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E: ISSN NO.: 2349-980X **Shrinkhla Ek Shodhparak Vaicharik Patrika**

Drinking Water is A Challenge in Churu District of Western Rajasthan (India)

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Abstract

Ground and rain water are the chief sources of drinking water in the western Rajasthan. Ground water contaminated with various element like fluoride, chloride, nitrate, arsenic etc. These elements play a important role in health matter. Fluoride mainly effect on bone and teeth related diseases. Nitrate can undergo endogenous reduction to nitrite and nitrosation of nitrites can form N-nitroso compounds, which are potent carcinogens. In infants blue baby syndrome occurs due to nitrites. Diarrhea is also a cause of nitrate concentration in the body. The purpose of the study is to understand the present contamination level of chloride, fluoride, and nitrate, alkalinity, hardness and TDS of ground water and their effects in people of Churu district. For these, total 40 samples were collected from different part of the study area. It was found that water constituents were not as per the permissible ranges of world health organization.

Keywords: Fluoride, Nitrate, Chloride, Potent Carcinogens, Alkalinity, Hardness, TDS Etc.

Introduction

Water is an essential pre-requisite for survive of living being and human development. It play key role in determining real dynamics of quality for desirable living standard. It is a high priority issue to a government for safe supply of drinking water for safeguards of human health. Country like India, it is a challenge for production and supply of adequate and safe drinking water for decreasing in morbidity and mortality. Due to a good solvent, some toxic and hazardous substances dissolve in water and produce water pollution problem posing many parameters of interest for water quality assessment. In Rajasthan, 71% of the irrigation and 90% of the drinking water supply sources are underground water (Rathore, 2005).

Churu district is the part of great Indian Thar desert and lies in arid zone of western Rajasthan. The region is situated between 73^{o} 5' to 75^{o} 5′ E longitude and 27^{o} 5' to 29^{o} 0′ N latitude. It is bordered by Sri Ganganagar in the north; Nagaur, Sikar and Jhunjhunu in south; Bikaner in the west and Haryana in the east (Figure 1). The physiography of whole district is characterized by shifting and stable sand dunes, which give it a desolate and barren look. Being situated in a shallow depression, the climatic conditions are very extreme here and very hot summer and very cool winter prevail. The rainfall in the district is scanty and irregular. Annual rainfall is very low, which range around 225 to 500 mm (Singh *et al.* 2009). Due to low rainfall in the district, the level of ground water is declining rapidly. In addition to this, the region doesn't have any perennial or semi-perennial river, neither fresh water lake nor canal.

Water is nature's one of most important gifts to mankind and availability of pure drinking water is essential for healthy life. The district has a major water stress in terms of both quality and quantity. The major problem of whole district is absence of surface water sources and ground water contaminated with fluoride, chloride, nitrate, arsenic etc natural chemical elements. As a result, many problems related to health, socio-economic backwardness, demographic and environmental problems are existed here. The ground water contaminated with fluoride causes dental and skeleton fluorosis like health problems that affects the matrimonial and behavioral aspects of people in the study area.

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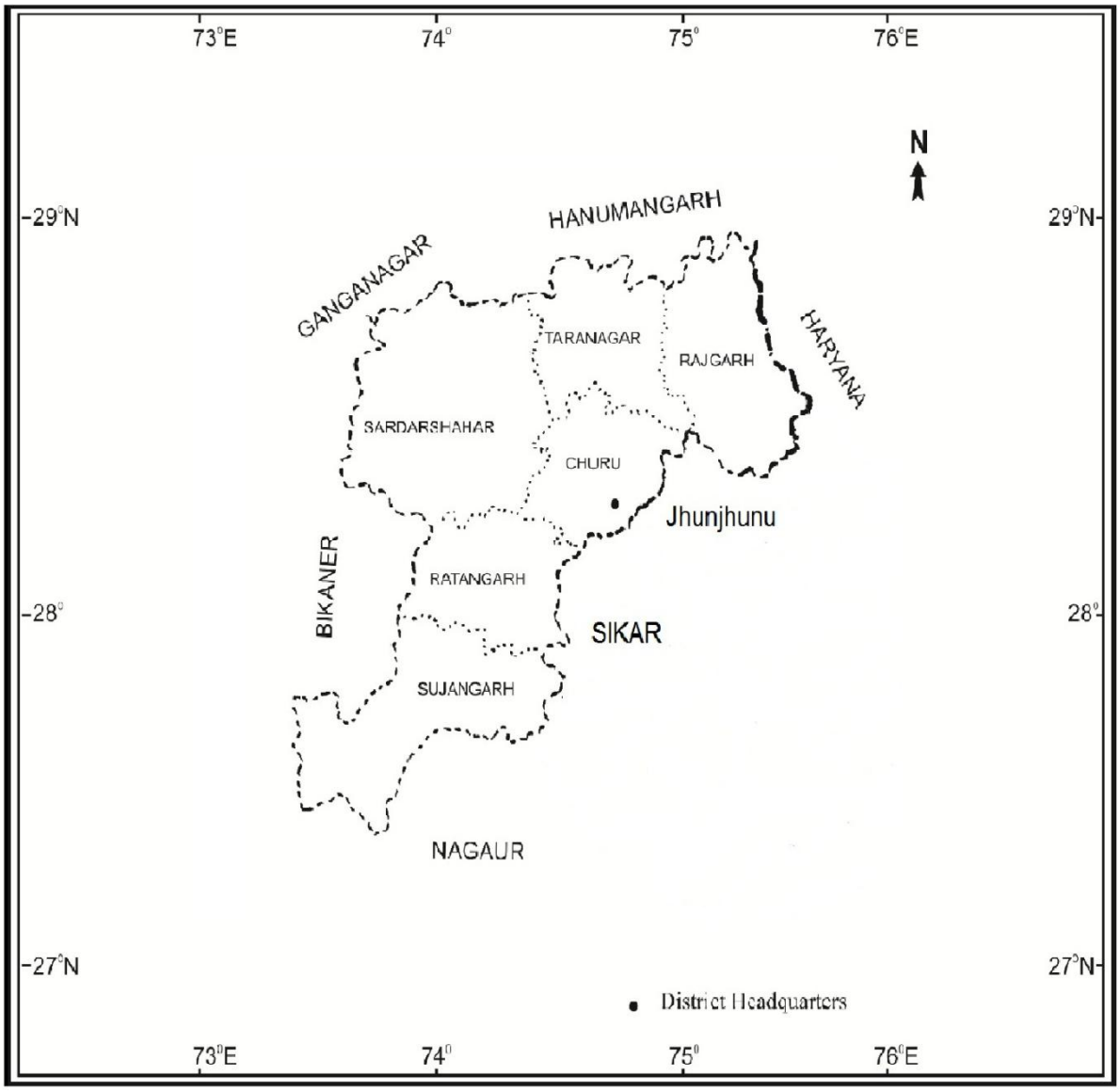
Figure -1 Location Map of The Study Area



There is no permanent source of surface water in the district. In absence of surface water resources, people of the area primarily depend upon underground water to meet out their drinking and agricultural requirements. The underground water in the study area is characterized by medium to high salinity. More than 57% water is of sodium chloride type and distributed throughout the district. The district is notorious for having high fluoride and nitrate concentration in underground water, which makes it unsuitable for drinking purpose. The dry climatic condition with high evaporation and insignificant recharge might have accelerated the strengthening of fluoride and nitrate concentrations in the underground water of this area.

There are many factors contributing to nitrate contamination to water sources in the region. An increase of nitrates in water is often associated with use of agricultural chemical by farmers such as fertilizer, pesticides or poor sanitary activities. It was found that the crop of family legumineaceae is the main reason of nitrate hazard in the Churu. The crop of this family takes atmospheric nitrogen and fixed it in the soil as nitrate and more nitrates are formed than the plants need. Such excess nitrates are available for leaching and ground water get contaminated with high concentration of nitrate. Nitrate is the ultimate oxidation state of nitrogen and is the source of pollution in ground water. Nitrates undergo reduction and nitrosation of nitrite can form N- nitroso compound that is a potent carcinogen. The use of High nitrate contaminated drinking water is a well known risk factor for infant methemoglobinemia (Mirvish, 1985). Gastric cancer, birth defects and hypertrophy of the thyroid are other health effects on humans that are potentially influenced by elevated levels of nitrate in drinking water (Kugali *et al*, 2013). The increased nitrate level in drinking water may also adversely affect the central nervous system.

The health problems arising as a result of fluoride contamination is more widespread. According to a report of national geophysical Research institute of Hyderabad about 177 districts of India are fluoride affected. The country has increasing incidences of fluorosis, both dental and Skeletal with some 66 million people being at risk (Sinha and Mustaria, 2004). In India, Rajasthan has maximum area affected by excess concentration of fluoride in ground water (Murlidharan *et al.* 2002). About 22 districts of Rajasthan have greater amount of fluoride than the permissible limits (Sinha *et al.* 1970). The reason of origin of these hazardous elements is attributed to geological reason. According to recommendation of WHO drinking water should not contain more than 1.5 mg/l fluoride. People who drink water containing fluoride in excess of this level over many years could get bone disease, including pain and tenderness of the bones. In moderate forms of dental fluorosis, brown staining or pitting of permanent teeth may appear.

Total alkalinity is the measure of capacity of water to neutralize the acids. It provides guidance in applying doses of chemicals in water and waste water processes specially in coagulations, softening and operational control of anaerobic digestion.

Hardness in ground water in the area is due to availability of limestone, sedimentary rock and calcium bearing minerals in soil. Hardness can also occur locally in groundwater from excessive application of lime to the soil in agricultural areas. Excessive hardness in drinking water results in urinary concentrations, stomach disorder, stone in kidney and bladder.

Chlorides are widely distributed in nature as salts of sodium chloride, potassium chloride, and calcium chloride. A normal adult human body contains approximately 81.7 g chloride. Excessive intake of drinking-water containing sodium chloride at concentrations above 2.5 g/l has been reported to produce hypertension (Fadeeva, 1971). This effect is believed to be related to the sodium ion concentration.

Material and Methods

Total 40 groundwater samples were collected from tube wells, open wells, and hand pumps of different locations of study area. The collected samples were analyzed for estimation of physical and chemical properties like pH, Total Alkalinity, total hardness, Ca, TDS, Chloride, Nitrate and Fluoride. Samples were collected in clean bottles of 1 liter capacity. Physical parameters like, pH, TDS were measured using digital meters immediately after sampling. The total hardness, alkalinity, nitrate, nitrite, chloride, fluoride were analyzed using standard titrimetric methods - APHA 1998.

Results and Discussion

Surface water and ground water are the two main sources of drinking water. Rainfall is the main source of surface water but Churu district is a part of arid zone lies in western Rajasthan where very low rainfall occurs for a very short time period (2-3 months), from first week of July to mid of September, through south-west monsoon. Ground water is not drinkable in the district because of excess quantity of chloride, floride, nitrate, sulphate, nitrite and arsenic like natural elements. This is because of availability of limestone, sedimentary rock and calcium bearing minerals in soil of the study region.

Present study is an overview of drinking water parameters in different areas of Churu district. The most of the water samples in study area are brackish to saline in nature and pH values ranged from 7.1 to 8.4, which is more than the WHO (1984) permissible limits.

The hardness of ground water ranged from 200 to 1480 mg $Caco_3$/l with an average of 615.75 mg in the study area, whereas WHO permissible limit for hardness of ground water for safe life is 500mg/l. The analysis reveals the increase in the concentration is mainly due to mineralization of ground water. The range of calcium in the groundwater of study area varied from 90 to 720 mg/l.

Alkalinity and pH in the groundwater of study area are caused by bicarbonate and carbonates. The values of alkalinity in all the samples range from 140 to 890 mg/l in the study area.

The amount of TDS in groundwater depends on the solubility of minerals in different geological regions of the area. Water containing TDS concentrations below 1000 mg/l is usually acceptable for consumption. In the present study TDS was found to vary from 690 to 4620 mg/l.

Chloride concentration was range from 160 to 2520 mg/l in the study area, which is higher in the most of samples than desirable level determined by ICMR (200 mg/l). Except three, all the study sites had chloride contents far above the permissible limit of WHO. Chloride concentration was maximum in Maharavansar and minimum in Lachharsar (figure 2).

High concentration of nitrate has been reported in ground water of Churu district. Data analysis reveals that nitrate concentration in collected water samples lie in the range from 10 to 300 mg/l, with an average of 60.5 mg/l (Table 1). WHO proposed permissible limit for nitrate is 45 mg/l but about 65% of samples collected in study area have high values of nitrate. Churu (GPF) and Balrasar had maximum nitrate contents far above the WHO permissible limit (Figure 3).

Fluoride content ranges from 0.1 to 5.4 mg/l in the district with an average of 1.61 mg/l (Table 1). The study indicates that most of the water samples contain high concentration of fluoride than that of the standard set by WHO and ICMR (1.5 mg/l). Rajgarh had the maximum fluoride contamination and minimum in Ratan nagar 0.1mg/l. Total nineteen samples in study area had fluoride contamination above than WHO permissible limit (Figure 4) and rest had the concentration within range. The analysis of data indicates that high concentration of fluoride is associated with salinity. Regular intake of fluoride contaminated water may cause bone diseases.

The results of data analysis showed that there is a significant association between chloride, fluoride and nitrate contaminated drinking water and diseases related to bone, teeth and digestion.

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Table.1

Results of the Physico-Chemical Parameters of Groundwater in Selected Areas of Churu

Sample No	Location (Churu distt.)	pH	Alkalinity	Hardness		TDS	Chloride	Nitrate	Fluoride
				Total	Calcium				
1.	Gajsar road	7.8	300	200	110	1020	200	30	0.7
2.	Chhajusar	8.2	400	260	110	1570	620	40	0.8
3.	Tidiasar	7.9	260	860	260	2310	1100	55	0.7
4.	Kusumdesar	8.2	820	810	310	3600	1900	55	0..9
5.	Lachharsar	8.6	280	320	90	690	160	25	0.5
6.	Gopalpuria	8.5	700	200	90	1570	620	55	1.9
7.	Bhinchari	8.0	460	1100	290	3700	1160	70	2.3
8.	Nausaria	8.2	400	400	110	1290	320	60	1.8
9.	Bhojasar I	8.2	380	500	120	1850	680	55	1.5
10.	Bhojasar II	8.2	450	390	90	1850	660	55	1.6
11.	Bhukhredi	7.8	890	580	190	2490	560	70	2.2
12.	Bhukhredi	7.8	860	660	290	2490	520	70	2.4
13.	Dhadhar T/W-I	7.7	680	640	320	2680	1380	95	1.2
14.	Ghanghu I	7.1	240	1480	620	1940	620	80	0.4
15.	Ghanghu II	7.5	140	1260	680	1940	580	70	0.4
16.	Dhadhria charnan	7.5	380	960	460	3090	1700	90	0.9
17.	Mehravansar	7.6	420	1420	720	3700	2520	70	2.2
18.	Asloo station	7.6	300	1200	700	4620	2000	30	2.3
19.	Shyopura	7.4	480	560	370	2770	780	80	0.7
20.	Ratan nagar	7.8	440	310	180	1760	610	65	0.1
21.	Ratangarh	7.7	310	450	310	1390	240	55	1.4
22.	Churu (GPF)	7.5	240	410	170	920	250	300	3.1
23.	Rajgarh	.3	260	310	170	920	260	90	5.4
24.	Hudera Aguna	8.1	640	890	260	2770	730	65	1.7
25.	Golsar(o/w)	8.7	430	410	170	1290	390	30	1.6
26.	Golsar(T/w-1)	8.6	440	590	170	1660	460	45	1.8
27.	Golsar(T/w-II)	8.6	460	520	160	1570	460	55	1.5
28.	Hansasar (T/w-1	8.8	410	310	110	1100	290	40	0.9
29.	Hansasar(O/w-II	8.2	410	370	110	1250	210	35	1.3
30.	Dhadhar T/W-II	7.1	680	580	310	3050	1580	90	1.2
31.	Sehla	7.8	480	400	280	2080	840	30	2.0
32.	Churu Goenka school	7.4	400	630	250	1725	600	30	1.0
33.	Churu Main pump house	7.4	170	280	400	820	200	10	0.7
34.	Churu Garh	7.8	430	1070	120	2960	800	50	0.9
35.	Churu Mishrawell	7.5	630	360	200	2480	700	45	2.6
36.	Churu T/W-3	7.7	620	580	170	2960	900	50	1.9
37.	Churu T/W-31	7.7	640	460	130	2350	750	40	4.3
38.	Churu T/W-58	7.8	700	670	230	2900	1050	50	2.4
39.	Churu T/W-95	7.6	500	690	290	2760	750	50	1.8
40.	Churu T/W-36	7.5	480	540	200	2140	630	40	1.5

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Figure 2: Distribution of Chloride in Churu district

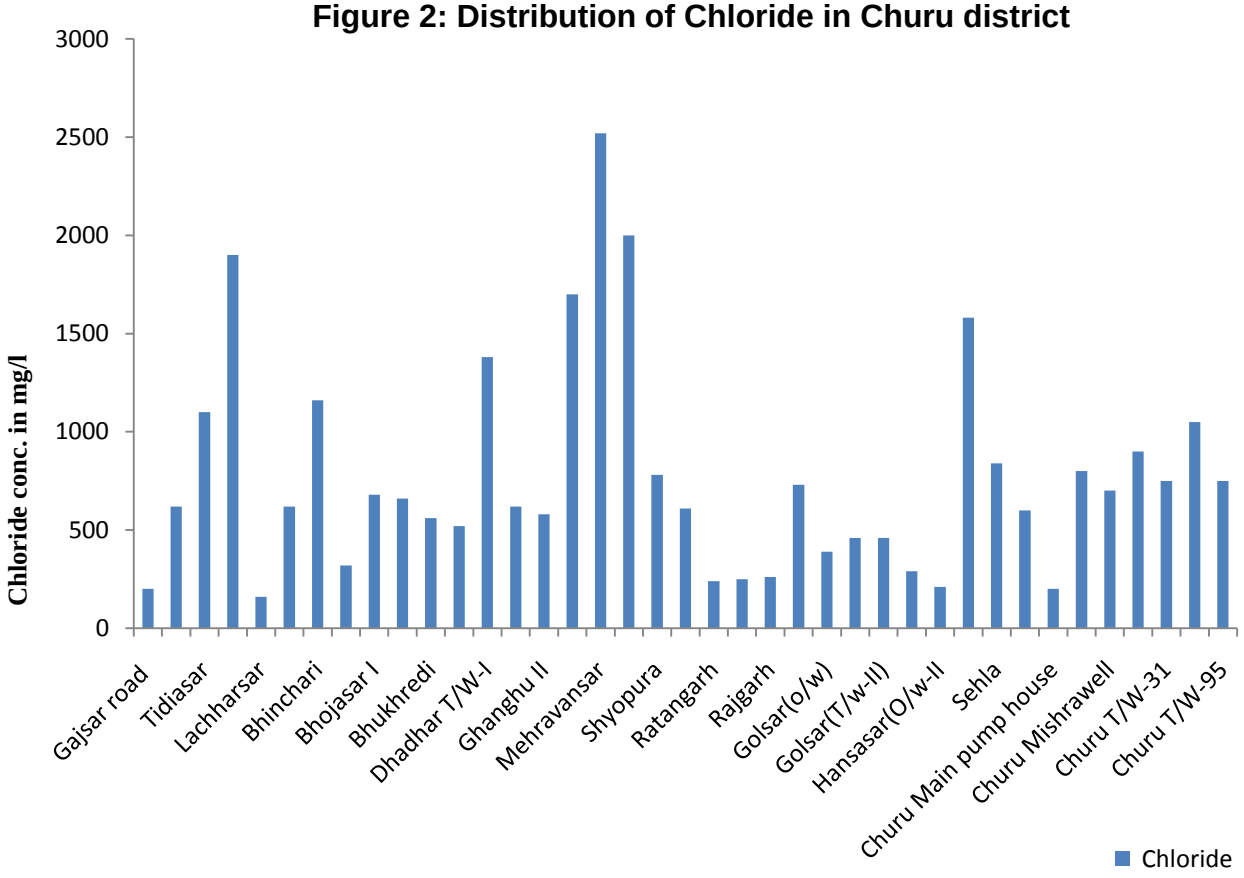


Figure 3: Distribution of Nitrate in Churu district

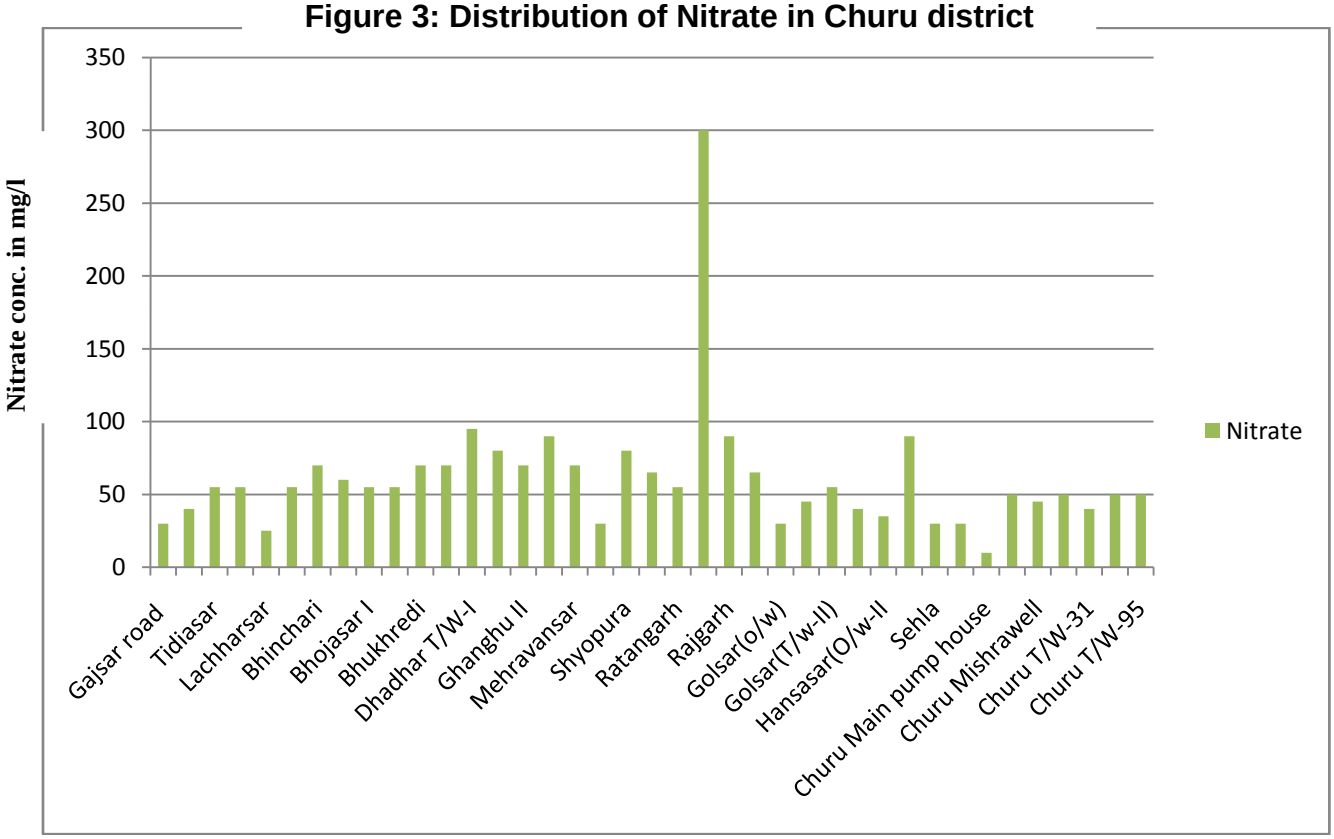
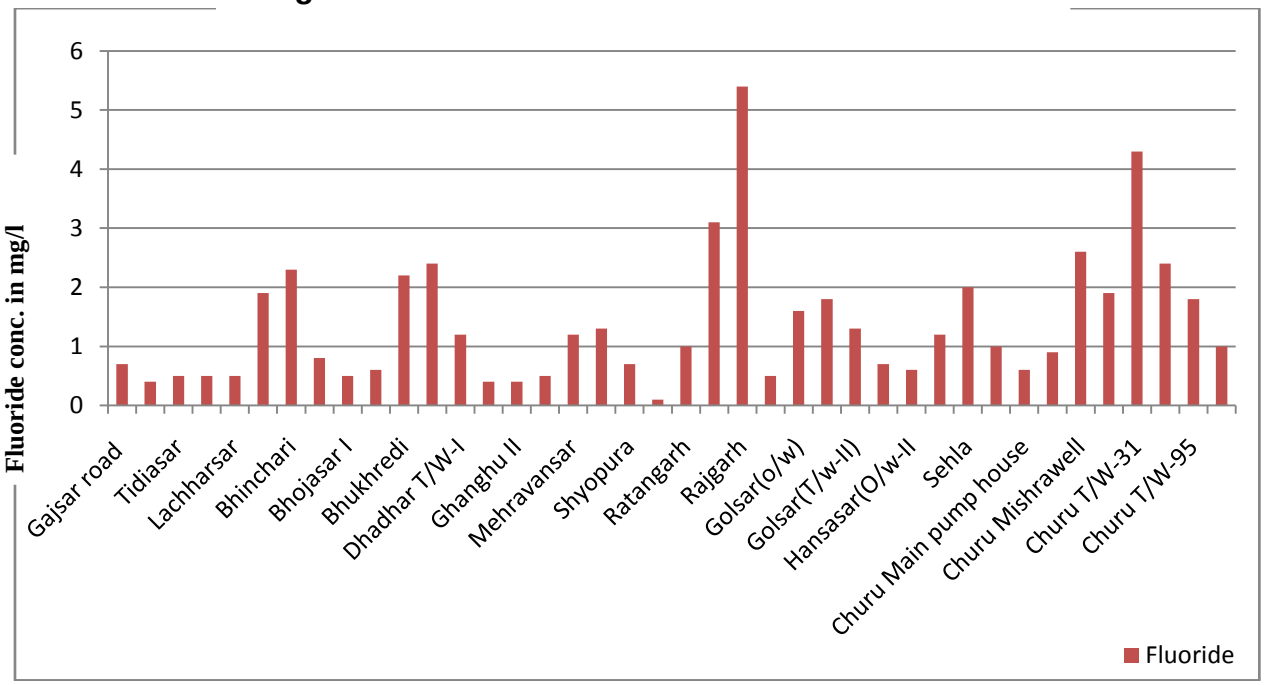


Figure 4: Distribution of Fluoride in Churu district



The quality component of groundwater in Churu district is not according to norms of Rajasthan government and WHO standards. . Earlier studies conducted in the Sadulpur tehsil of the district also revealed more or less same results (Singh 2014). Higher concentration of these salts had deleterious effect on the human health (Fetter 1980). Higher concentration of nitrates had been found to be associated with cancer in Slovakia (Gulis *et al.* 2002). Knobetoch (2000) reported blue baby syndrome associated with high nitrate concentration in water. Neal *et al.* (2000) analyzed the water quality of Thames tributaries and found them to be contaminated by anthropogenic activities. Arsenic contamination has found to be lethal in amany areas of India (Chakraborti *et al.* 2004, Rahman *et al.* 2005) and Nepal (Shretha *et al.* 2003). Fortunately arsenic contamination is not very high in the region. Mathur (2003) studied high concentration of fluoride in ground waters of Arid Rajasthan. Akhilesh *et al. (*2005) carried out study on the geochemical scenario of fluoride in the whole Rajasthan. The pH results indicate that ground water in study area is highly brackish-saline in nature. The total hardness of ground water of this area falls in the hard category. Salinity, hardness, chloride, nitrates and fluoride properties of drinking water in the study area indicate the sign of deterioration which calls for at least primary treatment of ground water before being used for drinking. During sample collection people of area also complained about diarrhea, gastric and other digestion related problems, which may be because of consuming ground water containing high amount of nitrate contents. Consumption of high concentration of fluoride has resulted in bone deformity and joint pains. Laanthe *et al. (*2002) has suggested some bioremediation methods of nitrate but these have yet to gain fruitful results.

The purpose to persuade present research work was to know ground water quality and to find out chemical and biochemical remediation of problematic ions. The study suggests that regular evaluation of water quality is needed in Churu district so that strategies can be developed to reduce excess chemical contaminations and the water can be made suitable for drinking purposes.

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