ASSESSMENT OF GROUND WATER QUALITY OF RAJASTHAN WITH SPECIAL REFERENCE TO BILARA (JODHPUR) REGION

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ABSTRACT: A well planned and systematic study was carried out to make assess of the water quality of Bilara region (Jodhpur district) of Rajasthan. The focus of the study was to determine the physico–chemical parameters of ground water samples collected from the populated regions of Bilara, where the same water is used as potable water. A comprehensive physico–chemical analysis of some parameters such as pH, conductivity, total dissolved solids (TDS), total hardness (TH), Calcium, Magnesium, Nitrate, Chloride, Fluoride, etc was done. The analysis reveal that some of the samples contained chemical constituent beyond permissible limits prescribed by Bureau of Indian Standards (B.I.S), which may result to various hazardous effects to the health of the people residing in those areas. In this paper, regional ground water contamination will broadly refer to the types of ground water contamination that can be observed at the regional scale. Based on the results of this study, it is recommended that any ground water source which comes under this study area should be tested before use for its portability and other domestic or industrial uses.

Key words: Ground water quality, Water Quality Index, Physico-chemical parameters, Bilara (Jodhpur) region.

INTRODUCTION:-

When asked about the most essential thing for survival then no doubt the answer is: Water! It is essential for the survival of all living forms of the earth. However, in recent years the quality of water bodies deteriorated causing environmental hazards. Pollution or contamination may sound small words but its impact is very broad and disastrous. Water pollution's magnitude is growing day by day and it is a major global problem. Like other developing countries, in India too water pollution has reached to a level of no recovery and revival, causing alarming. The water resources of earth are part of a finite close system and from time immemorial these water reservoirs had helped in quenching the thirst of millions of people. But with the rise in population, there is inevitable decrease in the per capita amount of water available for drinking and domestic purpose. The water related issues are becoming increasingly important for sustainable environment particularly regarding to human health and long term food security. As it is known to all that water pollution is a state of deviation from pure condition, whereby its normal functioning and properties are altered or affected which causes adverse effects. The change or alteration in physical, chemical and biological characteristics of water is defined as water pollution that is harmful to human beings and other forms of life. The requirement of water is to all forms of lives, from micro-organisms to man, and it is a serious problem today because all water resources have been reached to a point of crisis due to pollution and unplanned urbanization and industrialization. Water quality degradation has become a major concern around the world. The various activities of humans such as usage of more land for agricultural purposes which leads to increase in the usage of fertilizers, pesticide that result into soil salinization and erosion have become problems threatening natural water source even more today.

Jodhpur district is situated between 25051'08" & 27037'09" North latitude and 71048'09" &73052'06" East longitude covering geographical area of 22,850 sq km. This district comes under arid zone of Rajasthan State. Bilara is a city and an urban administrative division in Jodhpur. As it is arid to semi arid region so rainy days are limited to maximum 15 in a year. The average rainfall is 302 mm only. This increases water crises in the region so the major water resource is ground water reservoir on which the whole population is depended. Ground water occurs under unconfined to semi-confined conditions in rocks of and Bilara limestone which is the most potential aquifer in the district.

Bilara region comes under arid zone and also there is scarcity of rainfall so the potential source of water is ground water. But because of over dependence on one resource it is depleting rapidly. The ground water of Bilara comes under over exploited category now with Gross Ground Water Draft for all uses being 136.1517 mcm. As it is highly used for drinking and other domestic purposes, there is a need for analyzing the water for various parameters to examine its suitability for the same.

METHODOLOGY

Sampling methods:

Twenty water samples from different sites were collected from different regions of Bilara (Jodhpur) before monsoon season. These water sources are extensively used for drinking and other domestic purpose. The water samples were collected from

selected location by composite sampling method. All samples were collected in high density polypropylene bottles. In all cases plastic bottles were sterilized properly. Bottles were cleaned with dilute nitric acid first and then with double distilled water before their usage for collection of samples. Analytical Reagent (AR) grade chemicals were used during the study. Proper techniques and methods were followed for collection, preservation, analysis and interpretation.

Analysis method:

All results were checked within 6 hrs of collection of water sample whereas parameters like pH, temperature and electrical conductivity were measured at the site itself using portable meters. The concentration of magnesium, calcium, total hardness, chloride, alkalinity, were estimated by volumetric methods, nitrate concentration was analyzed by spectro-photometric method, fluoride concentration was measured by Ion Selective Electrode and the results were then compared with BIS standards.

Table 1: Methods employed to examine the parameters and their units

S. No.	Parameters	Unit	Method Employed
1.	pH		Digital pH-meter
2.	Electrical Conductivity	mhos/cm	Digital Conductivity-meter
3.	Total Hardness (as CaCO3)	Mg/L	Titrimetric method (with EDTA)
4.	Calcium Hardness (as CaCO3)	Mg/L	Titrimetric method
5.	Magnesium Hardness (as CaCO3)	Mg/L	Titrimetric method
6.	Chloride (as Cl-)	Mg/L	Titrimetric method (With AgNO3)
7.	Nitrate (as NO3 -)	Mg/L	Spectrophotometric method
8.	Fluoride (as F-)	Mg/L	Ion Selective Electrode
9.	Total Dissolved Solids	Mg/L	Digital Conductivity-meter

Location of sampling sites

The samples were collected before monsoon season from twenty different places of Bilara region; namely, Gharsuria (Blr_1), Sowniya (Blr_2), Bhagasni (Blr_3), Borunda (Blr_4), Haria Dhana (Blr_5), Jhak (Blr_6), Pichyak (Blr_7), Rampuri (Blr_8), Ransiga (Blr_9), Sambari (Blr_{10}), Barana (Blr_{11}), Bilara (Blr_{12}), Binjwaria (Blr_{13}), Harsh (Blr_{14}), Jelwa (Blr_{15}), Bagarki (Blr_{16}), Chirdhani (Blr_{17}), Khejarla (Blr_{18}), Malawas (Blr_{19}), Nanan (Blr_{20}).

RESULTS AND DISCUSSION

There is a large variation in chemical quality of ground water in the Bilara region depending on the characteristics of water bearing formation, movement of ground water, depth to water levels and leaching. Table 2 contains the standard permissible and excessive limits set by BIS of few parameters which are analyzed in this study.

Table 2: BIS standards of permissible and excessive limits of various parameters

Parameters	Permissible Limit	Excessive Limit
pH	6.5	8.5
TDS	500	1000
TH	300	600
TA	200	600
Chloride	250	1000
Fluoride	0.9	1.5
Nitrate	45	100

The below table shows the analyzed results of the physic chemical parameters of the ground water samples collected for examination from various regions of Bilara.

Table 3: Physico-chemical parameters of ground water of Bilara (Jodhpur) region.

S. No.	Location	Source	pH	EC	TDS	TH	Ca+2	Mg+2	F^-	Cl^-	NO_3^-
1.	Blr_1	Well	8.0	1700	908	325	76	33	0.84	241	61
2.	Blr_2	Well	8.4	1650	641	85	8	16	2.60	248	17
3.	Blr_3	Well	7.9	7200	4068	640	124	80	0.80	1929	10
4.	Blr_4	Well	7.8	3900	2250	405	86	46	1.44	922	37
5.	Blr_5	Well	8.6	2690	1508	230	36	34	1.60	560	33
6	Blr_6	Well	8.0	5050	2950	560	108	71	1.24	1305	17
7.	Blr_7	Well	7.8	2200	1241	255	62	24	1.88	440	16
8.	Blr_8	Well	7.8	5050	2853	480	76	71	1.76	1276	24
9.	Blr_9	Well	8.0	8000	4616	1010	220	112	1.80	2340	30
10.	Blr_{10}	Well	7.8	4220	2395	400	56	63	1.80	993	36
11.	Blr_{11}	Well	7.8	8350	4770	1270	116	238	2.40	2241	50
12.	Blr_{12}	Well	7.9	9100	5224	880	188	100	2.44	2411	38
13.	Blr_{13}	Well	7.8	7750	4409	870	188	97	2.80	1943	20
14.	Blr_{14}	Well	7.9	9000	5163	960	176	126	2.28	2454	32
15.	Blr_{15}	Well	8.5	5000	2893	500	48	92	2.48	1078	43
16.	Blr_{16}	Well	8.3	1950	1062	430	42	79	0.84	369	12
17.	Blr_{17}	Well	7.9	4250	2376	1310	389	83	0.08	1142	30
18.	Blr_{18}	Well	8.0	8750	4922	950	200	109	0.68	2482	28
19.	Blr_{19}	Well	8.6	1650	885	325	30	61	1.52	255	160
20.	Blr_{20}	Well	8.4	1600	960	300	52	41	0.08	383	53

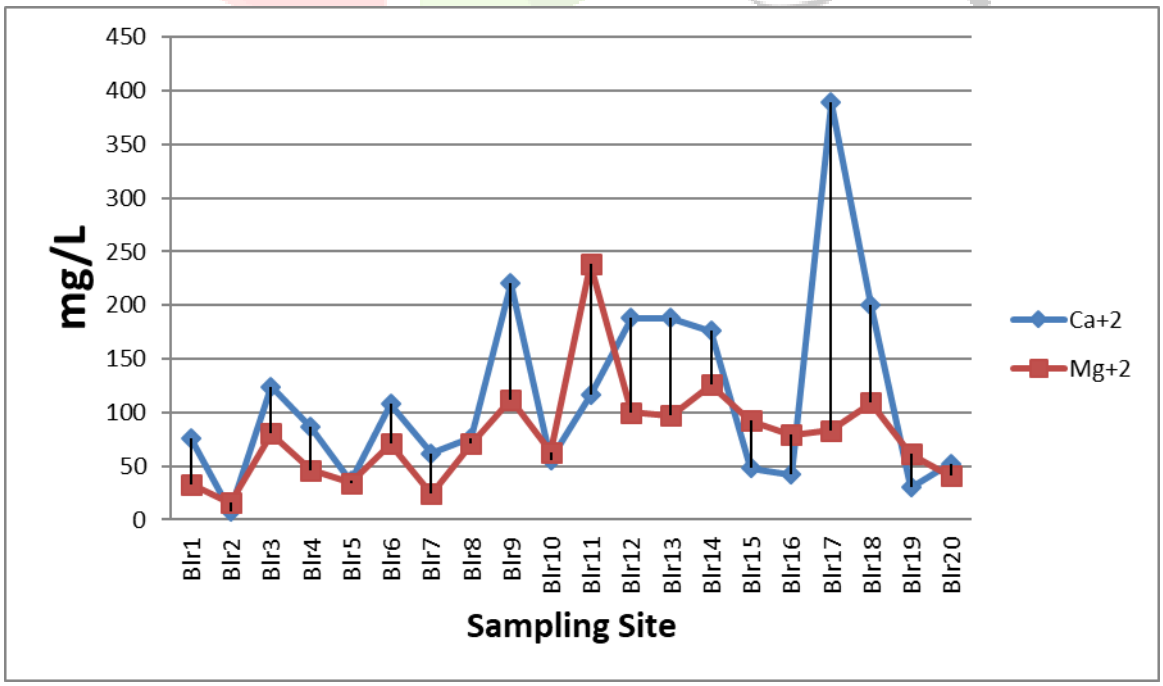

Fig 1: Graph showing variations in Calcium and Magnesium with sampling sites.

pH: The pH value of natural water changes due to biological and industrial contamination. The pH values of present investigation of ground water of Bilara were found in the range 7.8-8.6. It shows that water samples have slightly alkaline nature and have more salinity. These ground water samples are exceeds the permissible limits of pH by BIS.

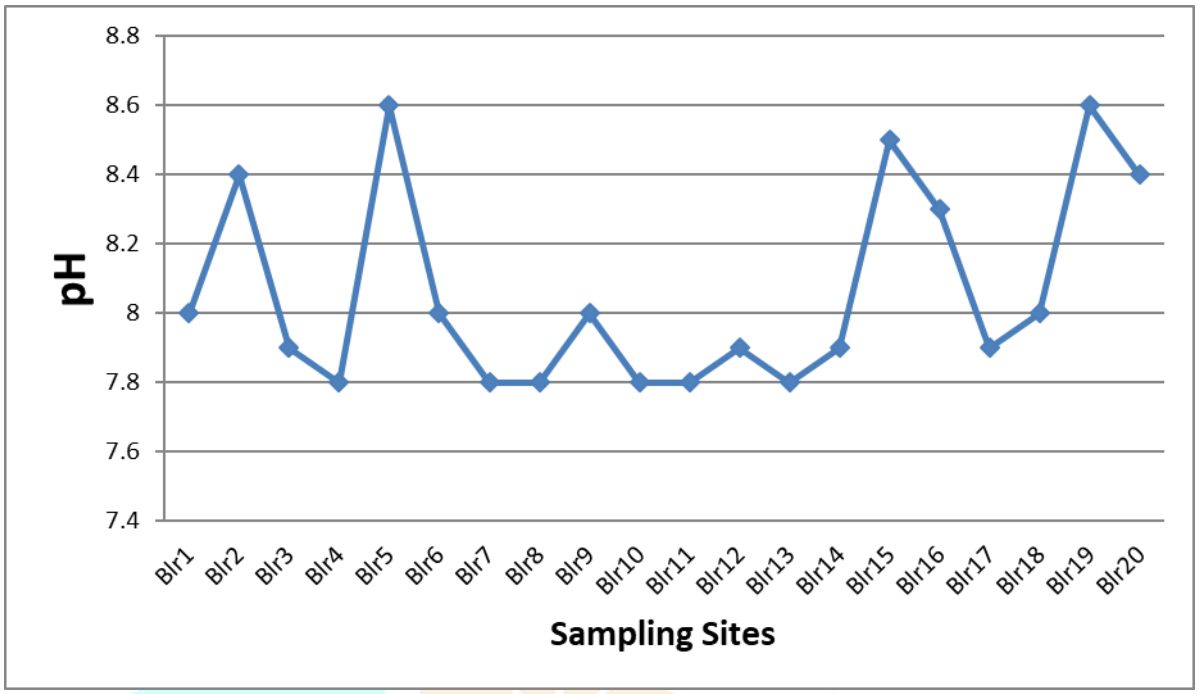

Fig 2: Graph showing variation in pH with sampling sites of Bilara region.

Electrical Conductivity: The analyzed results of EC for the ground water samples were ranging from 1600-9100 mhos/cm. As we know that electrical conductance is a measure of dissolved solids and excessive presence of sodium in water, which is unsafe for irrigation and also makes the soil uncultivable for future. Ground water on the basis of electrical conductivity is classified into four categories; < = 250 mhos/cm as excellent; 250-750 mhos/cm as good; 750-2250 mhos/cm as fair and > 2250 mhos/cm as poor by the U.S salinity laboratory. According to this classification only six water samples i.e. Blr_1 Blr_2 Blr_7 Blr_{16} Blr_{19} Blr_{20} belongs to fair category and rest all are poor.

Total Dissolved Solids: The TDS values of the study area were found ranging from 641-5224 mg/L. TDS indicate the nature of water quality for salinity. TDS values up to 500 mg/L are desirable and above 1000 mg/L is maximum permissible category, set by BIS. Based on the concentration values of TDS, ground water can be classified as: up to 500 mg/L as desirable for drinking, from 500 - 1000 mg/L as permissible for drinking and 1000 - 3000 mg/L as useful for irrigation. So from the results we can say that none of the sample is desirable for drinking, only four water samples falls under the category of permissible for drinking.

Total Hardness (TH): From the analyzed samples it was found that the hardness of water samples ranged between 85 - 1310 mg/L. When the results are compared according to the permissible and excessive limit (300 – 600 mg/L) standards set by BIS then we can say that the ground water of Bilara region shows a huge variation. TH of 60% of the water samples is under permissible limits.

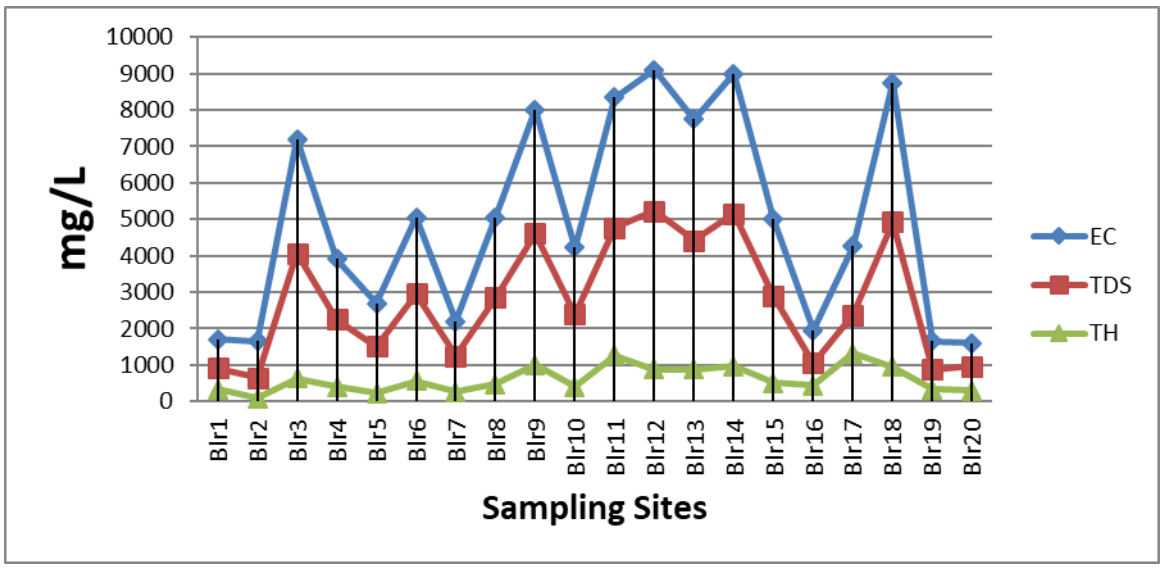

Fig 3: Variations of EC, TDS and TH with regards to sampling sites of Bilara.

Fluoride (F^-): The ground water of almost all the states contains fluoride. But Rajasthan contains excess levels of fluoride. Prolonged use of groundwater with fluoride for drinking purpose has resulted in the onset of widespread fluorosis disease, which varies from mild forms of dental fluorosis to crippling skeletal fluorosis. Higher fluoride concentrations in the water samples correlate positively with alkalinity and pH. The concentration of fluoride in the present study ranges from 0.08 to 2.80 mg/L. 12 samples out of 20 are within permissible limits set by BIS that is 60% of the total water samples.

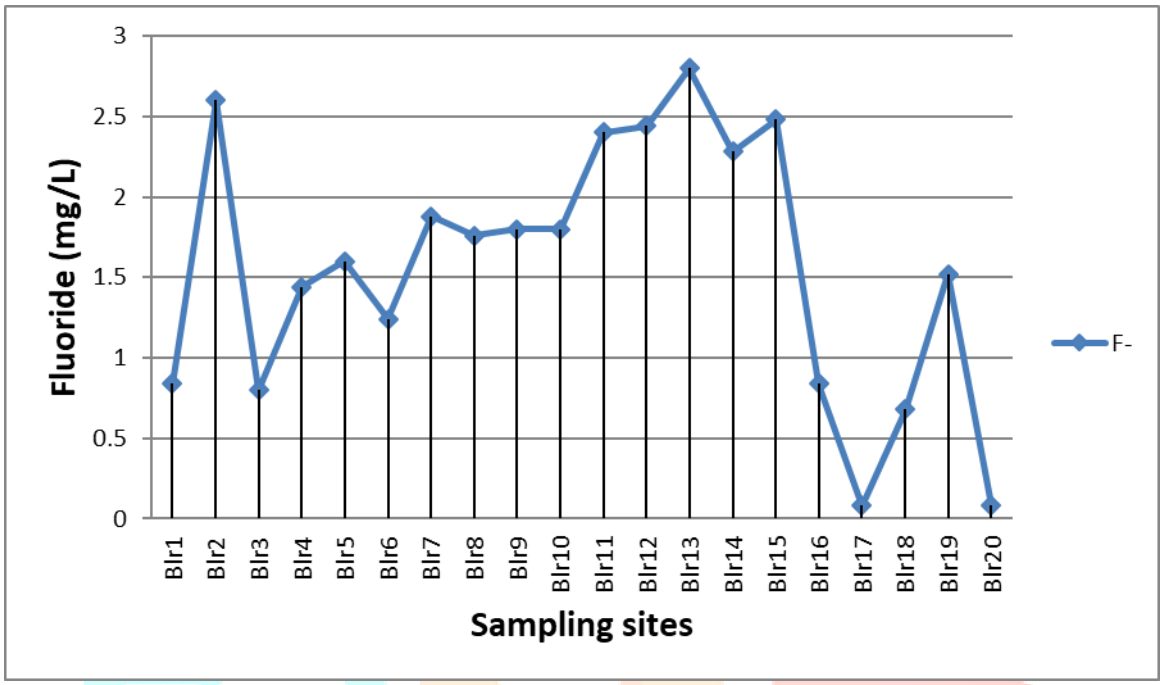

Fig 4: Variations in Fluoride (mg/L) with sampling sites of Bilara region.

Chloride (Cl^-): Chloride is one of the most common ion which occurs naturally in ground water. Water high in chloride concentration gives a salty and unpleasant taste. It causes damage to plants and is highly corrosive. Chloride generally forms salt by combing with calcium, magnesium or sodium. High concentration of sodium salt of chloride may cause heart problems and high blood pressure. The chloride content in the ground water of study area ranged between 241 to 2482 mg/L. The permissible limit of chloride in drinking water is 250 to 1000 mg/L according to BIS. Thus 45 % of the water samples come under permissible limit while rest 55 % are above permissible limit.

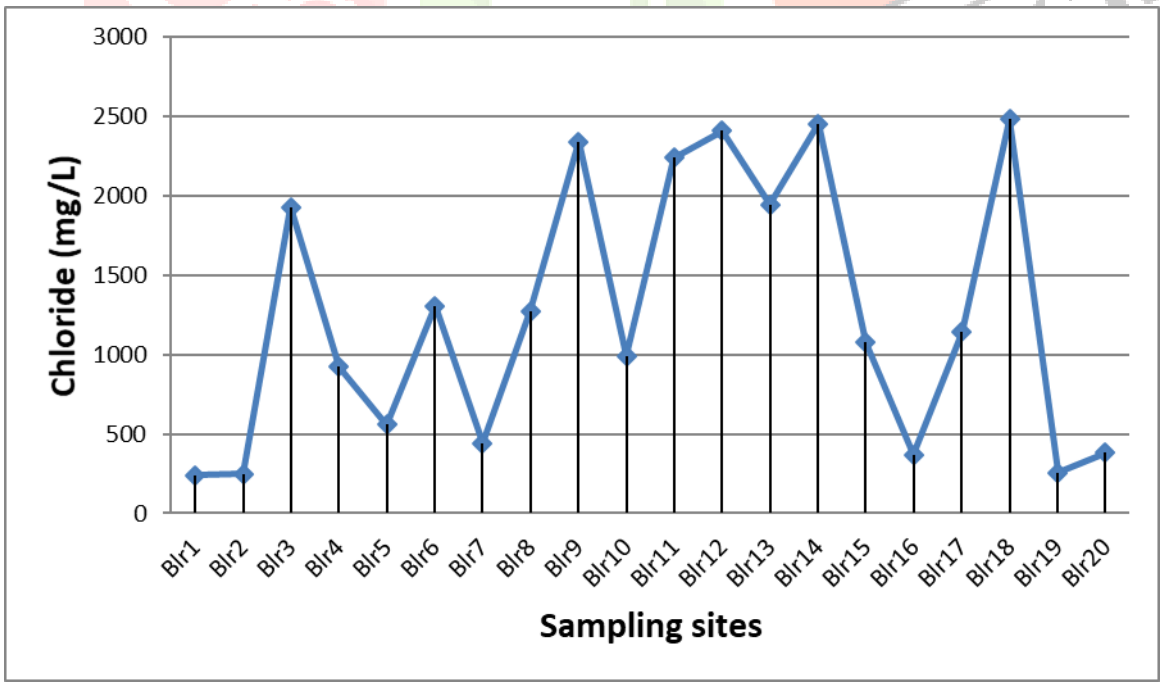

Fig 5: Variation in Chloride concentration with sampling sites.

Nitrate (NO_3^-): Concentration of Nitrate beyond standards set by BIS in drinking water may have carcinogenic effects. Nitrate levels equal to 100mg/l can lead to Blue Baby syndrome and also can hamper oxygen transportation in blood. Water containing more than 45 mg/l of nitrate concentration has been reported to cause methemoglobemia in infants. 300mg/l or more can cause

gastric cancer and have alarming effect on cardiovascular system. Water contaminated by higher levels of nitrate can cause nausea, fever, vomiting, gastroenteritis and intestinal inflammation. The high level of these ions in groundwater is mostly attributed to the discharge of wastewater from domestic activities and excessive use of nitrogen fertilizers in agricultural lands and also by leaching of hazardous industrial waste. Nitrate concentration of 45mg/L is permissible for drinking according to the standard set by BIS. The concentration of nitrate in the water samples varies from 16 to 160 mg/L. The determination of nitrate concentration in drinking water is important as it has adverse effects on health above 50 mg/L. In this study, out of 20 samples examined, 80% of the samples lie within the permissible limit.

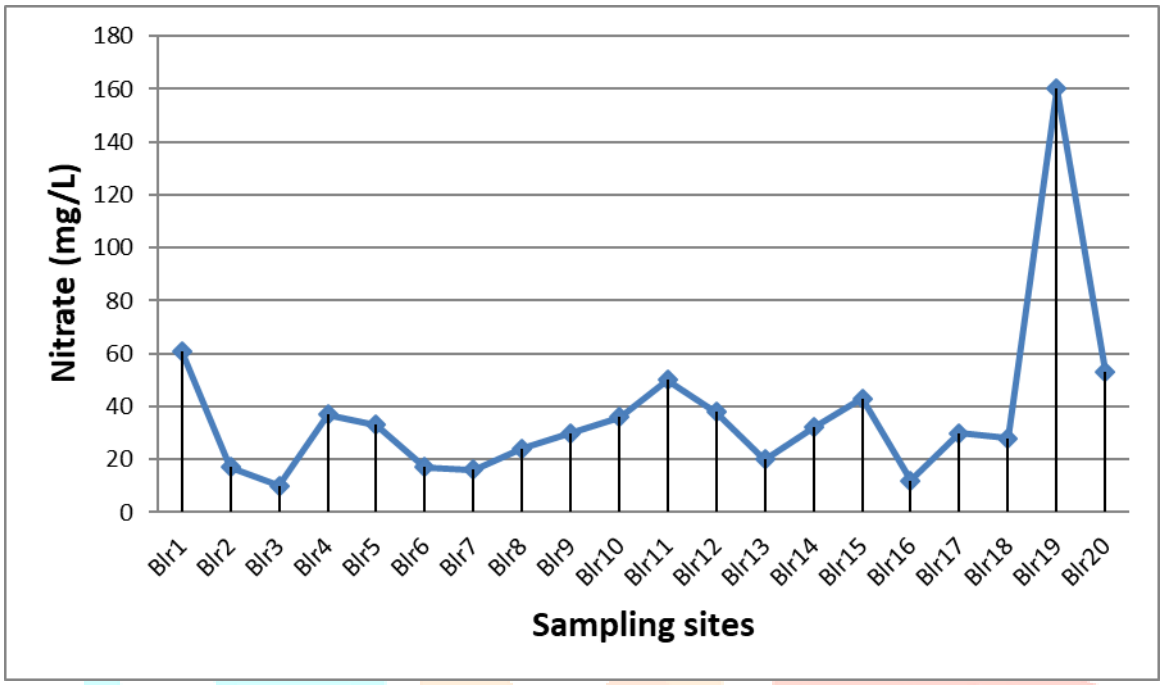

Fig 6: Variations in Nitrate concentration in mg/L with sampling site of Bilara region.

CONCLUSION:-

The detailed analysis of ground water on the various parameters shows higher concentration of chloride and nitrate in the samples of most of the region of Bilara (Jodhpur). Some of the regions under study area have higher values of TH, TDS and fluoride while EC and pH of the almost all water samples exceeds the permissible limits. Overall it can be concluded seeing the results of analyzed samples that none of the water sample, when examined for all the parameters collectively, is fit for drinking purpose.

Thus in these areas effective water treatment technologies must be implemented to ensure good health of the community. Also there is a need of heavy ground water withdrawal from potential zones of Bilara for agriculture use, where stage of ground water development has reached more than 300%, has to be controlled. Awareness program to educate about conservation of precious ground water resources
and training on rainwater harvesting will be beneficial to check decline in water level and also it will ensure safe water for drinking and other domestic purpose.

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