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Impact of Indiscriminate Disposal of Waste from Thermal Power Plant on Groundwater Resources

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Abstract:

Coal combustion in power plants produces large quantities of coal-related wastes, e.g. fly ash and bottom ash and results in enhanced concentration of most radionuclide's found in waste materials leaching into soils and groundwater. The primary objective of this paper is to study hydrogeochemical parameters to see pollution transport in the area of Parli Thermal Power Plant and to understand effect of thermal power plant waste on the quality of groundwater and suitability of groundwater for domestic and irrigation purposes in the area of parli. In the present study, geochemical investigation is carried out in the basaltic terrain. Sixty groundwater samples of bore wells and dug well have been collected from Parli region in May 2013 and analysed for physico-chemical parameters (pH, EC, TDS, TH, Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, HCO^{3-}, Cl^{-}, $SO4^{2-}$, Acidity). Comparison of the groundwater quality in relation to drinking water quality standards proves that most of the groundwater samples surrounding to power plant are not suitable for drinking. Some of the samples fall under high salinity and sodium hazard zone which are not suitable for irrigation purpose. Studies revealed that the high concentration of total dissolved solid, Calcium, Total Hardness, potassium and sodium are may be due to the anthropogenic or industrial activities, ash residues dump and weathering of basalt rocks.

Keywords: Groundwater, Geochemical, Irrigation, Water quality, Parli Thermal Power Plant, Beed, Maharashtra

1.0 Introduction:

The inherent qualities of groundwater such as consistent temperature, widespread and continuous availability, excellent natural quality, limited vulnerability, low development cost, and drought reliability have made it an immensely important and dependable source of water supply for both developed and developing countries (Jasmin *et al.*). The geochemical properties of groundwater also depend on the chemistry of water in the recharge area as well as the different geochemical processes that are occurring in the subsurface. Groundwater chemically evolves by interacting with aquifer minerals or internal mixing among different groundwater along-flow paths in the subsurface. (Manish Kumar *et al.* 2006). Groundwater has plays a pivotal role in fulfilling the demands of domestic, industrial and agricultural sectors. Measures need to be adopted in the country to meet the increasing demand and decreasing water quality. Evaluation of groundwater chemistry and delineation of various hydrogeochemical processes that are involved in the evolution of groundwater quality by adopting various graphical methods and interpreting different indices were attempted by many workers in the recent past (Tamma Rao *et al.* 2012). Generally, groundwater is safer than surface water under normal conditions, as its natural protection from the contamination by the infiltration of recharge water through soil cover. However, the soils can be contaminated by the influence of human activities due to not following the strict environmental norms. On the other hand, toxicity of minerals present in the soils and rocks can also be caused to groundwater contamination by geochemical processes. (Subba Rao *et al.*). The policies of the Government of India during the 1970s have led to large-scale development of groundwater through subsidies in the form of lower levies on power consumption. This resulted in increased agricultural production in the Green Revolution. However, the absence of regulatory policies on the extraction of groundwater or any mechanism for pricing of groundwater utilization for commercial purpose led to exploitation of the aquifers beyond their optimum yielding capacity. The Green Revolution was followed by Industrial revolution to attain selfsufficiency. This led to the setting up of a large number of wastewater generating industries especially in the vicinity of big cities. (Pujari *et al*.2012). There has been an increasing demand for electricity generation throughout the world with the ever-increasing growth in human civilisation, for example, advances in industrial development and human living standards. This increasing demand can be met only by combustion of fossil fuels. India depends largely on coal reserves for energy needs, which alone contribute 72% of the total power generated in India (Mandal and Sengupta 2003). Thermal power plant emissions have added new dimensions to the nature. Coal fly ash disposal on land affects soil, vegetation surrounding Thermal power plants and groundwater around disposal pond (Agrawal *et al*. 2008).When fly ash is not properly disposed, it may come into contact with the terrestrial, aquatic, and atmospheric environment, and if leached, these elements cause contamination of groundwater. (Hany El-Gamal *et al*. 2013). The increasing heaps of fly ash generated from coal based thermal power plants become a concerning environmental issue. The fly ash is burned residue of coal which has alarming dimensions, open dumping of fly ash can creates environmental problems such as contamination of surface and groundwater resources by leaching process (Nalawade e*t al.*2012). Fly ash from Parli Thermal Power Plant is main source of leaching of different pollutants in the surrounding area and it contaminates groundwater and surface water resources. Groundwater samples are taken mostly from dug wells and few from hand pumps or Bore wells in the study area to understand the spatial distribution of hydrogeochemical constituents and also interpret chemical variations in groundwater under various natural and anthropogenic influences.

1.1 Study area

Parli is one of the taluka of Beed District in Marathwada region of Maharashtra. Beed is flanked by Aurangabad and Jalna districts in the north, Parbhani in the east, Latur in the south east, Osmanabad in south and Ahmadnagar district in the west and southwest. The study area is bounded by latitude 18°45’ to 19° and longitude 76°25’ to 76°40’ (Fig.1).The area form a part of the Survey of India Toposheet No’s 56B/5, 56B/9**.** The area receives an annual average rainfall ranging between 650-750 mm. The maximum temperature ranges between 40°C and 42°C and minimum temperature ranges between 12°C and 13°C. Sugar factory, Cement factory and Thermal Power Plant of 500 MW capacities are located near Parli town.

1.2 Geology and Hydrogeology

Climate is an important factor affecting the potential for contaminant migration from a release source. Mean values for precipitation, evaporation, evapotranspiration, and estimated percolation help to determine the potential for contaminant transport (Gokmen Tayfur *et al.* 2008).The major part of the district is covered by Basaltic flows commonly known as Deccan Traps of Upper Cretaceous-Lower Eocene age. The Deccan Trap includes several flows of Basalt which are supposed to have extruded from fissure volcanoes. Groundwater in Deccan Trap Basalt occurs mostly in the upper weathered and fractured parts down to 20-25 m depth. At places potential zones are encountered at deeper levels in the form of fractures and inter-flow zones. The upper weathered and fractured parts form phreatic aquifer and groundwater occurs under water table (unconfined) conditions. Hydrogeologically, the Deccan basalts have been regarded as low-permeability rocks, but the crux of the problem of finding groundwater in the basalts is their high degree of inhomogeneity (Himanshu Kulkarni *et al.* 2000).To measure the level of pollution and to carry out a geochemical study, 60 groundwater samples were collected surrounding Thermal Power Plant at various locations as shown in figure 2a. Study area has a general slope is southwest to northeast and elevation ranging from 396 metre to 636 metre above mean sea level with number of residual hills (Fig. 2b). Samples are analysed for physico-chemical parameters in order to understand the hydrogeochemistry of the groundwater but the role of various factors in groundwater can be understood better by applying statistical analysis on the chemical parameters. The well inventory data shows the maximum depth to groundwater level varies from 1.01m (P18 Dug well, Ambalwadi) to 24.09 m (P28 Dug well, Saradgaon) in below ground level (bgl) during May 2013 as shown in figure 2c. But water levels in southwest and Eastern area have gone deeper, due to increasing need for agricultural activities and domestic purposes overexploitation of groundwater.

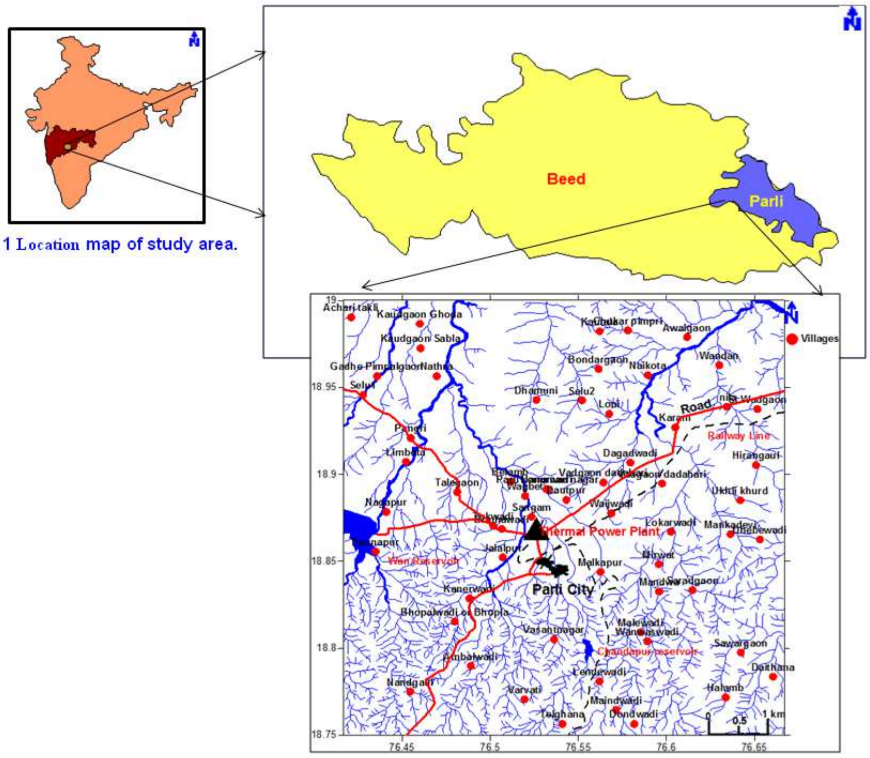

Fig. 1 Location map of study area.

2.0 Materials and Methods:

Groundwater samples were collected in HDPE bottles pre-washed with dilute hydrochloric acid and then labelled each one. The samples were stored bellow 5°C temperature to analysis in the laboratory. For collection, preservation and analysis of the samples, the standard methods (APHA 1995) were followed. EC and pH of groundwater samples were measured by using pH and Conductivity meters. Na and K were measured by using a flame photometer (Model: Elico-Cl 161 Flame Photometer). HCO_3, Acidity, Ca, Mg and TH, Cl were determined Titrimetric methods (Trivedy and Goel, 1986). Sulphate was analysed using Spectrophotometer (Model: Shimadzu UV-1800). The results of chemical analysis are given in Tables 1 the chemical analysis data have been interpreted using various plots such as Piper's trilinear diagram (1944), Gibbs (1970) and Wilcox (1955) diagrams, to assess the groundwater quality.

3.0 Results and Discussion:

3.1 Characterization of Groundwater:

The analytical results and the statistical parameters such as minimum concentration, maximum concentration, average concentration and correlation matrix of groundwater data are presented in Table 2 and table 3. Correlation coefficients commonly used to establish the relation between independent and dependent variable (Joshi and Seth 2011). The correlation coefficient values exhibiting + 1 or -1 between the variables reveals that there exist strong correlation and the value at zero indicates no relationship between them (Giridharan *et al,.* 2007). The pH of groundwater samples in this area ranges from 7.4 - 8 .6. The groundwater of this area is generally alkaline in nature due to presence of bicarbonates ions. Total Dissolved Solids is a measure of the combined content of all inorganic and organic substances contained suspended form (Gurugnanam and VenkatRaman, 2013). The maximum allowable limit of TDS for drinking purpose is 500 mg/l and the most desirable limit is 1500 mg/l as per WHO (1998) guidelines. The concentration of TDS ranges from 410 to 40556 mg/l, highest TDS is observed in sample number P12 (Dautpur). The EC is a measure of a material's ability to conduct an electric current so that the higher EC indicates the enrichment of salts in the groundwater (Subba Rao *et al.* 2012). EC readings can help locate potential pollution sources because polluted water usually has higher values than unpolluted waters (Bujar et al., 2013). EC ranges 642 to 63400 µS/cm. EC is very high in samples near to Thermal Power Plant these are P2 (Tokwadi), P4 (Sangam), P5 (Belamb), P6 (Wagbet), P7 (Lonarwadi), P12 (Dautpur), P13 and P14 (Vadgaon dadahari), P15 (Dagadwadi), P30(Lokarwadi), P38 (Talegaon), P39 (Limbota) (Figure 3a).

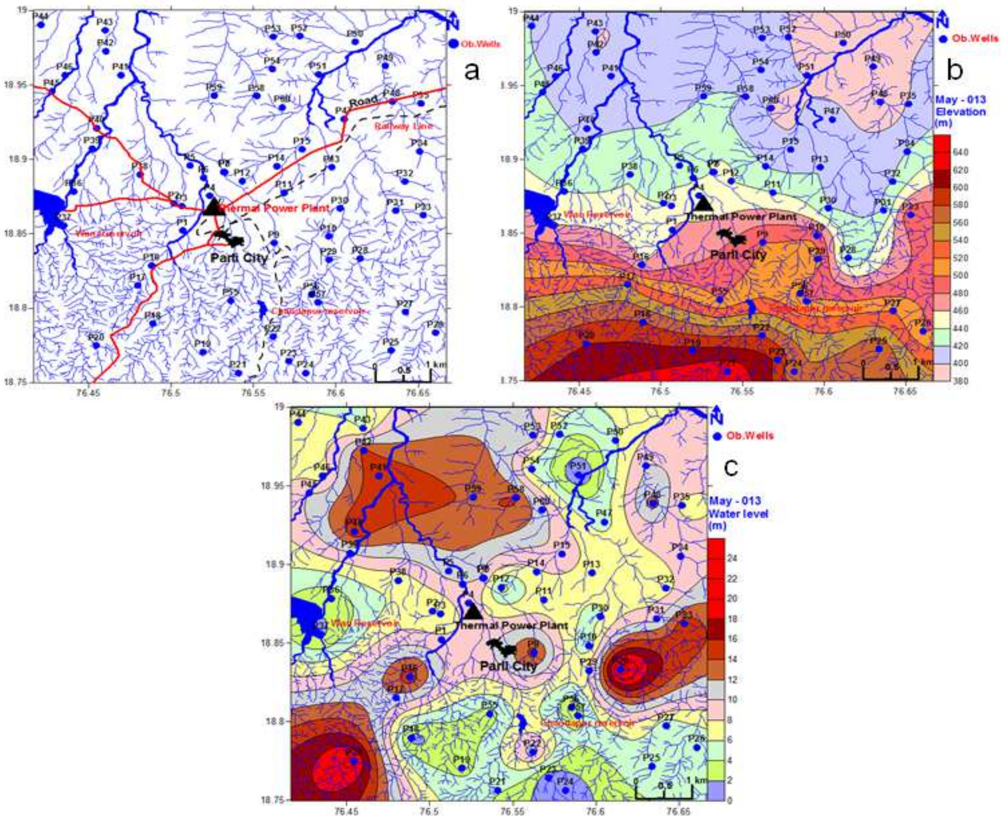

Fig. 2 a) Location of Observation wells and Drainage map of study area
b) Elevation map of study area c) Water level in study area, May 2013.

Table 1: Major Cations and Anions May-13, Parli

Sr No	pH	EC	TDS	Ca	Mg	TH	Na	K	Cl	SO_4	HCO_3	Acidity
P1	8	2652	1697.3	109.82	38.50	432	150	1.6	190	97.74	360	12.5
P2	8	60200	38528	239.68	7.80	630	353	1.5	544	76.16	330	40
P3	8.1	3352	2145.3	136.27	40.93	508	253	4.4	327	117.87	345	20
P4	7.7	44400	28416	44.89	89.17	478	347	0.7	413	139.25	350	27.5
P5	8.2	42000	26880	105.01	50.19	468	315	2.4	476	104.18	255	7.5
P6	8.1	55600	35584	130.66	69.20	610	393	0.9	585	121.40	430	12.5
P7	7.7	45200	28928	101.00	66.27	524	317	1.5	508	125.55	365	15
P8	8	1580	1011.2	81.76	16.08	270	127	3.9	49.7	81.56	385	10
P9	8.5	2018	1291.5	72.14	29.24	300	123	2.1	79.5	94.84	360	20
P10	8.2	2024	1295.4	93.79	35.09	378	82.1	0.9	73.8	64.33	395	27.5
P11	8.5	2172	1390.1	9.62	9.75	64	222	0.8	135	93.39	180	10
P12	8	63400	40576	216.43	63.35	800	300	46.1	579	116.01	485	35
P13	7.8	43400	27776	132.26	1.46	336	274	2.3	429	44.20	205	15
P14	7.8	52400	33536	218.04	4.39	562	285	1.6	477	48.35	255	17.5
P15	7.7	43600	27904	128.26	55.06	546	203	0.8	386	107.29	295	17.5
P16	7.9	1224	783.36	71.34	18.03	252	55.4	0.2	17	42.13	390	12.5
P17	8.4	848	542.72	64.13	2.92	172	53.2	0.2	19.9	33.62	230	7.5
P18	8.4	832	532.48	40.08	15.59	164	32.6	0.8	22.7	41.30	225	15

P19	8	2538	1624.3	120.24	36.06	448	99.1	1	143	76.37	335	17.5
P20	8.2	2432	1556.5	98.60	30.70	372	80.6	0.8	193	108.12	185	7.5
P21	8.4	832	532.48	44.09	11.70	158	52.6	0.1	34.1	45.45	200	10
P22	8.2	1686	1079	92.18	17.06	300	103	0.8	72.4	68.28	360	12.5
P23	8.3	876	560.64	54.51	14.13	194	30.9	0.7	28.4	20.13	275	7.5
P24	8.2	18800	12032	12.02	11.21	76	218	1.6	195	106.46	335	10
P25	8.2	1438	920.32	63.33	24.85	260	53.4	0.8	39.8	64.75	300	10
P26	7.8	1866	1194.2	106.61	13.16	320	54	0.1	79.5	71.18	295	30
P27	8.2	1230	787.2	71.34	13.16	232	52.5	1.6	44	117.87	180	7.5
P28	7.4	1632	1044.5	65.73	22.90	258	56.5	0.1	29.8	57.48	345	10
P29	8.1	1946	1245.4	89.78	24.85	326	80	0.8	66.7	87.16	310	17.5
P30	8	15520	9932.8	60.92	24.85	254	75.6	0.1	48.3	67.65	340	20
P31	8.2	2060	1318.4	71.34	29.72	300	107	2.4	78.1	63.92	385	12.5
P32	8.4	1672	1070.1	26.45	8.28	100	169	0.9	80.9	72.43	215	10
P33	7.9	1594	1020.2	76.95	29.72	314	78.7	0.1	32.7	44.41	335	12.5
P34	8.1	1718	1099.5	63.33	31.67	288	78.4	0.7	49.7	54.37	360	12.5
P35	8.2	1202	769.28	65.73	15.11	226	76.9	0.8	61.1	26.36	230	7.5
P36	8.2	1330	851.2	55.31	21.44	226	97.2	0.1	56.8	59.56	270	12.5
P37	8	2162	1383.7	88.18	34.60	362	97.1	0.1	59.6	68.07	435	7.5
P38	7.9	50600	32384	340.68	24.85	952	135	1.5	504	60.60	165	27.5
P39	7.9	40000	25600	200.40	45.32	686	168	0.8	305	81.97	350	42.5
P40	8.2	1910	1222.4	80.16	20.47	284	110	0.9	92.3	69.11	345	5
P41	8.1	3552	2273.3	162.72	20.95	492	189	0.7	115	50.22	415	12.5
P42	8	5380	3443.2	113.03	129.13	812	276	1.5	199	39.84	330	10
P43	8.3	1642	1050.9	32.87	40.45	248	116	2.3	59.6	73.26	335	45
P44	8.2	1346	861.44	53.71	48.24	332	135	3.1	63.9	56.65	230	27.5
P45	7.8	3760	2406.4	143.49	27.78	472	218	47.5	258	52.30	350	10
P46	8	2668	1707.5	110.62	30.21	400	170	2.3	132	41.92	345	17.5
P47	7.8	2570	1644.8	122.64	19.00	384	147	0.7	160	62.47	335	15
P48	8	1662	1063.7	37.68	14.62	154	167	0.8	89.5	41.30	210	10
P49	7.9	3098	1982.7	182.76	8.28	490	132	1.5	170	55.62	255	22.5
P50	8.2	2604	1666.6	63.33	0.49	160	275	0.9	183	120.78	240	7.5
P51	8.2	2744	1756.2	120.24	29.24	420	161	0.8	206	16.60	245	12.5
P52	8.2	1212	775.68	76.15	6.82	218	43.8	0.7	44	45.66	235	12.5
P53	7.8	2032	1300.5	84.97	16.57	280	129	0.8	119	71.39	225	22.5
P54	7.7	2698	1726.7	96.19	46.29	430	134	7	136	161.25	265	10
P55	7.9	1924	1231.4	102.60	17.54	328	47.4	0.7	71	48.77	270	17.5
P56	8.4	1086	695.04	52.10	14.62	190	42.7	0.1	32.7	30.30	250	42.5
P57	7.9	642	410.88	27.25	13.64	124	17.1	0.8	35.5	39.01	160	7.5
P58	8.6	1284	821.76	28.06	15.11	132	128	0.8	49.7	36.73	295	10
P59	7.8	1998	1278.7	131.46	15.11	390	74.7	1.8	78.1	27.81	310	10
P60	8.1	1774	1135.4	89.78	13.64	280	99.2	1.5	129	43.79	180	15

All the concentrations are in mg/l, except pH. EC is measured in µS/cm.

Table 2: Statistics of Major Ions in Groundwater May-13, Parli

Parameter	Min	Max	Average
pH	7.4	8.6	8.00018
Cond.	642	63400	11270.7
Ca	9.62	340.68	96.0151
Mg	0.49	129.13	27.2553
Na	17.1	392.7	144.239
K	0.1	47.5	2.78305
Cl	17.04	585.04	165.25
SO_4	16.6	161.25	68.7932
HCO_3	160	485	296.78

All the concentrations are in mg/l, except pH. EC is measured in µS/cm.

Table 3: Correlation Matrix of major ions in Groundwater May-13, Parli

	pH	Cond.	TDS	Ca	Mg	Na	K	Cl	SO4
pH	1	-0.3	-0.3	-0.419	-0.24	-0.208	-0.147	-0.345	-0.172
Cond.		1	1	0.615	0.337	0.735	0.226	0.927	0.389
TDS			1	0.615	0.337	0.735	0.226	0.927	0.389
Ca				1	0.123	0.372	0.281	0.667	6.10E-02
Mg					1	0.461	0.176	0.4	0.383
Na						1	0.262	0.855	0.501
K							1	0.313	0.146
Cl								1	0.46
SO4									1

Total hardness (TH) is caused primarily by the presence of cations such as calcium and magnesium and anions such as carbonate, bicarbonate, chloride and sulphate in water. Hard water is unsuitable for domestic use. In this area, the total hardness varies between 64-952 mg/l. Sample number P38 (Talegaon) showing highest hardness. The maximum allowable limit of TH for drinking purpose is 500 mg/l and the most desirable limit is 100 mg/l as per WHO (1998) guidelines. Total hardness is relatively high in sample numbers P2 (Tokwadi), P3 (Bramhawadi), P6 (Wagbet), P12 (Dautpur), P14 (Vadgaon Dadahari), P38 (Talegaon), P39 (Limbota), P42 (Kaudgaon Sabla) which are surrounding to Thermal Power Plant (figure 3b). The permissible limit of calcium in drinking water is 75 to 200 mg/l as per WHO (1998) guidelines. The calcium concentration in groundwater samples collected from the study area ranged from 9 - 340 mg/l. So, Samples from P2 (Tokwadi), P12 (Dautpur), P14 (Vadgaon Dadahari), P38 (Talegaon) exceed the permissible limit Distribution of calcium in study area is shown in Figure 4a. For magnesium acceptable limit is 30 - 100 mg/l as per Bureau of Indian standards (1991). In this present study area the magnesium level in the groundwater samples ranged from 0.4 - 129 mg/l. The highest Mg is observed in sample number P42 (Kaudgaon Sabla) which is exceeding the permissible limit. The primary source of sodium in natural water is from the release of the soluble products during the weathering of minerals. The concentration of sodium in the area varies from 17-392 mg/l. Samples from P2 (Tokwadi), P4 (Sangam), P5 (Belamb), P6 (Wagbet), P7 (Lonarwadi) are exceeding the permissible limit which are in the vicinity of Thermal Power Plant. The distribution of sodium in groundwater of the study area is revealed in figure 4b. The sodium concentration more than 200 mg/l (WHO, 1998) makes the water unsuitable for domestic use Groundwater of the surrounding Thermal Power Plant area comes under the non-safe zone for drinking with reference to the concentration of sodium, which is more than 300 mg/l. High concentration of sodium ions in water is undesirable because Na interferes with other ions absorption, destroying the soil structure, closing the soil pores and reducing the water flowing (Laze et al., 2002). The medium and high levels of sodium in water could become toxic for some sensitive plants (Magdalena et al., 2013). The permissible limit for Potassium is 10mg/l as per Bureau of Indian standards (1991) Potassium concentration varied from 0.1 – 47.5 mg/l. The highest concentration is in sample no P12 (Dautpur), P45 (Selu). Chlorides are important inorganic anions which contain varying concentrations in natural waters (Makhoukh et al., 2011). The chloride concentration in groundwater will increase if it mixed with sewage or sea water.

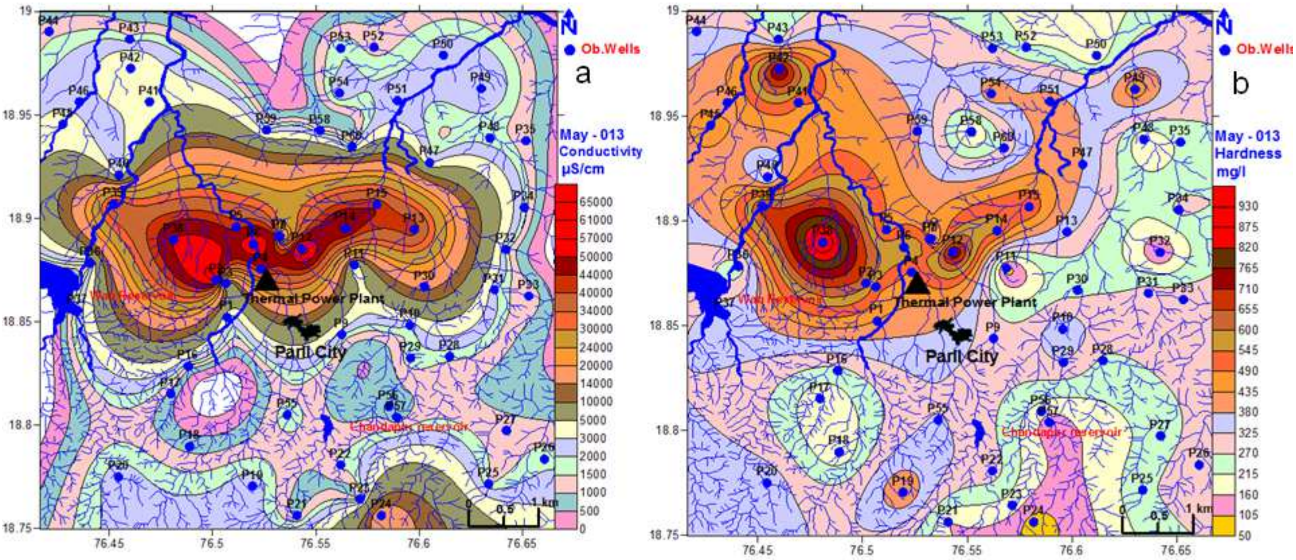

Fig. 3 Distribution of Electrical Conductivity (a) and Hardness (b) in and around Parli May 2013.

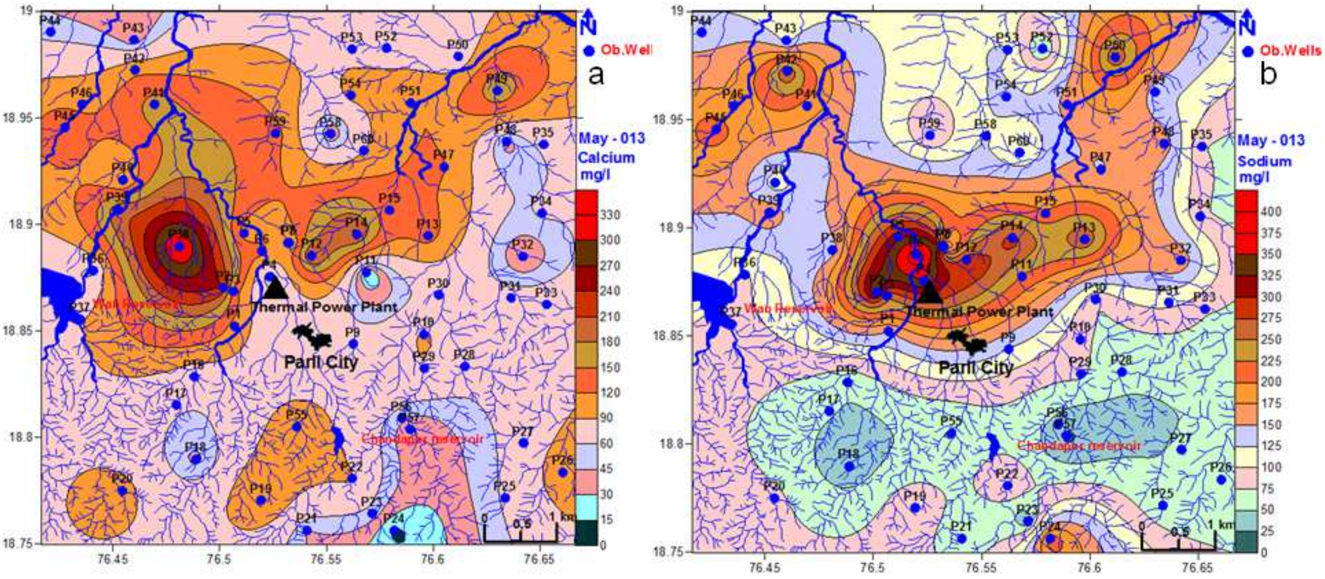

Fig. 4 Distribution of Calcium (a) and Sodium (b) in and around Parli May 2013.

Chloride concentration of more than 250 mg/L causes salty taste (RiteshVijay *et al.,* 2011). The chloride concentration varied from 17 - 585 mg/l. Chlorides are troublesome in irrigation water as well as harmful to aquatic life (Rajkumar et al., 2004). Sulphate is found in small quantities in groundwater. Sulphate may come into groundwater by industrial or anthropogenic additions in the forms of sulphate fertilisers (Janardhana et al., 2013). In present investigation, sulphate concentration was ranged from 16- 161 mg/l. The sulphate level is within the desirable limit of 200 mg/l as per WHO (1998) guidelines. Bicarbonate was observed higher of 160 - 485 mg/l, highest in P12 (Dautpur). In the study area the Bicarbonate level is within the permissible limit of 500 mg/l (Bureau of Indian standards 1991).

3.2 Hydrogeochemical facies

Facies are recognizable parts of different characters belonging to any genetically related system. Hydrochemical facies are distinct zones that possess cation and anion concentration categories (Sadashivaiah *et al.,* 2008). In order to understand the role of various cations and anions in the groundwater chemistry during May 2013 period, the data were plotted on the trilinear diagram (Piper, 1944). From figure 5a it is seen 40 samples (66%) belongs to Ca+Mg > Na+K (alkaline earths exceeds alkalies) hydrochemical facies and

18 samples (30%) represent Na+K > Ca+Mg hydrochemical facies. It is also observed that 32 samples (53%) belongs to HCO_3+CO_3 > CL+SO_4 (weak acid exceeds strong acid) and 26 samples (43%) CL+SO_4 > HCO_3+CO_3 (strong acid exceeds weak acid) hydrochemical facies (Table 4).

3.3 Groundwater for Irrigation Purpose

Extremely high salinities in irrigation waters have several adverse effects on both the irrigation soil and the crops being irrigated. High salinities affect plants both physically and chemically. High salinity waters reduce the osmotic ability of plants and thus interfere with the capacity of plants to absorb waterfrom the soils and transport it to the branches and leaves (Sandow Mark Yidana *et al.*, 2011) Majority of the samples fall in low sodium hazard and high salinity hazard, sample number P11 (Waijwadi) and P50 (Awalgaon) are fall in to high sodium hazard zones indicating non-suitability of groundwater for agricultural purposes (Fig.5b). Various factors controlling groundwater chemistry are analyzed by the diagram (Gibbs, 1970). The groundwater samples are scattered between the rock and evaporation dominance fields (Fig. 6). This suggests that the majority of the groundwater samples fall in the rock dominance field while very few groundwater samples fall in evaporation field. Lithology of the area may be controlling the groundwater chemistry.

Table 4: Distribution of groundwater according to water types with reference to the Piper's Trilinear Diagram.

Sr. No.	**Type of Facies**	**May 2013**
1	Ca+Mg > Na+K	40 (66%)
2	Na+K > Ca+Mg	18 (30%)
3	HCO_3+CO_3 > CL+SO_4	32 (53%)
4	CL+SO_4 > HCO_3+CO_3	26 (43%)

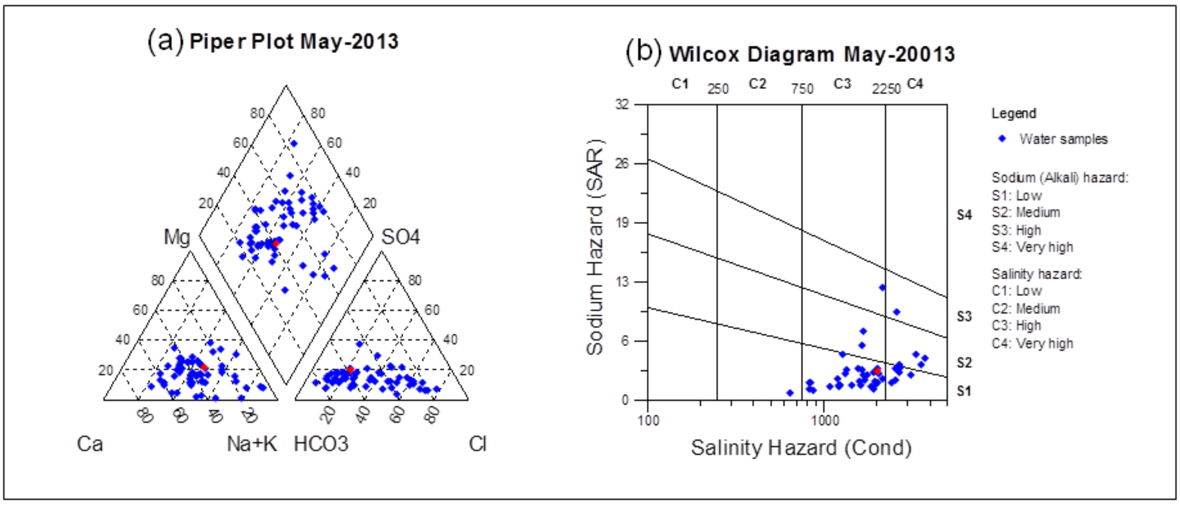

Fig 5. Distribution of water samples on Piper's Trilinear Diagram (a) and Wilcox Diagram (b).

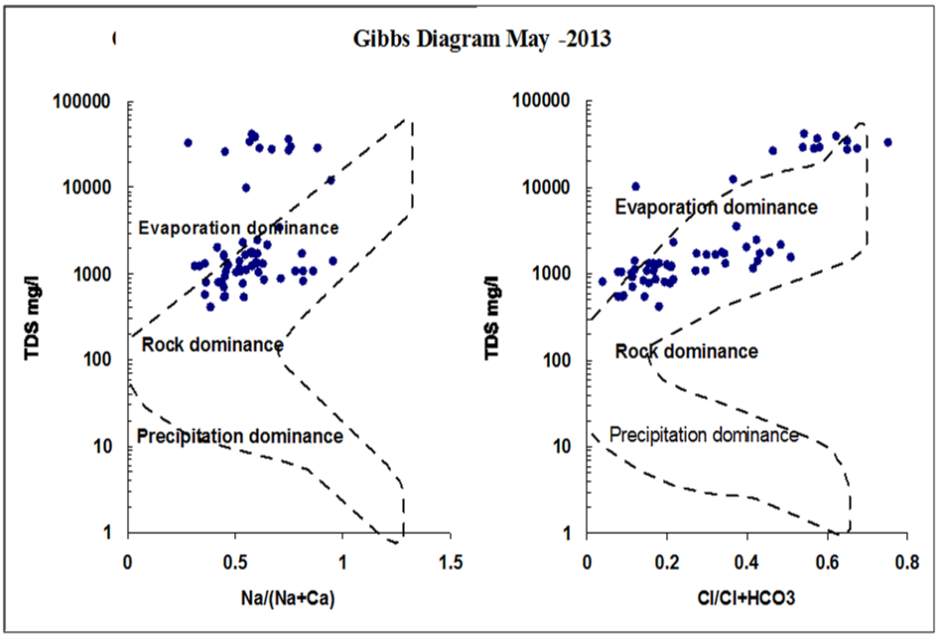

Fig.6 Distribution of water samples on Gibb's diagram.

3.4 Interrelations of chemical parameters

The interrelations among the chemical parameters are evaluated, using a correlation coefficient (r) model, to assess the sources of dissolved salts in the groundwater Table 4 pH shows negative correlation with TDS (r= -0.3), Ca (r= -0.41), Mg (r= -0.24), Na (r= -0.20), K (r= -0.14), Cl (r= -0.34), SO_4 (r= -0.17). In groundwater samples Ca shows good positive correlation with Cl (r= 0.66) and Na shows good positive correlation with Cl (r= 0.85), SO4 (r= -0.50).

4.0 Conclusion:

Groundwater quality in and around Parli Thermal Power Plant (PTPP) area has been analyzed in the present work. The groundwater is alkaline in nature. Total hardness is observed in all samples near to PTPP fall under hard to very hard category. The TDS in the north region and surrounding region of PTPP exceeds the permissible limit. The concentration of Bicarbonate and Sulphate is below the desirable limit. In most of groundwater samples in the vicinity of Thermal Power Plant, the concentration of Calcium, Total Hardness, potassium and sodium is high and above the permissible limit which are. Major hydrochemical facies identified using piper trilinear diagram were Ca+Mg > Na+K and HCO_3+CO_3 > CL+SO_4 in May 2013. The concentrations of physiochemical constituents in the water samples are compared with the WHO (1998) and BIS (1983) to know the suitability of water for drinking purpose. Based on the analysis, most of the area at many locations near to PTPP falls in moderately polluted to severely polluted leading the water is unsuitable for drinking purpose. According to the quality classification of irrigation water proposed by Wilcox and US salinity classification some of the water samples fall in the suitable range for irrigation purpose but samples near to PTPP are not suitable for irrigation. It was observed that the quality of groundwater was not suitable for drinking and irrigation purpose in surrounding area of Parli Thermal Power Plant which is very near to Parli city. These sampling sites have become unsuitable by the influences of urban activity and Thermal power plant and other industrial waste discharge, aquifer material mineralogy together with semiarid climate, other anthropogenic activities and increased human interventions in the groundwater quality in the study area. Based on the findings of the present multi-disciplinary study, the following follow-up actions are recommended. Avoide to use water from polluted wells which are in proximity of PTPP. Develop a drinking-water monitoring network, increase public awareness of water quality and health aspects. Continue the introduction of sustainable household practices and good agricultural practices with the communities.

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