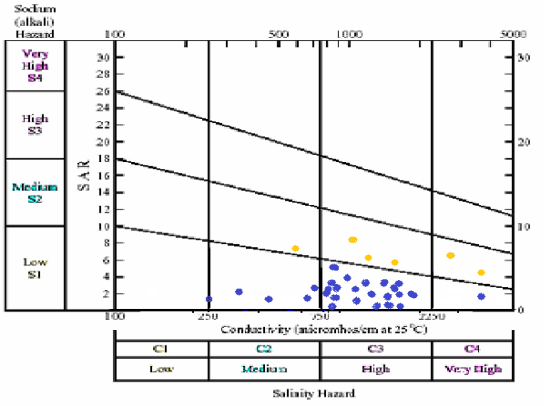

Fig 4: USSL Classification of Groundwater during Pre Monsoon & Post Monsoon.

The USSL classification diagram shows electric conductivity and salinity hazard on X-axis and Sodium Absorption Ratio on Y-axis. Maximum no. of samples lies under C3 category in the X-axis hence the water is having high electric conductivity and salinity hazard hence the water is not suitable for irrigation purpose. Whereas in the Y-axis all samples lie under S1 & S2 i.e. low and medium quality hence the water is free from sodium hazard.

V. RESULTS AND DISCUSSION

A total of 16 bore wells covering the study area have been selected for determining the physico-chemical characteristics of ground water for the purpose of evaluating the water quality.

The physical characteristics of the groundwater in the study area have been investigated to know pH, electric conductivity and total dissolved solids in water.

The results of the analysis of the data are as follows:

The electric conductivity is the function of dissolved solids or minerals present.

Table 4: Samples Lies Within The Permissible Limit.

GW 1	Naglavi Road
GW 6	Near vittal temple
GW 8	Anjaneya nagar
GW 9	Shiwananda nagar
GW 10	Janata plot
GW 12	Near garaged yellappa house
GW 15	Near kariyamma temple
GW 13	Dharwad road
GW 14	Garag road
GW 16	Near arjun gali house

Because these mineral content conduct the electricity and carry the electron charge, higher the conductivity which shows the higher minerals which allow the current to pass through them. When used for agricultural purpose it will give adverse effect on the growth of the plants.

Hence it is clear that the groundwater of 2 bore wells i.e. Naglavi road, near kannada school from pre-monsoon and 1 bore well i.e. near water tank from the post- monsoon exceed the permissible value of the electric conductivity.

Table 5: Sample Lies Below Permissible Limit.

GW 3	Near durgamma temple
GW 4	Near boguravar house
GW 5	Near jamadar house
GW 7	New bore well- NH4
GW 11	Near water tank

The classification of the water depending upon the total dissolved solids. About 5 bore well samples lies below the permissible limit, 10 bore well samples less within the permissible limit and 1 bore well sample (GW2)lies exceeds permissible limit in the post-monsoon season. About 5 bore well samples lies below the permissible limit, 10 bore well samples lies within the permissible limit. (Refer table 2.2 & 2.3).

The concentration of the bicarbonate is slightly high. As the alkaline salts like carbonates, bicarbonates of calcium and magnesium, sodium and potassium which are very common in the earth's crust due to the hydrolysis of these salts which will get dissolved in the water during precipitation and percolation and then in turn imparts alkalinity to the water. Hence the groundwater ids generally alkaline in nature it is clear that maximum no .of sample lies under permanent hardness which requires treatment.

From the salinity hazard it is concluded that 2 samples from pre monsoon and 1 sample from post monsoon are unsuitable for irrigation purpose (Refer table 2.1).

From the USSL classification it has been seen that max No. of samples fall under C3 group of USSL classification .Hence the water is not suitable for irrigation purpose. (Refer table 2).

From the GIBBS plot the mechanism governing the ground water Chemistry is due to Rock intrusion for 87.5% of samples and rest of them is due to evaporation. (Fig. 4).

The linear regression between pH & Fluoride indicates that as the pH increases Fluoride decreases. It is known fact that if Calcium is correlated with Fluoride it shows increase in Calcium with the decreases the Fluoride content. Hence in order to reduce fluoride content calcium content should be increased. In the present case all the values of the fluoride content are within the permissible limit.

VI. CONCLUSION

After the careful study of analysis, interpretation and discussion of the numerical data following conclusion are drawn for Belur, Heggeri and Neeralkatti areas.

Assessment of groundwater reveals that the groundwater in the study area comes under permanent hardness. The sequence of abundance of the major ion is Ca-Mg-HCO_3. The water samples in the rock dominance area in GIBBS plot indicates the interaction between rock chemistry and the percolation and precipitation waters in the sub-surface.

In the study area the dominant hydrochemical facies of groundwater is Ca-Mg-HCO_3. TDS values of the sample shows that the 57% of samples have the highest desirable category and remaining samples are within the permissible limit. SAR value of the sample indicates 85% are in excellent range and 15% fall in good quality of water.

From the USSL classification it has been seen that max No. of samples fall under C3 group of USSL classification .Hence the water is not suitable for irrigation purpose.

The analytical data plotted on the US salinity fall in the field C3S1 and C3S2 group indicating high salinity and medium to low sodium water. According to the RSC values, all of the groundwater samples belong to the good quality.

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