Available online at www.pelagiaresearchlibrary.com

Pelagia Research Library

Pelagia Research Library

Advances in Applied Science Research, 2012, 3 (4):2005-2014

Pelagia Research Library

ISSN: 0976-8610
CODEN (USA): AASRFC

Comparative study of groundwater from basaltic and granitic aquifers of Dharmabad Taluka of Nanded District, Maharashtra

Sangole Shivshankar, R. S. Pawar and D. B. Panaskar

School of Earth Sciences, Swami Ramanand Teerth Marathwada University, Nanded

---

ABSTRACT

The study was carried out the physicochemical characteristics of groundwaters from basaltic and granitic aquifers of Dharmabad taluka of Nanded District, Maharashtra (India). The water samples were collected from various regions of basaltic and granitic aquifers of Dharmabad during 2009 in pre monsoon season. The physico-chemical parameters such as pH, EC, total dissolved solids, hardness, alkalinity as well as chloride, sulphate, nitrates, sodium potassium and fluoride have been analyzed. Majority of the samples do not comply with BIS for most of the water quality parameters measured. The fluoride concentration in the groundwater of these villages was recorded upto 2 mg/l, causing dental fluorosis among people especially children of these villages. The nitrates concentration varied from 19.5 to 190 mg/l. Overall water quality was found unsatisfactory for drinking purposes without any prior treatment in maximum samples.

Key words: Groundwater, Physicochemical, Basaltic Aquifers, Granitic Aquifers, Dharmabad

---

INTRODUCTION

Groundwater has become the major source of water supply for domestic, industrial, and agricultural sectors of many countries. It is estimated that approximately one third of the world's population uses groundwater for drinking purposes [15].

Intensive use of natural resources and increased human activities are posing great threat to groundwater quality [6]. Presence of more than 200 chemical constituents in groundwater has been documented including about 150 organic and 50 inorganic and radio nucleotides. The reported sources of these chemicals in groundwater are both natural as well as anthropogenic [12]. Contaminants in groundwater aquifers exist for hundreds of years due to their slow movement in water aquifers.

In developing countries, contamination of water supplies by organic chemicals is of lesser concern, because most of the health problems are found to be associated with the presence of inorganic chemicals and pathogenic organisms in drinking water [11]. Due to variations in the regional geology and water-rock interactions, higher concentrations of many elements can occur in groundwater. The chemical composition of groundwater is controlled by many factors that include composition of precipitation, geological structure, and mineralogy of the watersheds and aquifers, and geological processes within the aquifer [2]. Substantial groundwater pollution has resulted from the coupling of agricultural systems demanding large inputs of fertilizers, pesticides, and irrigation water within a physical setting that comprises coarse soils and shallow groundwater [14]. The connection between agricultural and

groundwater pollution is well established [7] and groundwater contamination by anthropogenic activities, such as urbanization and agricultural activities, is a problem in arid and semiarid regions [8].

The quality of groundwater at any point below the surface reflects the combined effects of many processes along the groundwater flow path. Chemical reactions such as weathering, dissolution, precipitation, ion exchange and various biological processes commonly take place below the surface. Hydrogeochemical study is a useful tool to identify these processes that are responsible for groundwater chemistry. Contamination of the groundwater by domestic, industrial effluents and agricultural activity is a serious problem faced by developing countries.

According to Arrate (1997) in number of cases, water resources have been affected in such a way that they are not available for further use without prior treatment. Contamination of surface water may disappear within a short period of time, once the discharge source is controlled, but for groundwater, contamination may persist for many years and depuration strategies would require substantial research and financial efforts.

MATERIALS AND METHODS

Study Area

Dharmabad is situated 80 km towards south east of Nanded district of Maharashtra state of India. Dharmabad is located at 18.9° North Latitude and 77.85° East Longitude and at 359 meters (1177 feet) altitude above the mean sea level. Mainly two types of rocks viz Basalt and Granite are exposed in this area**.** The Karegaon, Pipalgaon, Salegaon, Kerkheli 1 and 2, Roshangaon, and Patoda villages are in basaltic region while Belgujari, Dhanora, Ilegaon, Kerkheli 3 and 4, Babulgaon villages are in granitic region. Figure 1 shows the locations of the groundwater samples collected. Groundwater is the major source of water, used for domestic purposes. The lithology is also responsible for the quality of groundwater.

Methodology

A total twenty groundwater samples were collected from bore wells of study area (Fig.1). Using pre-cleaned sterilized poly propylene plastic bottles with necessary precautions ten samples are basaltic aquifers and ten from granitic aquifers. The sampling has been carried out in the month of pre-mansoon 2009. The chemical analysis were carried out for pH, electrical conductivity (EC), total dissolved salts (TDS), total alkalinity (TA), total hardness (TH) as well as sodium (Na^+), potassium (K^+), chloride (Cl^-), sulphate (SO_4^{2-}), nitrate (NO_3^-) and fluoride (F^-) according to the standard methods (APHA, 2005). All the experiments were carried out in triplicate. The results were reproducible within ±3% error limit. The pH was measured using pH 600 Millwaukee make (made in Portugal) and Eutech-Cybernetics pH scan meter. Sodium and potassium was determined using ELICO CL-361 Flame Photometer. Ion meter (ion selective Orion electrode) was used to quantify fluoride and sulphate was determined using ELICO SL-164 Ultraviolet Spectrophotometer.

RESULTS AND DISCUSSION

The groundwater had no color, odor and turbidity. Taste of the water was slightly brackish at most of the locations. The result regarding the various physico-chemical parameters of groundwater collected from Basaltic and Granitic aquifers are presented in Table 1 and 2 respectively.

Hydrogen Ion Concentration (pH)

Generally pH of water is influenced by geology of catchments area and buffering capacity of water. The effect of pH on the chemical and biological properties of liquids makes its determination very important. The pH of the groundwater in the basaltic aquifers ranges from 7.16 to 8.35 and in the granitic aquifers the pH ranges from 7.2 to 10.32 (Figure 2). All samples have pH values more than 7, indicating alkaline nature of the samples. In general, the mean pH values of both the aquifers are more than the desirable limits of BIS (6.5-8.5).

Total Dissolved Solids (TDS)

Water with high dissolved solids may induce an unfavorable physiological reaction in the transient consumer and generally are of inferior palatability. The range of TDS values in basaltic and granitic aquifers was found to be in the range of 645-870 mg/l and 710-883 mg/l respectively. The Figure 3 shows that the TDS values are high in granitic aquifers than basaltic aquifers which are more than desirable limits of BIS.

Total Hardness (TH)
The hardness is due to the presence of polyvalent metal ion, e.g. Calcium and magnesium arising from dissolution of minerals. The total hardness is the measure of the capacity of water to precipitate soap [13]. The total hardness of ground water samples from basaltic aquifers was found in the range of 55-300 mg/l which is within the range of BIS limit and from granitic aquifers was found in the range of 62-456 mg/l which is further more than desirable range of BIS guideline. All groundwater samples were found to be hard except sample No. 9 in basaltic aquifers and very hard in granitic aquifers (Figure 4).

Total Alkalinity (TA)
The total alkalinity is mostly due to the presence of bicarbonate. The alkalinity of water is closely related to pH [5]. The value of alkalinity in water provides an idea of natural salts present in water. The Alkalinity values in basaltic aquifers and granitic aquifers were found to be in the ranges from 100 to 380 mg/l and 100 to 400 mg/l respectively. The total alkalinity of sample numbers 1, 2, 3, 4 and 7 is high in granite aquifers compared to basaltic aquifers and sample numbers 4, 6, 8, 9 and 10 is high in basaltic aquifers (figure 5) and more the desirable limits of BIS (200 mg/l).

Chloride (Cl^-)
The presence of chlorides in natural waters can mainly be attributed to dissolution of salt deposits in the form of ions (Cl^-). It is the major form of inorganic anions in water for aquatic life. The chloride content of all the groundwater from both the aquifers is within the desirable limit (250 ppm) of BIS, which indicates less contamination. When the chloride content of groundwater from basaltic and granitic aquifers is compares it is seen that the chloride content is more in groundwater from granitic aquifers than groundwater from basaltic aquifers except few exceptions (sample no. 2, 3, 4 and 7) (fig. 6).

Fluoride (F)
The Fluoride was recorded in 0.1 to 1 mg/l and 0.1 to 2 mg/l for groundwater of basaltic & granitic aquifers respectively. All the values are within permissible limit except for the sample no 6 from granitic aquifers. The Fluoride values are high in groundwater of basaltic aquifers as compared with groundwater of granitic aquifers (Figure 7). The fluoride content of sample no 6 from granitic aquifer (2 mg/l) is above desirable limit. If the fluoride concentration in drinking water is more than 1.0, it would result in fluorosis (dental and skeletal fluorosis) for human beings, especially for children and pregnant woman.

Nitrate (NO_3)
Nitrates are the most oxidized forms of nitrogen and the end product of the aerobic decomposition of organic nitrogenous matter. The groundwater contamination is due to the leaching of nitrate present on the surface with percolating water. Johnson and Reynolds (1977) found similar nitrate concentrations in stream water from plutonic rocks (quartz, granite) and from metamorphic and sedimentary rocks (schist and slate). The Nitrate contamination is common in basic extrusive granite formation and also may be attributed to the percolation of large amount of organic wastes from effluent nitrate fertilizers and other wastes like sewage disposal which on decomposition by microorganism results in the production of nitrates. Figure 8 show that, the nitrate content of groundwater of basaltic aquifers is well within the desirable limit of BIS (45 mg/l) except sample no 10. While the nitrate content from granitic aquifers range between to be 26 and 190 mg/l.

Sulphate (SO_4)
Sulphate ions usually occur in natural waters. Sulphates are found appreciably in all natural waters, particularly those with high salt content. Besides industrial pollution and domestic sewage, biological oxidations of reduced sulphur species also add to sulphate content. The sulphate content of groundwater from basaltic and granitic aquifers range between 12.0 to 56.1 mg/l and 14.0 to 62.0 mg/l respectively. The sulphate of groundwaters was found to be within the desirable limit from both basaltic and granitic aquifers (figure 9).

Sodium and Potassium (Na and K)
The major source of sodium and potassium is weathering of rocks besides the sewage and industrial effluents. The sodium content of groundwater from basaltic and granitic aquifers ranges between 16 to 150 mg/l and 32 to 129.3 mg/l respectively. The potassium content of groundwaters from basaltic and granitic aquifers ranges between 1.0 to 66 mg/l and 11 to 54.4 mg/l respectively.

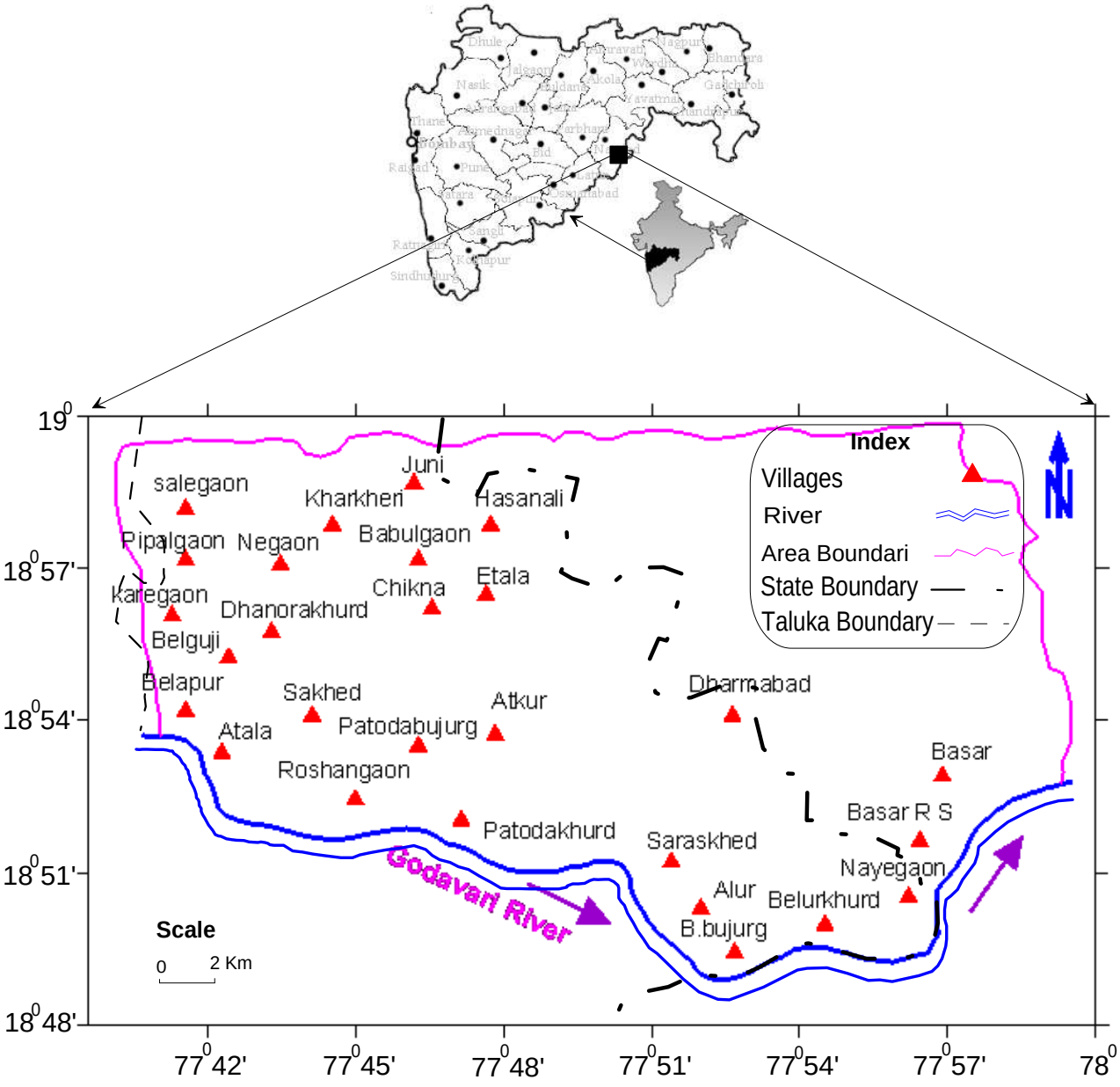

Figure 1: Location map of the study area

Table 1: Physico-chemical parameters of groundwater collected from Basaltic aquifers

Sr. No.	pH	EC	TDS	TH	TA	Cl^-	F^-	SO_4^{2-}	NO_3^-	Na^+	K^+
1	8.05	1060	678	148	220	57.2	0.72	23	22	52	66
2	8.35	1150	736	300	210	95.5	0	35.2	21	22	42
3	7.5	1260	806	268	156	72.1	0.46	56.1	19.5	29	1.4
4	7.4	960	645	172	130	38.2	1	42.1	20	30	5.6
5	7.6	1280	760	163	100	38.2	0.1	26.2	25	16	0
6	7.25	1300	832	215	180	27.4	0.16	22	28	20	1
7	7.8	1360	870	269	168	50.3	0	52.1	32.5	24.6	0
8	7.31	1060	678	192	380	42.5	0	12	35	79.6	87.1
9	7.16	1140	729	55	305	12	0.51	20.1	45	150	0
10	7.22	1210	774	148	300	20	0.93	18.6	49	112.2	0
Desirable limit of IS:10500:1991	6.5-8.5	--	500	300	200	250	1.0	200	45	--	--

Table 2: Physico-chemical parameters of groundwater collected from Granitic aquifers

Sr. No.	pH	EC	TDS	TH	TA	Cl^-	F^-	SO_4^{2-}	NO_3^-	Na^+	K^+
1	10.32	1330	851	456	360	114	0.39	20.5	190	100	14
2	7.5	1360	870	330	400	35	0.37	9.1	60	68	24.8
3	7.6	1380	883	268	330	32.5	0.15	13.4	88	74.5	22
4	8.2	1330	851	175	136	33.8	0.1	30	66	44.2	0
5	8.3	1280	819	139	100	42	0	14	64	32	12
6	8.3	1360	870	179	130	33.5	2	21	72	27.8	11
7	8.45	1110	710	153	210	12.5	0	13.1	70	49.8	28
8	7.71	1380	883	337	280	92	0	28	36	26.5	54.4
9	7.2	1140	729	220	200	56	0.4	62	38	72.5	0
10	10.2	1260	806	62	250	33.5	0.1	20	26	129.3	0
Desirable limit of IS:10500:1991	6.5-8.5	--	500	300	200	250	1.0	200	45	--	--

**All the values are expressed in mg/L except pH and EC.*
EC is expressed in µS/cm and ND- Not detected

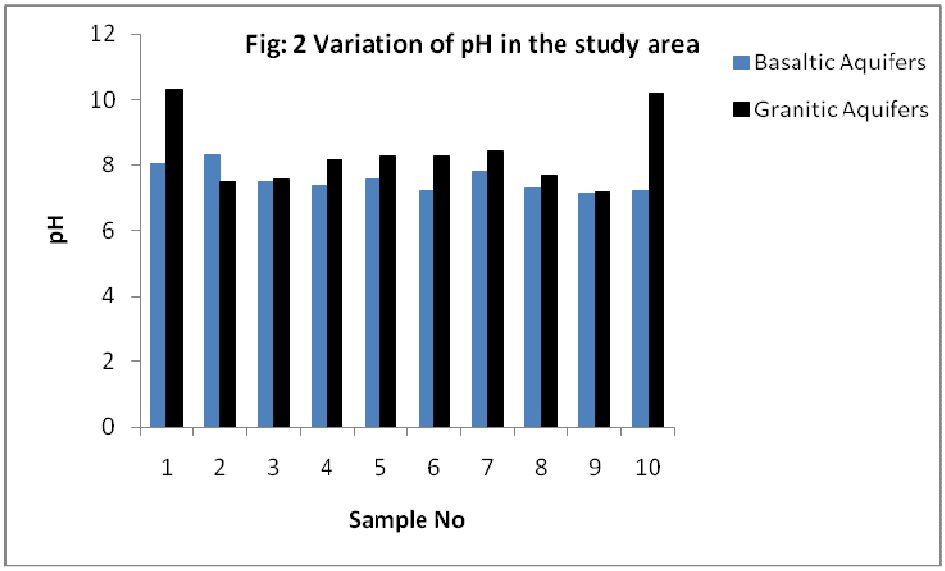

Figure 2: pH variation of the Study Area

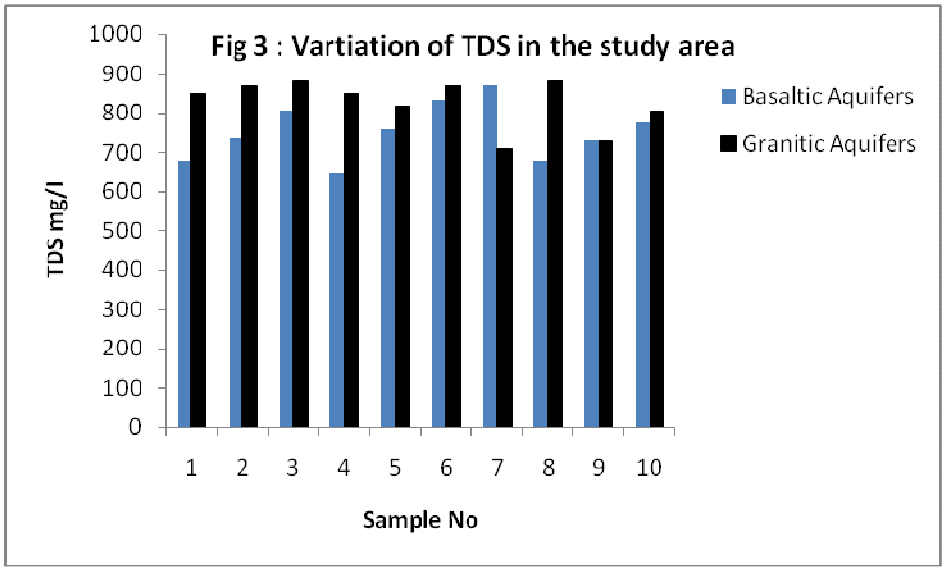

Figure 3: TDS variation of the Study Area

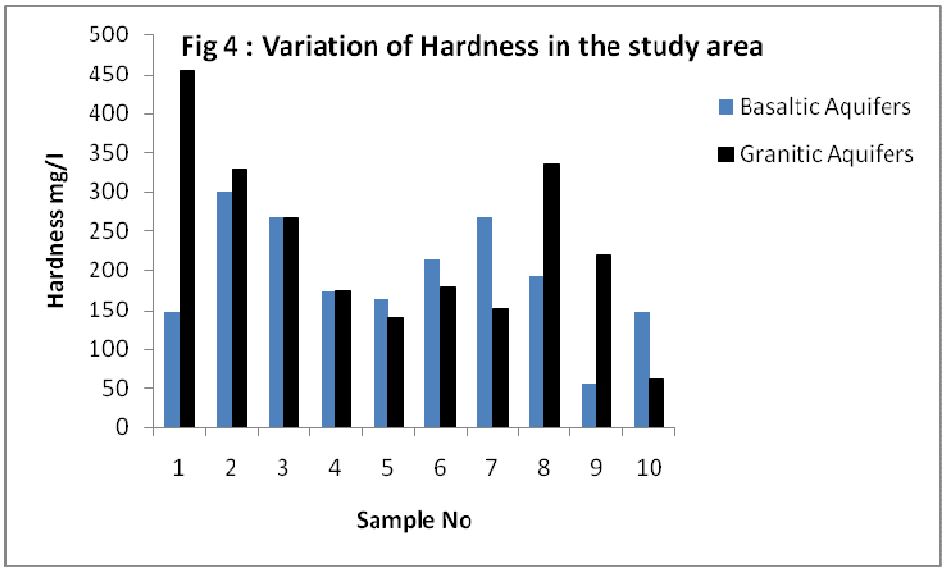

Figure 4: Total Hardness variation of the Study Area

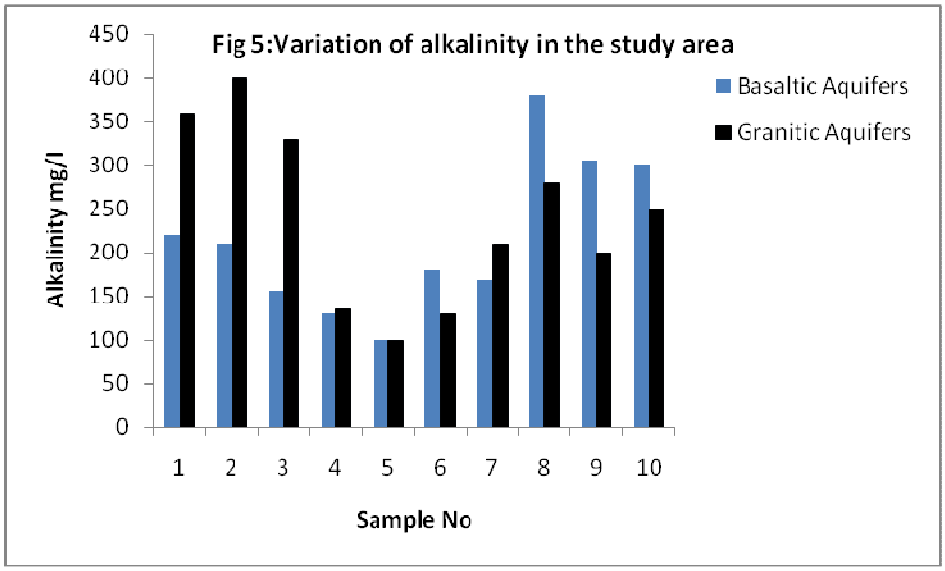

Figure 5: Alkalinity variation of the Study Area

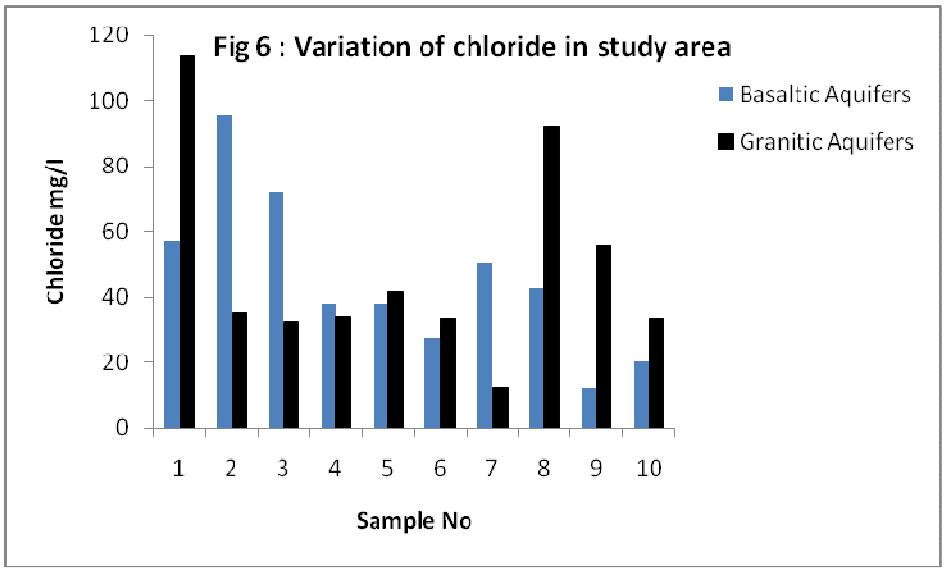

Figure 6: Chloride variation of the Study Area

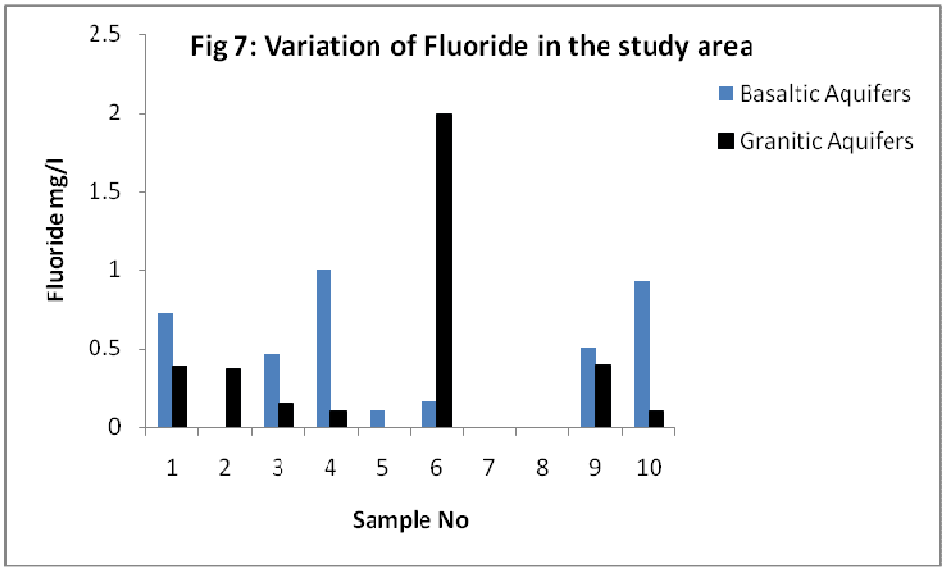

Figure 7: Fluoride variation of the Study Area

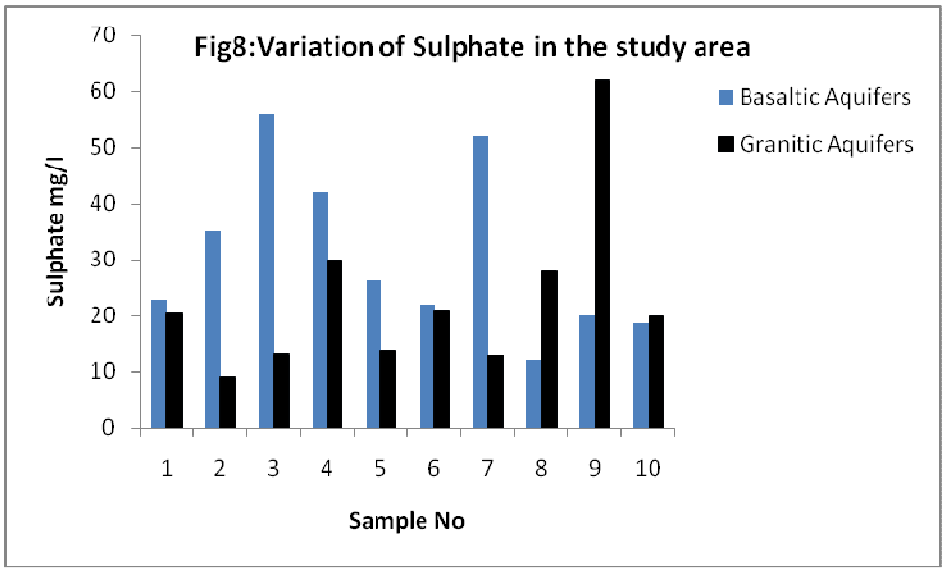

Figure 8: Sulphate variation of the Study Area

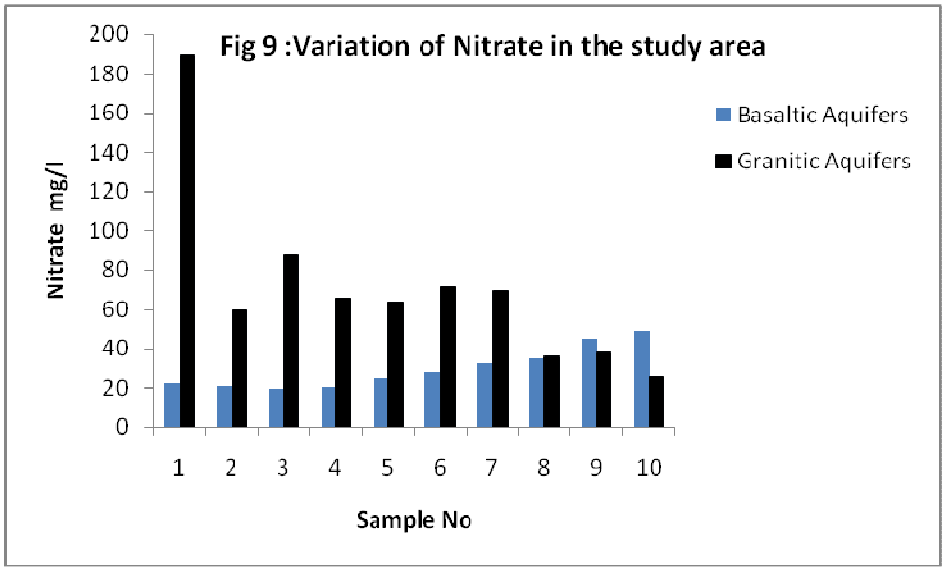

Figure 9: Nitrate variation of the Study Area

CONCLUSION

The groundwater samples collected and analyzed for various physico-chemical parameters of basaltic and granitic aquifers of Dharmabad taluka of Nanded district. The results of the above work show that most of the physico-chemical parameters like pH, TDS, TH, TA, F and NO_3 are more than desirable limit of BIS but within the maximum permissible limit. In most of the groundwater samples the average values of EC, TDS, Hardness, Alkalinity, Chloride, Nitrates are high from granitic aquifers as compare to basaltic aquifers in pre-monsoon season and the average values of Fluoride and Sulphate are high in basaltic aquifers. In groundwaters in some of the villages from both the aquifers have fluoride content above the safe limit (1.5 mg/l). The values also vary very widely within short distances and hence unpredictable. The nitrate contents are also high in drinking water in granitic aquifers in the study area because nitrate contamination is common in basic extrusive granite formation. The treated drinking water should be provided to the peoples from fluoride and nitrate contaminated villages. Rainwater harvesting is one of the solution to minimize the fluoride concentration in drinking water. Hydrological study of shallow and deep aquifers should be done in order to understand intensity of pollution and sources of pollutants.

REFERENCES

[1] APHA, AWWA,WPCF, Standard methods for examination of water and wastewater, 21st edition, American Public Health Association, Washington, DC (**2005**).
[2] Andre L, Frances chi M, Pouchan P, Atteia O. *J Hydrol*. **2005**, 305:40–62
[3] Arrate, J. M. Sanchez-Perez, I. Antiguedad, M. A. Vallecillo , V. Iribar, M. Ruiz. *Environmental Geology* 30 (3/4) April **1997** pp 257-265
[4] BIS:10500 (**1991**). Bureau of Indian Standards (BIS), Guidelines for Drinking-Water Quality standards.
[5] Brahmbhatt N. H, Rinku V. Patel and R.T. Jasrai. *Advances in applied science research*, **2012**, 3(3):1418-1422
[6] Foster, S. S. D. (**1995**). Groundwater for development – An overview of quality constraints. In H. Nash & G. J. H.
[7] Hamilton PA, Helsel DR (**1995**) *Ground Water* 33:217–226
[8] Jalali M (**2005c**) *Agric. Ecosyst Environ* 110:210– 218
[9] Johnson, A. H. and Reynolds, R. C., Jr. *Water Resources Res.* **1977**, 13, 469–473.
[10] McCall (Eds.), Groundwater quality. 17th Special Report (pp. 1–3). London United: Chapman and Hall.
[11] Nash, H., & McCall, G. J. H. (**1995**). Groundwater quality.17th Special Report. London, UK: Chapman and Hall.
[12] Office of the Technology Assessment (OTA) (**1984**). Protecting the nation's groundwater from contamination, vol. II. US Congress, OTA-0-276.

[13] Ramesh M., E. Dharmaraj and B. Jose Ravindra Raj. *Advances in applied science research*, **2012**, 3 (3):1709-1713
[14] Stites W, Kraft GJ (**2001**) *J Environ Qual* 30:1176–1184
[15] United Nations Environment Program (UNEP) (1999) Global Environment Outlook **2000**. Earthscan, UK
[16] Verma O. P., Bushra Khanan and Shruti Shukla. *Advances in applied science research*, **2012**, 3 (3):1531-1537