QUALITY CRITERIA FOR USING GROUNDWATER FROM AN URBAN PART OF MALKAJGIRI-MEDCHAL DIST, TELANGANA STATE, INDIA.

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Abstract Ground water is wide source for drinking and irrigation purposes in the all parts of Telangana. The ground water demand is increased due to rapidly population growth, intensive irrigation practices and industrial purposes which in turns caused depletion of resource and deterioration of quality. It is advised that ground water with high fluoride and nitrate concentration should be avoided for drinking purpose. In view of this , qualities studies have been undertaken 20 groundwater samples collected from the rock dominant semi-arid Medchal Mandal Ranga Reddy Distric of Telangana and analysed for pH, electric conductivity(EC), total dissolved solids(TDS), total hardness (TH), calcium(Ca^{2+}), magnesium(Mg^{2+}), sodium(Na^{+}), potassium(K^{+}), chloride(cl^{-}), sulphate(so_4^{2-}), nitrate (NO_3^{-}), and fluoride(F^{-}). Fluoride and nitrate concentrations in the groundwater of the study area are nitrate is not exceed but fluoride exceed 80% of samples, respectively. maximum acceptable limits of fluoride (1.5mg/L) and nitrates concentrations (45mg/L) ,respectively, thus making ground water unfit for drinking purpose. Data plotted in gibbs diagram revels that the groundwater chemistry is primarily controlled by rock water interaction . According to water quality index (WQI), <150 and 80% of groundwater samples falls in excellent and good categories for drinking purpose. A majority of ground water samples falls in deep meteoric percolations and Na^{+} types, but most belongs to Ca^{2+}-Mg^{2+}-HCO_3^{-} facies, and few are Ca^{2+}-Mg^{2+}-Cl^{-} and Na^{+}-Cl^{-} facies. 90% of ground water in the study region is well suitable for irrigation.
Keywords groundwater quality, Drinking and Irrigation, water quality index (WQI). Rock dominant semi-arid region . Telangana

Introduction

Introduction about water

Groundwater is a plays a prominent role in water supply system for drinking, Irrigation and industrial purposes in arid and semi- arid regions of the world . Recent studies reveals that nearly 65% of ground water in the world is used for drinking purposes, about 20% for irrigation and 15% is used for industrial purpose .UNEP(1999) reported that 1/3 of the world population uses ground water for drinking purposes ,especially developing countries like India and China. Groundwater plays a vital role in fulfilling the basic needs of the society and over –exploitation has tremendous stress on this important resources due to increasingdemand.

Water and Its Important

It is essential to monitor the groundwater quality and quantity, the ground water studies have the vital role in semi-arid regions to meet the increasing demand and asses the groundwater quality.
Since the water quality directly affects human health, Bureau of Indian standards (BIS 2012) and world health organization (WHO 2017) set right standard limits for different chemical variables for drinking purpose .If the safe limits exceed in the drinking water , they can affect the human health. Once the sources and causes of variations in the ground water chemistry are known, it is easy to take the efficient strategic management measure to improve the groundwater quality. If the good of groundwater would be suitable for drinking purpose in general . it may also used for irrigation and industrial purpose. Generally, the chemistry and quality of groundwater depend on the type of

geological formations, geochemical reactions ,and impacts of human activities. Thus , the understanding of the geochemical characteristics and ground water quality are the important decisive factors to deal with groundwater-related issues. Studies have been carried out over the world to demonstrate the groundwater measures/ groundwater quality and its stability for drinking and irrigation , and major contaminant sources. Faten et al. (2016) have observed that the rock-water interaction and evaporation are the main factors, to control the groundwater chemistry in Northeastern Tunisia. Li et al. (2016a) conducted in the semi-arid region of Northwest China and found that the hydrochemistry of ground water is mainly governed by rock-water interaction.

Significance of Researchs

1. This studies were taken by the reference of Adimalla and venkatayogi (2017) performed a ground water quality studies in the region of Medak, Telangana, and identified that rock-water interactions and geogenic sources are the main controlling factor of hydro geo chemistry. Over exploitation of groundwater has become one of the serious problems in many countries, including India. The every year extraction of groundwater in India is the e highest in the world, which even supersedes that of the USA and China put together (NGWA 2016) CGWB (2013) estimated that approximately $245x10^9$ m^3 of groundwater is being used for irrigation and also nearly 90% of rural population of the country uses groundwater for drinking and domestic purposes. More over groundwater population is a serious problem in India. Increasing water withdraws and consumption, intensive urbanization, industrial growth, over usage of fertilization and pesticides in agriculture regions, human animal wastage and unplanned drainage systems are some of the important causes for the deterioration of the quality of groundwater. Therefore, in recent previous years a number of researchers have focussed on groundwater quality studies for various usages in India(Adimalla and venkatayogi 2018; Adimlla et al. 2018a; Narasimha and Rajitha 2018; Narsimha 2018)In the current study region, residents merely rely on groundwater, since it's main source forbdrinking and irrigation purposes. In medchal malkajgiri district region of telangana, Residents of Hyderabad are drawing between 600% and 140% of the annual recharge of groundwater table, per scientists at the Telangana Ground water Departmet. “The groundwater table in Hyderabad and Telangana goes down rapidly because the extraction rate is high. On a mean, Hyderabad is drawing 340% of the annual recharge volume,” informs Pandith Madhnure, Director of Telangana Groundwater Department, quoting the newest data collected by the department.

In Qutbullapur, the groundwater level has reached 42.71 metres below the bottom level (MBGL). In Medchal, it's dipped by 23.13 m bgl, and in Hasmatpet, water levels have dropped by a whopping 10.47 m bgl. In 2018, Hyderabad received 27% below normal annual rainfall calculated by the IMD (inter modular distortion).The depth to geological formation varies from 5.1 to 19.5m bgl. The yields of the wells rang between 250 and 350 m3/day. Therefore, this study primarily deals with groundwater suitability for drinking purpose through the computation of a Water Quality Index (WQI). Water quality parameters also are compared with BIS (2012). In additions, the USSL (Richards 1954), Wilcox (1955), sodium adsorption ratio (SAR; Richards 1954), Sodium percentage (%Na+; Wilcox 1955),residual salt (RSC; Eaton 1950), magnesium hazard ratio (MHR; Raghunath1987),and Kelly index (Kl; Kelly 1963) were also accustomed determine the suitability of water quality for irrigation within the medchal malkajgiri district.

1.4scope of water research The overall goal of this study is to assess groundwater availability within the glacial aquifer system. The first objectives are to quantify current groundwater resources, evaluate how these resources have changed over time, and supply the tools needed to forecast system response to future anthropogenic and environmental stresses. Key features of this study include:

•Analysis of regional, sub-regional , and native water budgets;

• Documentation of trends in recharge, groundwater storage, and discharge to streams or other

surface-water bodies as impacted by human and environmental conditions;

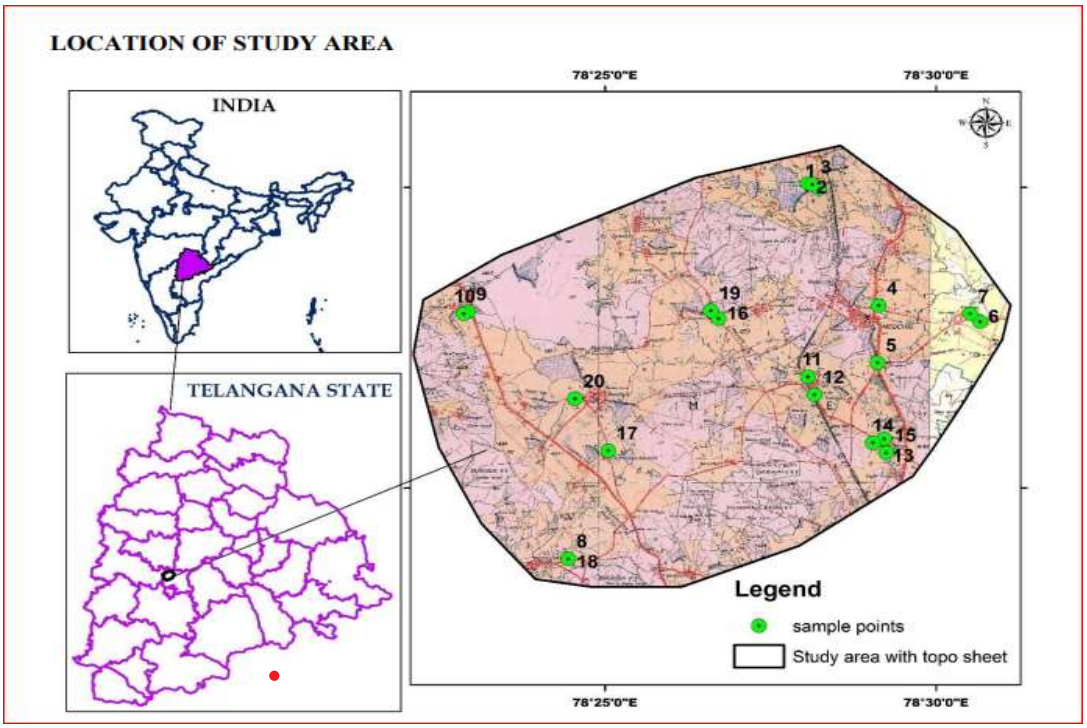
• Forecasts of system response to changes in external stress or climate.

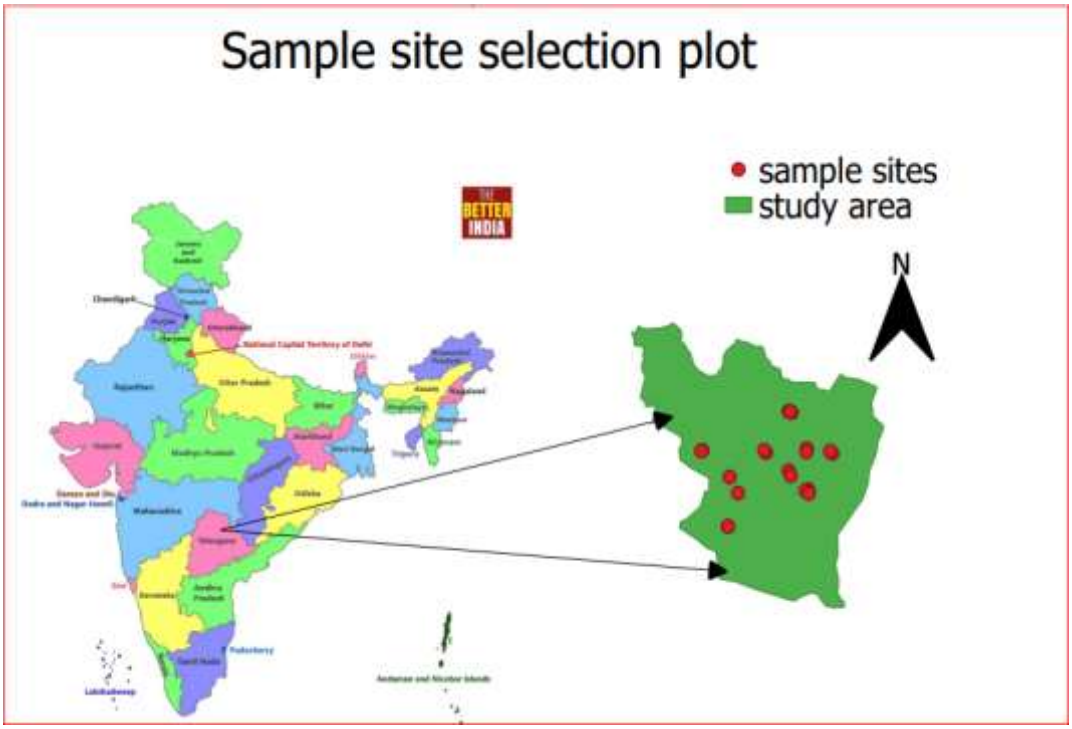
The assessment of groundwater availability for the glacial aquifer system requires consideration of the response of the whole hydrologic system to changes in imposed stresses or environmental conditions. Achieving these objectives will include 1) synthesizing in a very regional context, the hydrologic information obtained from previous studies; 2) quantifying the groundwater resources from predevelopment to current conditions; and 3) developing modeling tools which will be accustomed assess groundwater availability within the glacial aquifer system to assist extrapolate information to areas not specifically studied. Additionally, the regional analysis will provide temporal information about the inflows, outflows, and changes in storage system-wide and in selected subregions of the aquifer system. Results of this analysis are going to be wont to the extent possible to forecast the hydrologic responses of the aquifer system to future changes in anthropogenic and natural stresses. Finally, the study will provide analysis for characterizing limitations on groundwater availability in regions within glacial aquifer system arising from climatic setting, hydrogeologic conditions, water quality issues, constraints imposed by the will to keep up environmental flows, or other features of the system.

Assess and document current and projected groundwater conditions (water quantity and quality), the effects of groundwater conditions on pumpers, and the associated controlling factors. The geographic variability of the above-listed items should be assessed and documented.

Study Region

The study region or area is situated in the Telangana , we are taken only one district ,district name is Medchal mandal Rangar Reddy district the area latitudes and loangitudes are 17.6297 and 78.4814 this district is a northern suburb of Hyderabad, India. It is used be a suburban village and one of the largest Mandals in Rangareddy District of Telangana, India. This area has a continental arid to semi-arid climate with an annual average temperature is 26^{o}C, with May being the hottest month of the year. The average annual rainfall is 820.0mm this is the largest rainfall status in Medchal and July is the wettest month.





Groundwater Quality parameters such as sodium adsorption ratio (Richards 1954), residual soda ash (Eaton 1950), sodium percentage(Wilcox 1955), Kelly's ratio(Kelly 1963), and magnesium hazard ratio (Raghunath 1987) were evaluated for irrigation suitability. They were computed using the following equations:

$$SAR = \frac{Na^+}{\sqrt{(Ca^{2+}Mg^{2+})/2}} \quad (1)$$

$$\%Na = \frac{Na^+}{(Ca^{2+}+Mg^{2+}+Na^+)} \times 100 \quad (2)$$

RSC = (HCO3-+CO32-)-(Ca2++Mg2+) (3)

$$MHR = \frac{Na^+}{(Ca^{2+}+Mg^{2+})} \times 100 \quad (4)$$

$$Kl = \frac{Na^+}{(Ca^{2+}+Mg^{2+})} \quad (5)$$

The WQI used developed by Horton (1965). It's an mathematical effectual tool, which provides a comprehensive model of the groundwater quality and is employed to present large quantities of water quality data in to single number. WQI are employed by the scientists to assess the water quality for drinking purpose in various geological terrians. WQI are effective tool to estimate the overall groundwater quality for drinking purpose by examining individual water quality parmeters (e.g., pH , TDS, TH, Ca2+, Na+, K+, Mg2+, SO42-,Cl-,NO3— and F-). The subsequent three stages are involved in WQI calculations : (a) assignments of weights (wi) to every quality parameter involved; (b) calculations of relative weight (Wi)(supported on equation number 6); and (c) quality rating scale calculation (Qi) based on equation number 7

$$Wi = \frac{wi}{\sum_{i=1}^{n} wi} \quad (6)$$

$$Qi = \frac{Vi}{Si} \times 100 \quad (7)$$

Where Qi is that the quality rating for each chemical parameters I, Vi is that the concentration of every chemical parameters I in each water sample (mg/L, n is that the total number parameters , and Si is that the Indian drinking bevarage standard (BIS 2012) for chemical parameter i. To supply the weights for every chemical parameters is the most important part, which determines the significance of a water quality parameter for drinking uses. For each of 11 parameters , a weight (wi) has been assigned according to the relative importance with in the over all quantity of drinking bevarage as

shown in table number 2. The foremost significant parameters have a weight of 5 and least significant have a weight of two. Within the study, the maximum weight of 5 has been assigned to total dissolved solids , nitrate and fluoride, thanks to their major importance within the water quality assessment (Ramakrishnalah et al. 2009). Then , water quality sub-indices (SIi) for every chemical parameters are computed by Eq. (8), and therfore the WQI is decided by Eq. (9)

$$SIi = Wi \times Qi \qquad (8)$$

Table 1 Hydrogeological parameters of individual groundwater samples and parameters concentrations in the study area.

S.no	Village names	pH	T.D.S	HCO_3^-	CL^-	Ca^{2+}	N	F^-	K^+	Na^+	Mg^{2+}	NO_3^-	WQI
1	Dapilapur	7.54	1543	143	155	192	34	1.38	3	148	88	58	110.63
2	Dapilapur	7.83	1545	145	124	173	41	1.45	2.7	132	76	42	119.99
3	Dapilapur	7.46	1489	129	203	152	33	1.40	2.3	178	59	48	105.82
4	Medchal	7.5	1535	141	143	149	34	1.4	1.9	162	44	57	105.31
5	Medchal	7.42	1527	134	177	174	37	2.63	1.7	209	72	53	162.41
6	Medchal	7.56	1494	131	168	128	34	2.17	1.8	184	64	48	139.83
7	Medchal	7.68	1517	140	125	135	36	1.93	2.74	162	69	45	133.69
8	Medchal	7.69	1457	139	174	179	40	2.55	2.94	129	62	48.55	167.055
9	Dundigal	7.6	1438	136	158	142	42	1.57	2.57	187	58	57	123.71
10	Dundigal	7.40	1409	125	137	157	35	1.52	2.72	147	57	51	113.86
11	Dundigal	7.34	1543	138	136	163	38	1.52	2.17	173	89	42	117.48
12	Goudavally	7.40	1385	115	146	138	37	1.79	2.53	119	52	40	124.20
13	Goudavally	7.48	1563	147	164	185	39	1.6	2.25	159	83	48	122.73
14	Kandlakoya	7.62	1595	148	170	182	41	1.62	1.46	145	75	42	124.81
15	Kandlakoya	7.3	1463	137	163	169	43	1.29	1.79	184	82	56	112.08
16	Kandlakoya	7.32	1389	127	199	158	38	1.47	3.09	194	77	48	114.900
17	Rayalapur	7.42	1562	142	173	137	34	1.37	2.53	187	48	53	104.57
18	Dommara pochampally	7.65	1501	138	152	172	32	1.30	1.45	190	65	47	102.21

19	Dommara pochampally	7.64	1456	136	163	197	30	1.27	1.93	203	74	59	110.303
20	Railpur	7.23	1491	128	148	148	31	1.63	3.21	139	81	46	114.55
1	minimum	7.23	1385	115	124	128	30	1.27	1.45	119	44	40	102.21
2	maximum	7.83	1595	148	203	197	43	2.63	3.21	209	89	59	167.055
3	Mean	7.50	1495	135.9	158.9	161.5	36.45	1.643	2.339	166.55	68.75	49.425	121.50

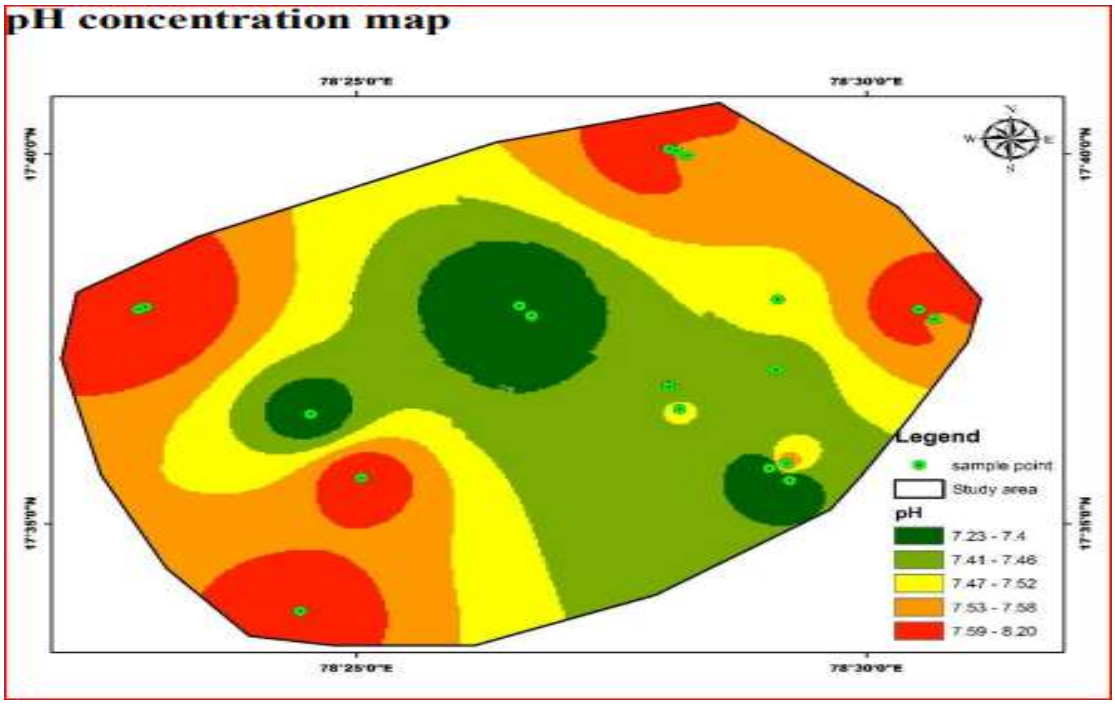


Table 2 present of groundwater samples below the permissible limits prescribed by BIS (2012) for drinking purposes.

Water quality parameters	Acceptable limits	Permissible Limits	% of the sample below the Permissible limits	Undesirable effect
pH	6.5—8.5	No relaxation	94%	Taste
EC	/	1500	76%	Gastrointestial irrigation
TDS	500	2000	100%	Gastrointestial irrigation
TH	200	600	99%	/
HCO_3^-	/	/	/	/
SO_4^{2-}	200	400	97%	Laxative effect
Cl^-	250	1000	100%	Salty taste

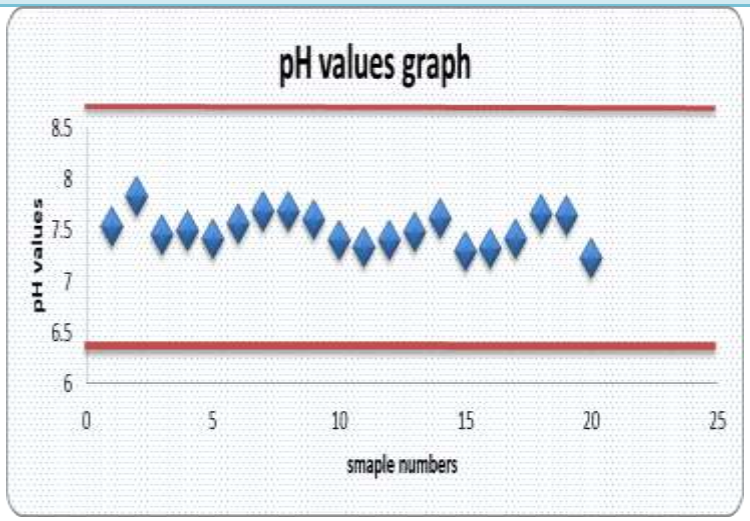
NO_3^-	45	No relaxation	29%	Methaemoglobinaemia
F^-	1	1.5	51%	Fluorosis
Ca^{2+}	75	200	100%	Scale formation
Mg^{2+}	30	100	100%	/
Na^+	/	200	99%	High blood pressure
K^+	/	12	95%	High blood pressure Bitter taste

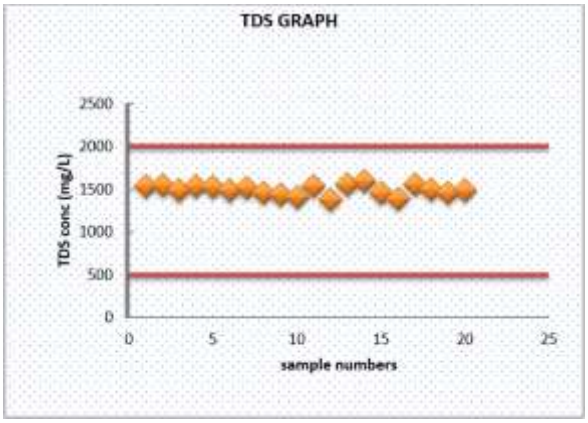
Water Quality Index (WQI)

Ground water samples (n=20) and its WQI values presented in Table 3. Therefore, the groundwater quality status can be categorized in to five types (Ramakrishnalah et al. 2009) based on WQI values, namely excellent water (<150),good water (150-200), poor water (200-250), very poor water (250-300) and unsuitable for drinking (>300) (table no 3). The computed WQI values ranged from 102.21 to 167.055 (Table 3). As per the classification of WQI 98% of the total groundwater samples fell under the excellent category, and 2% belongs to good water category for drinking purposes.

Table 3 The WQI values, type of water and percentage of sample in the study region (Ramakrishnalah et al 2009)

WQI values	Water Quality	Number of samples	% of saamples
<150	Excellent	18	80
150-200	Good water	2	20
200-250	Poor water	/	/
250-300	Very poor water	/	/
>300	Unsuitable for drinking	/	/





Conclusion

The results of the hydrogeological studies disbursed within the rock dominant semi-arid region of medhal mandal in Telangana are compared with the bureau of Indian Standards with the objectives of inferring water quality with regard to drinking and irrigation uses. Groundwater within the study area is gendrally alkaline, moderately hard to hard in nature and predominantly of Ca2+, Na+, CL-, HCO3- types. Fluoride and nitrate concentrations within the groundwater of the study area are nitrate isn't exceed but fluoride exceed 80% of samples, respectively. These fluoride and nitrate concentrations are alarming and should pose risks to the health of individuals using it for drinking purposes. SAR values are ranged from 11.75157798, 19.44333416, 15.61415502 clearly shows that >10 it in range good to doughtful for irrigation purpose. People are advised to not drink the groundwater where the fluoride and nitrate concentration exceed the permissible limits, and must dependent alternate sources for drinking and domestic use water.

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