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Analytical study of pollutant parameters in ground water of Chhota Udepur District, Gujarat.

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Abstract -*In real world, the main issue is quality of water for its user mainly drinking, agriculture and for industries. The sources of groundwater pollution are numerous and diverse due to human activity and industrial growth. The large scale Industries such as petrochemicals, pharmaceuticals, fertilizers, plastic, and chemical are manufacturing various products in Chhota Udepur district. It's an attempt to show the trend of some major pollutant parameters of different location in Chhota Udepur district by analyzing water samples of pre monsoon and post monsoon data for the duration of last 12 years. Twenty four samples of ground water were included from each of the five talukas during the pre-monsoon (May) and post-monsoon (October)seasons for pollutants parameters in terms of pH, TDS, Ca, Mg and Cl by monitoring open wells, tube wells and piezometers of agencies like Gujarat Pollution Control Board (GPCB). The concentrations of parameters were compared with the standards of BIS IS 10500:2012. The drinking water of all five talukas contains higher magnitude of TDS than the desirable limits were noticed. It has been revealed that maximum TDS was detected in Nasvadi, Kalarani and Laved villages. The pH of almost entire district showed no objectionable variation from the standard value (6.5-8.5), except in the year of 2015 samples of pre-monsoon and post-monsoon. Ground water of village Kalarani of Jetpur Pavi taluka was detected with above desirable value of Calcium, Magnesium and Chloride.*

Keywords- *Ground* ***water, Pollutant parameters, TDS, pH, Ca, Mg, Cl, APHA, GPCB.***

I. INTRODUCTION

Ground water is one of the major sources for drinking, agricultural and other uses. The sub-surface hydrology influence on groundwater movement and hence contaminants migrate to the subsurface water. The increasing rate of urbanization, agricultural activity and industrialization are mainly responsible for pollution (Mukesh A. Modi and Dr. N J Shrimali, 2012). Pollutants observed at a location may result from a single source or combination of sources with varying injection rates and release periods. This study is carried out for analysis of physical and chemical parameter of ground water at different location of Chhota Udepur, Gujarat, India. This area include an array of chemical, fertilizer, paint, dyes, glass, pharmaceutical, mine site, and other allied industries, which have impacted the local environment to a great extent. Leaching of pollutants into groundwater is significant hazard and concerned research worldwide (Zhang et al. 1999; Matos et al. 2001; Breward 2003). The pollutant parameters have been selected as per their common environmental concern along with health hazards to the human being and animals. It is important to carry out progressive groundwater quality mapping of the area systematically for better management of ground water resources. Generally the untreated wastages and chemical from industries dumped on the ground slowly infiltrate and pollute ground water. The present study objective is to assess the major physicochemical parameter concentration at various samples of open wells, tube wells and piezometers data of GPCB in the Chhota Udepur district and identification of root causes of such pollutants.

II. STUDY AREA

The Chhota Udepur district lies between north latitude 22° 19′ 12″ and east longitude 74° 00′ 36″ in Gujarat, India, covering an area of 3,087 km^2. The district is divided into 6 talukas, 889 villages (Table 1). Chhota Udepur District total population is 10, 71,831 (as per census 2001). This area has mostly tribal population which lives in rural area. Percentage of Rural Population is 93.2% of total population. This area known rich agriculture with fine crops of cotton, horticulture and vegetables due to fertile alluvial soils and perennial availability of water but 95% ground water sources used as irrigation for cultivated area (District Ground Water Brochure: Vadodara, 2011).

Table: 1 –Talukas of Chhota Udepur

Sr. No	Taluka	Area (Sq.km)	Urban (Sq.km)	Rural (Sq.km)	No. Villages
1	Chhota Udaipur	765.46	4.01	761.45	144
2	Jetpur	805.64	4.41	801.23	212
3	Kawant	607.76	2.04	605.72	132
4	Naswadi	535.17	0.00	535.17	219
5	Sankheda	722.61	31.84	690.78	182
		3436.64	42.30	3394.34	889

Total Enterprises including Manufacturing & Service Sector is 300 (DIPS report of Chhota Udepur, 2016-17). There are many industries like Food Processing & Agro Based Industries, plastics, glass and ceramics, Mechanical Based industries, live stock industries, mineral and forest based industries and textiles industries (DIPS report of Chhota Udepur, 2016-17).

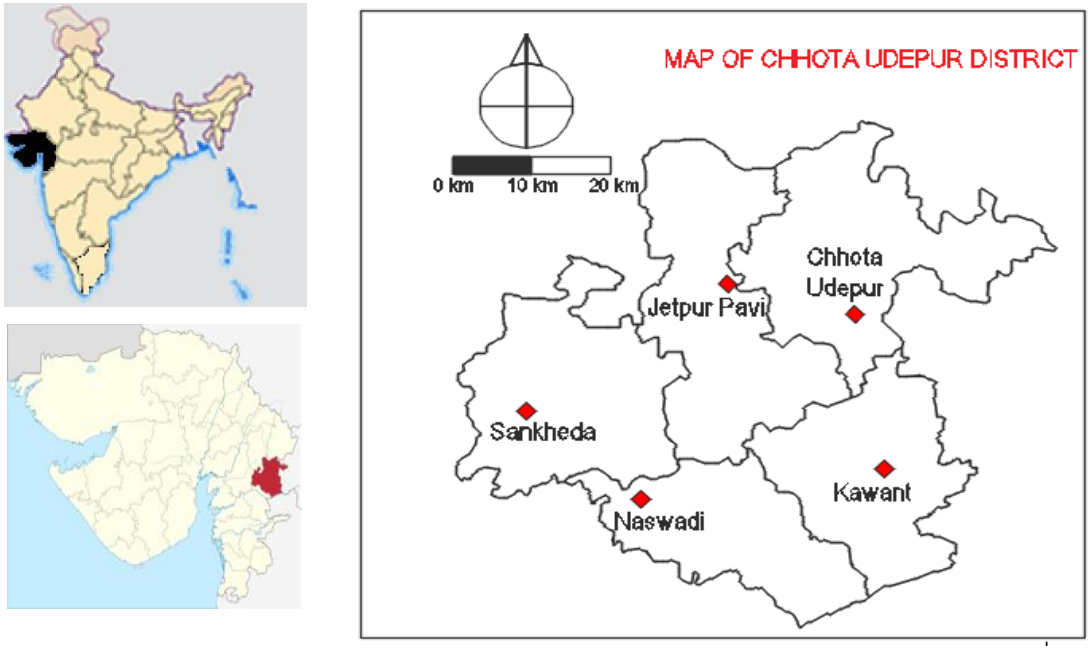


Figure 1:- Chhota Udepur district (study area)

A. GEOLOGY AND HYDROGEOLOGY

It has been observed during study of hydrogeology of Chhota Udepur that it has a large forest area and deposits of dolomite, fluorite, granite and sand all of which are mined. Land of Chhota Udepur district can be classified in four types as Hard Black Soil, Medium Black Soil, Sandy loam Soil and Saline Soil. Chhota Udepur district has occupied by various geological formations like granite gneiss and Aravalli meta-sedimentary rocks occupy large eastern part of the district.

The main rivers of the districts are Orsang, Ujeri, Heran, Aani, Sukhi, Ashwani, Menn and Rami (DIPS report of Chhota Udepur, 2016-17). The various season of the year are (a) monsoon - middle of June to October, (b) winter - November to February, and (c) summer – March to June. Normally atmosphere remains hot and dry in the district. Highest temperature is 48 degree centigrade in summer and lowest temperature comes down to 8 degree in winter season. Average annual Rainfall is 75 cm.

In Chhota Udepur district area, groundwater occurs both as unconfined and confined conditions. Saturated zones of unconsolidated shallow alluvium and weathered zones, shallow depth jointed and fractured rocks forms unconfined aquifers, whereas multilayered aquifer below impervious clay horizons in alluvium formation and interflow zones of basalts, deep seated fracture zones, shear zones in basalts, granites give rise to semi confined to confined conditions.

The depth to water is greater in upland areas whereas in valley portion and shallow grounds, the levels are very close to surface. The gradient is steep in eastern hilly terrain, a hard rock terrain. It becomes gentler towards central and western part of semi-consolidated to un-consolidated formation areas. (District Ground Water Brochure: Vadodara, 2011).

III. DATA COLLECTION

Ground water samples (well data) of all five talukas Chhota Udaipur, Jetpur pavi, Kawant, Naswadi and Sankheda of district were obtained of various locations during pre-monsoon month of May and post monsoon month of October for the duration of year of 2003 to 2015.

The of ground water samples of total 24 locations were analyzed for physical parameter like TDS and pH and chemical parameter like Ca, Mg, CL concentration in mg/liter. Also, the ground water level data for pre monsoon and post monsoon of these stations are also collected for this analysis. District Resources Map from GSI, Gandhinagar were collected and basic statistical information are studied for analysis.

Table: 2 –Various Sample Station of Chhota Udepur

District		Taluka	Village	Geology	R.L.(M)	Latitude	Longitude
Chhota Udepur	1	Chhota Udepur	Chhota Udepur	BAS	141.80	22°18'48"	74°00'48"
	2	Chhota Udepur	Ambala	BAS	163.26	22°22'18"	74°05'30"
	3	Kavant	Dungargam	BAS	197.20	22°08'30"	74°03'05"
	4	Chhota Udepur	Ferkuwa	BAS	220.06	22°22'17"	74°12'39"
	5	Chhota Udepur	Kevdi	BAS	193.37	22°32'00"	73°57'30"
	6	Kavant	Nalvant	BAS	227.22	22°05'05"	73°54'12"
	7	Kavant	Navalja	BAS	227.22	22°04'50"	74°06'18"
	8	Chhota Udepur	Zoz	BAS	161.57	22°26'24"	73°57'05"
	9	Nasvadi	Dugdha	BAS	197.85	22°00'15"	73°56'07"
	10	Nasvadi	Goyavant	BAS	151.08	21°58'40"	73°51'36"
	11	Nasvadi	Vadiya	BAS	71.90	22°00'42"	73°41'20"
	12	Jetpur Pavi	Kalarani	ALV	105.61	22°13'25"	73°52'03"
	13	Jetpur pavi	Kadval	PHS	170.86	22°29'17"	73°45'42"
	14	Chhota Udepur	Lagami	PHS	186.33	22°27'23"	74°00'16"
	15	Kavant	Raisingpura	BAS	249.22	22°01'36"	74°03'16"
	16	Nasvadi	Nakhalpur	BAS	129.58	21°58'05"	73°48'25"
	17	Nasvadi	Nasvadi	SST	80.26	22°02'32"	73°43'35"
	18	Nasvadi	Vadiya	BAS	71.19	22°02'54"	73°46'53"
	19	Jetpur pavi	Kashipura	BAS	80.12	22°07'33"	73°48'18"
	20	Sankheda	Sankheda	ALV	56.81	22°10'26"	73°35'09"
	21	Sankheda	Laved	BAS	66.88	22°16'03"	73°36'18"
	22	Jetpur pavi	Jabugam	GRT	85.95	22°17'21"	73°46'09"
	23	Kavant	Kavant	BAS	192.28	22°05'37"	74°03'13"
	24	Chhota Udepur	Malaja	GRT	141.29	22°20'58"	73°58'53"
Source: Gujarat Pollution Control Board (GPCB)							

IV. METHODOLOGY

All talukas of district profile has been observed and studied in detail to know various sources of contamination and various industries active in the district. Extensive study of District of Industrial Potentiality Survey Report of Study area (DIPS) has been done.Number of samples of ground water were collected following APHA standard by government agency GPCB from each of the five talukas during the pre-monsoon (May) and post-monsoon (October) seasons for the specific duration. The major pollutants parameters such as pH, TDS, Ca, Mg and Cl, etc. by monitoring open wells, tube wells and piezometers are studied and the concentrations of each were compared with the standards of BIS IS 10500:2012. To identify the correlation between the concentration of pollutants and their sources, the location of specific industries were studied along with hydrological and geological parameters with local ground water sample.

V. RESULT AND DISCUSSION

A. GROUND WATER LEVEL TREAND

The ground water first enters an aquifer through gravity induced downward movement which termed as percolation but through an aquifer water flows to lateral direction too. This flow can occur due to the gradient of the aquifer or artificial conditions enforced from the aquifer by pumping or recharging. Ground water flows through an aquifer is very slow such a way that it passes few centimeters in a day. The ground water level of well data for the pre monsoon and post monsoon for various locations in study area were collected and tabulated for analysis (Table 3). From the water level data and

study of litho log data of various well locations available from GWRDC of Gujarat government, it has been found that all stations were having general depth of water level up to 20 m below earth surface except Kavant village and Naswadi village. The geology of Kavant village was having Basalt hard rock below 20 m depth to 60m from ground level with sorted textured rocky soil. Thus such geologic formation of cannot sustain ground water for considerable period of time, even after monsoon. The Naswadi village were having sandy soil up to top 20 m and below 20 to 40 m there were sand stone with fine to medium, medium to course soil texture, therefore the ground water level were fluctuation around 20m depth from ground level. Rest all other station of sampling are having almost variation between 5 to 15 m depth from normal ground level.

Table: 3 –Depth of water level below ground level at various Sample Station of Chhota Udepur

	Taluka	**Village**	**Depth to Water Level (M)**									
			May-03	**Oct-03**	**May-06**	**Oct-06**	**May-09**	**Oct-09**	**May-12**	**Oct-12**	**May-15**	**Oct-15**
1	Chhota Udaipur	Chhota Udaipur	6.70	3.80	6.65	3.00	7.95	4.35	6.60	3.85	5.50	3.70
2	Chhota Udaipur	Ambala	6.60	3.00	5.70	1.90	5.80	4.40	7.20	2.40	5.40	4.00
3	Kavant	Dungargam	13.70	5.70	13.45	7.40	12.70	9.20	13.10	6.30	14.50	8.50
4	Chhota Udaipur	Ferkuwa	9.55	3.30	8.90	2.80	7.30	3.90	8.90	6.30	7.10	2.90
5	Chhota Udaipur	Kevdi	8.10	4.90	7.05	3.75	8.10	5.15	7.60	4.15	7.25	6.00
6	Kavant	Nalvant	9.60	4.30	8.50	4.30	7.90	6.85	9.60	4.95	8.90	8.10
7	Kavant	Navalja	13.64	7.90	12.65	7.90	11.95	9.90	12.40	10.20	11.30	10.10
8	Chhota Udaipur	Zoz	13.35	6.50	12.65	6.05	12.80	9.80	13.30	7.90	9.60	10.90
9	Nasvadi	Dugdha	5.90	2.90	5.95	2.30	6.80	3.45	6.50	3.85	5.90	4.20
10	Nasvadi	Goyavant	13.05	8.40	11.50	8.70	11.85	9.20	12.80	8.35	10.40	9.80
11	Nasvadi	Vadiya	10.70	6.28	8.88	5.90	9.70	8.55	10.80	7.58	9.30	8.90
12	Jetpur Pavi	Kalarani	10.45	5.90	9.75	2.05	7.80	6.30	8.70	2.60	7.80	5.40
13	Jetpur pavi	Kadval	15.68	6.20	11.47	2.95	11.43	7.69	13.15	3.45	11.85	13.55
14	Chhota Udaipur	Lagami	15.55	11.45	13.30	8.90	13.23	12.20	14.65	8.95	15.35	13.15
15	Kavant	Raisingpura	12.42	4.95	11.30	3.87	12.11	7.68	13.45	5.40	14.25	8.45
16	Nasvadi	Nakhalpur	14.35	5.75	15.55	8.22	17.28	8.45	21.50	7.90	24.50	10.30
17	Nasvadi	Nasvadi	22.85	16.10	14.40	13.60	15.78	12.88	15.70	12.00	15.70	18.30
18	Nasvadi	Vadiya	7.52	3.95	6.10	3.85	7.98	4.67	8.55	4.85	17.35	9.30
19	Jetpur pavi	Kashipura	16.58	3.75	10.20	1.81	11.72	4.78	13.10	2.60	17.50	16.20
20	Sankheda	Sankheda	19.58	17.53	18.35	13.15	18.32	18.00	19.25	17.30	19.15	23.20
21	Sankheda	Laved	11.20	5.35	6.05	1.40	4.22	3.20	4.05	1.60	4.20	3.15
22	Jetpur pavi	Jabugam	11.75	6.70	10.35	6.12	10.08	7.88	10.85	7.65	11.10	10.70
23	Kavant	Kavant	52.80	41.25	44.30	18.55	36.00	24.60	36.15	27.15	30.90	29.30
24	Chhota Udaipur	Malaja	10.38	3.05	8.75	2.68	9.48	4.43	10.80	3.40	11.05	8.90

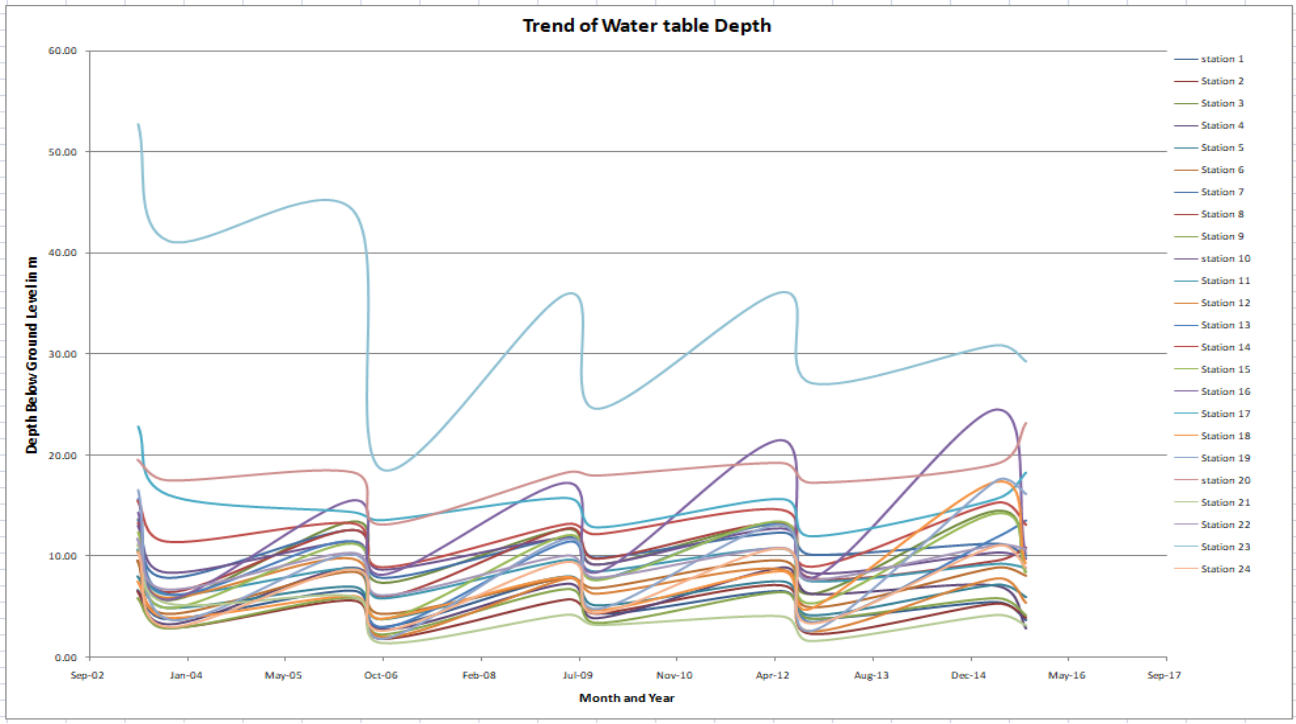


Figure :2 Ground water level trend graph

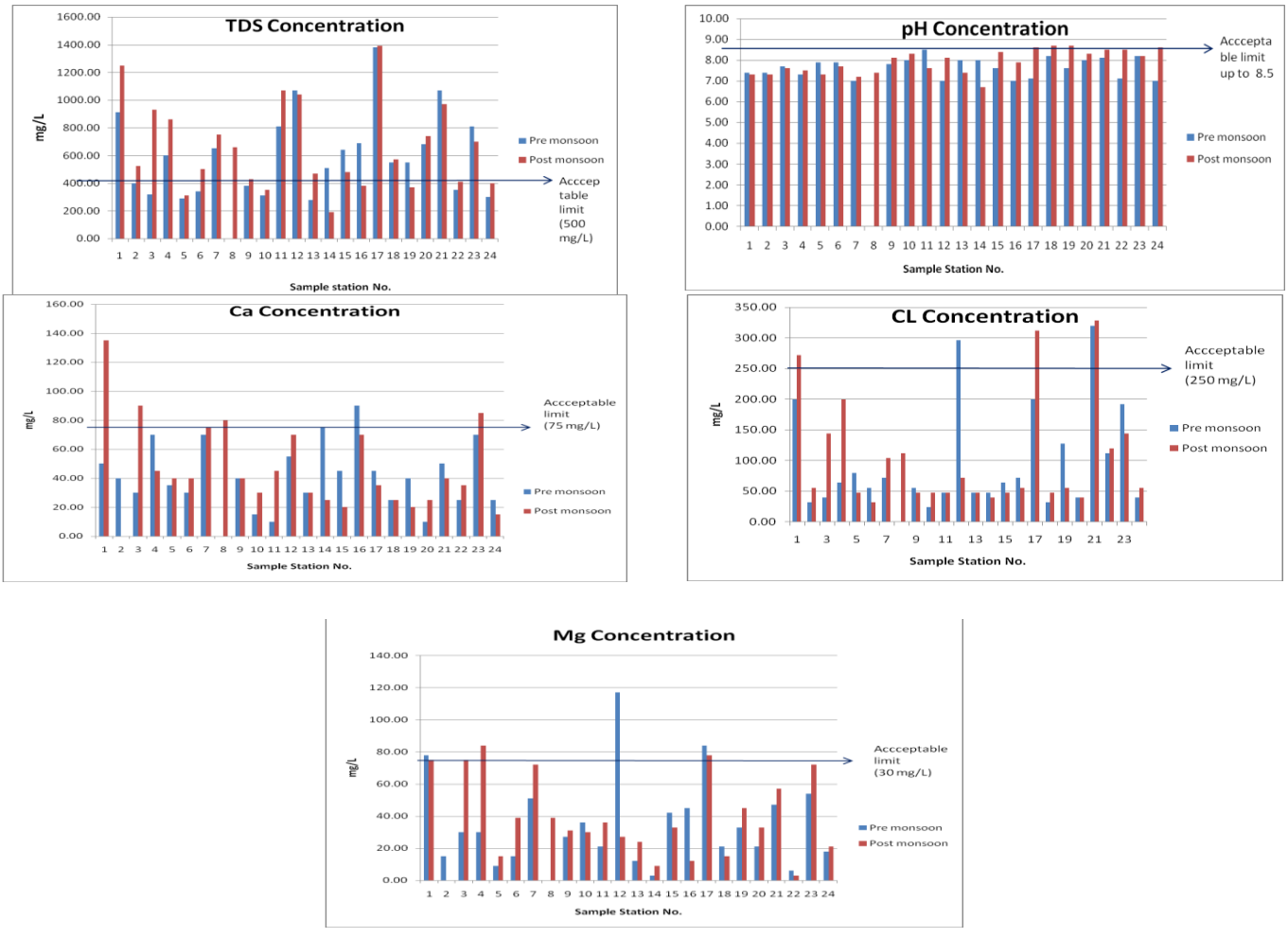


Figure : 3 Concetration of each parameters at various stations in Pre-monsoon and Post-monsoon year 2003

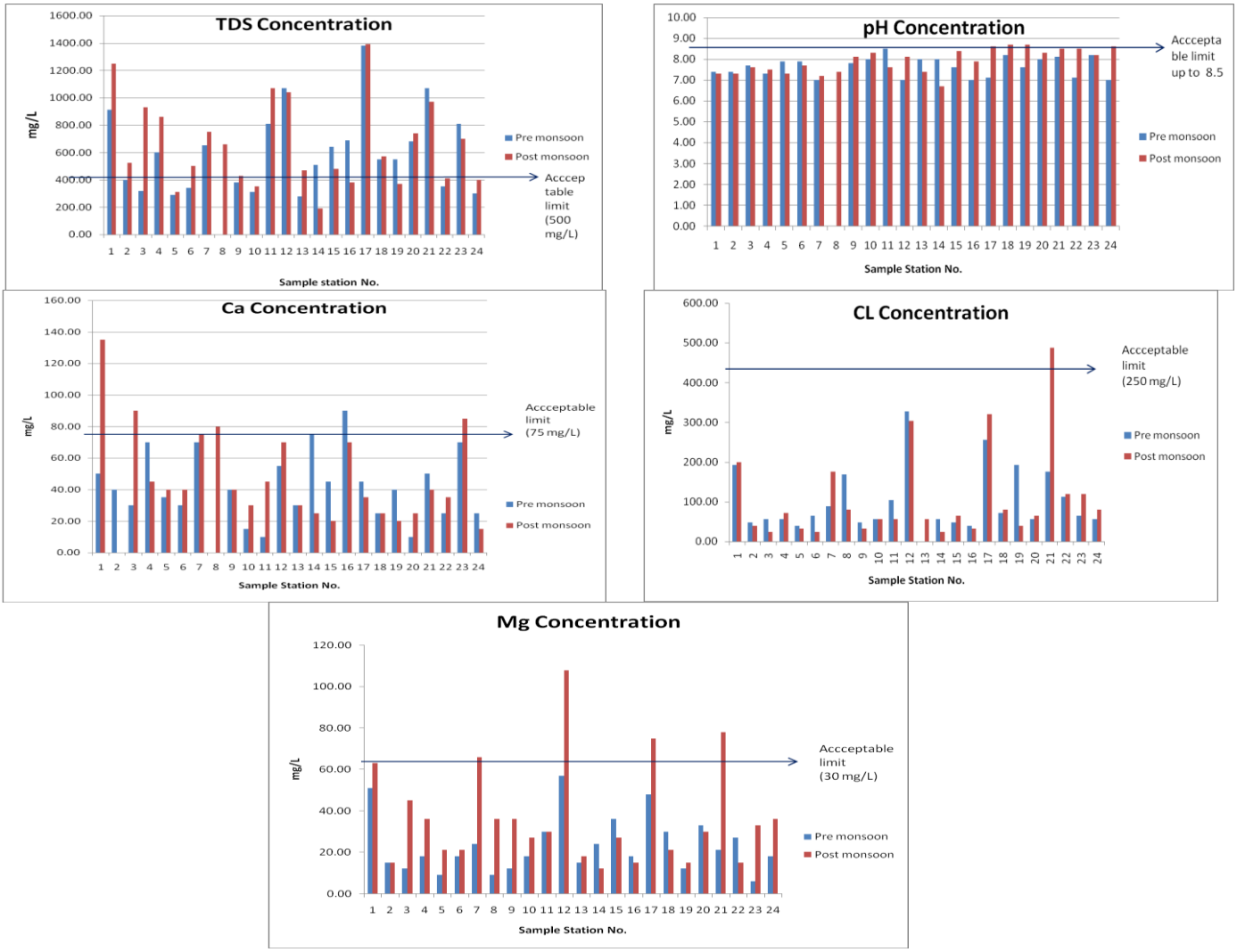
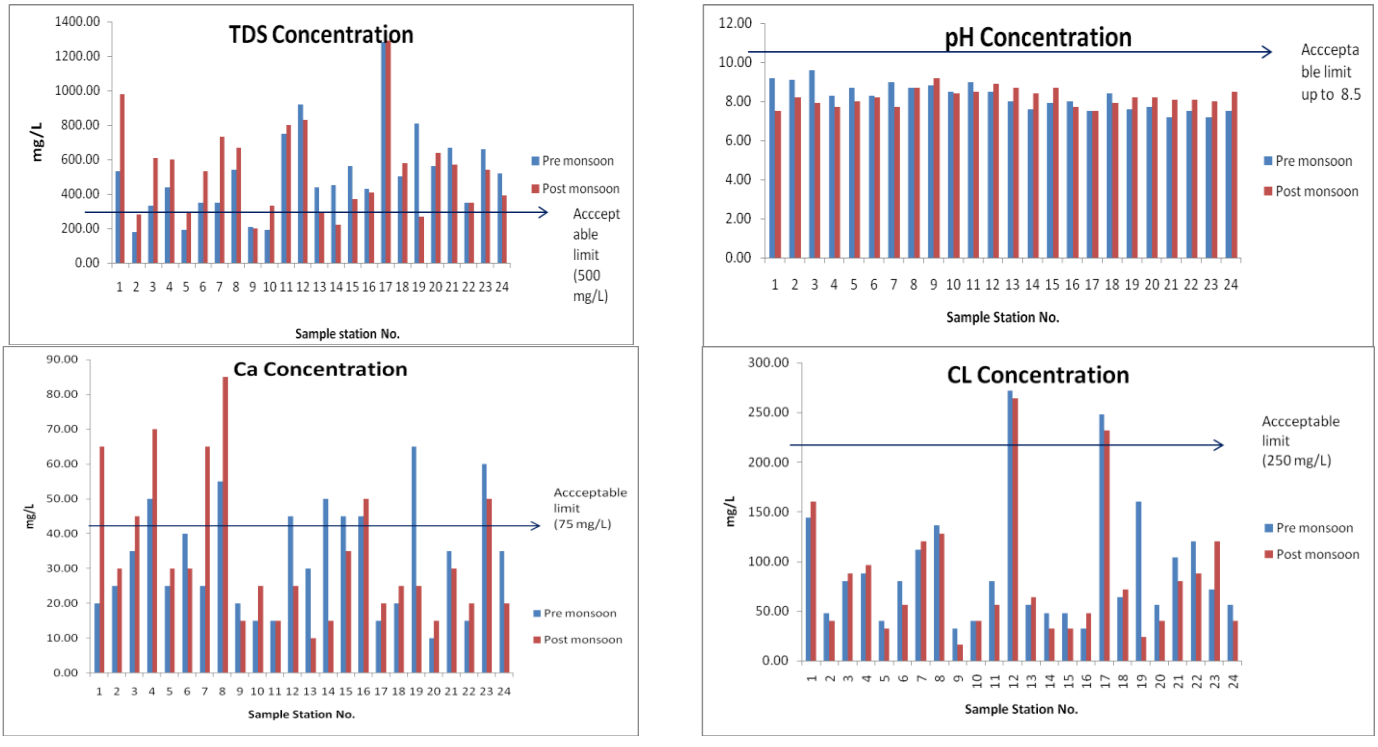


Figure : 4 Concetration of each parameters at various stations in Pre-monsoon and Post-monsoon year 2006



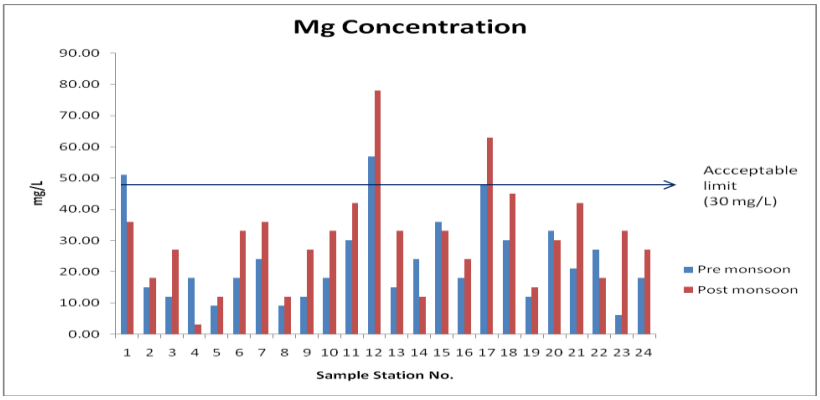


Figure : 5 Concetration of each parameters at various stations in Pre-monsoon and Post-monsoon year 2009

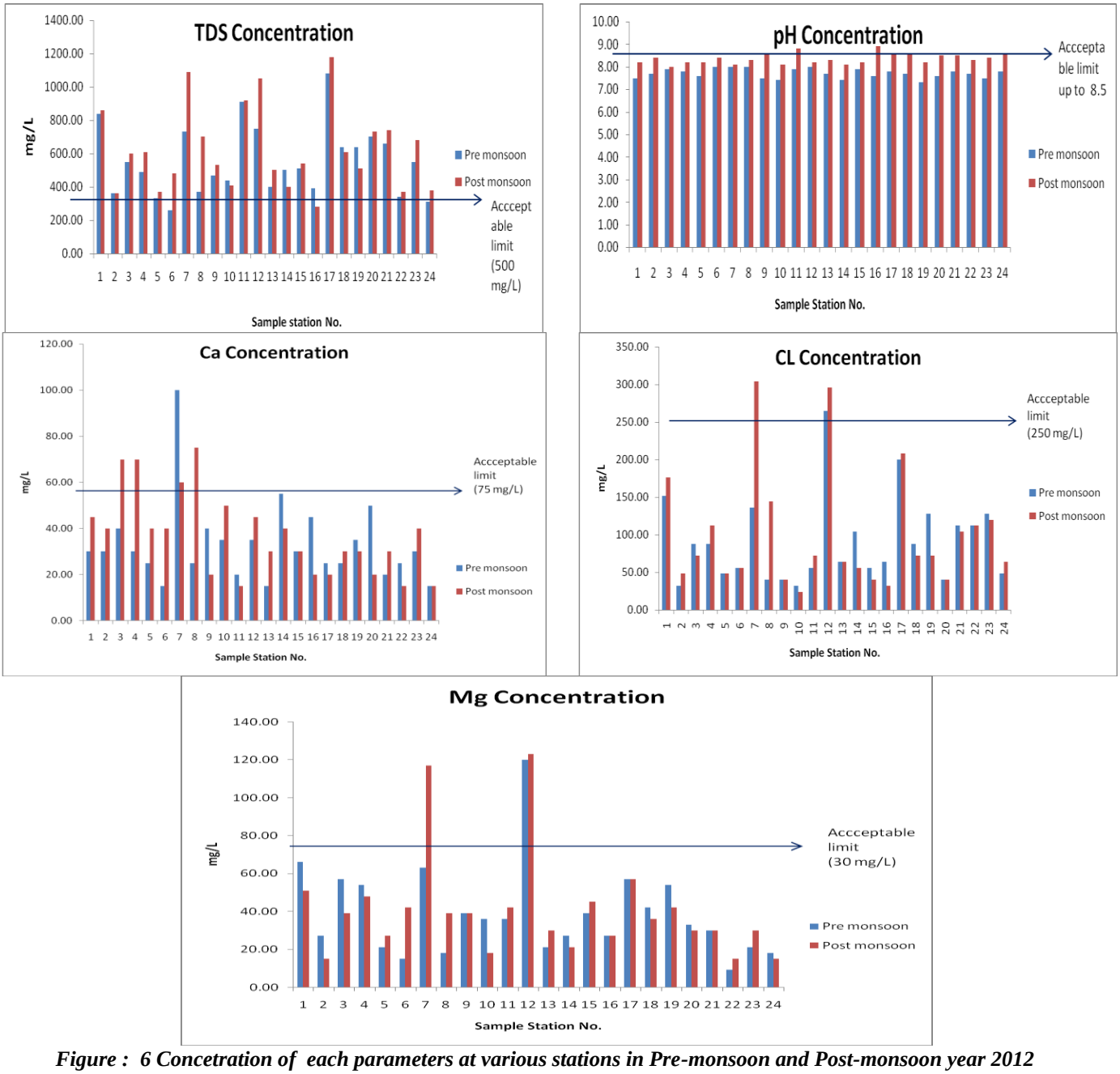


Figure : 6 Concetration of each parameters at various stations in Pre-monsoon and Post-monsoon year 2012

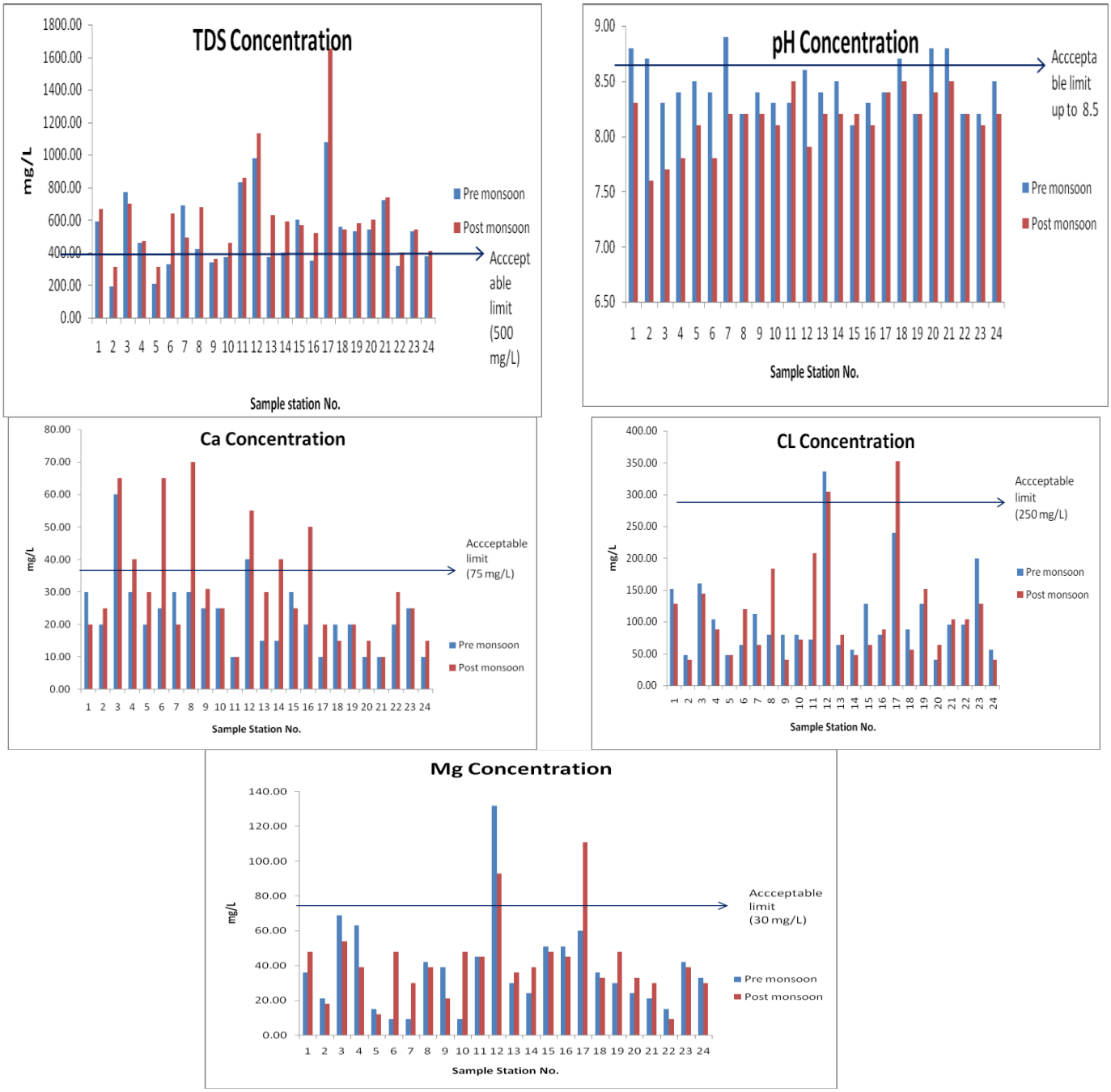


Figure : 7 Concetration of at various stations in Pre-monsoon and Post-monsoon year2015

B. pH

Natural and human processes determine the pH of water. pH measurement in scale of acidic/basic nature of water. pH less than 7 indicates acidity, where pH of greater than 7 indicates a base (Nwankwoala et. al., 2012). pH measurement is relative amount of free hydrogen and hydroxyl ions in the water. Water which has more free hydrogen ions is acidic, whereas water that has more free hydroxyl ions is basic. Since pH can be affected by chemicals in the ground water, pH is an important indicator of ground water that is changing chemically. The pH of water determines the solubility and biological availability of chemical constituents such as nutrients. High pH causes a bitter taste and water pipes and water using appliances become encrusted with deposits, and depress quantity of chlorine in water. Thus, it causes need for additional chlorine when pH is high. In Chhota Udepur district, pH is almost fit and within the range of acceptable limit as per IS standard (table: 3), however at station 21 has more pH than limit which is showing deteriorate ground water (figure: 7).

Table: 3. IS Standard for drinking water

Sr. No	Parameters	Desirable limits	Permissible limits
	mg/l	mg/l	mg/l
1	pH	6.5-8.5	No relaxation
2	Calcium (Ca)	75	200
3	Magnesium (Mg)	30	100
4	Chloride (Cl)	250	1000
5	TDS	500	2000
Source: IS Standard 10500:2012			

C. TOTAL DISSOLVED SOLID

In Chhota Udepur district, It has been observed from analyses that more than 12 station have high TDS more than 500 mg/L (Table: 3) acceptable limit which is remarkable however reason behind that should be both naturally and artificially. In naturally, Its depends on morphology of that area if that area have more ca and mg content geological strata then it have more TDS because of soil content mix with water and ultimately TDS of groundwater increase. In artificially or anthropogenic reason is industries' boiler and cooling tower effluent water which is dumped at land site and by leaching process. In district, Pharmaceutical Company is also having more TDS water in their effluent which is also main cause for TDS. From the analyses of graph, it has been showing that TDS is more in all station in period of Post-monsoon compare to Pre-monsoon which shown in above figures.

D. CALCIUM

Calcium is naturally present in water and also Temporary hardness is a type of water hardness caused by the presence of dissolved bicarbonate minerals calcium bicarbonate and magnesium bi-carbonate. Adequate calcium intake is essential for achieving peak bone mass and subsequent prevention of osteoporosis (WHO, 2009). Generally, Calcium is in the form of TDS and in study area post-monsoon concentration trend is showing more with respect to Pre-monsoon. In study area total four stations have more calcium content which should be reduced by treatment like softening and boiling. Calcium is noticed more at station no. 7 in study area.

E. CHLORIDE

Chloride imparts an undesirable taste to water and to beverages prepared from water (Ba-lakrishnan and Saleem, 2011). In addition, it can cause corrosion in water distribution systems. Desirable limit is 250 mg/l and thus content of chloride has to be regulated. Chloride in human blood is an important electrolyte and works to ensure that body's metabolism is working correctly. When there is a disturbance in blood chloride levels, it is often related to kidneys. Chloride helps the acid and base balance in the body (WHO, 2009). In study area, station12 and station 17 have more concentration than desirable limit 250mg/L. Here in analyses, chloride has been observed more in pre monsoon however, chloride is not affected due to seasonal change but it's main causes depends on that area.

F. MAGNESIUM

Magnesium is the fourth most abundant action in the body. Magnesium has many different purposes and consequently may end up in water from many anthropogenic sources e.g. chemical industries, fertilizer application and cattle feed Low. Magnesium status has been implicated in hypertension, coronary heart disease, and metabolic syndrome (WHO, 2009). In study area, mainly 2 stations no. 12, 17 have been observed more concentration in district.

VI. CONCLUSION

This study was carried out for pollutants parameters in terms of pH, TDS, Ca, Mg and Cl by monitoring open wells, tube wells and piezometers of Gujarat Pollution Control Board for entire Chhota Udepur district. The study area has many large scale Industries of petrochemicals, pharmaceuticals, fertilizers, plastic, and chemical have played major role for the pollution specifically in Jetpur pavi and Sankheda. The drinking water of all five talukas contains higher amount of TDS than the desirable limits were detected. It has been revealed that maximum TDS was detected in Nasvadi, Kalarani and Laved villages. The pH of almost entire district showed no objectionable variation from the standard value (6.5-8.5), however it was observed in the year of 2015 samples of Laved village of Sankheda taluka. Ground water of village Kalarani of Jetpur Pavi taluka was detected with above desirable value of Calcium, Magnesium and Chloride. During the

study and analysis it has felt that there is utmost required to investigate the metal concentration in various location looking to the growth of heavy industries in future.

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