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Seasonal variations in Groundwater Quality of Davangere town of Karnataka , India

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Abstract : The present study deals with the analysis of ground water quality in Davangere town of Karnataka. Five different sampling sites wereselected for analysis and parameters estimated include pH, alkalinity, total hardness, turbidity, sulphate, chloride, fluorides, total dissolved solids and electrical conductivity. Seasonal variations in the physico-chemical parameters in the water sample were observed and they were compared with BIS standards .Hence, the ground water samples are moderately polluted and impact to health hazards. In this study, the water samples of all the 5 sites of Davangere town were quite good (fair) for irrigation purpose due to high salinity of ground water.
Keywords : Groundwater, Davangere, moderately polluted, Karnataka.

Introduction

Groundwater is an important resource all over the globe. The term groundwater is usually reserved for the subsurface water that occurs beneath the water table in soils and geologic formation that are fully saturated. It supports drinking water supply; livestock needs irrigation, industrial and many commercial activities[1]. Groundwater is generally less susceptible to contamination and pollution when compared to surface water bodies. In India, where groundwater is used intensively for irrigation and industrial purposes, a variety of land and water based human activities are causing pollution of this precious resource[2,3] .

Water is one of the basic requirements of human beings. Groundwater is an important source of water supply throughout the world. The groundwater quality is normally characterized by different physico-chemical characteristics. These parameters change widely due to the various types of pollution, seasonal fluctuation, groundwater extraction, etc. Hence a continuous monitoring on groundwater becomes mandatory in order to minimize the groundwater pollution and have control on the pollution-caused agents. The quantity and the suitability of groundwater for human consumption and for irrigation are determined by its physical, chemical and bacteriological properties [4,5].

Groundwater use in irrigation, industries and domestic usage continues to increase where perennial surface water source are absent. The modernization, over exploitation, rapid industrialization and increased population has lead to fast degradation of our environment. To meet the rising demand it is imperative to recognize the fresh water resources and also to find out remedial methods for improvement of water quality. Industrial waste and the municipal solid waste have emerged as one of the leading cause of pollution of surface and ground water. In many parts of the country available water is rendered non-potable because of the presence of heavy metal in excess. The situation gets worsened during the summer season due to water

scarcity and rain water discharge[6].

The groundwater quality is degrading in Davangere town is due to increases human habitation and commercial practice. Therefore, the present study is undertaken to investigate some physico-chemical parameters of the ground water of Davangere town, Karnataka.

Materials and Methods

Study Area

Davangere is located 260km from the state capital Bangalore Karnataka India, at 13°.5' and 14°50'N and 75°30' and 76°30'E geographically. Davangere district receives average annual rainfall of 644 mm (25.4 inch). The district enjoys semi arid climate, dryness in the major part of the year and hot summer. In general, southwest monsoon contributes 58 % of total rainfall and Northeast monsoon contributes 22 % rainfall. The remaining 20 % rainfall is received as sporadic rains in summer months. It receives low to moderate rainfall. In Davangere city fractured granitic- gneisses and gneisses are the main water bearing formations. Ground water occurs within the weathered and fractured rocks under water-table conditions and semi-confined conditions[3].Figure 1 depicts map of the study area.

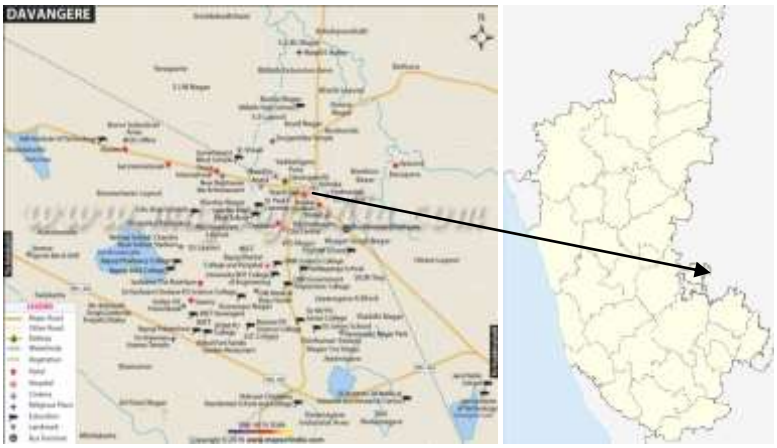

Figure 1 : Location of the study area (Source: www.mapsofindia.com; en.wikipedia.org)

Water analysis

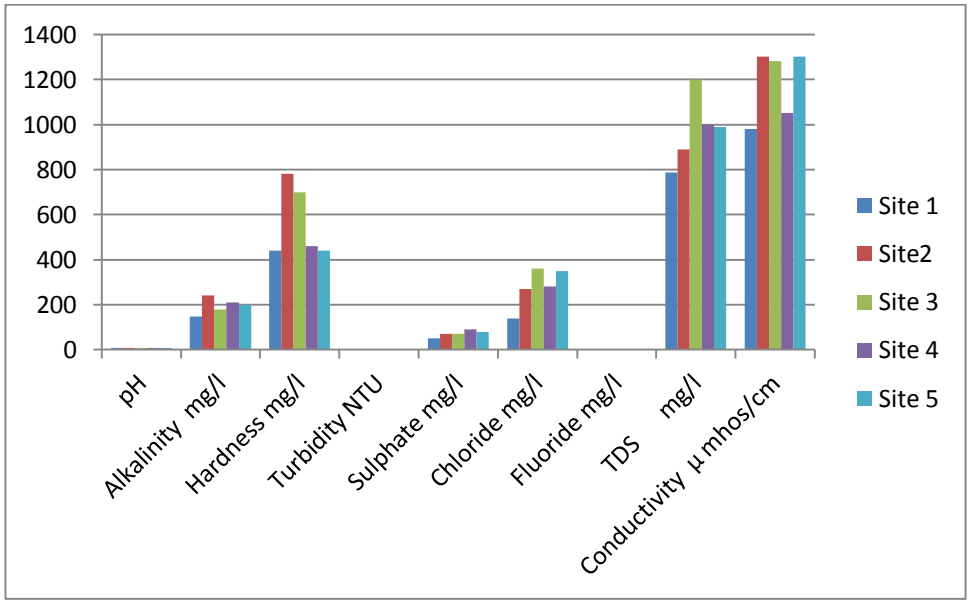

Figure 2:Ground water quality parameters in pre-monsoon season (February to May 2012)

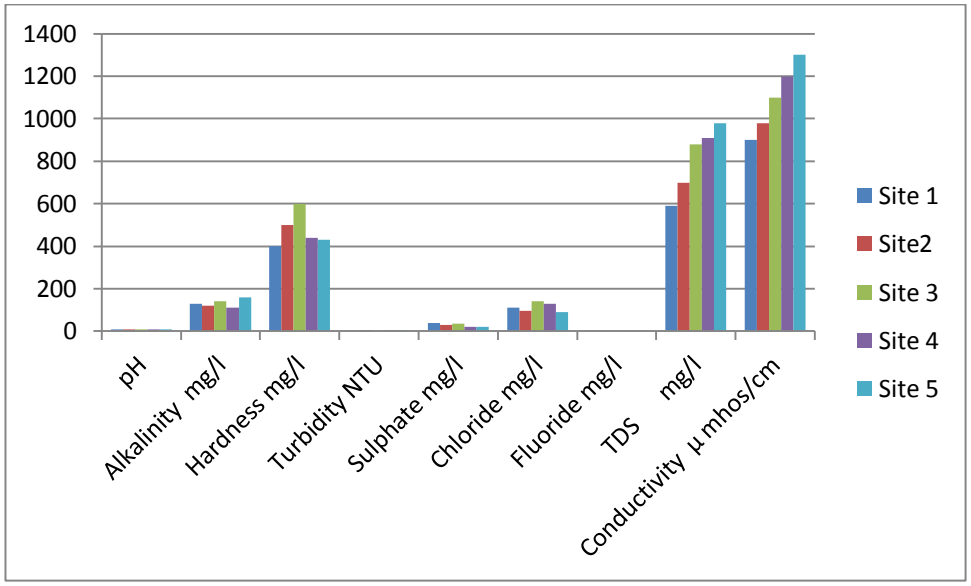

Figure 3: Ground water quality parameters in monsoon season (June and September 2012)

Groundwater samples were collected from five different sampling sites of Davangere city during the pre-monsoon (February to May 2011), monsoon (June and September 2011) and post monsoon seasons(October to January 2012). The water samples were collected from 5 sites in black colored carbouys of 2 liters capacity bottle. The various physico-chemical parameters were analyzed as per standard methods of APHA[7]and depicted in Figure 2 to 4.

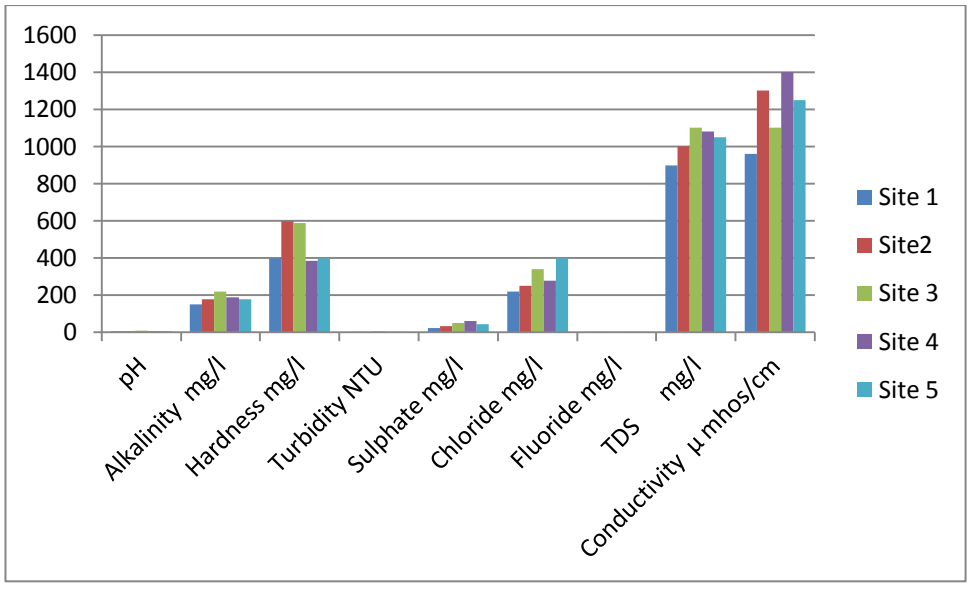

Figure 4: Ground water quality parameters in post-monsoon season (October 2012 and January 2013)

pH of the water samples was analyzed in the spot itself and it is determined by using pH meter.Total alkalinity of the water samples were determined by titrating with N/50 H_2SO_4 using phenolphthalein and methyl orange as indicators. The chloride content was determined by titrating the water samples against a standard solution of $AgNo_3$ using potassium chromate as an indicator. The electrical conductivity of the water samples were measured using the conductometric method. The total hardness of the water samples were determined by titrating with EDTA using Erichromebalck-T as an indicator. Sulphate and fluoride of the water samples were estimated by UV-visible spectrophotometer. TDS of water sample were measured using gravimetric method[8,9].

Table: 1 Sampling Site in the study area.

Sampling Site number	Sampling Sites	Condition of the area
1	Vinoba Nagar	Residential area
2	Near Bapuji Hospital	Hospital and Commercial area
3	Jayanagar A block	Residential and commercial area
4	Basaveshwara layout	Populated area
5	Karur Industrial area	Populated and industrial area

Table: 2 Methods adopted for estimation of physico-chemical parameters of water.

Sl.No	Parameters	Method
1	pH	pH Meter
2	Alkalinity	Conductivity
3	Hardness	EDTA Titration
4	Turbidity	Turbidity meter
5	Sulphate	Turbidiometeric Method
6	Chloride	Silver nitrate Method
7	Fluoride	Ion-Selective Electrode
8	Dissolved Solids	Conductivity meter
9	Electrical conductivity	Conductometer

Table 3: Drinking water standards of BIS[10] (IS:10500:1991) (Source:www.wqaa.gov.in**)**

Sl.No	Parameters	Desirable limit mg/l	Permissible limit mg/l
1.	pH	6.5-8.5	No relaxation
2.	Colour	5	25
3.	Nitrate	45	100
4.	Total Hardness	300	600
5.	Turbidity	5	10
6.	Sulphate	200	400
7.	Chloride	250	1000
8.	Fluoride	1.0	1.5
9.	Calcium	75	200
10.	Magnesium	30	100
11.	Iron	0.3	1.0

Result and Discussion

The physico-chemical parameters, which were analyzed in pre-monsoon, monsoon, post- monsoon seasons have been shown in Figure 2, 3 and 4 respectively.

Pre-Monsoon season

pH was maximum in site 3 (8.2) and minimum at sites 1,4 and 5 with 7.9. Alkalinity was found highest at site 2 with 240 mg/l and lowest in site 1 with 148 mg/l. However, total hardness was maximum with 780 mg/l at site 2 and minimum in sites 1 and 5 with 440 mg/l.Regarding turbidity, it was maximum in sites 1 and 5 with 4 NTU and minimum in sites 3 and 4 with 2 NTU respectively. Sulphate content varied 90 mg/l at site 4 and 50 mg/l in site 1.Chloride level was high in site 3 with 360 mg/l and low (140 mg/l) at site 1. Fluoride level was below permissible limit in all the sites. TDS content was maximum in site 3 with 1200 mg/l and minimum at site 1 with 788 mg/l. Nevertheless, conductivity level was highest in sites 2 and 5 with 1300μ mhos/cm and lowest (980 μ mhos/cm) in site 1.

Monsoon Season

pH was highest in site 1 with 7.7 and lowest at site 4 with 7.4. Alkalinity was found maximum at site 5 with 160 mg/l and low in site 4 with 110 mg/l. Conversely, total hardness was maximum with 600 mg/l at site 3 and minimum at site 1 with 400 mg/l. Regarding turbidity it was greatest in site 5 with 5 NTU and lowest in site 3 with 2 NTU .However, Sulphate content varied 40 mg/l at site 1 and 20 mg/l in sites 4 and 5respectively.Chloride content was highest in site 3 with 140 mg/l and lowest (90 mg/l) at site 5. Fluoride level was below permissible limit in all the sites. TDS content was highest in site 5 with 980 mg/l and minimum at site 1 with 590 mg/l. Nonetheless, conductivity level was maximum in site 5 with 1300 μ mhos/cm and minimum (900 μ mhos/cm) in site 1.

Post-Monsoon Season

pH level was peak in site 3 with 8.0 and lowest at site 1with 7.5. The alkalinity was found maximum at site 3 with 220 mg/l and low in site 1 with 150 mg/l. On the contrary, total hardness was maximum with 600 mg/l at site 2 and minimum at site 4 with 384 mg/l. About turbidity it was greatest in site 3 with 5 NTU and lowest in site 1 with 2 NTU .But, Sulphate content varied 60 mg/l at site 4 and 25 mg/l in site 1.Chloride content was high in site 5 with 400 mg/l and low with 220 mg/l at site 1. Fluoride level was below permissible limit in all the sites and deviated 0.4 to 1.1 mg/l. TDS content was highest in site 3 with 1100 mg/l and minimum at site 1 with 900 mg/l. However, electrical conductivity level was maximum in site 4 with 1400 μ mhos/cm and lowest (960 μ mhos/cm) in site 1.

Classification of water quality for irrigation purpose

Table 4 :Classification of water quality of Davangere city for irrigation purpose(According to the classification made by United state salinity Laboratory; Mayur C. Shah et al.[11]).

Electrical conductivity μmhos/cm	Category of water	% sites of Davangere town
< 250	Low salinity (Excellent)	0
250-750	Medium salinity (Good)	0
750-2250	High salinity (Fair)	100%
> 2250	Very high salinity (Poor)	0

The classification of water quality of Davangere town for irrigation purpose is presented in Table 4. It suggests that water samplesof all the 5 sites of Davangere town were quite good (fair) for irrigation purpose due to high salinity of ground water.

Discussion

According to BIS the permissible limit of pH value for drinking water is 6.5 to 8.5.Abnormal values of pH in water causes bitter taste, affects mucous membrane, causes corrosion in pipelines and also affects aquatic life. The standard desirable limitof alkalinity in potable water is 200 mg/las per BIS[10]. Excess alkalinity in water is also harmful for irrigation which leads to soil damage by altering the soil pH which enhancesoil pH to a great exert and reduce crop yields. A high content of dissolved solids elevates the density of water, influences osmo-regulation of fresh water organism, reduces solubility of gases (like oxygen) and reduces utility of water for drinking, irrigation and industrial purposes[12]. According to Indian specifications for Drinking water IS:10500 the desirable limit of TDS is 500 mg/l and the permissible limit is 2000 mg/l. Exceeding the permissible limits of hardness causes poor lathering with soap, deterioration of the quality of clothes, scale formation and skin irritation[13,14].

Most of the fluoride found in groundwater receives from the naturally occurring from the breakdown of rocks and soils or weathering and deposition of atmospheric volcanic particles. Fluoride can also come from Runoff and infiltration of chemical fertilizers in agricultural areas and Liquid waste from industrial sources.According to Indian standards for drinking water, desirable limit of chloride is 250 mg/l, and the permissible limit is 1000 mg/l.Sulphate occurs naturally in water as a result of leaching from gypsum and other common minerals. Sulphate content in drinking water exceeding the 400 mg/L impart

bitter taste and may cause gastro-intestine irritation and cantharsis[14,15].Total dissolved solids have showed the significant positive relation with the electrical conductivity, chloride, alkalinity, sulphate, total hardness, calcium and magnesium. Conductivity of ground water samples varied between 900 and 1400 μmhos/cm.

Conclusion

Groundwater is extremely important to the future economy and growth of rural India. If the resource is to remain available as high quality water for future generation it is important to protect from possible contamination. Hence, it is recommended that suitable water quality management is essential to avoid any further contamination. Local geological settings may support the increasing concentration of physico-chemical characteristics in groundwater. Porosity of the soil and rock also alters the characteristics of the groundwater.The study area shows the moderate levels of total dissolved solids and hardness in samples. Ground water parameters in sampling sites have varied due to anthropogenic activities, but this value does not have any harmful impact for the water to use for drinking purpose. Hence, the ground water in Davangere area is suitable for drinking, domestic, industrial, and agriculture purposes.The analysis reveals that the groundwater of the area, needs certain degree of treatment before consumption,and it also needs to be protected from the possible sources of contamination.

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