

Assessment of physical, chemical and heavy metal contamination in ground water of various North Gujarat region.

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ABSTRACT:

Water quality and chronic diseases are much related. The quality of drinking water has potential impact on the health of humans, and for social and economic development of country. Therefore physical and chemical assessment of water quality is very much important. Heavy metal concentration in sources of water would be detected. Statistical calculations would be important parameter for quality evaluation. With an objective to understand ground water pollution in this region, groundwater samples from different locations all over North Gujarat were analyzed for various physico-chemical parameters, viz., pH, conductivity, alkalinity, TDS, total hardness, nitrite, calcium, chloride, magnesium, sulphate and fluoride etc. moreover, heavy metal testing of water samples also performed. Samples were collected from different depth zones tapping shallow dug wells and tube wells from all the four districts viz., Patan, Mehsana, Sabarkantha and Banaskantha of North Gujarat during the period of one year. The results of physico-chemical analysis of ground water are discussed.

Key words: Ground water, physico-chemical parameters, North Gujarat region, water analysis.

INTRODUCTION:

Ground Water is an important and major source of drinking water in both urban and rural areas in India. People around the world have used ground water as a source of drinking water, and even today more than half the world's population depends on ground water for survival. The value of ground water lies not only in its widespread occurrence and availability, but also in its consistent good quality, which makes it an ideal source of drinking water. Since ground water is directly in contact with soil, rocks and plants, the constituents of these sources might contaminate the ground water. Determination of water quality is one of the most important aspects in ground water studies. The North Gujarat region is rich in agricultural production but is largely dependent on groundwater both for irrigation and drinking water requirements. This region has started facing a serious crisis of safe drinking water as the rate of under-ground water withdrawal is higher than recharging so the water levels in aquifers are receding at an alarming rate. On account of this, it is important to check the water quality time to time. In the present study attempt has been made to evaluate the quality of groundwater on the basis of physico-chemical to assess various water quality parameters. The North Gujarat region is between 230 to 240 7°N and 710 to 730 7°E it has a semi-arid to arid climate with an average monthly temperature varying from of 38 °C to 46 °C in summer and 25 °C to 32 °C in winter. The

average annual rainfall variation is between 600 and 700 mm. The study area is divided into four districts viz., Patan, Mehsana, Sabarkantha and Banaskantha. All these locations are selected for the studies (see Fig. 1).

Moreover, contamination of heavy metals in the aquatic environment has attracted global attention owing to its abundance, persistence and environmental toxicity. In this study an attempt would be made to evaluate the quality of water and concentration of trace elements in ground water in the area of North Gujarat region. After assessment of water quality during the project will indicate that ground water in the study area is chemically suitable for drinking purpose or not.

MATERIALS AND METHODS:

Sample collection and Analysis:

In North Gujarat Region, the groundwater samples were collected from the villages of thirty three tehsils. Sampling sites were chosen representative of different coverage areas in and around four districts. For the water sampling, from one site 3 samples were collected. The ground water samples were collected from the dug wells range in depth from 60 to 90ft and the bore wells range from 100 to 110 ft. For analysis samples were collected in precleaned polyethylene bottles having capacity of 1 liter and stored in the laboratory at 4oC. Physical and chemical analysis was done in the laboratory following different methods. The reagents used for the analysis were AR grade and double distilled water was used for preparation of solutions.

The collected water samples were carried to the laboratory for some repeat physico-chemical analysis. The chemical analysis was carried out for fluoride in addition to pH, electrical conductance, total dissolved solids, total hardness, nitrate, sodium and sulphate by different methods and equipments (Table 1).

Twelve samples from different regions of North Gujarat were selected for heavy metal analysis and sent to Accurate Laboratory. Analysis was done for determination of potential heavy metals Cadmium, Lead, Mercury and Arsenic. ICP-OES instrument was used for determination of heavy metal.

RESULTS AND DISCUSSION:

The quality of ground water depends on its physicochemical properties like TDS, pH, fluoride, alkalinity and presence of minerals as well as heavy metals. Present study involves measurement of physicochemical properties and potential heavy metals.

All the groundwater samples from dug wells and bore wells showed slightly alkaline to alkaline pH due to the presence of carbonates and bicarbonates. Though the Values meet the WHO standards, it is not considered to be good for disinfection of drinking water with chloride and ultimately affects the quality of drinking water.

TDS was higher in the groundwater samples exhibiting high EC. TDS value of all ground water samples of North Gujarat region is ranges between 216 and 2260 mg/L, higher TDS value (more than 1000 mg/L) is considered to be poor quality because it affects the taste of water.

Nitrate is most common contaminant present in the ground water of rural areas. High levels of nitrate in well water often result from improper well construction, well location, overuse of chemical fertilizers, or improper disposal of human and animal waste. Sources of nitrate that can enter well include fertilizers, septic systems, animal feedlots, industrial waste, and food processing waste. Wells may be more vulnerable to such contamination after flooding, particularly if the wells are shallow, have been dug or bored, or have been submerged by floodwater for long periods of time. Though the nitrate value is within limit, comparatively higher values were found in Sabarkantha region.

Total hardness was found to vary between 120 to 572 mg/L. None of the samples cross the maximum permissible limits of 500 mg/L of WHO standards except Bechraji, Patan and Chanasma.

BIS (Bureau of Indian Standard) have recommended a desirable limit of 250 mg /L of chloride in drinking water, however ground water having concentration of chloride more than 1000 mg/L are not suitable for drinking purposes. In our study chloride was found to be elevated in most of the sites with the highest value at Radhanpur (1012 mg/L), which can be obviously linked to the solidity of the soil and saline ingress. Range of chloride content was within 40 and 1012 mg/L. The excessive level of chloride is the reason of hyperchloremia.

Alkalinity of the samples is in the range of 127-412 mg/L. The alkalinity levels of all the water samples are high thus, resisting acidification of the groundwater samples.

Fluoride (F^-) concentration over and above the permissible limits (1.5 mg/l) in drinking water leads to human health hazards, such as dental and skeletal fluorosis affecting millions of people in many parts of India. The source of fluoride in the groundwater is mainly from geological occurrence (i.e. fluoride bearing minerals, viz. apatite and biotitic mica). Almost all the samples show the amount within permissible limit except Kheralu and Vijapur. Comparatively higher fluoride level is found in Mehsana district (Table 2-5).

Heavy metal pollution in drinking water is one of the most serious problems in many developing countries, so checking quality of water for presence of heavy metal is very important. Twelve samples were selected and analyzed for determination of potential heavy metals Cadmium, Lead, Mercury and Arsenic by ICP-OES instrument. Cadmium and mercury were analyzed at lower detection limit of 0.0005 mg/l and lead and arsenic were detected at the concentration of 0.005 mg/l. Heavy metals were not detected at above said level in any sample of water which suggests these heavy metals in collected water samples are present within the permissible level as per WHO guidelines.

CONCLUSION:

The groundwater plays crucial role as a decentralized source of drinking water for millions rural and urban families in North Gujarat Region. On the basis of higher conductivity and TDS values the groundwater quality is classified as hard water and the higher concentration of salts is injurious to those people suffering from diseases of heart or kidney. Apart from TDS values all other parameters and potent heavy metals are within permissible limits except some samples (Annexure 1). Fluoride level is found to be higher in Mehsana district and nitrate level is higher in Sabarkantha district compare to other districts. It is found that as the depth of well increases the amount of ionic impurities also decreased. Comparatively higher ionic impurities were found in samples collected from dug wells due to less depth.

Overall there are no estimates of the serious public health consequences due to drinking groundwater among all districts of North Gujarat.

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FIGURES:

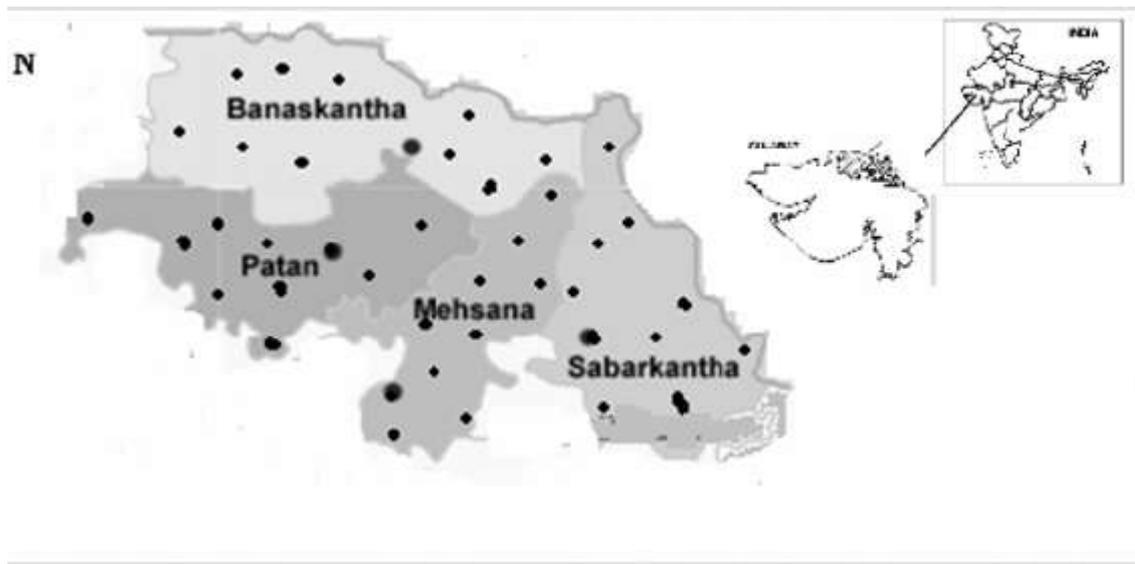


Figure 1: Location of study area



TABLES:**Table 1: Parameters and their determination methods.**

Parameters	Methods
pH	pH meter
Conductivity	Conductometer
TDS	TDS meter
Total hardness	Complexometric Titration
Ca ⁺²	Complexometric Titration
Mg ⁺²	Complexometric Titration
Cl ⁻	Precipitation Titration
NO ₃ ⁻²	UV spectroscopy analysis
NO ₃ ⁻²	UV spectroscopy analysis
SO ₄ ⁻²	Turbid metric Method
Alkali	Acid-base Titration
Heavy metals	ICP-OES

Table 2: Results of physico-chemical analysis of water samples in Patan district

TEHSIL	F ⁻	PH	COND	TDS	TH	Ca ⁺²	Mg ⁺²	Cl ⁻	NO ₃ ⁻	SO ₄ ⁻²	ALK	SOURCE	DEPTH ft
SANTALPUR	0.26	8.2	3020	1093	132	87	45	600	3.99	19	140	Bore well	100
RADHANPUR	0.28	8.03	3500	2260	112	66	46	1012	20.1	154	231	Dug well	64
SIDHPUR	0.64	8.47	2219	723	176	92	84	380	13.29	90	308	Dug well	90
PATAN	0.45	7.78	600	216	592	320	272	812	19.8	339	254	Dug well	65
HARIJ	0.38	7.78	2905	1018	308	212	96	360	7.39	82	151	Bore well	102
SAMI	0.64	7.8	3093	1332	376	237	139	424	9.13	55	256	Bore well	100
CHANSMA	0.68	7.9	3390	1996	572	312	260	672	18.44	224	225	Dug well	65

Table 3: Results of physico-chemical analysis of water samples in Sabarkantha district

TEHSIL	F ⁻	PH	COND	TDS	TH	Ca ⁺²	Mg ⁺²	Cl ⁻	NO ₃ ⁻	SO ₄ ⁻²	ALK	SOURCE	DEPTH ft
KHEDBRAHMA	0.81	7.52	1480	600	252	156	96	142	27.4	84	224	Bore well	105
VADALI	0.56	7.48	1358	652	242	158	84	126	28.1	80	216	Dug well	65
IDAR	0.71	7.24	1402	568	198	138	60	106	41.8	66	138	Dug well	60
HIMATNAGAR	0.38	7.9	655	240	184	124	60	60	16	5	189	Bore well	110
PRANTIJI	0.5	7.5	1400	613	260	156	104	160	23.2	86	136	Dug well	75
TALOD	0.56	7.6	1290	480	200	102	98	145	20.2	78	139	Bore well	105
MODASA	0.74	7.4	1304	552	198	150	48	155	21.4	55	127	Bore well	102
BAYAD	0.52	7.5	1390	590	273	169	104	152	26.7	61	164	Dug well	65

Table 4: Results of physico-chemical analysis of water samples in Banaskantha district

TEHSIL	F ⁻	PH	COND	TDS	TH	Ca ⁺²	Mg ⁺²	Cl ⁻	NO ₃ ⁻	SO ₄ ⁻²	ALK	SOURCE	DEPTH ft
THARAD	0.86	8.25	1002	470	232	142	90	92	26.58	333	186	Dug well	65
DHANERA	0.29	7.5	670	228	132	74	58	40	2.1	6	124	Bore well	110
DANTIWADA	0.98	7.98	702	274	184	98	86	36	15.51	16	160	Bore well	100
DANTA	0.88	7.01	780	358	180	134	46	40	24.37	68	134	Dug well	70
VADGAM	0.36	7	720	310	188	140	48	48	6.65	13	200	Bore well	100
PALANPUR	0.71	7.6	802	400	232	169	63	48	44.3	15	216	Dug well	60
DEESA	0.99	8.06	1290	526	140	98	42	84	13.7	32	240	Bore well	102
DEODAR	0.35	8.19	654	288	124	84	40	44	2.22	61	152	Bore well	110
BHABHAR	0.46	8.2	3298	1815	120	76	44	904	2.2	160	166	Bore well	100

Table 5: Results of physico-chemical analysis of water samples in Mehsana district

TEHSIL	F ⁻	PH	COND	TDS	TH	Ca ⁺²	Mg ⁺²	Cl ⁻	NO ₃ ⁻	SO ₄ ⁻²	ALK	SOURCE	DEPTH ft
SATLASANA	0.95	8.1	702	300	152	95	57	48	2.22	20	152	Bore well	110
KHERALU	1.86	8.08	1470	746	392	224	168	196	39.4	36	326	Dug well	65
UNJHA	1.22	8.12	2709	1117	432	296	136	288	24.3	63	322	Bore well	103
VISNAGAR	1.11	7.9	3110	1520	352	272	80	532	19.96	173	392	Dug well	70
VADNAGAR	0.97	7.9	580	289	156	101	55	44	2.22	13	156	Bore well	110
VIJAPUR	1.74	7.2	2690	1140	248	151	97	372	0.22	127	228	Bore well	110
MEHSANA	1.19	7.9	2850	1215	416	240	176	312	22.09	67	412	Bore well	100
BECHRAJI	1.35	8	3018	1582	528	396	132	708	41.6	122	172	Dug well	60
KADI	1.09	8.2	1402	750	190	134	56	552	6.65	163	194	Bore well	105

- F⁻, TDS, TH, Ca⁺², Mg⁺², Cl⁻, NO₃⁻, SO₄⁻², alkali unit is mg/L; Conductivity unit is µs/cm