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The Effect of Seasonal Variation on Physicochemical Properties of Tubewell Water of Latur District (MS), India.

S. N. Birajdar,[1] S. G. Vedpathak,[2] U. B. Chanshetti[3]
[1]*Department of Chemistry, Shankarrao Jawale-Patil Mahavidyalaya Lohara, Dist: Osmanabad (MH) India.*
[2]*Department of Chemistry, S. M. Dnyandeo Mohekar Mahavidyalaya Kalamb, Dist: Osmanabad (MH) India.*
[3]*Department of Chemistry, Arts, Science & Commerce College Naldurg, Dist: Osmanabad (MH) India.*
Corresponding author: ubchanshetti@gmail.com

Abstract: *The effect of seasonal variation on physicochemical properties of tubewell groundwater from various stations in Latur district of Maharashtra State was evaluated. The samples taken in three seasons (summer, monsoon and winter) from eleven different stations and were analyzed for major physico-chemical parameters such as temperature, pH, electric conductivity(EC), total hardness (TH), total dissolved solids (TDS), total alkalinity (TA), Ca^{+}, Mg^{+}, Cl^{-} by using standard analytical methods. The analysis showed that drinking water quality in the study area is rationally good and doesn't show any most awful level of pollutants. But it needs modest degree of treatment before utilization as the concentration of the parameters goes beyond the tolerable limits for drinking water.*

Keywords: *Dissolved oxygen, Electric conductivity, Latur, Total hardness, Tubewell water*

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Water is of great essence for life. The essentiality of water for living systems is quite apparent as without water, there is no life. It has a number of unique chemical and physical properties that make it essential for life. One such property is the only substance that exists naturally on Earth in all three physical forms of matter (gas, liquid, and solid). The Earth has oceans of liquid water and polar regions covered by solid water. Water vapour is a greenhouse gas that ensnares energy radiated from the surface of the earth and assists to maintain the earth planet warm enough to sustain the complex life that has evolved in this environment. It is being used for many purposes e.g., industrial water supply, irrigation, drinking, propagation of fish and other aquatic systems and generation of hydro-power plants.

Water covers about 70% of Earth's surface. Despite of this, less than 1% of the water on earth is actually fresh and utilizable. That signify only 1% part is accessible on land for drinking and domestic purpose, agriculture, power generation, industrial utilization, transportation and waste disposal.[1-4] Due to healthy population in India, the limited sources surface of water demands the need of ground water resources for drinking water and domestic purpose. The groundwater is supposed to be moderately clean and free from pollution than surface water. But growing population, accelerating industrialization and intensification of agriculture and also urbanization exert heavy pressure on our immense but limited water resources which results water pollution and created health problems. According to WHO organization, about 80% of all the diseases in human beings are caused by water.[3] Hence, there is always a need for and concern over the protection and management of surface water and groundwater quality. At many places, that severely limits the beneficial use of water for domestic and industrial application. The lakes have complex and fragile ecosystem, as they do not have self cleaning ability and readily accumulate pollutants.[4-7] Hence it is essential to check the quality of water at regular time to minimize the water born diseases. The aim of the present study was to give an idea about the pollution level of pond water in terms of physico-chemical characteristics. Considering the above aspects of surface water contamination, the present study was undertaken to investigate the physicochemical aspects of the surface water from some selected areas of Latur district of Marathwada region. Thus, an attempt has been made to assist the physical and chemical parameters of tubewell water, like Temperature (T), pH, electrical conductivity (EC), total dissolved solids (TDS), chemical oxygen demand (COD), total hardness (TH), total alkalinity (TA), calcium hardness (Ca H), magnesium hardness (Mg H) and chloride (Cl), was determined. The analyzed data were compared with standard values recommended by WHO.[7]

I. Experimental

1.1 Study area

The physicochemical analysis of water quality of tubewell water of Latur district, Maharashtra, India was carried out in the present study. The Latur district lie in the south-eastern part of the Maharashtra state situated on the Balaghat plateau, 540 to 638 mtrs from the mean sea level located between 17°52' to 18°50' North and 76°18' to 79°12' East. The climatic condition of the study area becomes hot in summer and cool in winter. Most of the rainfall occurs in the monsoon season from June to September. Rainfall varies from 9.0 to 693 mm/month. Average annual rainfall is 725 mm. In the present study period temperature range a minimum 29ºC and a maximum of 38ºC. The region gets much rainfall from south west monsoon. The place gets most of its rainfall from June to September during the monsoon. In October and November also increased rainfall from the north east monsoon. The average rainfall of this study area is 100.9 mm.

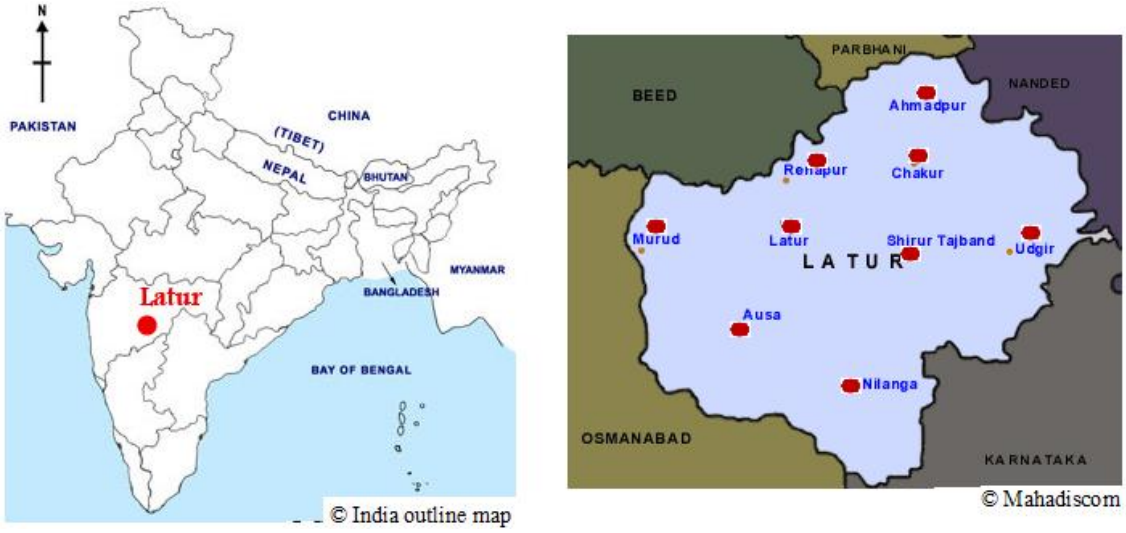

Figure-1 Sampling sites in Latur district

The ground water collected from the tubewells located at 12 different sites for Latur district, Maharashtra during March 2016 to February 2017 in three seasons (summer, monsoon, winter). The depth of the tubewells ranges from 90-350 feet in all these stations. The sampling locations, source and corresponding habitats are shown in Table 1.

1.2 Preparation of water samples

Pre-cleaned 2.0 litres polypropylene bottles, using standard procedure of grab or catch as per the methods of APHA,[8] were used for the collection of all samples. Temperatures of the samples were measured in the field itself at the time of sample collection. The samples were kept in refrigerator maintained at 5^{o}C. AR grade chemicals and reagents were used for water analysis.

Table 1. Sampling sites and corresponding habitats

Sr. No.	Sampling Site	Code	Habitat	Source
1	MIDC, Latur	S_1	Commercial	Tubewell
2	Harangul, Latur	S_2	Commercial	Tubewell
3	Mitra nagar, Latur	S_3	Residential	Tubewell
4	Shivajinagar, Murud	S_4	Residential	Tubewell
5	Vishvashanti dham Chakur	S_5	Residential	Tubewell
6	Kharola road, Renapur	S_6	Residential	Tubewell
7	Hashmi nagar, Aura	S_7	Residential	Tubewell
8	Vidhya nagar, Nilanga	S_8	Residential	Tubewell
9	Shirur Tajband	S_9	Residential	Tubewell
10	KGN nagar, Ahmedpur	S_{10}	Residential	Tubewell
11	Khadkali, Udgir	S_{11}	Commercial	Tubewell

All the samples in three seasons were examined within three days of collection for major physical and chemical water quality parameters like pH, Electrical conductivity (EC), Total Dissolved solids (TDS), total hardness (TH), Ca^{2+}, Mg^{2+}, as per the method Assessment of Ground Water Quality described in "Standard

methods for the examination of water and wastewater American Public Health Association (APHA).[8] The pH of all the water samples was determined using a pH meter (Model no LI120, Elico), calcium content by EDTA titrimetric method, total hardness (TH) by EDTA titrimetric method, chloride content by argentometric method, methyl orange for alkalinity and chemical oxygen demand (COD), total dissolved solids (TDS) by standard methods,[9] by open reflux method.

II. Result and Discussion

The ground water samples S_1 to S_{11}, collected from 11 sites in Latur district in three seasons, were evaluated for their physicochemical parameters are presented in Table 2. The temperature of on field samples was found to be in the range between 17.2 to 32.6^{o}C. The higher values could be attributed due to the summer season and minimum value of 17.2^{o}C in winter season prevailed during the period of investigation. The pH value is an important index of acidity or alkalinity of drinking water and is an important ecological factor. This means that pH of water is not a physical parameter that can be measured as a concentration or in a quantity. The slight alkaline nature of most of the water samples is attributed due to presence of carbonates and bicarbonates. The pH of water changes with various components like air temperature. The pH of water increases as the rate of photosynthetic activities reduces, due to lesser absorption of carbon dioxide and bicarbonates, and the low oxygen values also coincide with high temperature during summer season. In the present work, the average pH ranges from neutral to alkaline values ranging from 6.8 to 8.4 (Table 2). Out of the ground water analyzed, the minimum pH (6.5) was observed during summer season at S_5 and maximum average pH value (8.6) was recorded in the winter at S_1 and S_5 (Fig. 2a). The pH values are lower in summer while higher in winter and vary in a relatively small range and reveals slight alkaline nature.

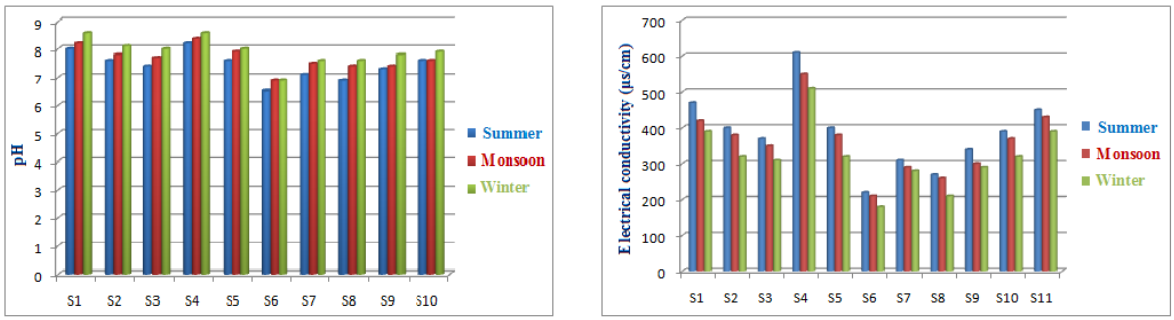

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Figure-2 Seasonal variations in a) pH and b) Electrical Conductivity of Latur District tubewell water

The Electrical conductivity is a measure to the capacity of water to conduct electrical current, it is directly related to the concentration of salts dissolved in water, and therefore to the Total Dissolved Solids (TDS). EC values of Latur district tubewell water were in the range of 180 - 610 µs/cm during the present study. The seasonal variations of present work revealed that EC was high during summer seasons (610 µs/cm) indicating the presence of high amount of dissolved inorganic substances in ionized form and low during winter seasons (180 µs/cm) (Fig. 2b). Electrical conductivity shows significant higher values at commercial sites as compared with residential sites.

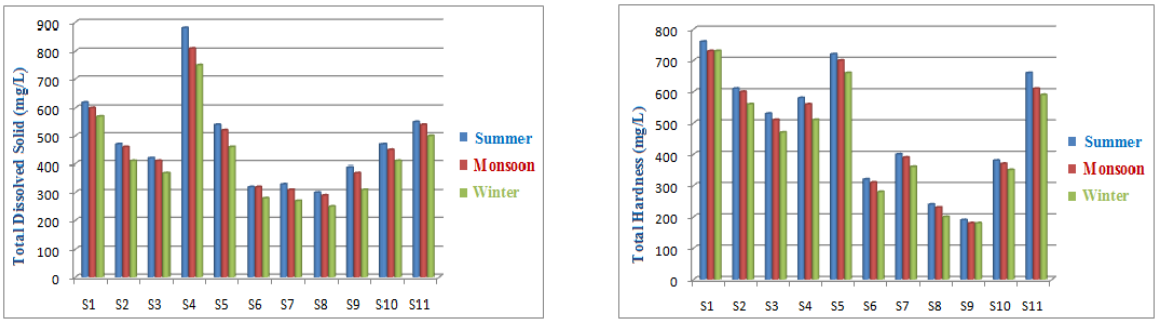

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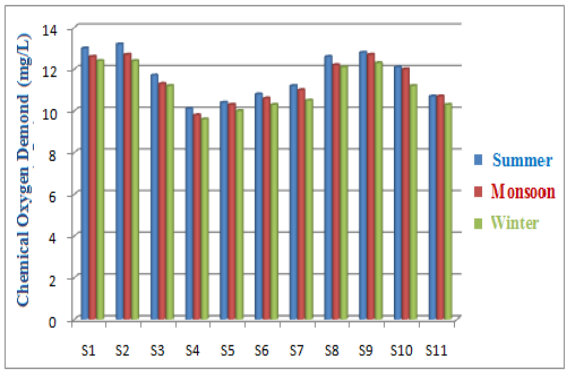
Figure-3 Seasonal variations in a) Total Dissolved Solids and b) Total Hardness of Latur District tubewell water

Table 2. Physicochemical parameters of tubewell water of Latur District

Sr. No.	Code	pH			EC µs/cm			TDS mg/L			COD mg/L			TH mg/L			Alk. mg/L			Ca H mg/L			Mg H mg/L			Cl⁻ mg/L		
1	S_1	S	M	W	S	M	W	S	M	W	S	M	W	S	M	W	S	M	W	S	M	W	S	M	W	S	M	W
1	S_1	8.0	8.2	8.6	470	420	390	620	600	570	13.0	12.6	12.4	760	730	730	360	380	430	200	190	170	40	40	30	110	80	90
2	S_2	7.6	7.8	8.1	400	380	320	470	460	410	13.2	12.7	12.4	610	600	560	280	310	340	170	170	160	40	40	30	80	50	60
3	S_3	7.4	7.7	8.0	370	350	310	420	410	370	11.7	11.3	11.2	530	510	470	210	220	250	140	130	110	30	30	20	60	30	40
4	S_4	8.2	8.4	8.6	610	550	510	880	810	750	10.1	9.8	9.6	580	560	510	320	330	360	60	60	40	110	90	70	140	100	110
5	S_5	7.6	7.9	8.0	400	380	320	540	520	460	10.4	10.3	10.0	720	700	660	110	100	140	70	60	40	50	50	30	30	20	30
6	S_6	6.5	6.9	6.9	220	210	180	320	320	280	10.8	10.6	10.3	320	310	280	140	140	180	90	80	60	30	30	30	20	10	20
7	S_7	7.1	7.5	7.6	310	290	280	330	310	270	11.2	11.0	10.5	400	390	360	110	130	150	50	40	40	40	30	30	50	30	30
8	S_8	6.9	7.4	7.6	270	260	210	300	290	250	12.6	12.2	12.1	240	230	200	90	90	120	30	20	20	30	30	20	30	20	30
9	S_9	7.3	7.4	7.8	340	300	290	390	370	310	12.8	12.7	12.3	190	180	180	160	170	210	20	30	20	40	40	20	20	20	20
10	S_{10}	7.6	7.6	7.9	390	370	320	470	450	410	12.1	12.0	11.2	380	370	350	250	270	300	40	40	30	80	60	60	40	30	40
11	S_{11}	7.2	7.5	7.7	450	430	390	550	540	500	10.7	10.7	10.3	660	610	590	320	330	380	120	100	90	70	50	40	60	40	60

A total dissolved solid (TDS) of water determines the combined content of all organic and inorganic substances present in it. In the present study, the TDS exhibited a wide range of disparity with a minimum value of 250 mg/L in summer season and maximum of 880 mg/L during winter season. During the winter season, the range of the concentration of TDS of tubewell water was 250 – 750 mg/L. The TDS of water during the study period shows significant higher values of samples taken in summer as compared with winter (Fig. 3a). This may be due to the climatic change and presence of decreased water level of tubewells. The TDS of all samples was observed within the limits (500 mg/L) of WHO for drinking water except sample S_1, S_4, S_5 and S_{11}. Usually the water samples have high values of TDS making them unsuitable for drinking purpose.

Chemical Oxygen Demond[8] (COD) is a measure of the oxygen required for the oxidation of organic matter with the help of strong chemical oxidant. High COD may cause oxygen exhaustion on account of decomposition of microbes to a level unfavorable to aquatic life. The experimental COD values in all the stations are varying from 9.6 to 13.2 mg/L which is extreme lower than the permissible limit of COD for drinking water is 255 mg/L. The COD values are lower in winter season and higher in summer (Fig. 4a).



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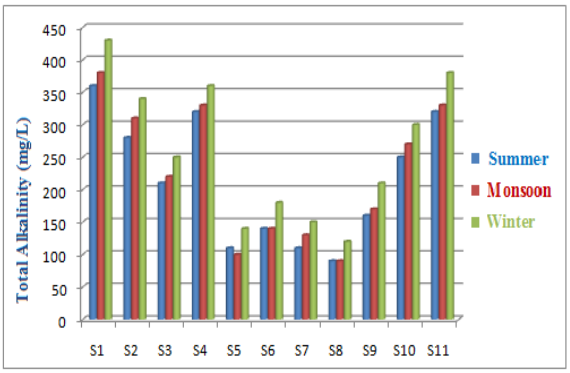

b

Figure-4 Seasonal variations in a) Chemical Oxygen Demand and b) Total Alkalinity of Latur District tubewell water

Total alkalinity shows the presence of natural salts in water. Alkalinity results due to the contribution of various types of salts like bicarbonate, hydroxide, phosphate, borate and organic acids.[10] Total alkalinity obtained in the range of 90 mg/L to 430 mg/L. The highest value shows during the winter months and lowest in the summer months during both the study period (Fig. 4b). The values of alkalinity in the tubewell water of present study exceeded the desirable limit of potable water (120 mg/L) [9] in all stations except S_5, S_7, and S_9.

Hardness of water is a significant measure to resolve the usability of water for domestic, drinking and many industrial supplies.[11] Calcium content in water plays very important role in growth and metabolism of

aquatic organisms and its presence gives alkaline nature to the water. In the present investigation calcium content ranges from minimum of 20 mg/L in winter season (Sample S_8 and S_9) and maximum of 200 mg/L in summer season (Sample S_1) (Fig. 5a). These values are far away from the tolerable limit values as prescribed by ICMR, BIS and WHO. A gradual decrease in the concentration of calcium in all sampling sites was observed from summer to winter season due to increased water level of tubewells. The magnesium content of tubewell water varies from 20 mg/L to 110 mg/L which are far away from the permissible limit as prescribed by WHO for drinking water (Fig. 5b).

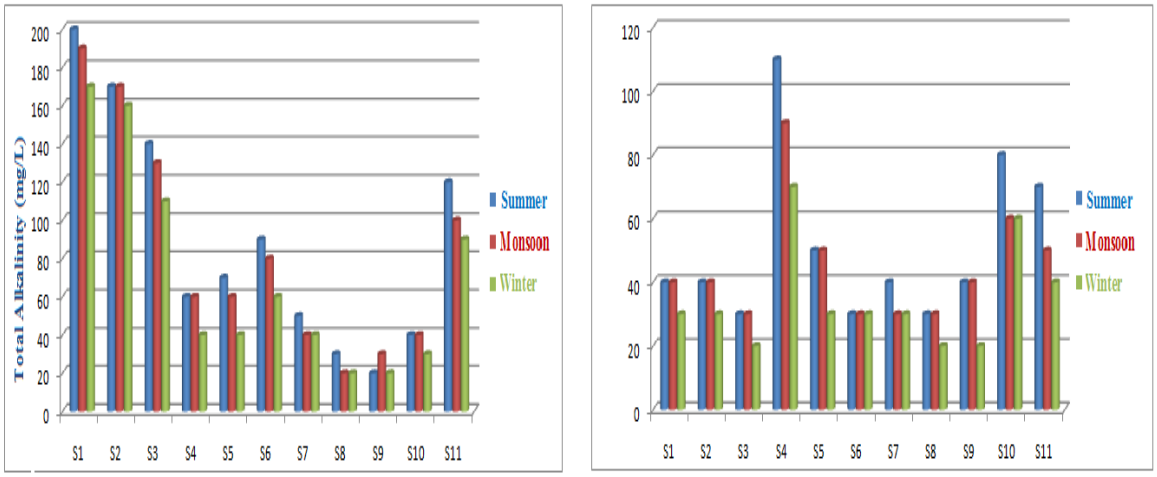

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Figure-5 Seasonal variations in a) Calcium and b) Magnesium hardness of Latur District tubewell water

Chloride is believed as one of the most important inorganic anion in water. Due to its high solubility character, it occurs naturally in all types of water and also largely attributed due to evaporation and precipitation.[12] In the present study, chloride content value ranges between 10 mg/L to 140 mg/L. In the present investigation, minimum chloride was recorded during winter season and maximum during the summer season (Fig. 11).

III. Conclusion

The overall quality assessment of selected sites of Latur district shows that most of the parameters are within the level of pollution recommended by WHO for drinking water quality with few exceptions. The study also reveals that the pH, total hardness, COD, calcium and chloride ion values are well within the permissible limits. All the physicochemical parameter values increases gradually from summer to winter through monsoon except alkalinity where exactly opposite trend has been observed. The TDS of S_4 was well above the desirable limit and the average of alkalinity has also within the desirable limits. In conclusion, the tubewell water from selected sites of Latur district is good for domestic and drinking purpose but necessitate some amount of treatment to reduce the contamination especially TDS and alkalinity.

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