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"A Comparative Study of Premonsoon and Postmonsoon Status of Different Physical and Chemical Parameters of Water Samples Collected from the Various Sources of Water in Todaraisingh Tehsil of Tonk (Rajasthan) India"

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Abstract - The study of the water quality of Todaraisingh tehsil of tonk district, rajasthan india has carried out to assess the risk to human health. A comparative study has also been done in premonsoon and postmonsoon periods considering the change in various parameters and concentration of different ions. It has been found that the concentration of ions in premonsoon period is higher than postmonsoon which is natural phenomenon. This study is main consideration to assess the quality of water for its best utilization like drinking. For this purpose the study area has been divides into five zones. Only two sample sites named hamirpura (s-5) and lamba khurd (s-7) are found fit for in all studied water quality parameters on comparision with standards. These two villages are located in north zone of tehsil.

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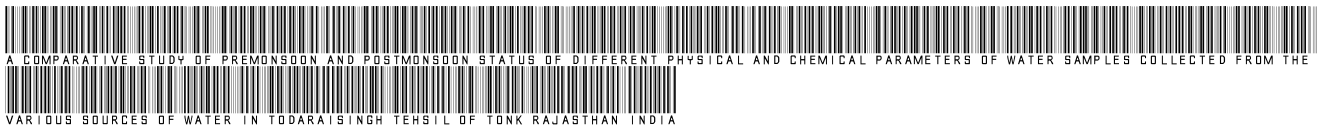

Strictly as per the compliance and regulations of :

"A Comparative Study of Premonsoon and Postmonsoon Status of Different Physical and Chemical Parameters of Water Samples Collected from the Various Sources of Water in Todaraisingh Tehsil of Tonk (Rajasthan) India"

Ashok Kumar Yadav [α] & Praveen Khan[σ]

Abstract - The study of the water quality of Todaraisingh tehsil of tonk district, rajasthan india has carried out to assess the risk to human health. A comparative study has also been done in premonsoon and postmonsoon periods considering the change in various parameters and concentration of different ions. It has been found that the concentration of ions in premonsoon period is higher than postmonsoon which is natural phenomenon. This study is main consideration to assess the quality of water for its best utilization like drinking. For this purpose the study area has been divides into five zones. Only two sample sites named hamirpura (s-5) and lamba khurd (s-7) are found fit for in all studied water quality parameters on comparision with standards. These two villages are located in north zone of tehsil.

Contamination of ground water with fluoride is due to the naturally fluoride rich rock salt system. Hence almost all the area is fluorosis prone.

Keywords : premonsoon, postmonsoon, concentration of ions, fluoride, fluorosis, water quality standards, water quality parameters.

I. Introduction

Today cry of environment pollution is heard from all corners of the world. Pollution has become a distinct threat to the very existences of mankind on this earth. For centuries man has been disturbing the balance of nature for comfort, wealth and ego but now nature has started its revenge.

The unique physical and chemical properties of water have allowed life to evolve in it. The following quote from Szent Gyorgyi ellustrates this point of view "That water function in varieties of ways within the cell cannot be disputed life originated in water, is thriving in water. Water beings its solvent and medium. It is the matrix of life."

Water is colour less, tasteless and odourless liquid in its pure form. Since it has very high dielectric constant, it is used as a universal solvent. As it dissolves nearly all natural compounds it transports the minerals and nutrients necessary for growth of plants. Many body fluids are water solution of biologically important solutes. More than two third of the earth's surface is covered by water out of which 71 % is covered by oceans. The earth therefore appears blue from space and hence called "blue planet"

The water in oceans and seas is highly saline, the estimated 1011 million cubic km of the total water present on earth, only 33400 cubic meter of water is available for drinking, industrial consumption and waste disposal.[1]The main sources of water are rain, sea, ground water and surface water. According to an assumption, the annual rain fall in india is about 400 million hectare meters (mhm) out of which, 70 mhm of water evaporates immediately, 115 mhm runs off into surface water bodies and the remaining percolates into the soil. Net annual recharge in India is 67 mhm although only 35 mhm is available for utilization. The great Indian Thar Desert which is a part of Rajasthan cover most of the area of state has extremely arid and dry climate condition. It receives only 5mm to 20mm annual rainfall, thus ground water is deeper and contains high mineral concentrated chemicals. Eastern part of the state is semi desert and hilly therefore, water availability in this area is limited. This geographical and geological setup, arid and semi-arid climate lead to insufficient water resources and deterioration of water quality hence Rajasthan mostly depended on ground water for drinking and agriculture purposes. Unfortunately the groundwater quality in a large number of districts is not according to WHO and ISI standards.

Rajasthan is the only state where almost all the districts are affected by high fluoride. Geological distribution of rocks in Rajasthan reveals that fluoride ores occupy large area of eastern and south east part of this state, in constricted synclinal bands in the central region of Aravali Synchronium. Secondly, around the mica mines ground water is rich in fluorides and Rajasthan is a rich source of mica.[2]

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In Rajasthan all the 33 districts have been declared as fluorosis prone areas and fluorosis problem can be visualized at various intensity levels i.e. Dental fluorosis, skeletal fluorosis and non-skeletal fluorosis etc. PHED habitations survey 1991-93 shows total 83200 villages and habitations have fluoride problem.[3] In Tonk district (part of eastern Rajasthan) occurrence of high fluoride in ground water is quite common.[4]

Besides this pollution of sources of drinking water is frequent due to domestic water, earthen septic tanks, urban and rural garbage, agriculture discharges, soluble effluents, industrial effluents, seepage pits etc.

So water from all sources may not be fit for drinking it can have dissolved salts along with suspendebal particles and microorganisms.

The physico-chemical water parameters viz- pH, turbidity conductivity, alkalinity, total dissolved solid (TDS), hardness concentration of chloride, fluoride, sulphate, nitrate etc. should be in limited values.[5-9]

Quality of water is affected adversely, when these parameters in water exceed permissible limit that can be tolerated. So WHO has published the maximum and minimum values for each parameter with in that limit the water quality is considered suitable for drinking, agriculture and other uses.

Besides other factors discussed above, monsoon factor also affects the concentration of ions in water in pre monsoon periods and post monsoon period. So it is very important to study and compare the physico-chemical parameters before rainfall and after rainfall. Many researchers have been reported seasonal physico-chemical parameters studies in India since 1990[10] up to now.[11-16]

Hence we are discussing here the change in the physico-chemical parameters in the pre and post monsoon season in Todaraisingh Tehsil of Tonk district Rajasthan, India.

a) Study Area and Climatic Conditions

To darisingh is in the east of Tonk district at the 75.19' & 76.16' at the longitude position. The latitude position is 25.41' & 26.24'in north. Its area is 7194 sq. km whereas forest area is 27048 hectares. Temperature remains 26-45°c in summer and 8-22°c in winter. The annual average rainfall is 613.6mm is recorded.

Study area:

In this block most of area is rural and public depends on farming and so that on ground water and rain water. People are not aware about impact of water due to lack of knowledge. On primary investigation it was found that people of this area suffered from fluorosis (Dental and Skeletal) and the symptoms of fluorosis could be seen by naked eyes too. So an attempt was made to screen of water quality in Todaraisingh area of Tonk.

II. Materials and Methods

The standard known methods and quality material is used for analysis of different ions in water. pH and conductivity are determined by PH metric and conductometric methods while other parameters are also determine and compared by standard methods.[17-19] Fluoride ion was determined by ion selective electrode method by ion selective meter.

a) Comparison and discussion of results obtained

Water quality standards are discussed and shown in table -1. Drinking water standards prescribed by different agencies are given in table-2.

The study area Todaraisingh is divided into main five regions to cover north, south, east, west and central part for the comparison and discussion purpose. We have collected 60 water samples of different sources of 30 villages in this Tehsil from the above divisions. We have taken samples from tube wells and hand pumps sources. The results of physico-chemical characteristics of various samples are discussed and region wise – monsoon wise observation are tabulated in the various tables and compared by different methods viz: graphs.

b) Colour, Odour and Taste

All the physical characteristics of the samples collected from different places and various sources are not objectionable. All water samples are colourless and odourless. They have agreeable taste. The appearance of the all water samples showed that the water quality is fit to drink. From physical appearance the water seems suitable for drinking.

Table 1 : Water Quality standards

Parameters	USPH Standards	ISI Standards (IS:10500-1991)
Colour	Colourless	Colourless
Odour	Odourless	Odourless
Taste	Tasteless	Tasteless
pH	6.0-8.5	6.5-8.5
T.D.S.	500	500-2000
Chloride	250	250-1000
Calcium	100	75-200
Magnesium	30	30-150
Fluoride	1.5	1.5

Nitrate	10	45
Total Hardness	-	300-600
Alkalinity	-	200-600

USPH: United state Public Health drinking water standards (USPH)
ISI: Indian standard Institution (ISI)

Table 2 : Drinking water standards prescribed by different agencies

Parameter	Agencies									
	BIS Limit		WHO Guideline		MUD Limit		MWH Limit		ICMR Limit	
	Desirable	MPL	Desirable	MPL	Desirable	MPL	Desirable	MPL	Desirable	MPL
pH	6.5-8.5	No Relaxation	7-8.5	6.5-9.2	7-8.5	6.5-9.2	7-8.5	6.5-9.2	7-8.5	6.5-9.2
Fluoride	1	1.5	0.5	1-1.5	1	1.5	–	–	–	–
TDS	500	2000	500	1500	500	1500	–	–	500	1500
Chloride	250	1000	200	600	200	1000	200	1000	200	1000
Ca Hardness	75	200	75	200	75	200	_	_	75	200
Mg Hardness	30	150	30	30	30	150	_	_	50	150
Nitrate	45	45	45	45	45	100	45	45	20	50
Alkalinity	200	600	–	–	200	600	–	–	–	–

BIS - Bureau of Indian Standard
WHO - World Health Organization
MUD - Ministry of Urban Development
MWH - Ministry of Works and Housing
ICMR - Indian Council of Medical Research
MPL - Maximum Permissible Limit

c) pH

Here pH was found in the range of 6.75 to 8.95 comparatively higher pH recorded during pre-monsoon than post monsoon be due to dilution of water as a result of precipitation.[20]

Graph 1 : pH Comparison in Pre & Post Monsoon Season

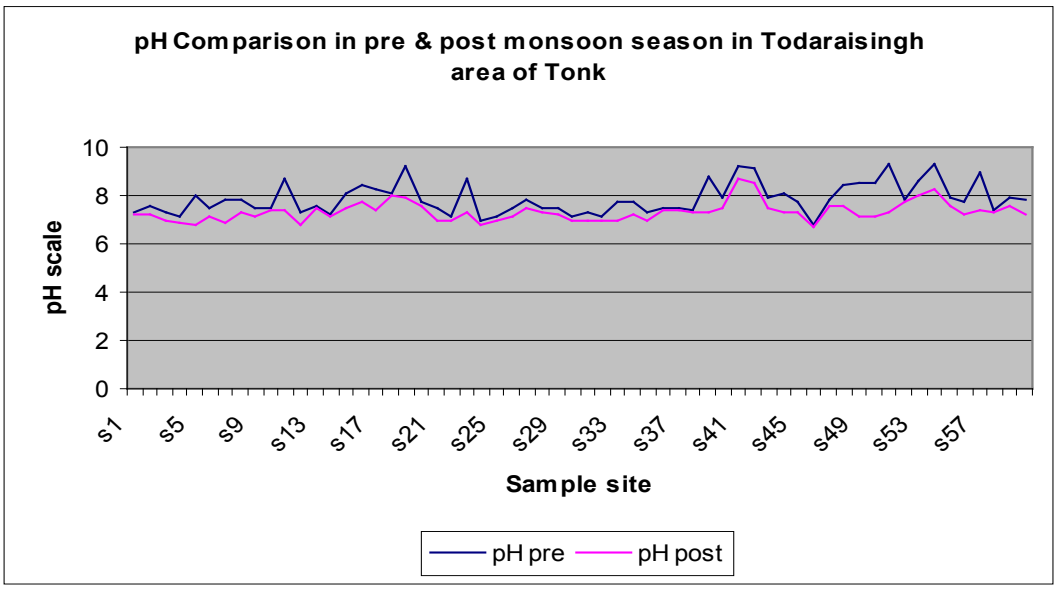


Table 3 : Comparison of Data of pH in Study Area (Pre & Post-Monsoon)

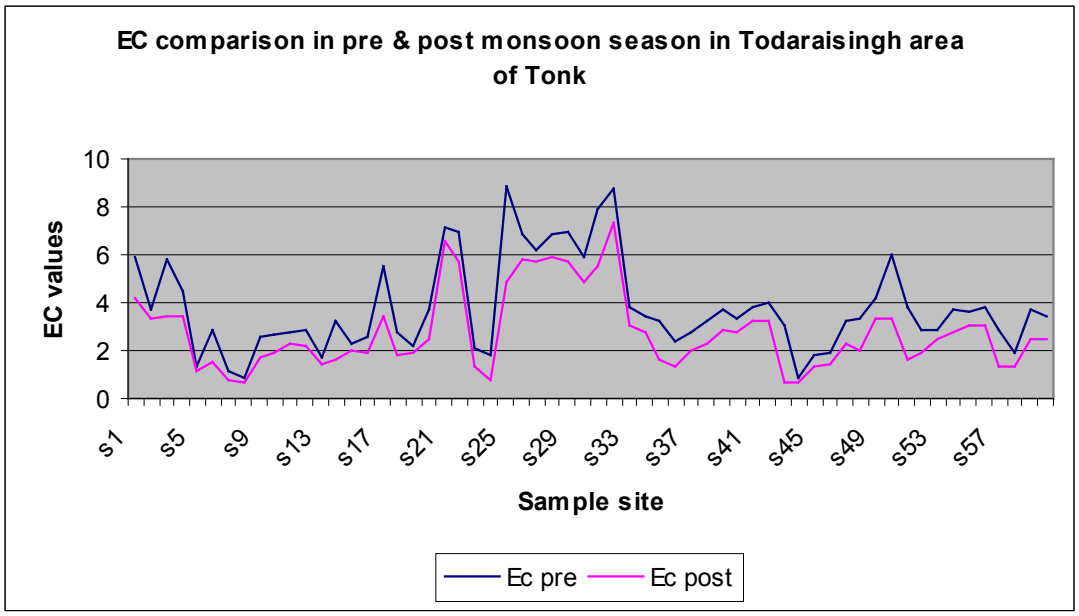
Parameter	Pre-monsoon				Post-monsoon			
	N	Min A	Max B	Range (A-B)	N	Min A	Max B	Range (A-B)
pH	60	6.8	9.3	2.5	60	6.7	8.7	2

Table 4 : Comparison of pH Content in the Groundwater of the Study Area with Drinking Water Standards

Parameter	ISI		WHO		NO of sample exceeding permissible limit	% of sample exceeding permissible limit
	HDL	MPL	HDL	MPL		
pH	6.5	8.5	6.5	8.5	4	6.66

d) EC

Graph 2 : EC Values Comparison in Pre & Post Monsoon Season



Conductivity in pre-monsoon maximum and post-monsoon minimum values observed due to increased rate of evaporation leading to high concentration of salts and dilution resulting from precipitation respectively.[21, 22]

Table 5 : Comparison of EC (Pre & Post-Monsoon) in Study Area

Parameter	Pre-monsoon				Post-monsoon			
	N	Min- A	Max- B	Range (A-B)	N	Min- A	Max- B	Range (A-B)
EC	60	0.87	8.85	7.98	60	0.64	7.3	6.66

e) Total Dissolve Solids (T.D.S.)

The TDS concentration varied from 532 mg/L to 4837.5 mg/L in Todaraisingh tehsil 21.77% villages are within the desirable limit. In present study concentration of TDS was found influenced by physical factor such as evaporation. This can be evident by the fall of TDS in postmonsoon season.[21, 23, and 24]

Graph 3 : TDS Content Comparison in Pre & Post Monsoon Season

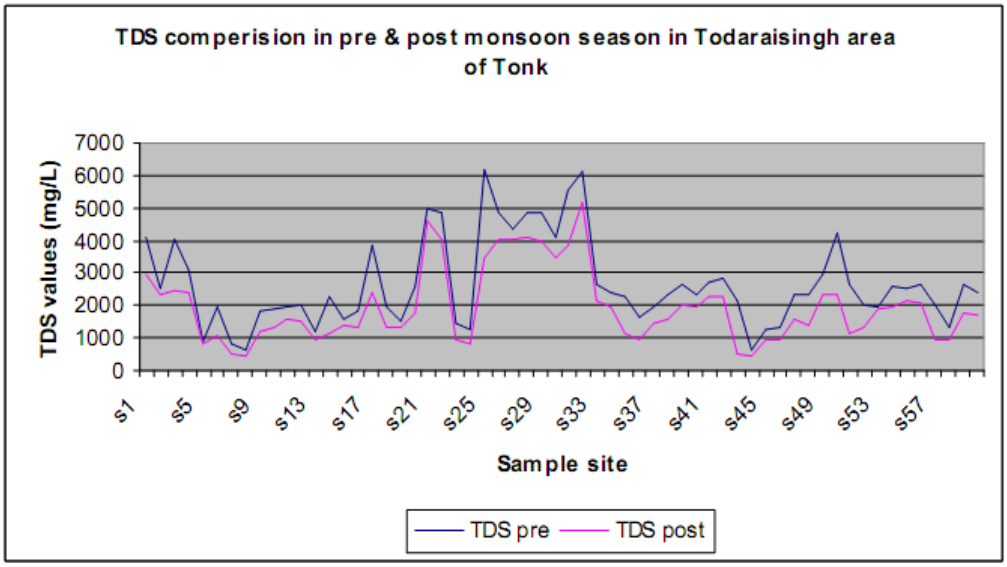


Table 6 : Comparison of Data of TDS in Study Area (Pre & Post-Monsoon)

Parameter	Pre-monsoon				Post-monsoon			
	N	Min A	Max B	Range (A-B)	N	Min A	Max B	Range (A-B)
TDS	60	609	6195	5586	60	448	5160	4712

Table 7 : Comparison of TDS Content in the Groundwater of the Study Area with Drinking Water Standards

Parameter	ISI		WHO		NO. of sample exceeding permissible limit	% of sample exceeding permissible limit
	HDL	MPL	HDL	MPL		
TDS	500	2000	1500	500	29	48.33

f) Alkalinity

Groundwater samples shows alkalinity value fluctuates between 200mg/L to 810mg/L. excess alkalinity in water is harmful for irrigation which lead to soil damage and reduce the crop yield.[25]

Increase level in pre monsoon and decrease in post monsoon may result of evaporation and the dilution of water during monsoon.[26]

Graph 4 : Alkalinity Comparison in Pre & Post Monsoon Season

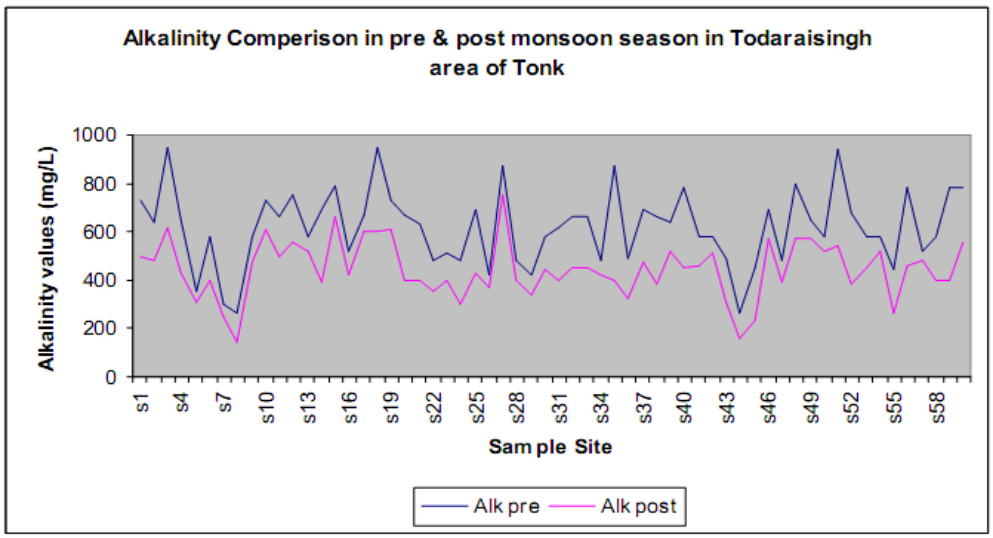


Table 8 : Comparison of Data of Alkalinity in study area (Pre & Post-monsoon)

Parameter	Pre-monsoon				Post-monsoon			
	N	Min A	Max B	Range (A-B)	N	Min A	Max B	Range (A-B)
Alkalinity	60	260	950	690	60	140	750	610

Table 9 : Comparison of Alkalinity Content with Drinking Water Standards in the Study Area

Parameter	ISI standards		WHO standards		No. of sample exceeding permissible limit	% of sample exceeding permissible limit
	HDL	MPL	HDL	MPL		
TH	200	600	200	600	17	28.33

g) Total Hardness

It was observed with minimum of 205 mg/L and maximum 1465 mg/L. hardness of water is mainly due to the presence of ca^{2+} and Mg^{2+} and is an important indicative of toxic effects of poisonous elements.[27] Hardness value observed high in premonsoon and low in postmonsoon season is in agreement with Baggde and Verma[28].

h) Calcium Hardness

Graph 5 : Comparison of Calcium Hardness in Pre & Post Monsoon Season

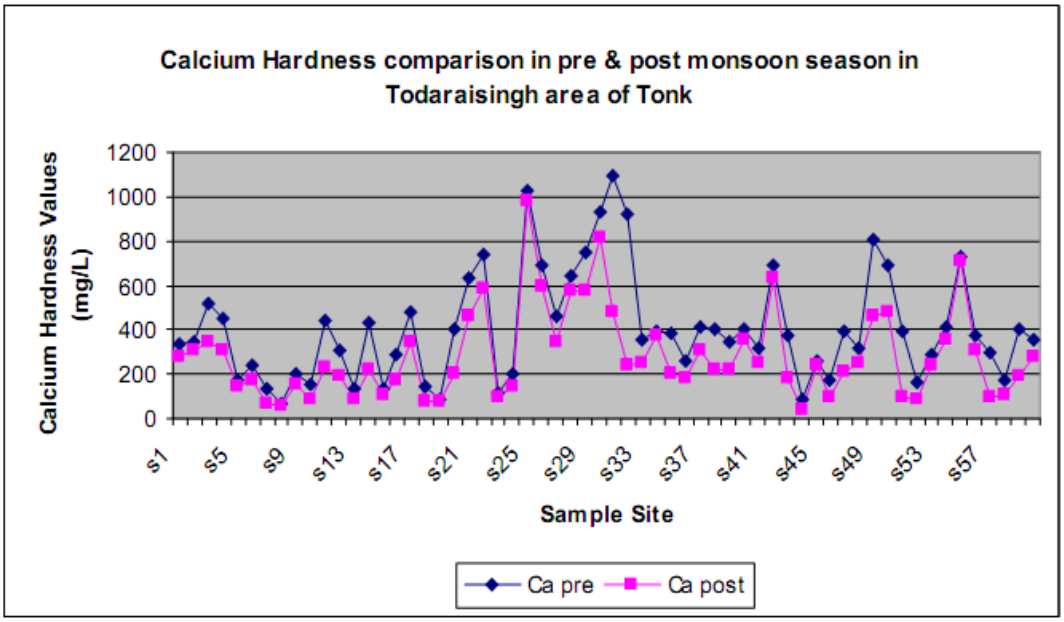


Table 10 : Comparison of Data of Calcium Hardness (Pre & Post-Monsoon) In Study Area

Parameter	Pre-monsoon				Post-monsoon			
	N	Min A	Max B	Range (A-B)	N	Min A	Max B	Range (A-B)
Calcium Hardness	60	70	1090	1020	60	40	980	940

Table 11 : Comparison of Calcium Hardness Content in the Ground water of the Study Area with Drinking Water Standards

Parameter	ISI		WHO		No. of sample exceeding permissible limit	% of sample exceeding permissible limit
	HDL	MPL	HDL	MPL		
$Ca+^2$ Hardness	75	200	75	200	44	73.33

It was observed with minimum of 62 mg/L and maximum 1005 mg/L high concentration of Ca^{2+} is due to its presence in rocks; from there it has leached to ground water.[29]

i) Magnesium Hardness

Graph 6 : Comparison of magnesium hardness in pre & post monsoon season

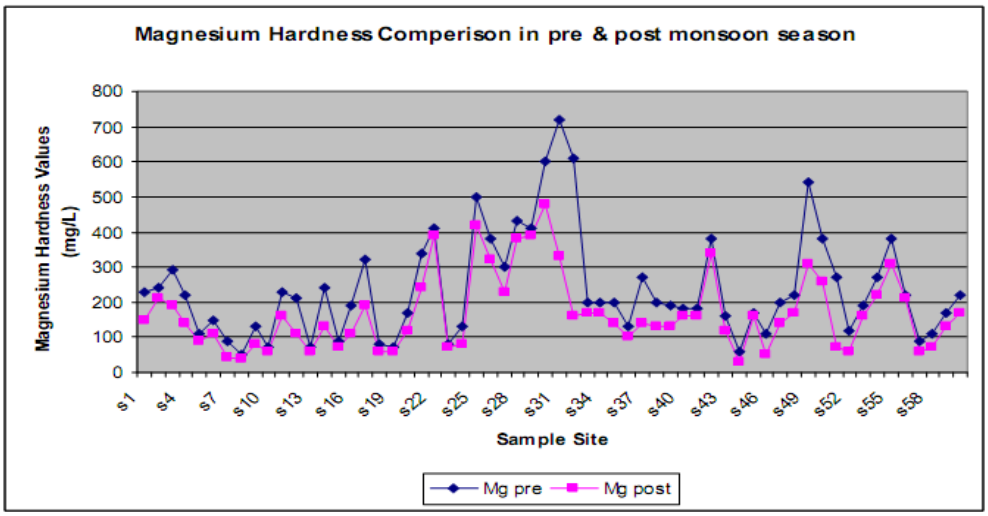


Table 12 : Comparison of Data of Magnesium Hardness in Study Area (Pre & Post-Monsoon)

Parameter	Pre-monsoon				Post-monsoon			
	N	Min A	Max B	Range (A-B)	N	Min A	Max B	Range (A-B)
Magnesium Hardness	60	50	720	670	60	30	480	450

Table 13 : Comparison of Magnesium Hardness Content in the Groundwater of the Study Area with Drinking Water Standards

Parameter	ISI		WHO		No. of sample exceeding permissible limit	% of sample exceeding permissible limit
	HDL	MPL	HDL	MPL		
Mg^{+2} Hardness	30	150	30	30	38	63.33

It was found with minimum of 43 mg/L and maximum 540 mg/L. the study shows that calcium hardness is higher than magnesium hence it may be suggested that hardness of water is mainly due to salts of calcium.[30]

j) Chloride

Graph 7 : Comparison of Chloride Content in Pre & Post Monsoon Season

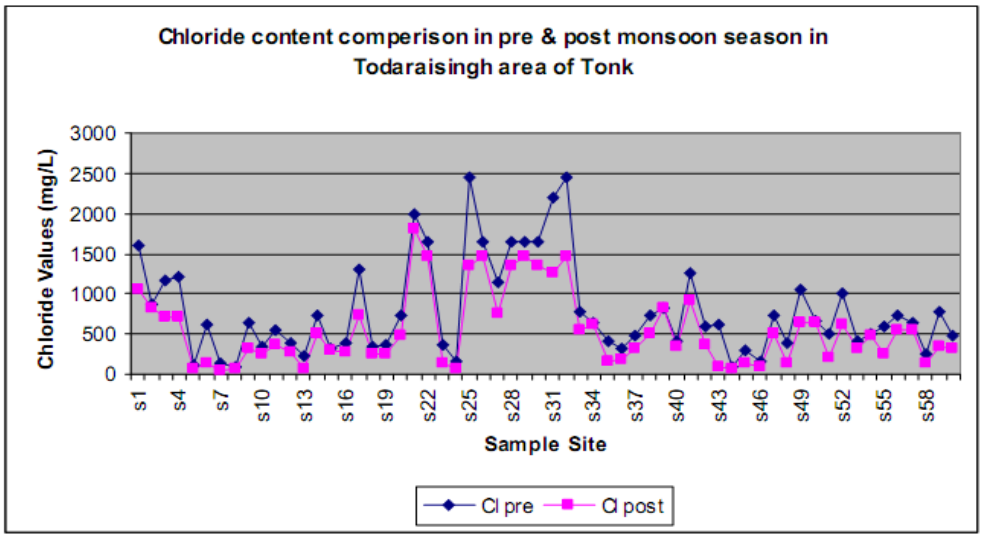


Table 14 : Comparison of Data of Chloride in Study Area (Pre & Post-Monsoon)

Parameter	Pre-monsoon				Post-monsoon			
	N	Min A	Max B	Range (A-B)	N	Min A	Max B	Range (A-B)
Chloride	60	90	2450	2360	60	50	1820	1770

Table 15 : Comparison of Chloride Content in the Groundwater of the Study Area with Drinking Water Standards

Parameter	ISI		WHO		No. of sample exceeding permissible limit	% of sample exceeding permissible limit
	HDL	MPL	HDL	MPL		
Chloride	250	1000	250	600	12	20

Chloride concentration varied from 80mg/L to 1955 mg/L. chloride in water influence salinity balance and ion exchange by dissolution of salts deposits, sewage discharge and irrigation drainage to natural water. High value in premonsoon may be due to evaporation and anthropogenic influences.[31]

k) Nitrate

Graph 8 : Comparison of Nitrate Content in Pre & Post Monsoon Season

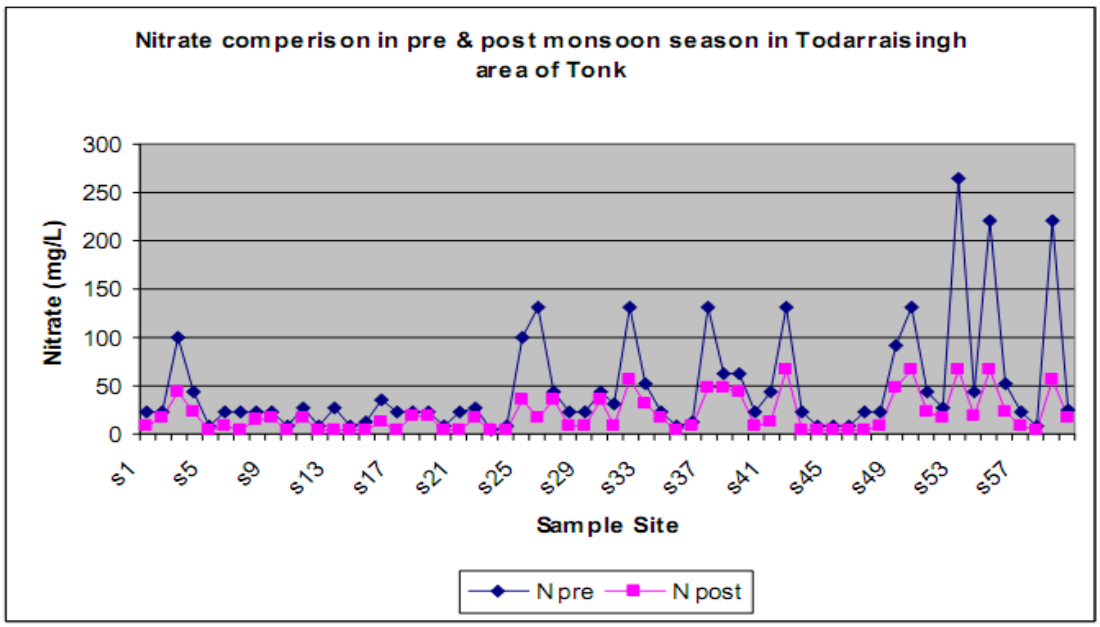


Table 16 : Comparison of Data of Nitrate in Study Area (Pre & Post-Monsoon)

Parameter	Pre-monsoon				Post-monsoon			
	N	Min A	Max B	Range (A-B)	N	Min A	Max B	Range (A-B)
Nitrate	60	4.4	264	259.6	60	4.4	66.6	62.2

Table 17 : Comparison of Nitrate Content in the Groundwater of the Study Area with Drinking Water Standards

Parameter	ISI		WHO		No. of sample exceeding permissible limit	% of sample exceeding permissible limit
	HDL	MPL	HDL	MPL		
Nitrate	45	45	45	45	13	21.66

Nitrate is used mainly in inorganic fertilizers so as to results of agricultural activities and nitrate concentration may rise easily in natural water.[32]

I) Fluoride

Graph 9 : Comparison of Fluoride Content in Pre & Post Monsoon Season

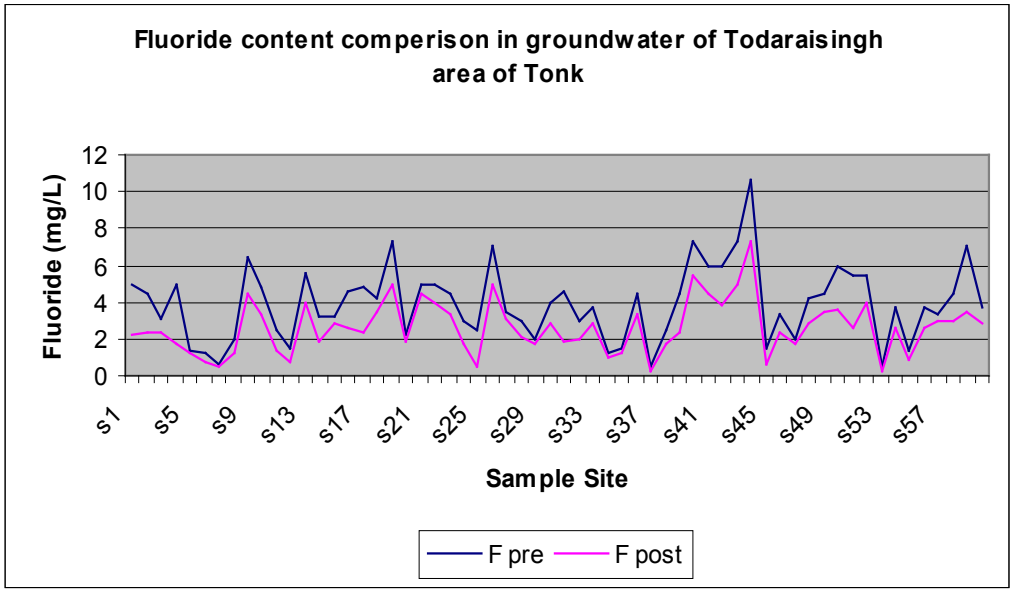


Table 18 : Comparison of Data of Fluoride in study area (Pre & Post-monsoon)

Parameter	Pre-monsoon				Post-monsoon			
	N	Min A	Max B	Range (A-B)	N	Min A	Max B	Range (A-B)
Fluoride	60	0.4	10.7	10.3	60	0.2	7.3	7.1

Table 19 : Comparison of Fluoride content in the groundwater of the study area with drinking water standards

Parameter	ISI		WHO		No. of sample exceeding permissible limit	% of sample exceeding permissible limit
	HDL	MPL	HDL	MPL		
Fluoride	1	1.5	0.5	1.5	49	81.66

Fluoride content in the present study are ranged from 0.35 mg/L to 9 mg/L. The higher value of fluoride in pre monsoon period may be due to the evaporation, lowering of water table and geological rock system.[33]

Summary of highest and lowest reading of water quality parameters of Todaraisingh Area of district Tonk

S No	Parameters	L R in mg/l	H R in mg/l	Range
1	pH	6.75	8.95	2.2
2	EC	0.76	6.87	6.11
3	TDS	532	4837.5	5121
4	Alkalinity	200	810	610
5	Total Hardness	105	1465	1360
6	Ca^{2+} Hardness	62	1005	943
7	Mg^{2+} Hardness	43	540	497
8	Chloride	80	1955	1875
9	Nitrate	4.4	165.3	160.9
10	Fluoride	0.35	9	8.65

LR: Lowest Reading HR: Highest Reading

*All parameters results are in mg/l except pH and EC

III. Conclusion

In this study we have analysed almost 60 samples from the different regions of the Todaraisingh Tehsil area of Tonk (Rajasthan), India, in premonsoon and postmonsoon periods the higher values were generally found for each parameter in the premonsoon period.

It may be due to the evaporation of water and lowering of water table as the atmospheric temperature increases up to 46°c in the summer before monsoon.

IV. Acknowledgement

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