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Comparative Study of Water Quality for Pre Monsoon 2015 and Pre Monsoon 2016 in and around Gandhidham, Kachchh, Gujarat, India

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Abstract: ***To collect the information on the level of contamination ,16 Ground water samples were collected from various zones of Kachchh in and around Gandhidham Taluka, Gujarat during 23rd March and20th April 2015 and 25 April, 2016 to 15thMay,2016 i.e. Two consecutive Pre Monsoon Seasons. . Parameters like pH, electrical conductivity, TDS, salinity, total dissolved solids, total hardness, calcium and magnesium hardness, fluoride, potassium, sulphate, nitrate, silicate chloride and metals like Iron,Cadmium, Cobalt, Zinc, Manganese, Nickel and Copper were analysed.***

Keywords: Analyses, Heavy Metals, Water, Gandhidham, Anjar Area

1. Introduction

1.1 Water is very important abiotic component of the environment. Without water life on earth would not exist. Water occurs 97.2 % in ocean as salt water, 2.09 % in icecaps & glaciers, 0.6 % ground water, 0.11% runoff & surface water.

1.2 Pollution typically refers to chemicals or other substances in concentrations greater than would occur under natural conditions. It is the contamination of Earth's environment with materials that interfere with human health, the quality of life, or the natural functioning of ecosystems (living organisms and their physical surroundings).
Pollution of groundwater resources has become a major problem today. The pollution of air, water, and land has an effect on the pollution and contamination of groundwater. The solid, liquid, and the gaseous waste that is generated, if not treated properly, results in pollution of the environment; this affects Groundwater too due to the hydraulic connectivity in the hydrological cycle.

Heavy metals are important environmental pollutants. Metal contamination of the environment results both from natural sources and industrial activities. Metals in soil and water may enter the food cycle with an additional contribution from air (Gül, 2009). When the air is polluted, rainfall will settle many pollutants on the ground, which can then seep into and contaminate the groundwater resources. Water extraction without proper recharge and leaching of pollutants from pesticides and fertilizers into the aquifers has polluted groundwater supplies. In addition, leachates from agriculture, industrial waste, and the municipal solid waste have also polluted surface- and ground-water.

1.3Kachchh district, located on the westernmost tip of India is the largest district of Gujarat,the total area of the district is 45,652 sq. km, that is more than 23% of the total area of the state, and lies in the extreme western part of the state. Kachchh district is situated between north latitudes 22°44'11" & 24°41'25" and east longitudes 68°09'46" & 71°54'47"

1.4 Population Growth for Kachchh District recorded in 2011 for the decade has remained 32.03 %. Same figure for 1991-2001 decade was 25.40 %.

Total Area of Kachchh District is 45,652 with average density of 46 per sq. km.

Kachchh Population constituted 3.46 % of total Gujarat Population

1.5 Soils of Kachchh region have moderately deep (75-100 cm) to deep (100 to 150 cm)
In Kachchh region, Soils are Loamy (medium textured) , Saline due to large coast line and Saline desert.

1.6 With large reserves of limestone, bauxite, lignite and bentonite, Kutch district is one of the preferred destinations for most of the mineral based industries .It has largest reserves of limestone, lignite, bauxite, china clay and silica sand inthe country.The district has the highest production of Lignite and Chinaclay in Gujarat.

1.7Temperatures vary considerably from season to season. The summers are generally hot and winters are cool. Mean maximum temperature ranges between 26.7°C during January to about 39.5°C during May and the mean minimum temperatures vary between 9°C during January and 27°C during June.

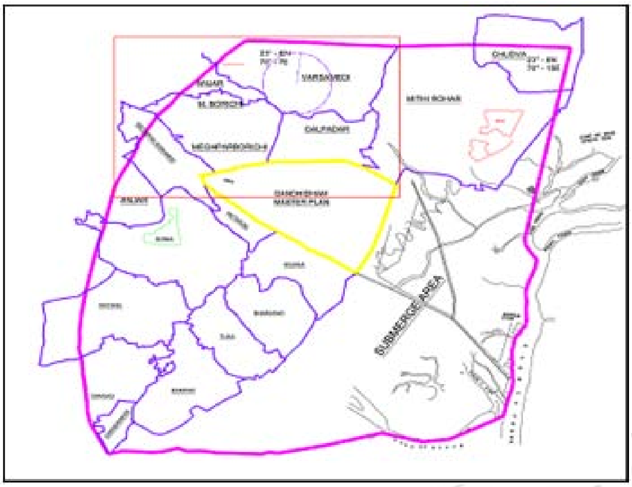
The relative humidity in Kachchh as per IMD varies between 43.5% during March and 77% during August. The wind velocity in the district varies from about 124 km/d during November and 375 km/d during June.

The potential Evapo-transpiration varies between 3.4 mm/d during December and 9.2 mm/d during May.

1.7 Average rainfall from 16th January,2015 to 22nd September, 2016, in Gandhidham area is 450 mm only.

2. Material and Methods

2.1 Selection of sample sites- Work Area has been divided into different zones accordingly



Work Area in and around Gandhidham, Kachchh, Gujarat, India

SrNo	*Sample site*	*Type*	*General characteristic of Sample site*
1	Anjar	Rural	Residential , Agricultural
2	Shinai	Rural	Residential, , Agricultural
3	Sangad	Rural	Residential
4	Devadia	Rural	Green Belt
5	MeghparKumbharadi	Rural	Residential, Industrial
6	Meghpar Borichi	Rural	Residential, Industrial
7	Kandla	Urban	Residential, Industrial, Port
8	Varsamedi	Rural	Residential, Industrial
10	Galpadar	Rural	Residential, Industrial
12	Kidana	Rural	Residential
13	Bharapar	Rural	Industrial
14	Tuna	Rural	Residential, Industrial
15	Rampar	Rural	Residential, Industrial
16	Gandhidham / Adipur	Urban	Residential
17	Mathak	Rural	Residential , Agricultural
18	Antarjal	Rural	Residential

2.2 Collection of Samples

The water samples have been collected in pre-cleaned wide mouth sampling bottles. The sampling bottles have been soaked in 10% HNO_3 after washing with detergents, afterwards rinsed with double distilled water. At the time of sampling, the bottles have been thoroughly rinsed two to three times using ground water to be sampled and collected water sample have been analysed in laboratory within 24 hours of sampling.

2.3 Methods of analysis

2.3.1 PH/EH: (PH):pH is a value of negative log 10 of H^+ concentration in water sample, it is determined at room temperature by a Systronic digital pH meter. The standardization of instrument is done with a buffer solution of 7.4 and 9.2 pH.

2.3.2 EC Electrical conductivity and Total Dissolved Salt - Electrical conductivity and total dissolved solids are related to each other because dissolved ionic compounds are responsible for conductance of electric current. Both the parameters are estimated by using EC/TDS - analyser and values are expressed in μ mhos/cm and ppm respectively.

2.3.3 The alkalinity of water sample is determined by titrating the sample with standard solution of strong acid using phenolphthalein and methyl orange as an indicators, expressed as phenolphthalein, methyl orange, total hydroxyl, bicarbonate and carbonate alkalinities, as prescribed in APHA-AWWA-WPCF (1980).

2.3.4 Calcium and magnesium **-** The usual method for determination of Ca and Mg is by (EDTA) titration (Cheng and Bray, 1951).

2.3.5 Silicate Sulphate and Nitrates are analysed using UV Spectrophotometer.

2.3.6 Heavy metals such Sodium, potassium, Iron, Nickel, Manganese, Cadmium, Lead,Copper,Zinc are analyse using AAS (Atomic absorption Spectrophotometer).

3. Results and Discussion

3.1 Pre Monsoon 2015 and 2016

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Table 1: Standard parameters

SN.	name	pH		Cond.		TDS		Cl		otal alk.		as CaCo3		Ca2+		Mg2+		as SiO2		as SO_4^{2-}		as NO3-		as F-	
	WHO Norms	6.5-8.5				500-2000		250-1000		200-600		300-600		75-200		30-100				200-400		45-100		1-1.5	
	Year	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
1	Bharapar	8	7.58	5357	5381	3535.6	3551.5	1204	1532	490	380	1199	1420	444	540	755	880	29.92	46.127	80.89	161.78	13.12	23.75	0.66	0.88
2	Tuna	7.2	6.86	5301	4079	3498.7	2692.1	1116	857	407	389	824	778	302	287	522	491	39.28	49.043	99	100.27	3.69	34.592	0.68	1.14
3	Rampar	7.2	7.17	2592	1465	1710.7	966.9	486	1045	356	418	534	486	184	141	350	345	28.98	51.597	21.07	69.093	0.92	7.08	0.94	0.96
4	Sangad	8.3	8.38	5022	5578	3314.5	3681.5	1108	1451	369	463	535	378	145	88	390	290	26.34	26.963	110.8	116.28	5.95	23.084	0.72	4
5	Sangad	8.6	7.5	5687	2583	3752.4	1704.8	1266	516	540	373	275	207	83	105	192	102	26.46	32.745	119.7	164.31	8.82	0.1548	2.24	2.6
6	Kidana	7.4	7.71	2633	2158	1737.7	1424.3	480	462	289	219	375	441	195	272	180	169	18.22	7.8623	12.64	47.607	1.578	2.7189	0.726	1.94
7	Adipur	7.2	7.39	2067	2006	1364.2	1324	285	320	342	445	346	459	191	287	155	172	29.01	19.089	63.62	58.982	4.582	9.9133	0.517	1.46
8	Shinai	6.8	7.22	3148	2436	2077.6	1607.8	783	1040	348	381	751	656	435	369	316	287	74.9	72.293	75.42	210.65	5.658	2.8872	0.338	0.74
9	Varsamedi	6.57	6.8	1721	1538	1135	1015.1	371	424	264	282	327	280	178	159	237	121	14.27	0	30.33	138.19	2.071	0	0.258	0.426
10	MeghparB	7	7.69	4195	6989	2768	4612.7	1044	669	361	505	664	668	289	298	375	370	20.76	24.584	79.2	494.61	29.48	5.9157	2.75	1.94
11	Anjar	6.77	6.93	1751	2208	1155.6	1457.3	301	479	230	254	291	432	163	285	128	147	12.13	12.821	99.01	32.44	3.362	7.6318	0.864	0.594
12	Anjar(Muni well 15	6.9	7.04	2886	2467	1904.7	1628.2	575	529	264	293	543	550	349	355	194	195	13.34	14.94	145.8	35.811	28.62	20.17	1.113	0.676
13	MeghparK	7.32	7.96	5374	4971	3546.8	3280.9	905	973	823	845	264	375	95	145	169	230	22.9	23.911	423.4	287.75	8.323	1.7363	3.47	4
14	Galpadar	7.05	7.07	5290	5958	3491.4	3932.3	582	858	416	402	829	924	361	348	468	576	22.75	21.032	84.26	105.75	15.79	9.7922	0.77	3.9
15	Devadia	8	8.22	1534	2063	1012.4	1361.6	6	105	468	495	69	125	19	55	50	70	38.36	37.056	0	32.861	3.895	6.5819	0.343	1.2
16	Mathak	7.2	7.58	5814	1864	3837.2	1230.2	120	551	377	358	954	468	301	108	653	360	24.31	17.93	96.89	10.954	67.24	12.578	0.386	1.08
	Avg	7.3444	7.44	3773.3	3359	2490.16	2216.94	664.5	738.2	396.5	406	548.8	540.44	233.38	240.13	320.9	300.31	27.619	28.6245	96.372	129.207	12.693	10.537	1.0484	1.721
	Std Dev	0.5736	0.49	1619	1800	1068.5	1188.07	390.2	347	144.2	148	256.1	211.04	116.18	108.5	166.7	146	15.371	18.7291	99.436	126.671	17.598	9.62	0.9633	1.2713
	Std Error	0.1434	0.12	404.74	450	267.124	297.018	97.56	86.75	36.06	37	64.02	52.76	29.046	27.125	41.68	36.501	3.8428	4.68227	24.859	31.6678	4.3995	2.405	0.2408	0.3178

Table 2: Heavy metals – Pre monsoon 2015-16

SN.	name	Na		K		Fe		Ni		Mn		Cd		Pb		Cu		Zn	
WHO Norms		200		1--4		0.3-1		0.02		0.1-0.3		0.01ppm	0.01ppm			0.05-1.5		5--10	
Year		2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
1	Bharapar	240	391.837	18	30	0.1818	0.25	0.216	0.045	0.145	0.02404	0.018	0.00537	0.007	0.07759	0.38	0.01882	0.219	0.12533
2	Tuna	468	395.102	2.7	97.5	0.563	0.36	0.024	0.03	0.024	0.03005	0.014	0.00293	0.005	0.00862	0.138	0.02471	0.159	0.07511
3	Rampar	578	84.898	5.4	32.5	0.091	0.52	0.018	0.0175	0.024	0.01202	0.011	0.00293	0.004	0.02586	0.069	0.00706	0.2	0.1821
4	Sangad	774	733.032	3.5	2.5	0.127	0.11628	0.054	0.01159	0.072	0.01334	0.0138	0.00446	0.007	0.02308	0.334	0.00357	0.35	0.00858
5	Sangad	800	945.455	72	0.125	0.054	0	0.024	0.015	0.048	0	0.0125	0.00195	0.005	0.00862	0.103	0.00118	0.25	0.15197
6	Kidana	334	563.636	11	1.625	0.091	0.21	0.015	0.025	0.2659	0.01052	0.007	0.00146	0.003	0.02586	0.034	0.00471	0.08	0.03974
7	Adipur	208	481.818	4.4	0.875	0.0272	0.53	0.009	0.02	0.012	0.0015	0.0055	0.0039	0.002	0.12069	0.068	0.00471	0.099	0.0393
8	Shinai	296	727.273	1.7	0.2625	0.8	0.02	0.006	0.02	0.024	0.00751	0.0061	0.0039	0.143	0.02586	0.0225	0.00235	0.152	0.20044
9	Varsamed	184	137.143	15.4	13.875	0.909	0.47	0.018	0.0225	0.024	0.0556	0.004	0.00439	0.086	0.01724	0.0096	0.04706	0.1487	0.07031
10	MeghparI	535	690.612	5	11.25	0.55	0.05426	0.0012	0.01844	0.237	0.00333	0.0037	0.02475	0.046	0.03077	0.01	0.00476	0.05	0.11674
11	Anjar	222.5	225.306	11.88	11.75	0.69	0.22	0.0003	0.03	1.394	0	0.008	0.00585	0.026	0.0431	0.006	0.08235	0.026	0.17205
12	r(Muni w	339.07	120.816	12.09	4.1375	0.204	4.65116	0.001	0.0029	0.1225	0.0025	0.004	0.00198	0.04	0.01538	0.007	0.00238	0.015	0.00086
13	MeghparI	958.9	654.222	4.8	4.5	0.096	6.20155	0.001	0.01014	0.0765	0.0025	0.004	0.00446	0.033	0.01538	0.003	0.00238	0.256	0.13519
14	Galpadar	731.125	878.367	29.38	1.0875	0.303	0.18	0.0015	0.0525	0.1148	0.03005	0.009	0.01024	0.064	0.07759	0.0094	0.01176	0.0153	0.18297
15	Devadia	264.9	266.667	0.462	1.37203		0.07752	0.0004	0.0029	0.06126	0.00584	0.0016	0.00198	0	0.00769	0.004	0.02024	0.154	0.00129
16	Mathak	757.62	140.444	7.15	6.46438	0.289	0	0.003	0.00145	0.107	0.0025	0.0048	0.00099	0.053	0.00769	0.006	0.025	0.218	0.01202
	Avg	480.6947	464.7893	12.80388	13.73899	0.331733	0.866298	0.024525	0.020308	0.171998	0.012582	0.007938	0.005096	0.03275	0.03319	0.075219	0.01644	0.1495	0.094624
	Stddev	255.8033	294.7362	17.9983	24.94193	0.301614	1.866852	0.014635	0.013069	0.346018	0.015488	0.003967	0.005894	0.040125	0.030775	0.087616	0.022283	0.099036	0.074058
	Std Error	63.95082	73.68405	4.499576	6.235482	0.075403	0.466713	0.003659	0.003267	0.086505	0.003872	0.000992	0.001474	0.010031	0.007694	0.021904	0.005571	0.024759	0.018514

Most of the samples has TDS, Calcium ,Magnesium, Chloride, Sodium , Potassium, Iron and Lead, beyond the desired levels for Drinking water, set by WHO.

3.2 Statistical analysis of data samples

Statistical analysis of data samples from different sample sites were compared based on the similarity of their chemical compositions and concentrations. Duncan packaged statistical programme was employed for this work using descriptive statistical and One-way ANOVA of the statistical package for the social science (SPSS, 1999) in analysis of the collected data. The measures of central tendencies used in the analysis were the mean and standard error (S.E). The significance of difference was set at 95% confidence limit (P=0.05and 0.01

Correlation- Pre monsoon 2015

Table 3

Correlations ---Pre monsoon 2015

		pH	Cond.	TDS	Cl-	Alkalinity	hardness	Ca	Mg	Silicate	Sulphate	Nitrate	Fluoride	Sodium	Potassium	Iron	Ni	Mn	Cd	Pb	Cu
pH	Pearson Correlation	1																			
Cond.	Pearson Correlation	.242	1																		
TDS	PearsonCorrelation	.242	1.000**	1																	
Cl-	Pearson Correlation	.336	.607**	.607**	1																
Alkalinity	Pearson Correlation	.185	.733**	.733**	.483*	1															
hardness	Pearson Correlation	-.072	.429	.429	.322	-.057	1														
Ca	Pearson Correlation	-.361	.177	.177	.171	-.229	.868**	1													
Mg	Pearson Correlation	.081	.501*	.501*	.359	.032	.948**	.674**	1												
Silicate	Pearson Correlation	.044	.117	.118	.271	.228	.240	.278	.164	1											
Sulphate	Pearson Correlation	.009	.417	.417	.222	.494*	-.088	-.104	-.088	-.151	1										
Nitrate	Pearson Correlation	-.157	.606**	.606**	.010	.438	.334	.232	.340	-.036	.184	1									
Fluoride	Pearson Correlation	.089	.439	.439	.622**	.652**	-.171	-.266	-.114	-.052	.518*	.145	1								
Sodium	Pearson Correlation	.180	.842**	.842**	.362	.750**	.010	-.202	.109	-.027	.518*	.546*	.520*	1							
Potassium	Pearson Correlation	.459*	.192	.192	.275	.017	-.069	-.115	-.026	-.212	.012	-.095	.172	.133	1						
Iron	Pearson Correlation	-.358	-.163	-.164	-.313	-.105	-.028	.117	-.078	.159	-.069	.261	-.367	-.174	-.218	1					
Ni	Pearson Correlation	.436	.191	.191	.421	.045	.558*	.374	.608**	.060	-.102	-.116	-.109	-.210	.122	-.202	1				
Mn	Pearson Correlation	-.239	-.258	-.258	-.241	-.252	-.158	-.073	-.205	-.357	.031	-.001	-.068	-.219	-.009	.309	-.091	1			
Cd	Pearson Correlation	.492*	.215	.215	.369	-.185	.466*	.274	.512*	-.009	-.044	-.284	-.274	-.040	.337	-.175	.666**	.027	1		
Pb	Pearson Correlation	-.574*	-.051	-.051	-.177	-.167	.207	.487*	.045	.329	.084	.143	-.215	-.053	-.103	.493*	-.261	-.043	-.274	1	
Cu	Pearson Correlation	.598**	.311	.312	.607**	.114	.447	.177	.550*	.148	-.099	-.135	-.021	-.005	.071	-.322	.840**	-.172	.711**	-.421	1
Zn	Pearson Correlation	.623**	.369	.369	.250	.308	.041	-.273	.232	.183	.314	.047	.005	.394	.073	-.064	.327	-.346	.426	-.152	.506*

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

From the above table formulated using Pearson's Correlation using software SPSS , it is found that there is significant positive correlation of Conductance with Chloride , Magnesium and Nitrate., Chlorides with Alkalinity, Fluorides and Copper , Alkalinitywith Sulphates and Fluoride , Hardness with Nickel and Cadmium , Calcium with Magnesium and Lead , Sulphate with Fluoride and Sodium . Fluoride with Sodium Iron with Lead, Nickel with Cadmium, Cadmium with copper and Copper with Zinc. There is significant Negative correlation between pH and Lead.

Table 4: Correlation Pre Monsoon 2016

Correlations pre Monsoon 2016

		pH	Coduc	TDS	Chloride	Akalinity	Hardness	Ca	Mg	Silicate	Sulphate	Nitrate	Flouride	Na	K	Fe	Ni	Mn	Ca	Pb	Cu	Zn
pH	Pearson Correlation	1																				
Coduct	Pearson Correlation	.312	1																			
TDS	Pearson Correlation	.312	1.000**	1																		
Chloride	Pearson Correlation	.161	.561*	.561*	1																	
Akalinity	Pearson Correlation	.519*	.454	.454	.244	1																
Hardness	Pearson Correlation	-.241	.531*	.531*	.621*	-.091	1															
Ca	Pearson Correlation	-.412	.317	.317	.336	-.275	.856**	1														
Mg	Pearson Correlation	-.099	.588*	.588*	.710**	.038	.946**	.642**	1													
Silicate	Pearson Correlation	.035	.084	.084	.495	.199	.338	.201	.375	1												
Sulphate	Pearson Correlation	.187	.663**	.663**	.271	.512*	.185	.154	.178	.164	1											
Nitrate	Pearson Correlation	-.061	.320	.320	.440	-.104	.521*	.328	.567*	.230	-.228	1										
Flouride	Pearson Correlation	.526*	.617*	.617*	.318	.577*	-.071	-.265	.061	-.130	.291	-.065	1									
Na	Pearson Correlation	.322	.575*	.575*	.264	.313	.094	.071	.095	.176	.496	-.183	.736**	1								
K	Pearson Correlation	-.397	.102	.102	.250	-.064	.371	.190	.432	.358	-.033	.663**	-.275	-.264	1							
Fe	Pearson Correlation	.057	.088	.088	.042	.539*	-.105	-.005	-.153	-.189	.136	-.024	.239	-.095	-.109	1						
Ni	Pearson Correlation	-.413	.395	.395	.357	-.237	.715**	.660**	.647**	.085	.069	.173	.093	.288	.282	-.332	1					
Mn	Pearson Correlation	-.415	.084	.084	.180	-.240	.276	.144	.319	-.110	-.036	.170	-.102	-.141	.395	-.210	.505*	1				
Ca	Pearson Correlation	.035	.696**	.696**	.094	.215	.285	.266	.256	-.071	.796**	-.104	.195	.332	-.050	-.131	.267	.001	1			
Pb	Pearson Correlation	-.135	.186	.186	.105	-.035	.477	.550*	.363	-.069	-.051	.075	.057	.163	-.145	-.173	.578*	.033	.200	1		
Cu	Pearson Correlation	-.433	-.271	-.271	-.255	-.391	-.061	.012	-.099	-.322	-.300	.000	-.445	-.486	.191	-.234	.228	.258	-.047	-.018	1	
Zn	Pearson Correlation	-.386	.177	.177	.339	.106	.317	.309	.276	.432	.367	-.334	.078	.350	.060	-.088	.546*	.041	.282	.171	.107	1

In Pre Monsoon 2016 Correlation analysis it is found that there is significant positive correlation between TDS – Chloride, Hardness, Sulphate, Fluoride and Sodium. Nickel is positively correlated Lead and Zinc.

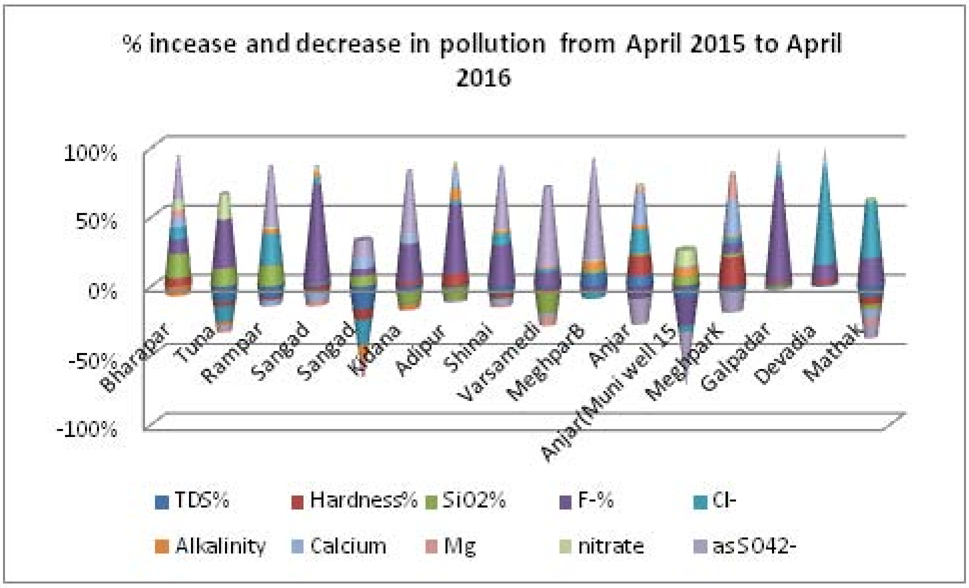
Table 5: % increase or decrease in concentration of different parameters, from March – April, 2015 toApril - May, 2016

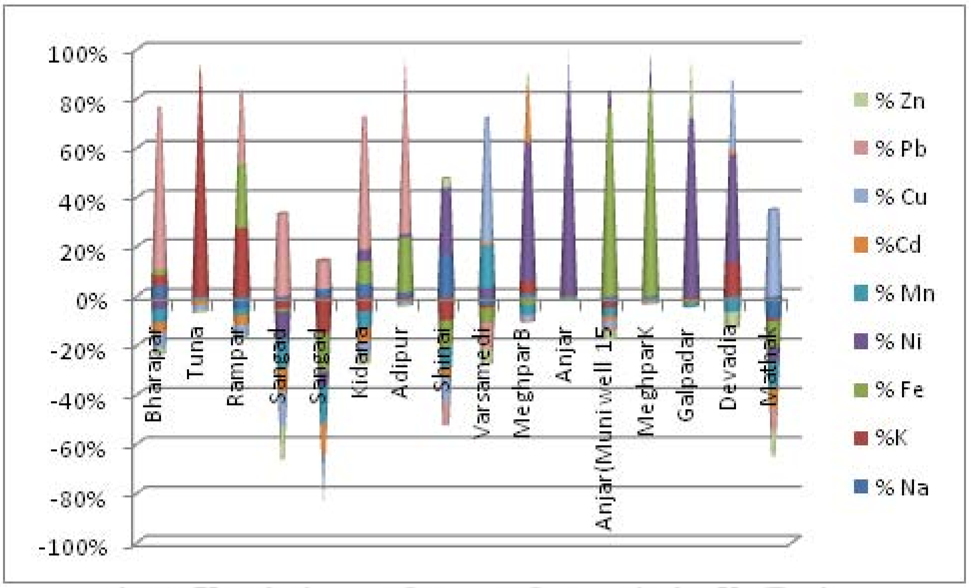
SN.	name	pH%	Cond%	TDS%	Cl %	T Alk. %	Hardness %	Ca %	Mg %	SiO2%	SO4 %	NO3%	F-%
1	Bharapar	-5.25	0.44801	0.44801	27.2425	-22.449	18.432027	21.6216	16.5563	54.1675	99.999	81.0226	33.3333
2	Tuna	-4.7222	-23.052	-23.052	-23.208	-4.4226	-5.582524	-4.9669	-5.9387	24.8665	1.28222	837.458	67.6471
3	Rampar	-0.4167	-43.48	-43.48	115.021	17.4157	-8.988764	-23.37	-1.4286	78.043	227.922	669.561	2.12766
4	Sangad	0.96386	11.0713	11.0713	30.9567	25.4743	-29.34579	-39.31	-25.641	2.36301	4.94477	287.965	455.556
5	Sangad	-12.791	-54.581	-54.569	-59.242	-30.926	-24.72727	26.506	-46.875	23.7524	37.323	-98.245	16.0714
6	Kidana	4.18919	-18.04	-18.036	-3.75	-24.221	17.6	39.4872	-6.1111	-56.848	276.637	72.3016	167.218
7	Adipur	2.63889	-2.9511	-2.9497	12.2807	30.117	32.65896	50.2618	10.9677	-34.2	-7.2843	116.353	182.398
8	Shinai	6.17647	-22.618	-22.615	32.8225	9.48276	-12.6498	-15.172	-9.1772	-3.4807	179.303	-48.972	118.935
9	Varsamedi	3.50076	-10.633	-10.566	14.2857	6.81818	-14.37309	-10.674	-48.945	-100	355.61	-100	65.1163
10	MeghparB	9.85714	66.6031	66.6452	-35.92	39.8892	0.6024096	3.11419	-1.3333	18.4465	524.471	-79.933	-29.455
11	Anjar	2.36337	26.0994	26.1059	59.1362	10.4348	48.453608	74.8466	14.8438	5.72557	-67.234	127.002	-31.25
12	Anjar(Muni well 15	2.02899	-14.518	-14.516	-8	10.9848	1.2891344	1.7192	0.51546	12.0073	-75.434	-29.521	-39.263
13	MeghparK	8.74317	-7.4991	-7.498	7.51381	2.67315	42.045455	52.6316	36.0947	4.43651	-32.04	-79.138	15.2738
14	Galpadar	0.28369	12.6276	12.6276	47.4227	-3.3654	11.45959	-3.6011	23.0769	-7.5373	25.5	-37.965	406.494
15	Devadia	2.75	34.485	34.4903	1650	5.76923	81.15942	189.474	40	-3.4018	#DIV/0!	68.9843	249.854
16	Mathak	5.27778	-67.939	-67.939	359.167	-5.0398	-50.9434	-64.12	-44.87	-26.239	-88.695	-81.293	179.793

Table-6

SN.	name	% Na	%K	% Fe	% Ni	% Mn	%Cd	% Cu	% Pb	% Zn
1	Bharapar	63.26531	66.67	37.51375	-79.1667	-83.4185	-70.1897	-95.046	1008.374	-42.7728
2	Tuna	-15.5765	3511.1111	-36.0568	25	25.22523	-79.0941	-82.097	72.41379	-52.7615
3	Rampar	-85.3118	501.85185	471.4286	-2.77778	-49.9099	-73.3925	-89.77	546.5517	-8.95197
4	Sangad	-5.29307	-28.57143	-8.44168	-78.5293	-81.4759	-67.7142	-98.931	229.6703	-97.5475
5	Sangad	18.18182	-99.82639	-100	-37.5	-100	-84.3902	-98.858	72.41379	-39.214
6	Kidana	68.7534	-85.22727	130.7692	66.66667	-96.044	-79.0941	-86.159	762.069	-50.3275
7	Adipur	131.6434	-80.11364	1848.529	122.2222	-87.4775	-29.0466	-93.08	5934.483	-60.3017
8	Shinai	145.7002	-84.55882	-97.5	233.3333	-68.6937	-36.0256	-89.542	-81.9146	31.86624
9	Varsamedi	-25.4658	-9.902597	-48.2948	25	131.6667	9.756098	390.196	-79.9519	-52.7198
10	MeghparB	29.0864	125	-90.1339	1436.643	-98.5931	568.9858	-52.381	-33.1104	133.4764
11	Anjar	1.261179	-1.094276	-68.1159	9900	-100	-26.8293	1272.55	65.78249	561.74
12	Anjar(Muni well 15	-64.3683	-65.7775	2179.982	189.8551	-97.9586	-50.495	-65.986	-61.5385	-94.2775
13	MeghparK	-31.7737	-6.25	6359.948	914.4928	-96.731	11.38614	-20.635	-53.38	-47.1902
14	Galpadar	20.13915	-96.2985	-40.5941	3400	-73.8205	13.82114	25.1564	21.22845	1095.879
15	Devadia	0.666918	196.97655	#DIV/0!	624.6377	-90.4749	23.76238	405.952	#DIV/0!	-99.1639
16	Mathak	-81.4624	-9.589092	-100	-51.6908	-97.6629	-79.3729	316.667	-85.4862	-94.4875
		red colour shows Increased concentration								
	Area %	56.25	31.25	43.75	68.75	12.5	31.25	31.25	62.5	25

After comparing the concentration of various analysed parameters it is observed that most of the parameter has been increased to alarming level with in one year duration.Although total dissolved salts are diluted but concentration has been increased in 68% area. Fluoride conc. has been increased in 81% areas Nickel and Lead conc. increased in 69% and 63% respectively. Concentration of Lead is found to be increased by 5939% in Adipur that is really objectionable on the part of human health .





4. Conclusion

- Hardness of water and excess Fluoride and lead is a challenge which is engraved since last year.
- Nickel is an important industrial metal. It is extensively used in stainless steel and other corrosion resistant alloys. Because of its extensive cultural use nickel can be contributed to the environment in significant amount by waste disposal.
- Organic and inorganic copper have been extensively used in agricultural pesticides sprays. The element is therefore likely to be more available for solution in surface and ground water.
- Zinc is extensively used as a white pigment (zinc oxide) in paint and rubber. These applications tend to disperse the element widely in the environment and its availability for solution in water has been greatly enhanced by modern industrial civilization.
- Cadmiumis used in electroplating and for pigments used in paint, printing ink and plastics. It is also used extensively as a stabiliser in PVC plastic and in electrical batteries and fluorescent and video tubes. Many of these uses will tend to make the element available to water that comes in contact with buried wastes.Cadmium affects lungs, kidneys, liver and skeletal system. It binds to sulfhydryl groups, displacing other metals from metalloenzymes, disrupting those enzymes. Cadmium has been classified as a suspected human carcinogen (AK Gosh, personal communication)
- Fluoride in blood and soft tissues has short half-life of few hours, but that in hard tissues like bone and teeth has long half-life of eight years. Accumulation in these two tissues is dose and age dependent. Unlimited accumulation of fluoride in bones is the main cause of the disease, skeletal fluorosis. Fluoride toxicity can be acute due to exposure to a single massive dose, as happens with industrial workers (industrial fluorosis) or chronic (endemic fluorosis) due tocontinuous ingestion of water and food containing high amounts of fluoride. In both the types, teeth and bone are the primary targets. However, fluoride does not sparesoft tissues and causes non-skeletal fluorosis.
- In adults, almost 20-30% and in children almost 50% lead is absorbed through the Gastro Intestinal track. Since lead is chemically similar to calcium, body handles it like calcium. In the body lead is distributed throughout bone, teeth, liver, lung, brain and spleen; bone being the major

accumulator. Leadcan cross blood brain barrier as well as placental barrier.

5. Ground Water Related Issues and Problems

- Due to excessive development and deepening of water levels, most of the dug wells have gone dry.
- With a specific combination of geology, climate and topography, there are structural constraints in the quantum of water available in this district. The most common problem is inherent Salinity of geological formations depositing under marine conditions. Frequent drought is another major problem. Kachchh district receives minimum rainfall in entire Gujarat because of erratic rainfall and exploitation the ground water level is declining. The continuous fall in water table has resulted into several problems like increasing salinity, problem of fluorides, reduction in bore yields and high failure rate of bores. The prolonged use of saline ground water for irrigation has led to decline in agricultural and horticulture productivity and soil fertility in these regions. Villagers are forced to shift to cash crops like BT cotton and salinity tolerant crops production
- Salinity ingress is another problem in the coastal Kachchh. Low rain fall, skewed rain fall ratio and over exploitation of ground water have aggravated the salinity ingression. There is an indirect impact on the health of the villagers living in this region. Villagers complain of increasing kidney and gastric problems.
- Many industrial scale desalinisation units are being established in Kachchh to overcome water crisis.
- Sardar Sarovar project envisages supply for drinking, irrigation and industrial use in Kachchh district.

6. Remedies

- Taking up artificial recharge on large scale through appropriate techniques on a regional scale with active community participation
- Emphasis should be laid mainly on Surface water use after proper treatment to minimize Ground water exploration
- Proper care should be taken for Disposal of waste.
- Community water purification plants based on reverseosmosis technique should be installed by Government authorities like Panchayats, so that TDS level can be reduced and each and every villager must get the basic necessity of life that is water and diseases like stone and other related problems can be controlled and medical cost and suffering can be reduced.

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