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Comparative Study of Pre and Post Monsoon Water Quality in and Around Gandhidham, Kachchh, Gujarat, India, for the Year 2015

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Abstract: ***The major objective of the present report is to do comparative study of the physiochemical parameters including heavy metal contamination in surface, ground and potable water in industrial, residential and commercial zone in and around Gandhidham, Kachchh. To collect the information on the level of contamination 40 water samples were collected from various zones of Kachchh in and around Gandhidham Taluka, Gujarat during 23rd March and20th April 2015 i.e. Pre Monsoon Season. and 22nd October to 14th November 2015 ie Post Monsoon. 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.***

Keyword: Water quality, ground water, physico-chemical, Gandhidham and Anjartaluka.

1. Introduction

Contamination of aquifers is an increasing problem in several parts of India. This along with scarcity of groundwater resources due to increase in water demand and also by reduction in recharge of groundwater from changing land use, combines to further compound the problem. High Salinity, Fluoride, Nitrate and pollution from industrial effluents have caused contamination of aquifers which beset with numerous quality problems, some of which are increasing in intensity over the years. Largest producer of Salt, Saline desert and gulf regions add sea water intrusion into aquifers is a common problem. Excessive Fluoride is another problem in groundwater. Saline water being denser occupies the lower layer than fresh water. Under equilibrium conditions between fresh inland water and sea water, a depletion of water table can result in the depth of saline water below sea level reduce by forty times as compared with drop in water tables above sea-level. Intensification of groundwater use combined with decreased recharge of fresh groundwater into inland aquifers and high evaporation rate has electrified the problem.

Kachchh, after an earth quake of January, 2001 has various pockets of high industrial activity where large amounts of effluents are released, sometimes directly into wells Toxic substances releases from industries need to be treated according to norms laid by the Pollution Control Board. But, many industries release their effluents without proper treatment causing harmful heavy metals and chemicals to be released into the environment. Lead is detected beyond desired limits in various belts of Kachchh.

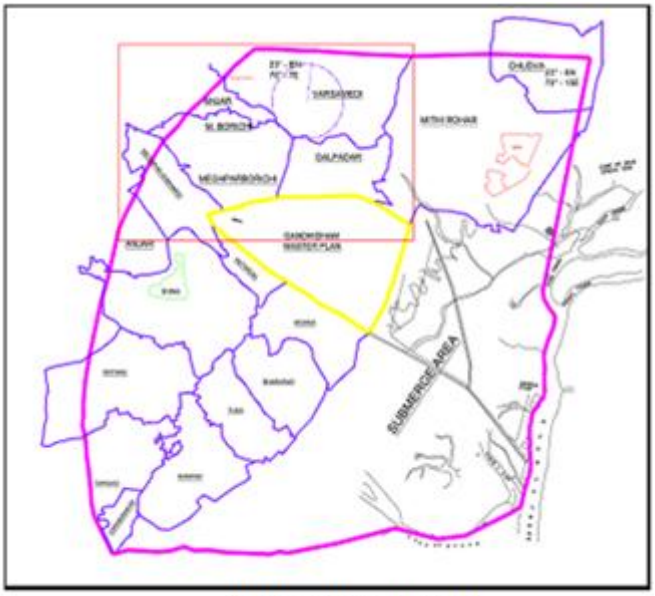
Several toxic metals which are important to the environment and human health have been detected in aquatic media. These toxic metals include the non-essential metals and are of no importance to humans (Borgmann and Norwood, 2002). These toxic metals have been found to have accumulated mainly in the kidney and liver and high concentrations have also been found to lead to chronic kidney dysfunction. Steoppler (1997) has shown that when lead is ingested by man, it enters the blood stream and soon it begins to appear in the liver and kidney but ultimately over 90% of Pb absorbed end up in bones where it replaces calcium.heavy metal toxicity can cause chronic degenerative diseases the symptoms being mental disorders, pain in muscle and joints, gastro intestinal disorders, vision problems, chronic fatigue, and susceptibility to fungal infections. Sometimes the symptoms are vague and difficult to diagnose at early stage. Genotoxicity and cancers can also occur. Some elements like Fe, Zn, Cu, Co, Mn , Ni, are needed in small quantities for human metabolism as they work as coenzymes , but may be toxic at higher levels. Others like lead, mercury, cadmium, and arsenic etc. have no beneficial role and are positively toxic. Small amounts of fluoride help to prevent dental caries, but excess is harmful.

2. Work Area

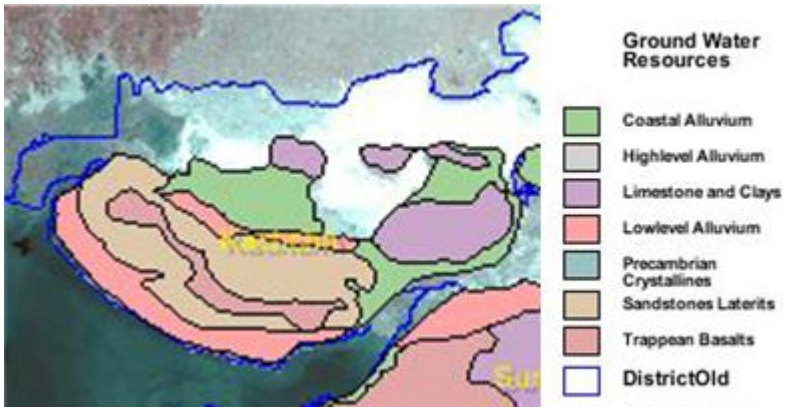
Kutch District forms part of the SAURASHTRA Region of Gujarat State having an area of 45652 Sq. Km. the Largest in India. It is situated in the South western corner of the Gujarat between 22.44° and 24.41° North Latitude and 78.89° and 71.45° East Longitud

Gujarat

Gandhidham Taluka



Villages in work area



Aquifiers of Kachchh

For this the study area is divided in different zones

Sr. No.	*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	MeghparBorichi	Rural	Residential, Industrial
7	Kandla	Urban	Residential, Industrial, Port
8	Varsamedi	Rural	Residential, Industrial
10	Galpadar	Rural	Residential, Industrial
11	Mithirohar	Rural	Industrial, Residential
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

Analysis Methods Population in last 20 Years

Analysis Methods

Parameter	Method	Instrument/Apparatus
pH	Potentiometry	Digital pH/EC meter- Model- LabIndia
EC	Conductometry	
TDS	Conductometry	Digital TDS Meter
Nitrate	Brucine method	UV-VIS Spectrophotometer
Phosphate	Ascorbic acid method	
Sulphate	Turbidimetry	
Fluoride	SPADNS Method	
Silicate	Molybdosilicate method	
Sodium		AAS
Potassium		
Calcium	EDTA Titration Method	-------
Magnesium		-------
Total Hardness		
Alkalinity		
Chloride	(Titrimetric)	-------
Heavy metals (Pb, Cu, Cd, Ni, Fe, Mn, Ni and Co etc.)	Solvent extraction cum pre-concentration method	Atomic Absorption Spectrometer

Population in last 20 years

name	1991	2001	2011
Anjar	51,209	68,343	87,183
Antarjal		6,036	11,256
Galpadar			13,155
Gandhidham	1,04,585	1,51,693	2,47,992
Kandla	19,787	14,695	15,782

3. Results and Discussion

Comparative study of Pre and Post Monsoon Water Quality

Ground Water(19 Samples)

Sr. No.	*Parameters(all values one in mg/l except pH)*	*Range Pre-Mon*	*Range Post-Mon*	*Std BIS*	*% samples exceeding desired limit- pre monsoon*	*% samples exceeding desired limit- post monsoon*	*Range of Increase Concentration after monsoon (%)*	*sample showing increase after Monsoon (%)*
1	pH	6.75 - 8.6	6.79 - 8.96	6.5 - 8.5				
2	Total Dissolved salt	1012 - 5091	803 - 4035	500	100	100	0.3- 47.7	26
3	Chloride as Cl^-	6- 1506	105 - 1327	250	89	94	3.2- 1650	63
4	Total Alkalinity	230 - 1012	115 - 728	200	100	94	1.5-56.7	47
5	Total hardness as CaCo3	69 - 1199	52 - 1238	300	78	84	2.3- 180	47
6	Calcium as Ca^{2+}	19 - 444	36 - 700	75	94	89	0.2- 636	57
7	Magnesium as Mg^{2+}	50 - 755	16 - 798	30	100	97	0.5-36	31
8	Silicates as SiO_2	12.12 - 74.9	1.88 - 51.4	17			2.3- 94	36
9	Sulphates as So_4^{2-}	0 - 423	0 - 241	200	5	15	29.5- 203	31
10	Nitrates as NO_3^-	0.9 - 72.7	1.4 - 89	45	5	15	2- 1846	57
11	Sodium	184 - 1070	72.7 - 1036	200	100	94	4-108	31
12	Potassium	0.46 - 18	0 - 64	1	5	100	21-1107	68
13	Fluoride as F^-	0.34 - 3.47	0.29 - 4.12	1	26	57	1.6-291	73

Heavy Metals

Sr.No.	Parameters(all values one in mg/l)	Range Pre- Mon	Range Post-Mon	Std BIS	% samples exceeding desired limit- pre monsoon	% samples exceeding desired limit- post monsoon	Range of Increase Concentration after monsoon (%)	sample showing increase after Monsoon (%)
1	Iron	0.09 - 5.63	0.04 - 1.03	0.3	36	21	40-999	36
2	Nickel	0.004 - 0.216	0 - 0.213	0.02	21	84	64-3848	78
3	Manganese	0.012- 1.39	0.003 - 0.103	0.1	36	10	149-330	10.5
4	Cadmium	0.001- 0.018	0.004 - 0.008	0.01	26	0	16-490	36
5	Lead	0 - 0.143	0.002 - 0.06	0.01	52	94	45-1343	52
6	Copper	0.004 - 0.18	0.001- 0.011	0.05	31	0	12-206	10
7	Zinc	0.02- 0.26	0 - 0.225	5	0	0	15-866	36

Potable Water (14 Samples)

Sr. No.	Parameters(all values one in mg/l)	Range Pre-Mon	Range Post-Mon	Std BIS	% samples exceeding desired limit- pre monsoon	% samples exceeding desired limit- post monsoon	Range of Increase Concentration after monsoon (%)	sample showing increase after Monsoon (%)
1	Total Dissolved salt	778- 4732	647.3 - 216.9	500	100	100	Dec-57	29
2	Chloride as Cl^-	59- 2152	156-827	250	71	85	5-223	57
3	Total Alkalinity	126-410	143- 379	200	79	71	2.8- 200	43
4	Total hardness as $CaCo_3$	212- 1218	234 - 556	300	71	71	Oct-41	35
5	Calcium as Ca^{2+}	134- 376	123- 327	75	100	100	10- 23.5	29
6	Magnesium as Mg^{2+}	72-1063	72- 259	30	100	100	Jun-69	43
7	Silicates as SiO_2	5.41- 27.6	0.09- 27.05				8-102	36
8	Sulphates as So_4^{2-}	5.05- 25.24	4.21- 153.35	200	7	0	30.5- 48	43
9	Nitrates as NO_3^-	2.93- 9.84	0.1- 27.7	45	0	0	4.8- 320	50
10	Sodium	74.17- 480	190.9- 754.5	200	71%	93	6-917	50
11	Potassium	2.74- 120	0- 19.45	1	100	100	35- 162	64
12	Fluoride as F^-	0.219- 1.35	0.3-0.84	1	7	0	7- 105	71

Heavy Metals

Sr.No.	Parameters (all values one in mg/l)	Range Pre-Mon	Range Post-Mon	Std BIS	% samples exceeding desired limit- pre monsoon	% samples exceeding desired limit- post monsoon	Range of Increase Concentration after monsoon (%)	sample showing increase after Monsoon (%)
1	Iron	0- 7.27	0.06- 0.567	0.3	29	36	35- 210	29
2	Nickel	0.0005- 0.036	0- 0.118	0.02	7	71	31-50951	71
3	Manganese	0- 0.323	0.008 - 0.065	0.1	0	0	100- 258	29
4	Cadmium	0.0004- 0.02	0.002- 0.015	0.01	14	0	31- 687	50
5	Lead	0-0.08	0.019- 0.06	0.01	36	71	113- 2143	57
6	Copper	0 -0.172	0.00- 10.009	0.05	14	36	8- 308	36
7	Zinc	0.0075- 0.224	0 - 0.0.22	5	0	0	1000- 1162	43

Surface Water(7 Samples)

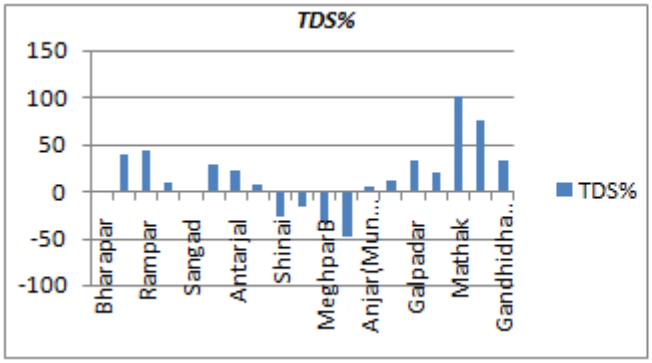
Sr.No.	Parameters(all values one in mg/l)	Range Pre-Mon	Range Post-Mon	Std BIS	% samples exceeding desired limit- pre monsoon	% samples exceeding desired limit- post monsoon	Range of Increase Concentration after monsoon (%)	sample showing increase after Monsoon (%)
1	pH	7.3- 8.8	8- 9.32	6.5 - 8.5				
2	Total Dissolved salt	182.5-2368	182	500	100	100	0	0
3	Chloride as Cl^-	4- 10740	31- 98	250	57	42	0- 675	14
4	Total Alkalinity	164- 697	139- 271	200	71	14		
5	Total hardness as CaCo3	103- 3644	53- 488	300	57	14	0-14.2	74
6	Calcium as Ca^{2+}	43- 175	47- 137	75	71	28	9-111.8	28
7	Magnesium as Mg^{2+}	53- 3469	6- 351	30	100	85	0- 14.2	36
8	Silicates as SiO_2	1.74- 12.235	0- 50.67	17			27- 888	57
9	Sulphates as So_4^{2-}	5.48- 790.78	2.94- 46.343	200	0	0	0	0
10	Nitrates as NO_3^-	0- 39.98	0- 2.52	45	0	0	102- 240	28
11	Sodium	2.98-897	72.72- 500	200	57	57	19- 48	28
12	Potassium	5.48-35	3.69- 60.86	1	100	100	24- 295	28
13	Fluoride as F^-	0.48- 2.57	0.28- 1.43	1	28	28	0.8-48	28

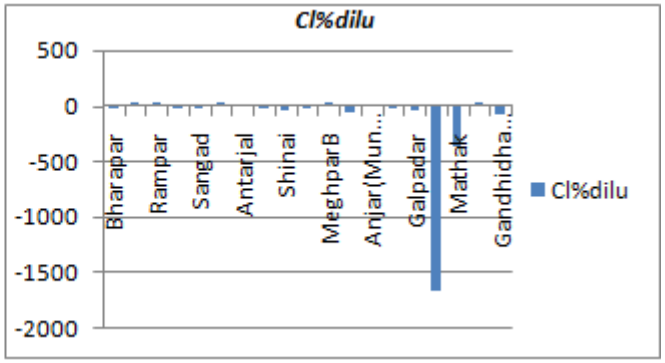
Heavy Metals

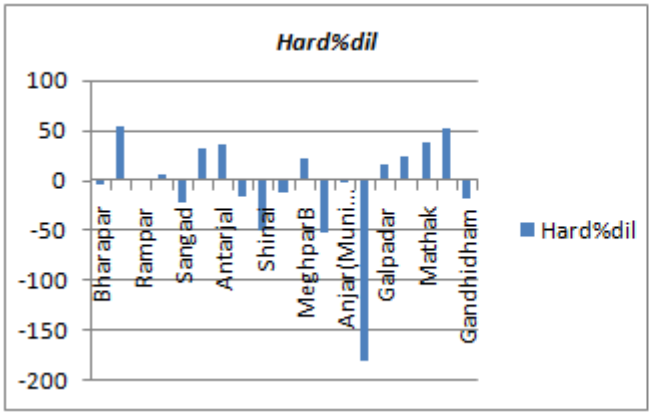
Sr. No.	Parameters(all values one in mg/l)	Range Pre-Mon	Range Post-Mon	Std BIS	% samples exceeding desired limit-pre monsoon	% samples exceeding desired limit-post monsoon	Range of Increase Concentration after monsoon (%)	sample showing increase after Monsoon (%)
1	Iron	0.054-0.13	0.195- 0.9	0.3	71	42	22-1846	57
2	Nickel	0.0004- 0.096	0 - 0.118	0.02	0	28	23- 17668	71
3	Manganese	0- 3.37	0.015- 0.08-	0.1	28	0	0- 40	14
4	Cadmium	0- 0.027	0.0017- 0.0078	0.01	28	0	0-57	14
5	Lead	0.003- 0.11	0- 0.028	0.01	14	0	60- 220	42
6	Copper	0.004- 0.38	0.002- 0.005	0.05	28	0	0	0
7	Zinc	0.054- 0.022	0.08- 0.3	5	0	0	52- 460	42

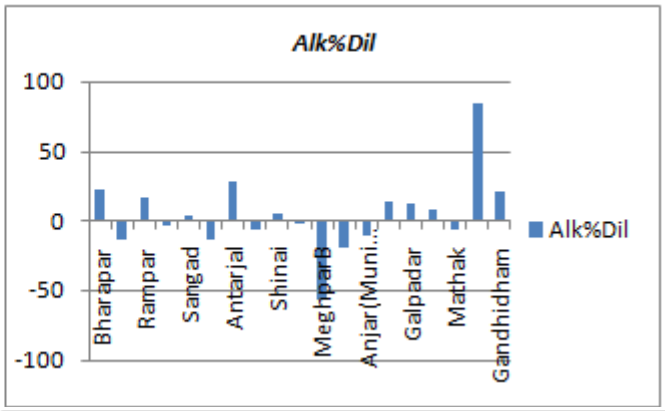
Down pour in Gandhidham from 16th January till 22nd of September 2015 was 450mm, .Concentration of various Parameters has been found increased between April 2015 to November 2015. Following Graphical representation shows the dilution of different parameters. Negative values show increased concentration while Positive values shows dilution.

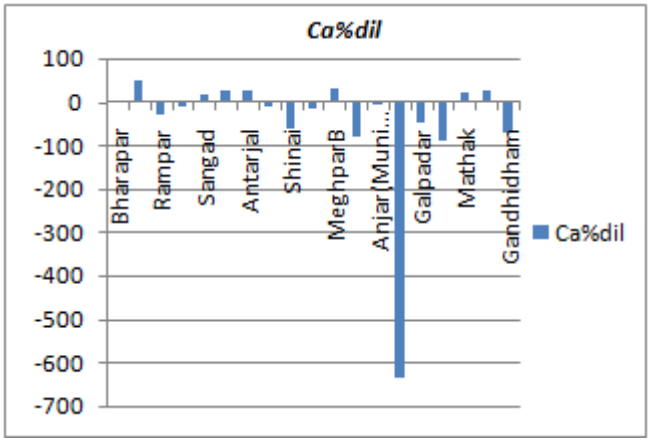
Ground Water

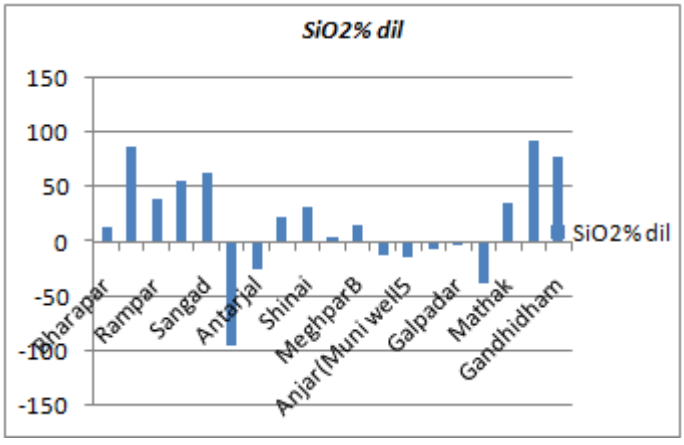


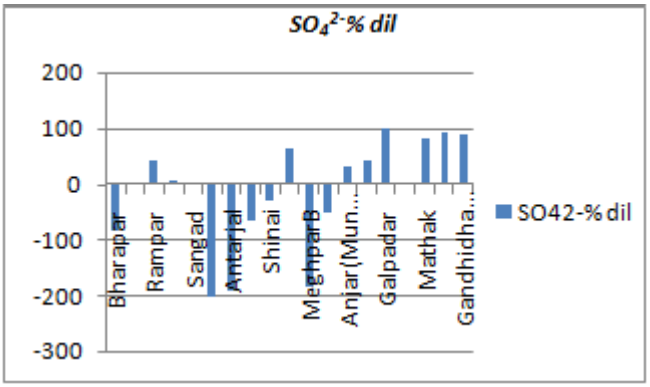


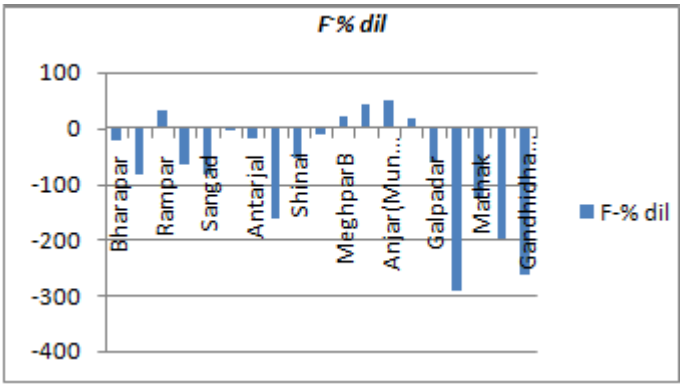


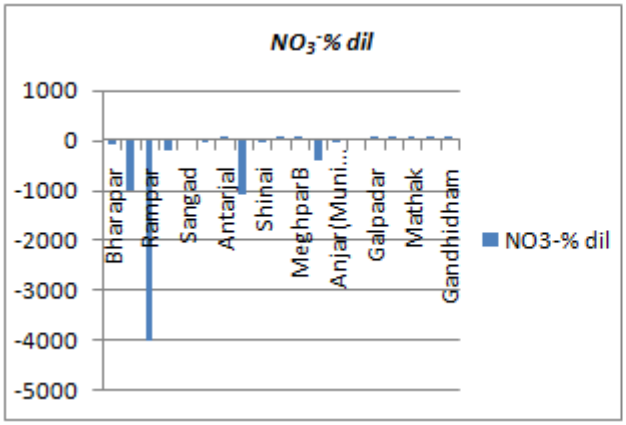


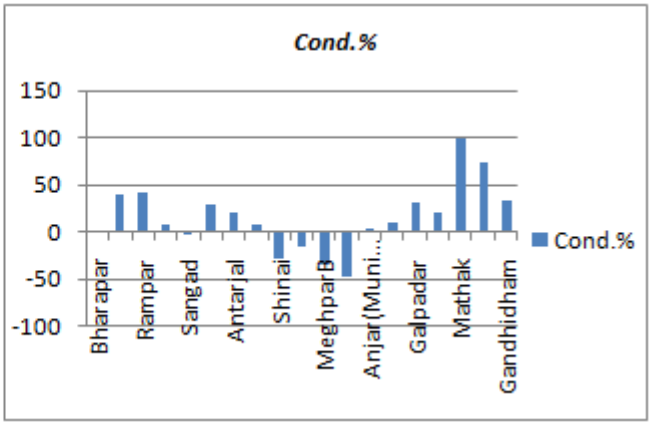




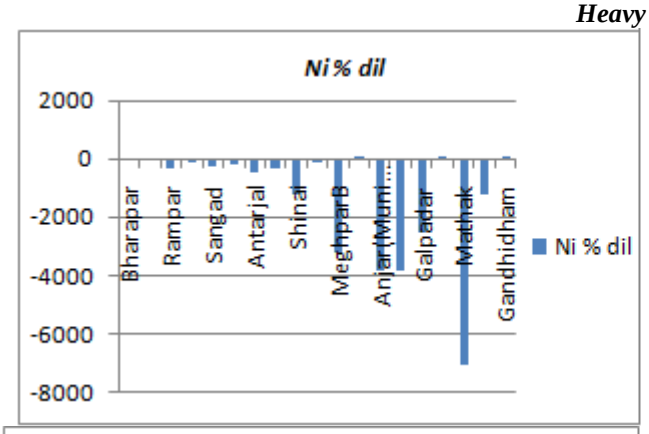


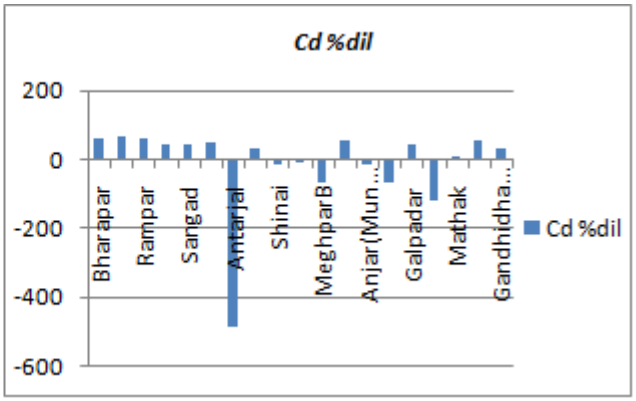


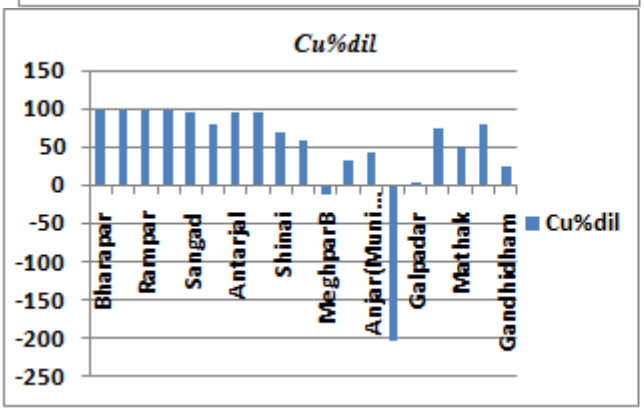


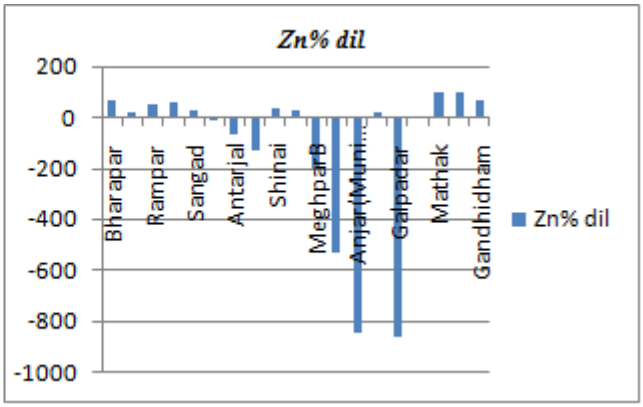


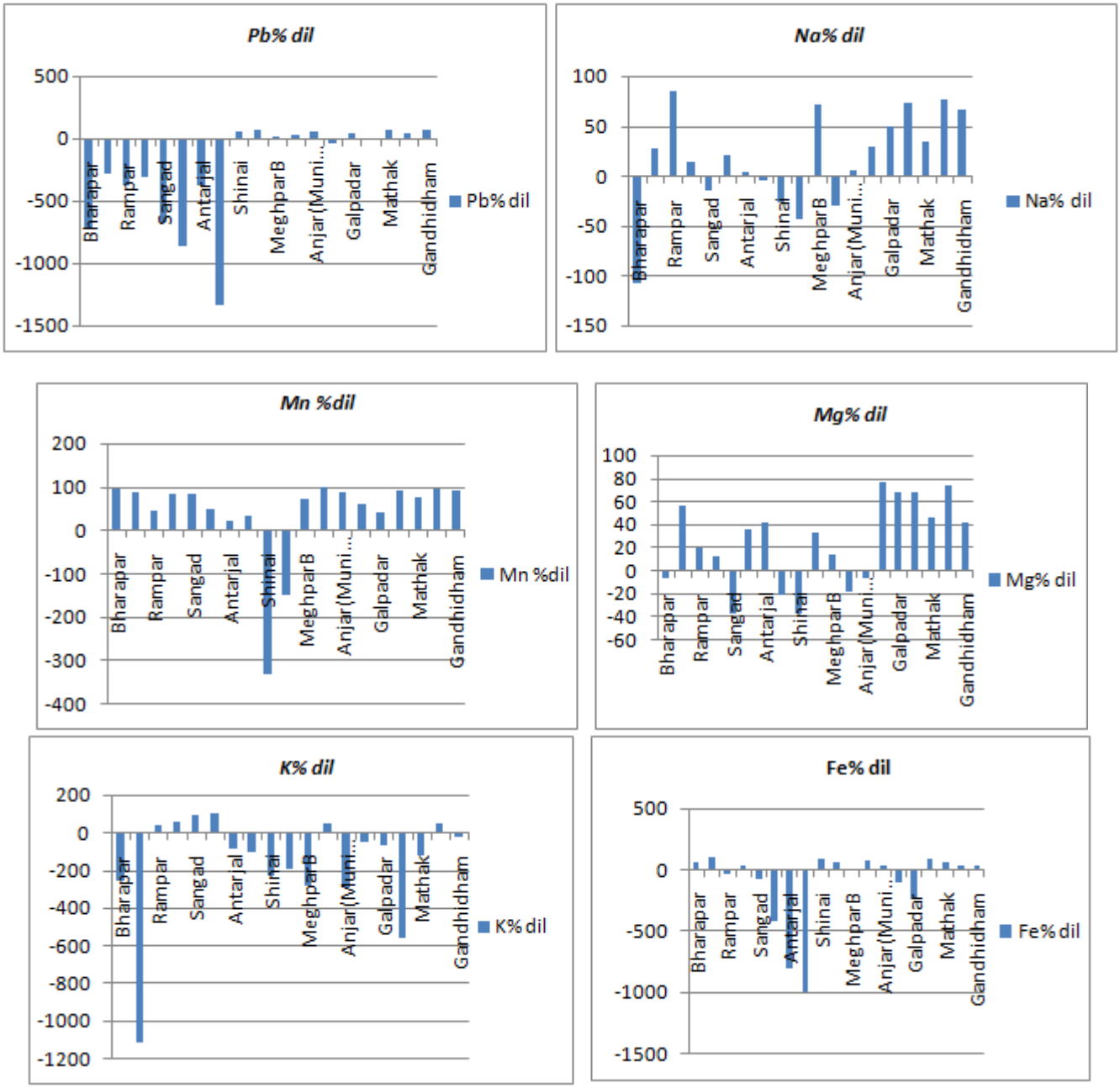
Heavy Metals











4. Conclusion

In comparative study of Ground Water it is found that 26% of samples showed increased TDS. Mostly Calcium, Potassium Nitrates chloride ions, and fluoride ions are washed off with rain water and leached to ground water table. 71%samples of ground water showed increased concentration of Fluoride after monsoon. 68% samples have increased concentration of Potassium which is in the range of 21 to 1107 % more than the pre- monsoon. Cl^- in 68% samples and in 57% samples $No_3^-$is found to be increased after Monsoon.

Among heavy metals Pb and Ni showed maximum increase in the concentration in post Monsoon.
In Potable water which is mainly ground Water from Nangalpar, Viri and surface water from Tappar dam the concentration of fluoride (71% Samples), K (64% samples) ,Mg (43% samples) is found to be increased. 57% samples showed increase in Pb concentration and 71% samples showed increased Ni concentration.

After monsoon 71% of the samples showed more than desired limits are really alarming as this water is used for human consumption. In surface water 71% of the samples showed increase in concentration of nickel after Monsoon but under desired limit.

5. Remedies

1) More and more check dams should be constructed but only after checking the percolation rate of the soil layers and soil texture so as to increase the water percolation with less concentration of metallic and non-metallic constituents which makes water unfit for consumption.
2) Construction of the bore wells i.e. exploration of the ground water should be strictly under government authorities to control haphazard use of Ground water and

it must be made compulsory to have provisions for recharge of Ground water along with drilling bore well.

3) As it is found that the concentration of Lead and Nickel increased after the down pour concludes that Pb and Nickel has been washed along with water from the land sources which may be either industrial or garbage .Nickel and Lead are mainly used in Battery cells for domestic electric supports or in vehicles .Most of the areas showing increased concentration of these metals are residential and even if they are industrial, they have small scale industries which is also very less in Number. Municipal authorities should take initiative for proper disposal of E Garbage.
4) Area around the dams should be cleaned especially before monsoon so that washing off of pollutants from waste can be avoided

6. Acknowledgement

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