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Pre and Post Monsoon Monitoring of Ground Water Quality in Region Near Kupwad MIDC, Sangli, Maharashtra.

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Abstract: Degradation of water resources in rural and urban area due to industrialization, urbanization, over-population and modern lifestyle is becoming serious issue for the mankind. These resources are being deteriorated by various ways at high alarming rate. As water is one of the basic amenity for human being, waterborne diseases have adverse impact on human health. As well as use of contaminated water for domestic purposes and irrigation have irreversible disadvantages on human civilization. So pre and post monsoon study of physico-chemical characteristics of ground water (bore well and dug well) in region near Kupwad MIDC is done, to know its suitability for domestic use and irrigation. Water samples were collected from twelve different sites covering borderline area of MIDC and neighboring village downstream to it. These samples were analyzed for various parameters such as pH, EC, TDS, total hardness, Ca/Mg hardness, Na^+, K^+, total alkalinity, chlorides, free CO_2, DO, sulphate, nitrate and phosphate using standard method. It was found that values of TDS, total hardness, chloride, Na^+, total alkalinity and sulphate of the samples are out of the highest desirable limit or exceeded the permissible limit. Some samples are extremely hard and highly saline and absolutely unfit for consumption, domestic use and irrigation. Half of these twelve sites are moderately hard and saline for which proper treatment is essential before its domestic and irrigational use. The study reveals no major changes in water quality during study period i.e. pre and post monsoon. This is because of industrial effluent, which is percolated through ground as well as mixed with water stream causing deterioration of water resources.
Key words: Ground water, quality, physico-chemical parameters, MIDC, irrigation, effluent.

Introduction

Water plays a vital role in human life .The consequences of urbanization and industrialization leads to deterioration of quality of the water[1]. During last few decades, it is observed that ground water get polluted drastically because of Rapid industrialization, improper solid and toxic waste management[2-3]. Consequently number of cases of water borne diseases has been the cause of health hazards, as well as use of such water for agriculture purposes leads adverse effect on crop production & fertility of agricultural land. Groundwater resource in study area (Savali) is widely exploited for irrigation and other domestic purposes in addition to drinking purpose. The chemical composition of groundwater plays a significant role in determining the water quality for various utility purposes[4]. The objective of the study is to analyze the physico-chemical parameters of water along 12 locations of villages nearby Kupwad MIDC for pre monsoon and post monsoon (during 2012) period.

Methodology

Two liters of groundwater samples were collected in a clean polyethylene bottles from all the sampling locations in dug wells and bore wells from the study area. The samples collected were characterized by different parameters such as pH, conductivity, TDS, total alkalinity, total hardness, Calcium, Magnesium, Chloride, Nitrate, Sulphate, Phosphate, Sodium, potassium, DO, free CO_2 etc. The temperature, pH is recorded by pH-meter (Model No. EQ-610 Equiptronics), conductance is measured by conductivity bridge (Model No. EQ-660, Equiptronics). The other parameters are determined by using standard method available in literature[5].

Results and discussion

The physico-chemical characteristics of groundwater in the area of investigation are given in Table-1 and Table-2. There is little variation in the physical characteristics of groundwater, whereas the changes have been noticed in the chemical parameters of the groundwater in the study area.

The pH value of the samples in the study area varied from 6.5 – 7.5 during pre monsoon and 6.4 – 7.6 during post monsoon, indicating slightly acidic to slightly alkaline nature. pH below 6.5 starts corrosion in pipe thereby releasing toxic metals such as zinc, lead, cadmium and copper. Electrical conductivity value varied from 121 – 782 µmhos/cm and 129 – 769 µmhos/cm during pre and post monsoon respectively. Slightly increase or decrease in EC values may be due to concentration and rainfed dilution during pre and post monsoon.

The total dissolved solids (TDS) ranges from 540 – 10500 mg/l and 500 to 10000 mg/l during pre and post monsoon period. Dissolved inorganic salts, small amounts of organic matter and gases contribute to TDS. Based on TDS groundwater is classified as follows:

Classification	TDS in mg/l
Non – saline	< 1000
Slightly saline	1000 - 3000
Moderately saline	3000 - 10000
Very saline	10000 - 35000
Brine	> 35000

Water from Site B7 is highly saline while other sites except B10 are slightly or moderately saline. Increase in TDS during pre monsoon is due to evaporation effect while in post monsoon increase is contributed by dissolution of salt and industrial discharge by rain water.

Alkalinity is a measure of ability to neutralize acids. Excess alkalinity gives bitter taste to water and reacts with cations forming precipitates, which can damage the pipes, valves, etc. Total alkalinity ranges from 110 mg/l to 290 mg/l and 120 to 280 during study period the maximum value (290 mg/l) was recorded in pre-monsoon period.

Total hardness is due to the presence of cations such as calcium and magnesium and anions such as carbonate, bicarbonate, chloride and sulphate in water. Water hardness has adverse effects; hardness above 500 mg/l is undesirable for domestic use or irrigation, as it causes unpleasant taste to water, spoils milk, tea and reduces ability of soap to produce lather, forms scaling inside the irrigation pipes and chokes the nozzles of drip line. In this region, the total hardness varies between 400-2500 mg/l and 375-2400 mg/l during pre and post monsoon. The maximum allowable limit of TH for drinking purpose is 500 mg/l and the most desirable limit is 100 mg/l. The total hardness is very high in all samples except at site B10. Values are slightly higher in pre monsoon than post monsoon season. Variation in hardness is due to leaching of carbonate and bicarbonate salts in rainy season. Water from site B1 and B7 is extremely hard, this may be due to geology of the rocks and industrial discharge; as these sites are near to water streams which flows downstream to MIDC.

Calcium harness fluctuates between 204.4 to 921.8 mg/l and192.4 to 965.9 mg/l during pre and post monsoon period. High values of Ca hardness at some site during post monsoon season are due to dissolution of $CaCO_3$ by water recharge. Sodium content ranges between 230 to 534 mg/l and 290 to 480 mg/l during study period. Na and K concentrations are higher than desirable limit almost in all sites in both seasons. Potassium concentration is between 2.98 to 14.12 mg/l and 3.13 to 14.8 in pre monsoon and post monsoon season respectively, slight increase is noticed in post monsoon period.

The chloride concentration varied from 390 - 2750 mg/l and 350 - 2649 mg/l during pre and post monsoon. Most of sites in study area have higher concentration of chlorides, which could be dangerous from health point of view. Sites B1, W3 and B7 shows extremely high concentration of chlorides as these sites are directly affected by industrial discharge.

The nitrate concentration in groundwater collected from the study area ranged between 10.30 to 32.79mg/l in pre and post monsoon. It is well known that the nitrogenous fertilizers are one of the important sources for groundwater nitrate. In excessive limits, it contributes to the illness known as methenglobinemia in children. The permissible limit of nitrate is 45 mg/l prescribed by standards. Hence as far as the nitrate is concerned it is within the permissible limit. The origin of nitrate is may be from agricultural areas due to leaching process from plant nutrient, nitrate fertilizers.

The sulphate is mainly derived from gypsum. The sulphide minerals add the soluble sulphate into the groundwater through oxidation process. In present investigation sulphate concentration was ranged from 12.06 - 75mg/l and 16.65 – 89.40 mg/l during pre and post monsoon season. In the study area the sulphate level is within the permissible limit of 250 mg/l. The higher sulphate content in post monsoon may be contributed due to bio chemical, anthropogenic sources and industrial process etc.

The value of phosphate fluctuates from 0.12 - 0.61 mg/l during pre monsoon and 0.23 to 0.75 mg/l during post monsoon, the maximum value (0.75mg/l) was recorded in post monsoon season. The high values of phosphate rain, surface water runoff, agriculture run off.

Parameters	B1	W2	W3	W4	B5	W6	B7	W8	W9	B10	W11	W12
pH	7.1	7.2	6.5	7.1	6.5	7.3	7.5	7.0	6.8	7.1	7.0	7.1
Conductivity	716	254	692	437	454	252	782	242	221	121	190	351
TDS	3400	1500	3500	2200	3200	1100	10500	1350	1240	540	1500	1050

The DO concentration is an indicator of organic pollution. It depends upon physical, chemical and biological activities of water body. The DO fluctuates from 4.5 mg/l to 7.4 mg/l during study period. Very slight increase is noticed in post monsoon season.

The value of free CO_2 ranges from 15.12 mg/l to 70.28 mg/l and 17.6 – 73.92 mg/l during pre and post monsoon. It may depend upon alkalinity and hardness of water body. Little increase is observed in post monsoon period.

Pre-Monsoon

Total Alkalinity	140	290	210	248	225	270	110	250	275	230	240	210
Total Hardness	2200	800	1890	1450	1330	750	2500	800	760	400	510	970
Ca Hardness	801.6	364.7	800.7	761.5	649.3	396.8	921.8	348.7	324.6	204.4	276.6	480.9
Sodium	300	231	534	230	314	300	532	365	305	386	346	389
Potassium	5.32	5.16	4.85	5.65	4.89	5.15	12.23	3.65	4.74	2.98	14.12	12.26
Chloride	2750	600	2500	1310	1290	540	2200	820	850	390	510	1560
Nitrate	22.45	12.22	23.56	16.19	15.12	12.35	20.72	21.28	20.45	10.30	19.60	20.05
Sulphate	75.00	14.65	74.42	35.25	29.85	15.15	56.95	12.59	16.65	20.15	12.06	32.12
Phosphate	0.59	0.23	0.51	0.61	0.59	0.25	0.38	0.40	0.41	0.12	0.22	0.53
Dissolved Oxygen	5.4	7.4	7.3	7.1	4.5	6.8	6.5	6.8	7.1	6.4	7.2	7.1
Free CO2	25.12	19.18	40.15	30.25	50.13	70.28	25.12	40.12	40.12	15.12	15.12	19.18

All values are in mg/l; except pH and EC, unit of EC are μmhos/cm (B- bore well,W- Dug well).

Post-Monsoon

Parameters	B1	W2	W3	W4	B5	W6	B7	W8	W9	B10	W11	W12
pH	7.2	6.4	7.3	7.0	6.7	7.2	7.6	6.9	6.9	7.0	7.2	7.0
Conductivity	727	200	665	448	410	217	769	215	200	129	178	302
TDS	3800	1100	3305	2345	3015	1200	10000	1600	1130	500	1640	1290
Total Alkalinity	160	280	240	248	220	280	120	260	280	220	240	200
Total Hardness	2050	645	1750	1325	1175	690	2400	650	625	375	465	825
Ca Hardness	849.7	340.68	841.68	705.4	577.2	356.7	965.9	328.6	312.6	192.4	248.5	404.8
Sodium	350	348	410	290	294	302	480	342	340	350	365	324
Potassium	4.89	5.10	5.15	4.80	4.68	4.50	9.75	3.13	4.68	3.46	14.8	8.76
Chloride	2649	525	2299	1175	1125	499	1974	699	725	350	474	1249
Nitrate	28.44	22.25	33.65	25.15	28.15	19.62	32.79	29.62	32.45	16.37	26.62	26.64
Sulphate	81.0	16.65	89.40	32.25	30.81	20.12	61.99	17.98	19.65	19.12	15.97	39.65
Phosphate	0.51	0.26	0.55	0.75	0.68	0.29	0.35	0.56	0.59	0.23	0.25	0.68
Dissolved Oxygen	5.5	7.4	7.2	7.1	4.8	6.7	6.6	6.9	7.0	6.5	7.3	7.0
Free CO2	28.16	21.12	49.28	35.2	63.36	73.92	24.64	42.24	42.24	17.6	17.6	21.12

All values are in mg/l; except pH and EC, unit of EC are µmhos/cm (B- bore well, W-dug well).

Conclusion

Analysis of samples clearly reveals that water from all sites except B10 is moderately or highly polluted. Only B10 water sample is suitable for drinking and domestic use. Other sites such as W2, W6, W8, W9, W11 and W12 are moderately polluted; water from these sites can be used for domestic and irrigation purpose after proper treatment. B1, W3, W4, B5, B7 these sites are highly polluted, water from these sites require proper treatment and management to make its suitability for domestic and agricultural use. All the parameters from study area show slight variations, no major changes are observed in water quality during study period. This is because of industrial effluent, which is percolated through ground as well as mixed with water stream throughout the year causing deterioration of water resources. As well as improper water and crop management also responsible for pollution of ground water.

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