Available online at **www.joac.info**

ISSN: 2278-1862

Journal of Applicable Chemistry

2019, 8 (4): 1946-1952

(International Peer Reviewed Journal)

Seasonal Variation of Groundwater Quality of Coastal Villages of Olpad and Choryasi Taluka, Surat District, Gujarat, India

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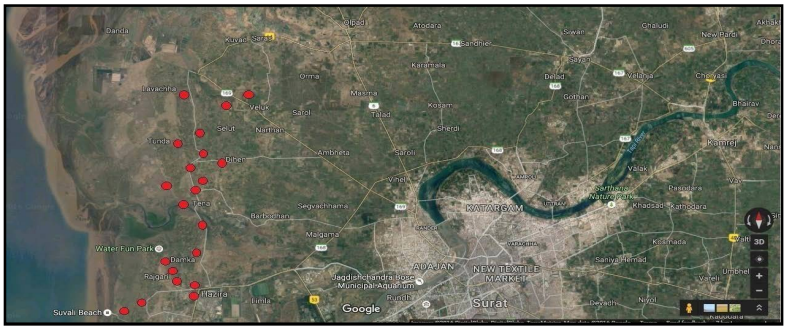
Accepted on 8th July, 2019

ABSTRACT

Seasonal study on the groundwater quality was carried out among the coastal villages of Olpad and Chroyasi taluka, Surat district in the year 2015-2016 and the study covers three seasons namely post monsoon, pre monsoon and monsoon. Ground water samples were collected from 20 different sampling stations of coastal villages of Olpad and Chroyasi taluka, Surat district and were analyzed for their physico-chemical characteristics by using the standard analytical procedure of APHA. The samples were analyzed for the following parameters like pH, Total alkalinity, Total hardness, Chloride and TDS. The results conclude that Total alkalinity, Total hardness, Chloride and TDS are above the permissible limit in the three seasons through all of these factors; may pose health hazard (on long term) the degraded quality of drinking water and therefore water requires treatment before using it for drinking purpose directly.

Graphical Abstract



Aerial view of Coastal villages of Olpad and Choryasi Taluka, Surat-Gujarat
(Image source: Google earth) Sampling stations

Keywords: Ground water, Physico-chemicals parameters, Seasonal study, Olpad and Choryasi Taluka.

INTRODUCTION

Water is unique liquid and is wonderful gift of nature, without it life is impossible. 2/3rd part of earth's surface is covered by ocean water [1] and that consist of 97% of water, rest 2.3% is covered by

glaciers and polar ice caps and land surfaces like rivers, lakes and ponds occupying 0.6% of water. Water is essential for survival; 70% body weight of all living organisms is due to water, so it should be clean, fresh and potable.

Good quality of drinking water is the basic requirement of every human and is one of the human rights. People of rural area who are living near the shore don't have generally municipal water purveyance in India and in many other countries. In many rural areas water is being used from bore well and well in most of all such cases the water is used directly for drinking purpose. Hence they render upon nearby groundwater sources for their daily needs which include farming, washing and bathing etc. Near seashore location due to seasonal fluctuations and faster withdrawal of groundwater makes sea-water intrusion possible in such areas [**2**]. High TDS > 4000 ppm and chlorides value >2000 ppm clearly supports the sea-water intrusion at coastal aquifer [**3**].

Due to fast industrialization, the population of coastal villages of Olpad and Choryasi Taluka has increased; as a result, demand of water is also increasing for industrial, agricultural as well as for domestic purpose. Therefore, it is essential for protection and management of ground water quality [**4**]. After collecting the samples, physico-chemical parameters of groundwater were studied. These water quality parameters were used to determine the quality of water and compared with drinking water standards prescribed by WHO (1993) and ICMR (1986) [**5, 6**]. In this direction, many researchers have carried out ground water study [**7-11, 21- 23**].

MATERIALS AND METHODS

Topography: Gujarat has area of 1, 95,984 sq. km. The state consists of the longest coastline of 7,516.6 kms in India [**12**]. Surat district is considered as developed district with pleasant climate. It is situated on the bank of Tapi river. Olpad is a Taluka in Surat district of Gujarat State, India. It is located 22 km towards North from district headquarters Surat. Choryasi is a Taluka in Surat district of Gujarat State, India. It is located 7 km towards west from district headquarters Surat. Olpad and Choryasi taluka covers the coastal track which is facing Arabian Sea. There is a chance of humidity in the weather. There are ample chances of sea water intrusion from Arabian Sea to Olpad and Choryasi taluka, if drinking water drawn at faster rate at SUDA area.

Study area: Different samples of ground water were collected from 20 sampling stations i.e. Junakavas, Hazira, Junagam, Suvali, Rajgari, Mora, Bhatlai, Damka, Vansva, Lavachha, Admor, Bhandut, Pinjarat, Tena, Motakosadiya, Chhini, Dhanser, Tunda, Maya and Dihen; Coastal villages of Olpad and Choryasi Taluka, Surat district is situated in radius 35 km. this area has large scale industrial development. Geographical location of study area is shown in the figure 1.

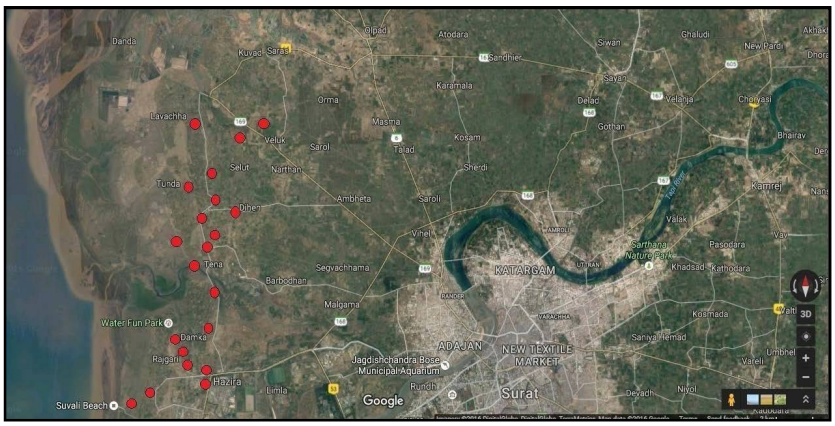


Figure 1. Aerial view of Coastal villages of Olpad and Choryasi Taluka, Surat-Gujarat (Image source: Google earth) Sampling stations

Temperature and rainfall: Summer temperature of Olpad and Choryasi taluka ranges between 30°C to 32°C. The climate is pleasant during the monsoon, average temperature ranges between 22°C to 26°C. The climate in winter is cool; the temperature ranges from 17°C to 21°C. The average rainfall in Olpad taluka is 977 mm and Choryasi taluka is 1274 mm.

Experimental: The present study deals with ground water quality monitoring of coastal villages during the May 2015 to April 2016. Samples were taken from coastal villages of Olpad and Choryasi taluka nearby residential area and industrial area of the Surat district. The ground water samples were collected by grab sampling method, for the further analysis samples were taken to laboratory in cleaned polythene bottles having capacity of 2 liter and labeled properly and stored in ice-box. Analytical grade chemicals were used without further purification [13]. The physico-chemical analysis was done according to APHA standard methods [14] for examination of water and waste water. The various physico- chemical parameters like pH, Total alkalinity, Total hardness, chloride and TDS studied.

RESULTS AND DISCUSSION

The physico-chemical parameters values of post monsoon, pre monsoon and monsoon seasons are represented in table 1 2 and 3.

Table 1. Physico-chemical parameters of groundwater sample in post monsoon

Parameter	pH	Total Alkalnity	Total Hardness	Chloride	TDS
Average	7.95	418.02	428.60	1300.67	823.22
Median	7.85	430	362.99	1137.15	839.5
Min.	7.25	0	57.96	466.20	271
Max.	8.66	1080	1075.9	4668.50	1766

Table 2. Physico-chemical parameters of groundwater sample in pre monsoon

Parameter	pH	Total alkalinity	Total Hardness	Chloride	TDS
Average	7.693	597.33	443.55	1161.14	1029.38
Median	7.665	555	330	934.8	981
Min.	6.89	255	45	232.86	252
Max.	9.38	1080	2560	5253.14	3460

Table 3. Physico-chemical parameters of groundwater sample in monsoon

Parameter	pH	Total alkalnity	Total Hardness	Chloride	TDS
Average	8.29	511.02	350.39	1141.95	636.73
Median	8.30	500	263.44	996.93	537.5
Min.	7.27	80	17.76	465.73	125
Max.	9.25	900	1411.92	3151.88	1679

pH: It was observed form the pH values were ranging from 7.25 to 8.66 in post monsoon,6.89 to 9.38 in pre monsoon and 7.27 to 9.25 in monsoon. Most of the samples are alkaline in nature except only one station in pre monsoon as acidic in nature. pH values of all the samples are within the permissible limit all the three seasons. pH trend is plotted in figure 1.

Total alkalinity: It was observed form the alkalinity values were ranging from 0 to 1080 in post monsoon, 255 to 1080 in pre monsoon and 80 to 900 in monsoon. Total alkalinity values of all the

samples are above the permissible limit all the three seasons. More alkalinity needs more water softening during treatment of raw water [6]. Total alkalinity is shown in figure 2.

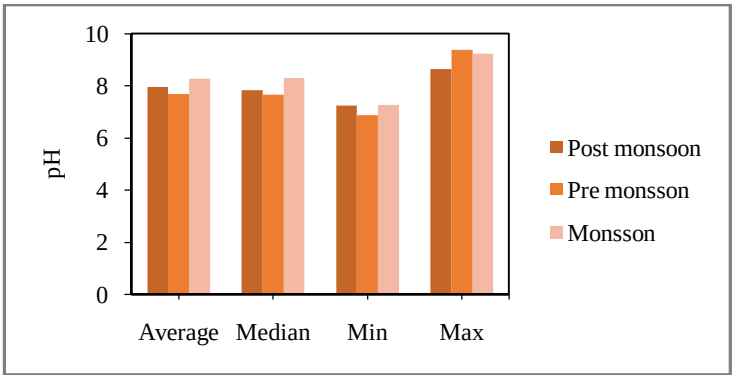


Figure 1. pH values in different seasons.

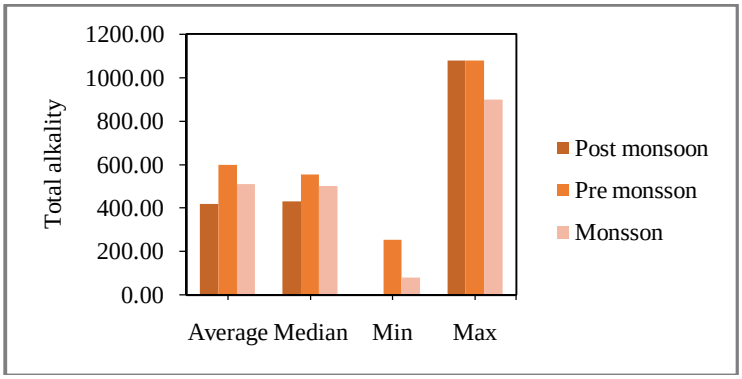


Figure 2. Total alkalinity in different seasons.

Total hardness: Total hardness is caused primarily by the presence of cations such as calcium and magnesium and anions such as carbonates and bicarbonates, chloride and sulphate in water [15, 20]. It was observed form the hardness values were ranging from 57.96 to 1075.9 in post monsoon, 45 to 2560 in pre monsoon and 17.76 to 1411.92 in monsoon. Most of the samples are above the permissible limit in all the three seasons. Principal cations imparting hardness are calcium and magnesium. So the high value is due to the dissolved Ca and Mg from sedimentary rocks and soil leakage and overflow. Hardness is called temporary if it is caused by bicarbonates and carbonates salts of cations, since it can be removal easily by boiling the water. Permanent hardness is caused mainly by sulphate and chloride of the metals [16]. Total hardness is shown in figure 3.

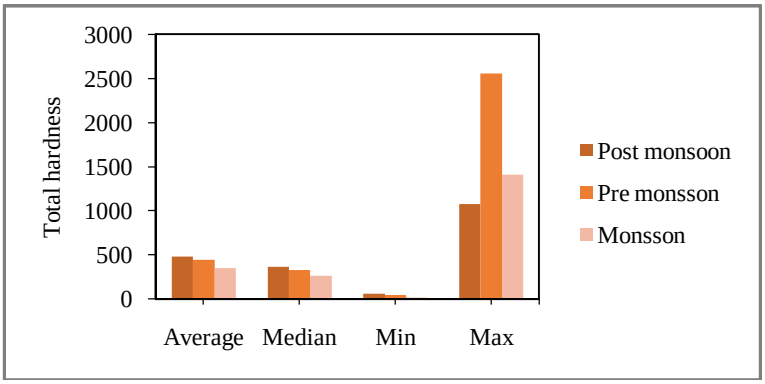


Figure 3. Total hardness in different seasons.

Chloride: It was observed form the chloride values were ranging from 466.20 to 4668.50 in post monsoon, 232.86 to 5253.14 in pre monsoon and 465.73 to 3151.88 in monsoon. Most of the samples are above the permissible limit in all the three seasons. High chloride reacts with sodium and makes water salty, which in unacceptable for human consumption. The higher percent of chloride leads to dangerous [19]. It also increases the TDS values there by affecting the quality of water. Chloride is shown in figure 4.

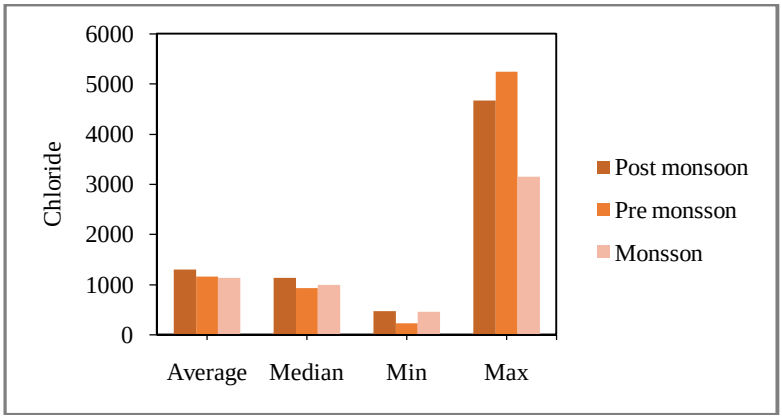


Figure 4. Chloride in different seasons.

TDS: The TDS are the sum of total cations and anions. It includes the total ionic species such as sodium, potassium, calcium, magnesium, chloride, bicarbonate, nitrate, sulphate and other trace elements [17]. It was observed form the TDS values were ranging from 271 to 1766 in post monsoon, 252 to 3460 in pre monsoon and 125 to 1679 in monsoon. Most of the samples are above the permissible limit in all the three seasons. It may be due to the agricultural runoff. Water with high dissolved solids generally has inferior palatability and may induce an unfavorable physiological reaction in the person who drinks it. Highly mineralized water is also unsuitable for many industrial applications [16, 18]. TDS is shown in figure 5.

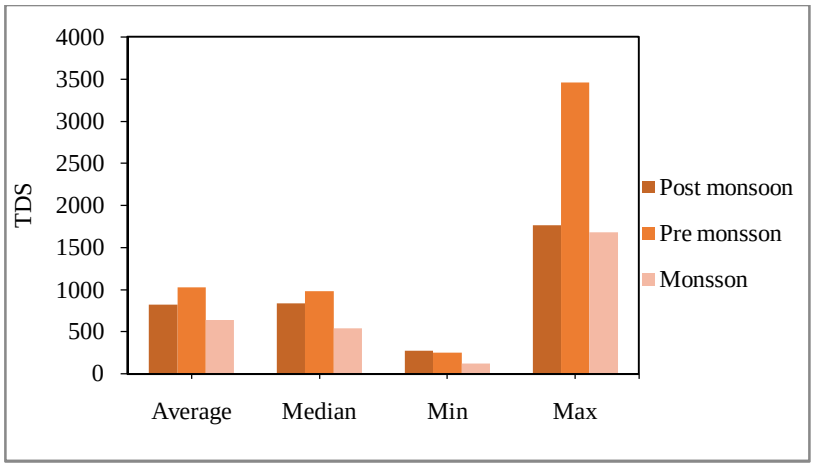


Figure 5. Total dissolved salts in different seasons.

APPLICATION

Study is done in the Coastal area of Olpad and Choryasi Taluka. And most important part is, in the coastal area peoples are using the water for both drinking as well as for domestic purposes. They treated water before drinking it.

CONCLUSION

It can be concluded from the results that the groundwater in radius of 22 km in Olpad and 7 km in Choryasi possesses high value of Total alkalinity, Total Hardness, Chloride and TDS. The results found to be high value in most of the sample in all the three seasons. All of these factors may pose health hazard (on long term), degraded quality of drinking water and therefore require to be treated before directly drinking purpose.

ACKNOWLEDGEMENTS

The authors are thankful to Principal Dr. A. S. Patel, Navyug Science College, Surat for providing necessary research facility. Patel F. T. is thankful to the authorities of UGC for the award of NFOBC Fellowship.

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