

TREND ANALYSIS OF GROUND WATER AND SURFACE WATER UNDER NWMP (FROM APRIL-2022 TO MARCH- 2023)



TABLE OF CONTENT

Table of Content.....	
1. Introduction.....	1
2. Ground Water Sampling Site.....	5
3. Observation Table of Ground Water.....	8
4. Result & Discussion of Ground Water.....	14
5. Conclusion.....	15
6. Trend Analysis of Ground Water from Upstream to Downstream.....	16
7. Surface Water Sampling Site (Kaylana Lake), Jodhpur.....	17
8. Observation Table of Surface Water.....	18
9. Result & Discussion of Surface Water.....	23
10. Conclusion.....	24
11. Recommendations & Remedial Measures for Control of Surface & Ground Water Pollution.....	25
12. The Team - Preparation of NWMP Report.....	26
13. Photographs During Sampling.....	27
List of Tables.....	
• Table 1. List of Parameters with the Recommended Method of Analysis.....	3
• Table 2. Monitoring Protocol for Ground Water & Surface Water	4
• Table 3. Location of Ground Water well from Vinayaka to Kharda Bhandu along with Jojari River, Jodhpur).....	5
• Table 4. Water Quality Standard (BIS Indian Standard (IS 10500: 2012).....	6
• Table 5. Comparative table of different Parameter of ground water along with the Jojari River, Jodhpur.....	8
• Table.6 Comparative table of different Parameter of surface water (Kaylana Lake)...18	
List of Figures.....	
• Fig. 1 Location Map of Jojari River in Jodhpur City.....	5
• Fig. 2 Sampling Point of Ground water along with the Jojari River, Jodhpur	6

• Fig. 3 Upstream to Downstream Location of well from Vinayaka to Kharda Bhandu along with the Jojari River.....	7
• Fig. 4 pH, Conductivity, Turbidity and Total Dissolved Solids of ground water during pre - monsoon & post – monsoon along with the Jojari River.....	10
• Fig. 5 Total hardness, Total Alkalinity, Temperature and C.O.D of ground water during pre - monsoon & post – monsoon along with the Jojari River.....	11
• Fig. 6 Fecal Coliform, Chloride, Fluoride and Nitrate of ground water during pre - monsoon & post – monsoon along with the Jojari River.....	12
• Fig. 7 Nitrite, Phosphate, Potassium and Sulphate of ground water during pre - monsoon & post – monsoon along with the Jojari River.....	13
• Fig. 8 Trend analysis of ground water from upstream to downstream along with the Jojari River, Jodhpur.....	16
• Fig. 9 Location Map of Sampling site of surface water (Kaylana Lake), Jodhpur....	17
• Fig. 10 pH, Conductivity, Turbidity and T.D.S of surface water (Kaylana Lake), Jodhpur.....	19
• Fig. 11 Total Hardness, Total Alkalinity, Temperature and C.O.D of surface water (Kaylana Lake), Jodhpur.....	20
• Fig. 12 Fecal Coliform, Chloride, Fluoride and Nitrate of surface water (Kaylana Lake), Jodhpur.....	21
• Fig. 13 Nitrite, Phosphate, Potassium and Sulphate of surface water (Kaylana Lake), Jodhpur.....	22
• Fig. 14 Collection of Water Sample from Ground water & Surface water in Jodhpur City.....	27

INTRODUCTION

Jodhpur is third largest district of the Rajasthan after Jaisalmer and Bikaner. It is situated at 26°0' and 27°37' at North Latitude and 72°55' and 73°52' at East Longitude and spread over 22,580 Sq. Km. Most of the houses in Jodhpur are painted blue. That's why this city is also called 'Blue City'. According to census 2011, it is the second highest populated district of Rajasthan (out of 33 district), after Jaipur district. The total population of this area is 3,687,165 and the density 160 person/km² and the percentage of urban area is 34.30 percent. Jodhpur has a sex ratio of 916 females for every 1000 males, and a literacy rate of 65.94%. In urban area 34.30% of the population lives. The district is bounded on the north by Bikaner District, on the northeast by Nagaur District, on the southeast and south by Pali District, on the southwest by Barmer District, and on the west and northwest by Jaisalmer District. As the census of 2011, there were seven sub-divisions (Jodhpur, Bhopalgarh, Luni, Osian, Phalodi, Bilara and Shergarh) in the district and eleven tehsils (Jodhpur, Bhopalgarh, Bawadi, Luni, Osian, Tinwari, Phalodi, Bap, Bilara, Shergarh, and Balesar).

Industrial sector is growing rapidly which is defined as a key factor of development of any country. Increasing rate of industrialization also increases problem of its effluent discharge. Thousands of ton waste material is discharged annually. The treated and untreated both types of effluents are discharged from industrial units. Untreated effluents contain many chemicals, minerals, acids, bases etc. Many times these pollutants are discharged into the sewage system, water bodies or directly on the land that causes serious soil pollution and water pollution. Jojari River is seasonal river and life-line of Jodhpur agricultural farms but it has been polluted due to disposal of industrial effluents. This effluent and sewage mixed water is also used by farmer for sown many important crops like Pearl millet, Moth-bean and Sorghum etc. Heavy metals and other pollutants accumulate in crops and cause many diseases.

Central Pollution Control Board (CPCB) in collaboration with **State Pollution Control Boards (SPCBs)** in the States and Pollution Control Committees (PCCs) in Union Territories has established a **National Water Quality Monitoring Network (NWMP)** in order to assess status of water quality of water resources and to facilitate for prevention and control of pollution in water bodies. The preamble of **Water (Prevention and Control of Pollution) Act, 1974** stated that Pollution Control Board both at State and Central level to restore and maintain the wholesomeness of water bodies in India. Water quality monitoring is therefore an

imperative prerequisite in order to assess the extent of maintenance and restoration of water bodies. The water quality monitoring is performed with following main objectives: -

1. To assess nature and extent of pollution control needed in different water bodies or their part.
2. To evaluate effectiveness of pollution control measures already in existence.
3. To evaluate water quality trend over a period of time.
4. To assess assimilative capacity of a water body thereby reducing cost on pollution control.
5. To understand the environmental fate of different pollutants.
6. To assess the fitness of water for different uses.
7. Rational planning of pollution control strategies and their prioritisation.

Water quality data is used for identification of polluted water bodies, identification of pollution sources in cities for formulation of River Action Plans including interception, diversion and treatment of municipal wastewater, waste management and stricter surveillance of industrial pollution sources. Water quality data is also used for dissemination of information i.e., to reply Parliament Questions, VIP references, Public Queries, for filing replies in Supreme Court, High Courts and in NGT, sharing of information with Non-Governmental Organization, Students, and Researchers.

Water samples are analysed for **9 core parameters, 19 general parameters, 9 trace metals and set of pesticides** as per Guidelines on **Water Quality Monitoring, 2017** issued by **Ministry of Environment, Forest and Climate Change (MoEF & CC)**. Analysed water quality parameters are compared with the designated best use water quality criteria recommended by CPCB or primary water quality criteria for outdoor bathing notified under **The Environment (Protection) Rules, 1986** or BIS Drinking Water Specifications i.e. **IS:10500-2012** or water quality standards for coastal water depending on the use of water bodies.

Surface water bodies comprising rivers, lakes, tanks, ponds, creeks/sea water, canals & drains are monitored on monthly or quarterly basis, and half yearly basis in case of ground water. Water Quality for various parameters is assessed as per Guidelines for **Water Quality Monitoring, 2017 issued by MoEF&CC**. Micro pollutants such as metals and pesticides are monitored twice in a year, before and after monsoon.

In India, Rajasthan and Jodhpur 229 lakes and 890 wells, 16 Lakes and 87 wells and 1 Lake and 12 wells are selected for trend analysis of surface water and ground water. Along with the Jojari River total 12 sites are selected for ground water trend analysis. Sampling are conducted twice a year during pre-monsoon and post monsoon. The upstream to downstream flow of water is from Vinayaka to Kharda Bhandu. The main objective of this study to determine how much amount of contamination are going into the ground water. Kaylana Lake selected for trend analysis of surface water. Sample are collected each & every month in a year.

Table. 1 List of Parameters with the Recommended Method of Analysis.

S.N	Parameter	Recommended Method
1	Temperature, C	Thermometric Method
2	pH	Thermometric Method
3	Turbidity, as NTU	Nephelometric Method
4	Velocity of flow, m/s	1. Current Meter 2. Float Method 3. Chemical Method
5	Dissolved Oxygen, mg/l	Iodometric Method
6	Biochemical Oxygen Demand, mg/l	Dilution Method
7	Total Kjeldhal Nitrogen as N mg/l	1. Digestion 2. Distillation 3. Ammonia Estimation 4. Titration Method 5. Nesslerization Method
8	Nitrate as mg/l	Amalgamated Cadmium reduction method for reduction of nitrate to nitrite by dissociation method.
9	Total Coliform, (MPN) / 100 ml	Multiple Tube Dilution Technique/ Membrane filtration techniques.
10	Faecal Coliform (MPN) / 100 ml	Multiple Tube Dilution Technique/ Membrane filtration techniques.
11	Conductivity, as CaCO ₃ mg/l	Conductometric Method
12	Chloride, as Cl mg/l	1. Argentometric Method 2. Macurimetric Method
13	Total Hardness as CaCO ₃ mg/l	EDTA Titrimetric Method
14	Calcium, as CaCO ₃ mg/l	EDTA Titrimetric Method
15	Magnesium as CaCO ₃ mg/l	By difference of 13 and 14
16	Alkalinity as CaCO ₃ mg/l Alkalinity – P as CaCO ₃ mg/l	1. Electrometric Method 2. Visual Titration Method
17	Sulphate as SO ₄ mg/l	Turbidimetric Method
18	Sodium as Na mg/l	Flame Photometric Method
19	Chemical Oxygen Demand, mg/l	Dichromate Reflex Method

20	Total Dissolved Solids and fixed dissolved Solids, mg/l	Gravimetric Method
21	Phosphate as PO ₄ mg/l	Molybdate Method (Colorimetry)
22	Boron as B mg/l	Curcumin Method (Colorimetry)

Table. 2 Monitoring Protocol for Ground Water & Surface Water

Parameter to be measured	Frequency	Location
<u>Monitoring Protocol for Ground Water:</u> <u>General Parameters:</u> pH, Conductivity, Turbidity, Temperature, Faecal coliform, Calcium, Chloride, Fluoride, Magnesium, Nitrate, Nitrite, Phosphate, Potassium, Sodium, Sulphate, COD, Total Dissolved Solids, Hardness, Total Alkalinity.	Twice in a year – April & Oct.	All Location
<u>Monitoring Protocol for Surface Water:</u> <u>General Parameters:</u> pH, Conductivity, Turbidity, Temperature, Faecal coliform, Calcium, Chloride, Fluoride, Magnesium, Nitrate, Nitrite, Phosphate, Potassium, Sodium, Sulphate, COD, Total Dissolved Solids, Hardness, Total Alkalinity.	Monthly	All Location

GROUND WATER SAMPLING SITE

Along with the Jojari River total 12 sites are selected for ground water trend analysis. Sampling are conducted twice in a year during pre-monsoon (April) and post monsoon (Oct). The upstream to downstream flow of water is from Vinayaka to Kharda Bhandu. The main objective of this study to determine how much amount of contamination are going into the ground water.

Table. 3 Location of Ground Water well from Vinayaka to Kharda Bhandu along with Jojari River, Jodhpur

Station	Location	Latitude	Longitude
1.	Well of Sh. Mangilal (Near village, Vinayaka)	26.26455	73.05854
2.	Well of Sh. Hukum singh (Near village, Vinayaka)	26.260103	73.072542
3.	Well of Sh. Badri kumar (Near village, Vinayaka)	26.257117	73.06667
4.	Well of Sh. Ram Chandra (Near village, Sangariya)	26.189853	73.0311
5.	Well of Sh. Bhagaram (Near village, Salawas)	26.1349	72.983798
6.	Well of Sh. Hazari singh (Near village, Salawas)	26.126686	72.985144
7.	Well of Sh. Birmaram (Near village, Salawas)	26.132884	72.996065
8.	Well of Sh. Girdhariram (Near village, Nandwan)	26.126665	72.971348
9.	Well of Sh. Magaram (Near village, Nandwan)	26.127325	72.971248
10.	Well of Sh. Tilaram (Near village, Nandwan)	26.12436	72.9636
11.	Well of Sh. Devaram (Near village, Kharda Bhandu)	26.115903	72.929437
12.	Well of Sh. Dalaram (Near village, Kharda Bhandu)	26.123047	72.920712



Figure. 1 Location Map of Jojari River in Jodhpur City

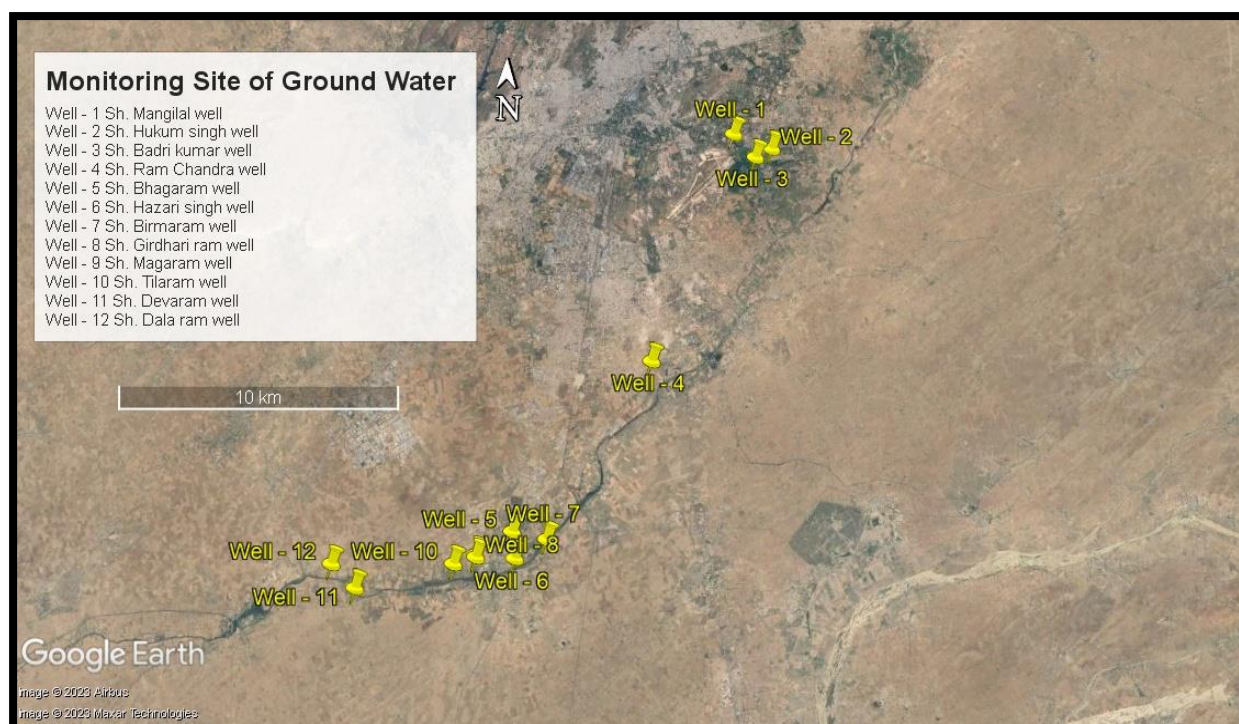
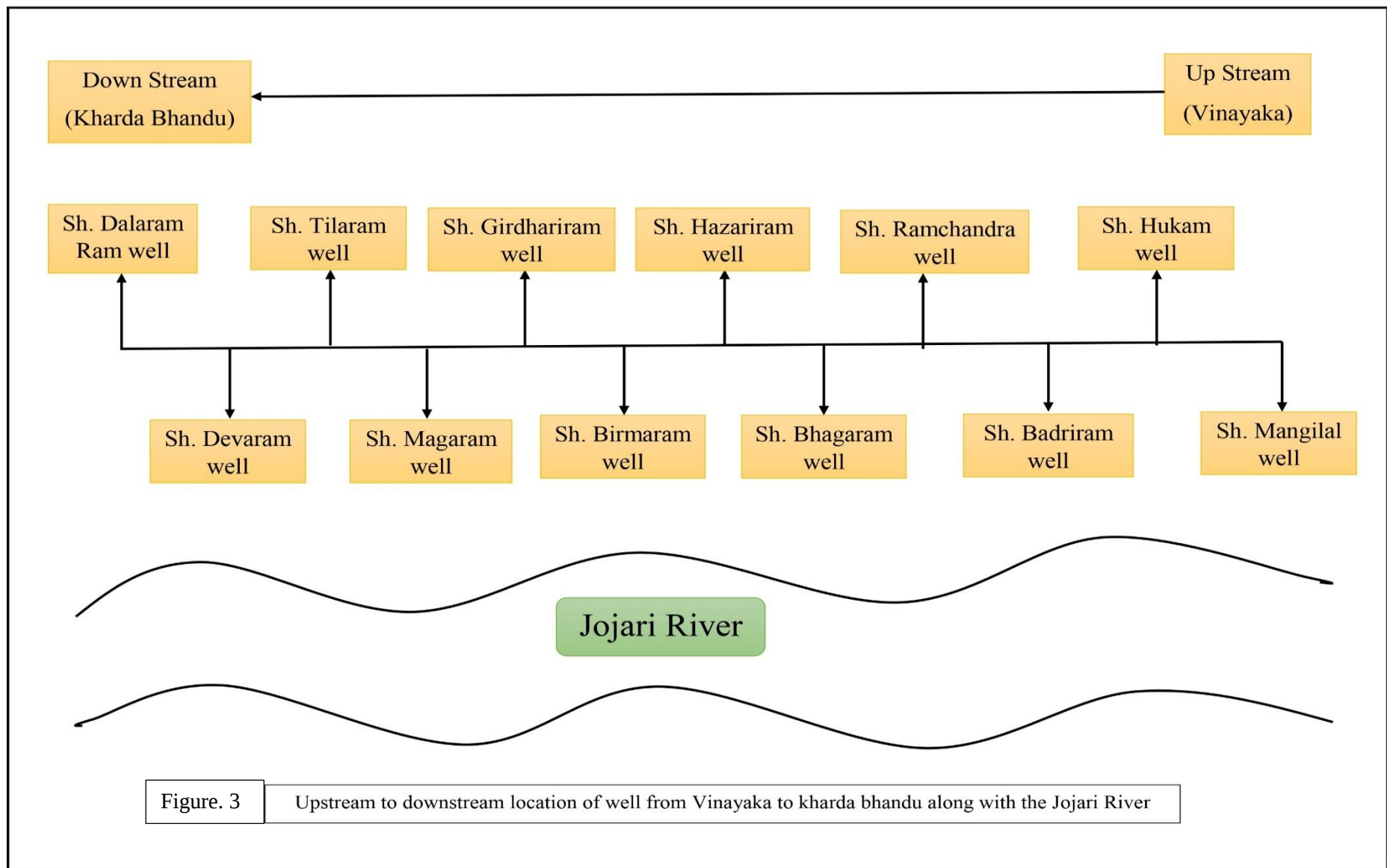


Figure. 2 Sampling Point of Ground water along with the Jojari River, Jodhpur

Table. 4 Water Quality Standard (BIS Indian Standard for Drinking Water (IS 10500: 2012))

S.N	Name of Parameter	BIS Indian Standard for Drinking Water (IS 10500: 2012)
1.	pH	6.5 – 8.5
2.	Conductivity	-
3.	Turbidity	1 NTU
4.	T.D.S	500 mg/l
5.	Total Hardness	200 mg/l
6.	Total Alkalinity	200 mg/l
7.	Temperature	-
8.	C.O.D	-
9.	Fecal Coliform	Nil/100ml
10.	Chloride	250 mg/l
11.	Fluoride	1.0 mg/l
12.	Nitrate	45 mg/l
13.	Nitrite	-
14.	Phosphate	-
15.	Potassium	-
16.	Sulphate	200 mg/l



OBSERVATION TABLE OF GROUND WATER

Table. 5 Comparative Table of different Parameter of ground water along with the Jojari River, Jodhpur

S.N	Well	pH		Conductivity ($\mu\text{mho/cm}$)		Turbidity (NTU)		Total Dissolved Solids (mg/l)		Total Hardness as CaCO_3 (mg/l)	
		Pre monsoon	Post monsoon	Pre monsoon	Post monsoon	Pre monsoon	Post monsoon	Pre monsoon	Post monsoon	Pre monsoon	Post monsoon
1	Station 01	7.1	7.37	2390	2540	0.32	0.17	1551	1710	556	517
2	Station 02	7.25	7.65	2200	2160	0.11	0.15	1430	1460	452	252
3	Station 03	7.16	7.47	8160	9140	0.25	0.33	5300	6120	728	940
4	Station 04	7.52	7.85	22700	19820	1.88	0.68	14740	13298	1520	1050
5	Station 05	7.77	8.36	22900	20200	3.83	3.55	14890	12622	2320	1121
6	Station 06	7.26	7.78	11130	11880	5.12	1.22	7230	7840	1648	1298
7	Station 07	8.1	7.87	4740	3200	0.86	1.03	3080	2170	564	315
8	Station 08	6.97	7.58	5280	5730	2.61	4.47	3430	3853	604	491
9	Station 09	7.11	7.19	9030	8650	0.39	0.56	5870	5890	1044	861
10	Station 10	6.96	7.27	6180	5200	2.04	2.95	4000	3330	900	630
11	Station 11	7.16	7.33	18830	13980	0.22	0.32	8230	9260	852	739
12	Station 12	7.22	7.4	6880	6390	0.3	0.9	4410	4280	484	298

S.N	Well	Total Alkalinity (mg/l)		Temperature ($^{\circ}\text{C}$)		C.O.D. (mg/l)		Faecal Coliform (MPN/100ml)		Chloride As Cl (mg/l)	
		Pre monsoon	Post monsoon	Pre monsoon	Post monsoon	Pre monsoon	Post monsoon	Pre monsoon	Post monsoon	Pre monsoon	Post monsoon
1	Station 01	364	328	31.4	27	15.81	12	2	2	465	394
2	Station 02	340	292	29.8	27	11.86	12	6	4	736	528
3	Station 03	392	368	29.6	27	15.81	24	6	4	2280	2820

4	Station 04	456	520	29.8	27	106.7	31	6	8	5986	5489
5	Station 05	604	476	28.4	26	47.42	59	1.8	6	6675.55	6508
6	Station 06	412	304	29.8	27	39.52	43	4	2	2896	4372
7	Station 07	292	248	29.8	27	23.71	24	4	2	1694	1472
8	Station 08	440	668	28.9	27	75.09	16	11	2	1116	923
9	Station 09	212	236	29	27	71.14	16	10	4	2247	1797
10	Station 10	192	388	28.5	26	55.33	8	2	8	1804	282
11	Station 11	448	364	28.9	27	47.42	24	4	2	2137	2023
12	Station 12	216	296	29.6	26	51.38	8	6	6	1251.67	967

S.N	Well	Fluoride As F (mg/l)		Nitrate as N (mg/l)		Nitrite As N (mg/l)		Phosphate As PO4 (mg/l)		Potassium As K (mg/l)		Sulphate (mg/l)	
		Pre monsoon	Post monsoon	Pre monsoon	Post monsoon	Pre monsoon	Post monsoon	Pre monsoon	Post monsoon	Pre monsoon	Post monsoon	Pre monsoon	Post monsoon
1	Station 01	1.62	0.54	3.6	5.1	0.0089	0.0041	0.3	0.1	4.7	1.8	75	108
2	Station 02	0.857	1.34	2.9	4.2	0.0055	0.0171	0.2	0.1	6.8	11.6	129	146
3	Station 03	1.69	2.7	4.1	13.3	0.0094	0.0122	0.3	0.2	9.4	18.5	197	213
4	Station 04	2.31	1.92	4.9	10.95	0.0108	0.0142	2.9	1.1	16.4	12.8	194	258
5	Station 05	2.14	3.16	4.8	9.2	0.008	0.0182	0.8	0.5	15	20	262.5	225
6	Station 06	1.56	1.9	4.8	12.5	0.0083	0.0157	0.33	0.25	20	17	189	142
7	Station 07	0.36	0.62	3.2	7.4	0.0153	0.0145	0.4	0.2	13	16	139	113
8	Station 08	1.46	1.78	5.53	18.5	0.0089	0.015	0.3	0.6	14.8	11.6	263	288
9	Station 09	2.32	1.94	4.6	4.1	0.0159	0.0121	0.42	0.18	10.5	8.3	333	308
10	Station 10	1.31	2.8	4.5	7.9	0.0131	0.0135	0.41	0.2	13.2	17	254	358
11	Station 11	2.82	1.67	5	4.8	0.0106	0.01	0.42	0.2	16.7	18.5	300	271
12	Station 12	2.68	1.82	4.88	5.8	0.0083	0.0109	0.51	0.3	5.5	7.2	200.83	188

Note: Yellow colour showing the data which exceeded the prescribed Standard According to BIS Standard (IS 10500: 2012).

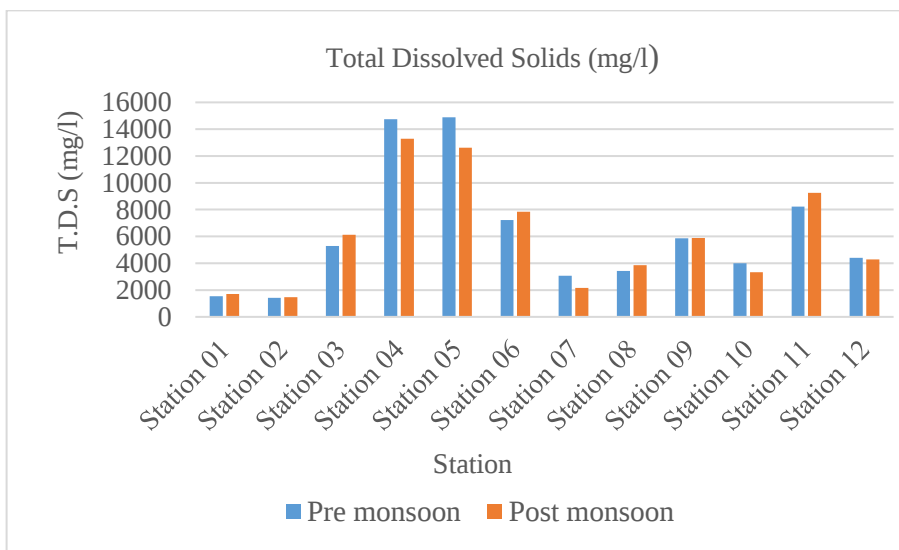
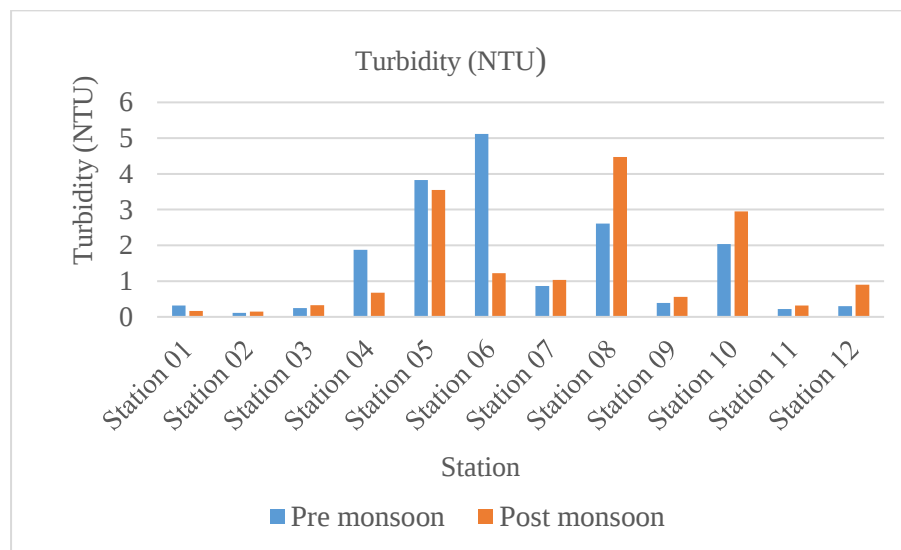
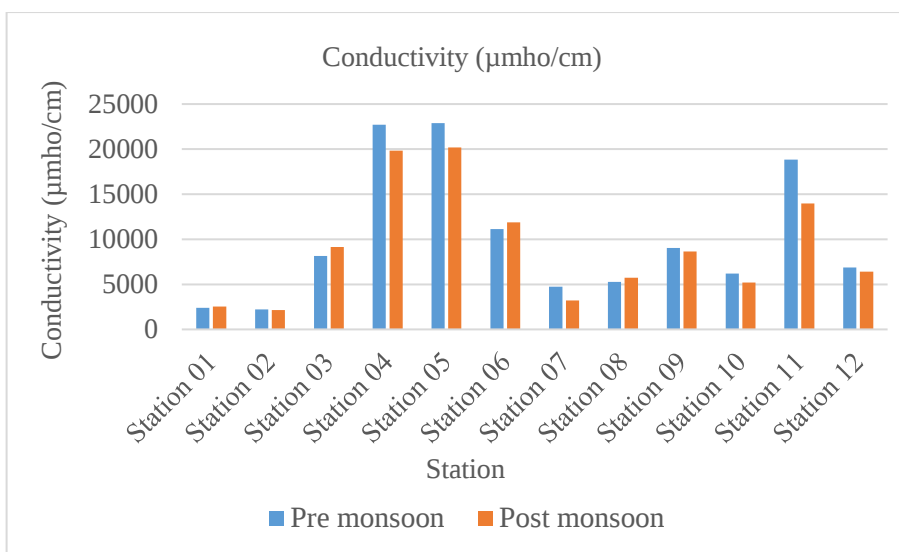
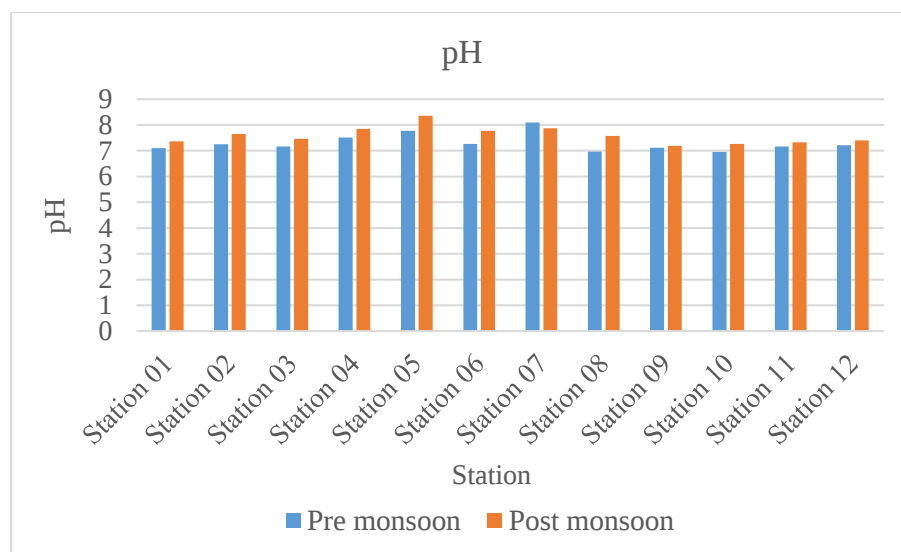


Figure. 4 pH, Conductivity, Turbidity and Total Dissolved Solids of ground water during pre - monsoon & post – monsoon along with the Jojari River.

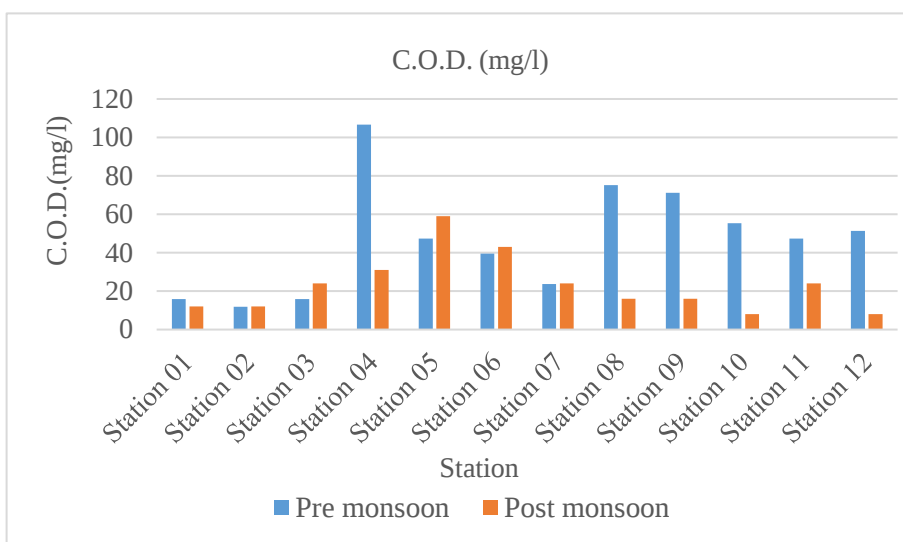
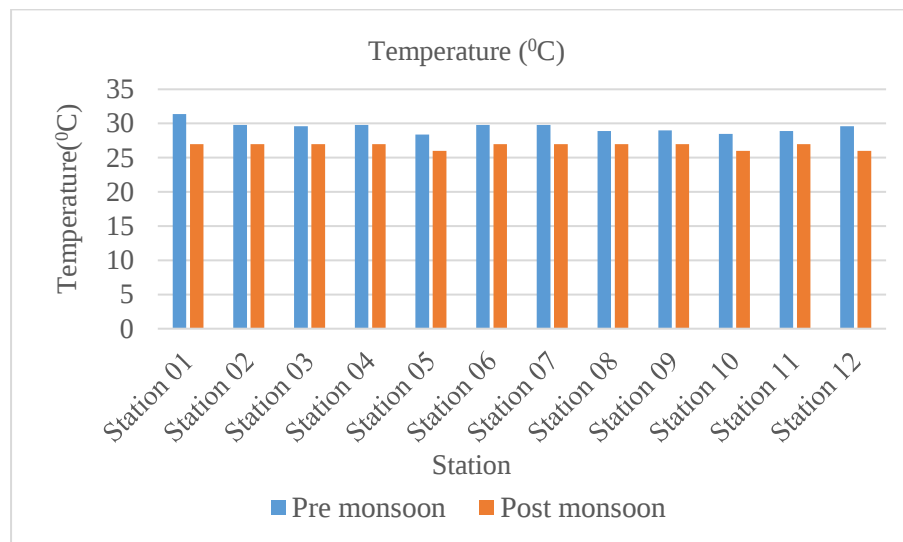
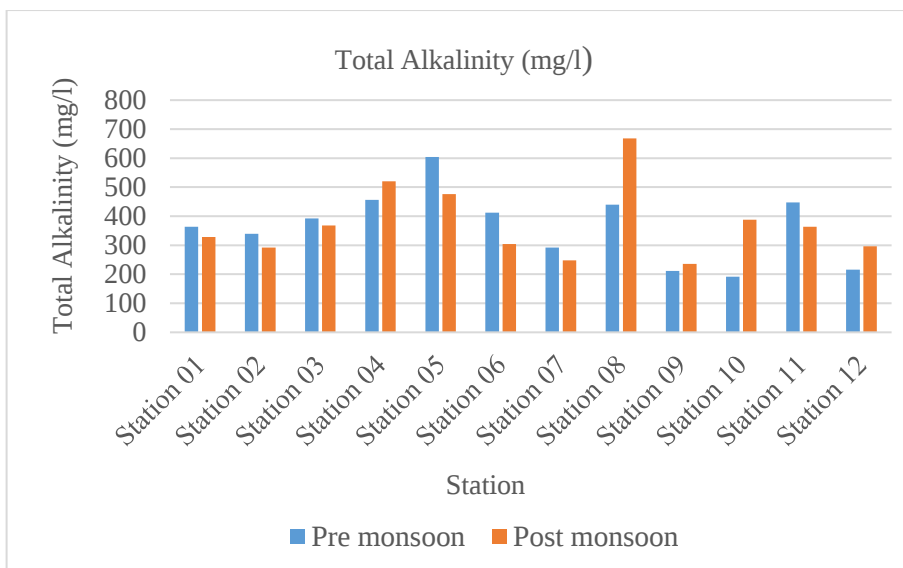
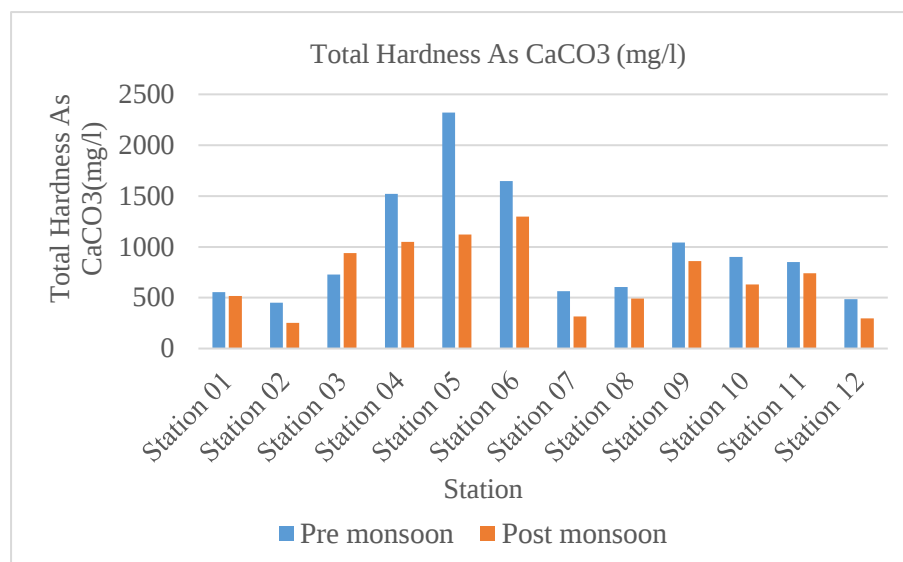


Figure. 5 Total hardness, Total Alkalinity, Temperature and C.O.D of ground water during pre - monsoon & post – monsoon along with the Jojari River.

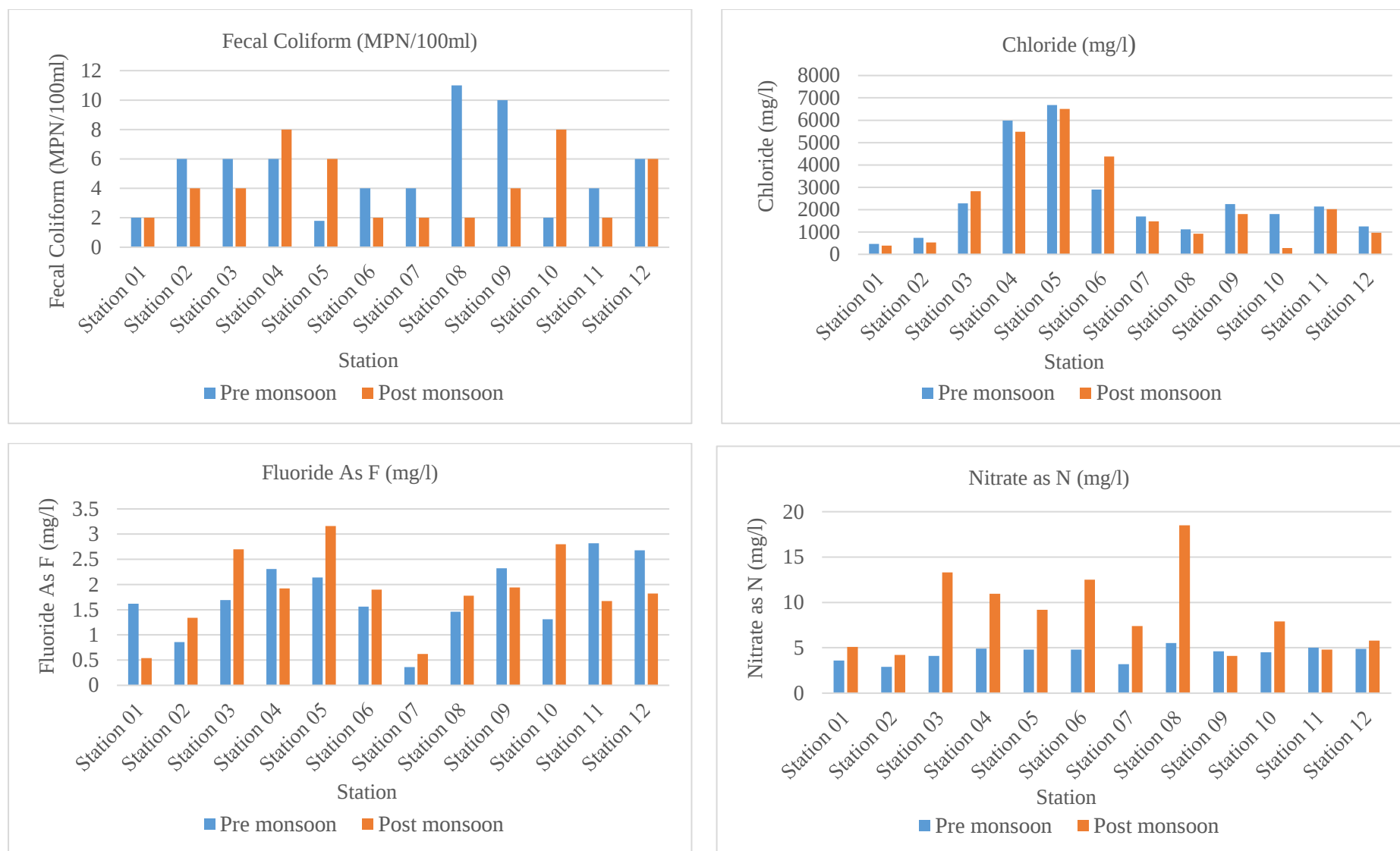


Figure. 6 Fecal Coliform, Chloride, Fluoride and Nitrate of ground water during pre - monsoon & post – monsoon along with the Jojari River.

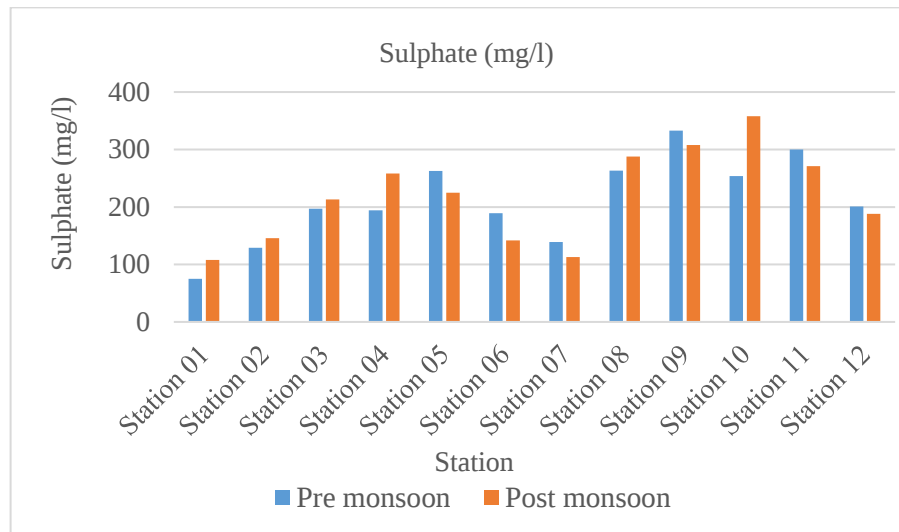
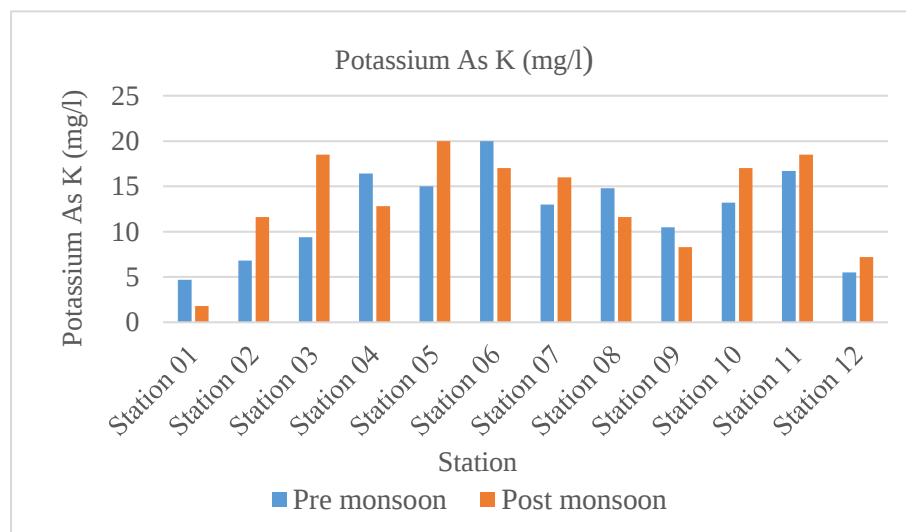
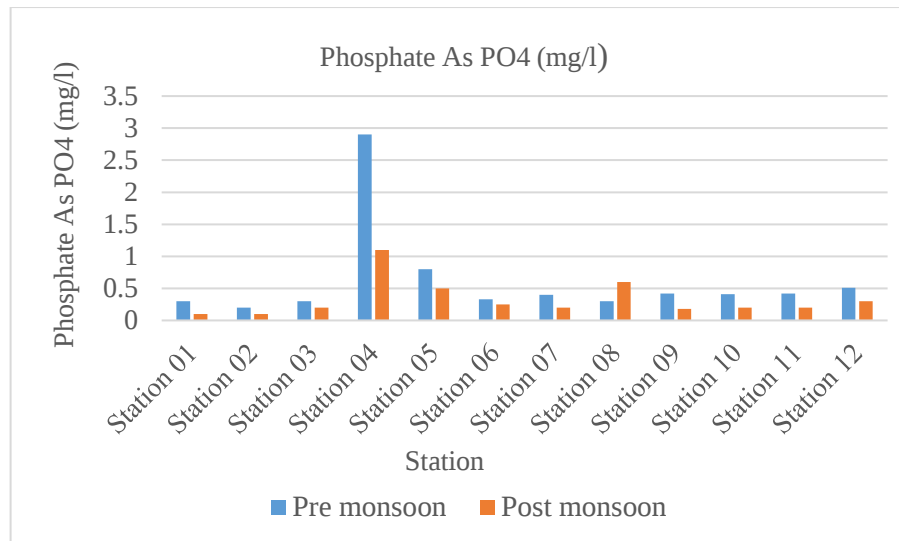
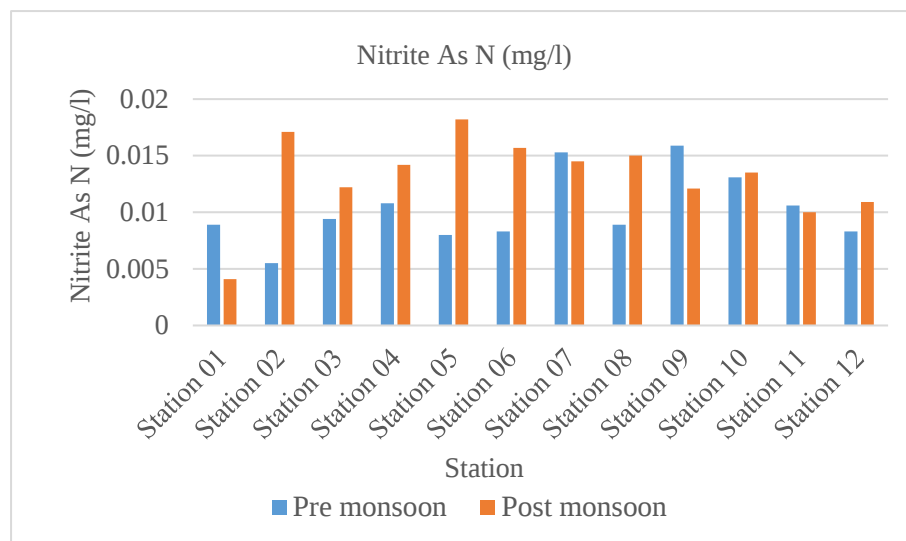


Figure. 7 Nitrite, Phosphate, Potassium and Sulphate of ground water during pre - monsoon & post – monsoon along with the Jojari River.

RESULT & DISCUSSION OF GROUND WATER

1. **pH:** The pH varied between 6.96 and 8.36. Pre-monsoon groundwater minimum and maximum pH values are 6.96 and 8.1, whereas post-monsoon groundwater minimum and maximum pH values are 7.19 and 8.36 respectively.
2. **Conductivity ($\mu\text{mho/cm}$):** Pre-monsoon groundwater minimum and maximum conductivity values are 2200 $\mu\text{mho/cm}$ and 22900 $\mu\text{mho/cm}$, whereas post-monsoon groundwater minimum and maximum conductivity values are 2160 $\mu\text{mho/cm}$ and 20200 $\mu\text{mho/cm}$ respectively. .
3. **Turbidity (NTU):** Pre-monsoon groundwater minimum and maximum turbidity values are 0.11 NTU and 5.12 NTU, whereas post-monsoon groundwater minimum and maximum turbidity values are 0.15 NTU and 4.47 NTU respectively.
4. **Total Dissolved Solids (mg/l):** Pre-monsoon groundwater minimum and maximum total dissolved solids values are 1430 mg/l and 14890 mg/l, whereas post-monsoon groundwater minimum and maximum total dissolved solids values are 1460 mg/l and 13298 mg/l respectively. .
5. **Total Hardness as CaCO_3 (mg/l):** Pre-monsoon groundwater minimum and maximum total hardness values are 452 mg/l and 2320 mg/l, whereas post-monsoon groundwater minimum and maximum total hardness values are 252 mg/l and 1298 mg/l.
6. **Total Alkalinity (mg/l):** Pre-monsoon groundwater minimum and maximum total alkalinity values are 192 mg/l and 604 mg/l, whereas post-monsoon groundwater minimum and maximum total alkalinity values are 236 mg/l and 668 mg/l.
7. **Temperature ($^{\circ}\text{C}$):** Pre-monsoon groundwater minimum and maximum temperature values are 28.4°C and 31.4°C , whereas post-monsoon groundwater minimum and maximum temperature values are 26°C and 27°C .
8. **C.O.D. (mg/l):** Pre-monsoon groundwater minimum and maximum C.O.D values are 11.86 mg/l and 106.7 mg/l, whereas post-monsoon groundwater minimum and maximum C.O.D values are 8 mg/l and 59 mg/l.
9. **Fecal Coliform (MPN/100ml):** Pre-monsoon groundwater minimum and maximum fecal coliform values are 1.8 (MPN/100ml) and 11 (MPN/100ml) whereas post-monsoon groundwater minimum and maximum fecal coliform values are 2 (MPN/100ml) and 8 (MPN/100ml).

- 10. Chloride (mg/l):** Pre-monsoon groundwater minimum and maximum chloride values are 465 mg/l and 6675.55 mg/l, whereas post-monsoon groundwater minimum and maximum chloride values are 282 mg/l and 6508 mg/l.
- 11. Fluoride as F (mg/l):** Pre-monsoon groundwater minimum and maximum fluoride values are 0.36 mg/l and 2.82mg/l, whereas post-monsoon groundwater minimum and maximum fluoride values are 0.54 mg/l and 3.16 mg/l.
- 12. Nitrate as N (mg/l):** Pre-monsoon groundwater minimum and maximum nitrate values are 2.9 mg/l and 5.53 mg/l, whereas post-monsoon groundwater minimum and maximum nitrate values are 4.1 mg/l and 18.5 mg/l.
- 13. Nitrite as N (mg/l):** Pre-monsoon groundwater minimum and maximum nitrite values are 0.0055 mg/l and 0.0159 mg/l, whereas post-monsoon groundwater minimum and maximum nitrite values are 0.0041 mg/l and 0.0182 mg/l.
- 14. Phosphate as PO₄ (mg/l):** Pre-monsoon groundwater minimum and maximum phosphate values are 0.2 mg/l and 2.9 mg/l, whereas post-monsoon groundwater minimum and maximum phosphate values are 0.1 mg/l and 1.1 mg/l.
- 15. Potassium as K (mg/l):** Pre-monsoon groundwater minimum and maximum potassium values are 4.7 mg/l and 20 mg/l, whereas post-monsoon groundwater minimum and maximum potassium values are 1.8 mg/l and 20mg/l.
- 16. Sulphate (mg/l):** Pre-monsoon groundwater minimum and maximum sulphate values are 75 mg/l and 333 mg/l, whereas post-monsoon groundwater minimum and maximum sulphate values are 108 mg/l and 358 mg/l.

Conclusion: Total Eight parameter (Turbidity, Total Dissolved Solid, Total Hardness, Total Alkalinity, Fecal Coliform, Chloride, Fluoride and Sulphate) of water sample exceed range according to the BIS Standard (IS 10500: 2012).

TREND ANALYSIS OF GROUND WATER FROM UPSTREAM TO DOWNSTREAM

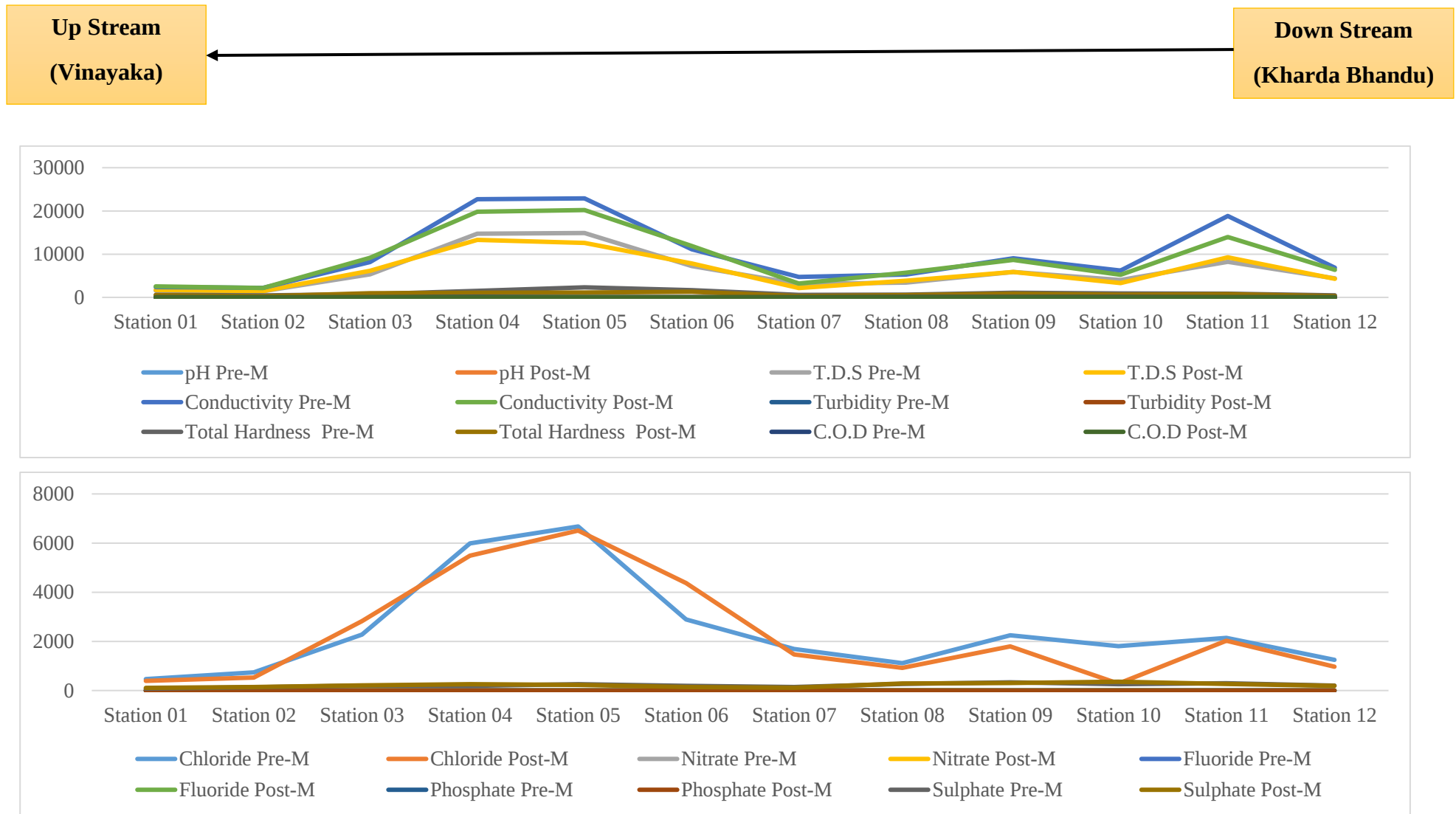


Figure. 8 Trend Analysis of Ground Water from Upstream to Downstream along with the Jojari River,

SURFACE WATER SAMPLING SITE (KAYLANA LAKE), JODHPUR

Kaylana is one such freshwater artificial lake situated on the outskirts of Jodhpur city. It lies in between 26°16' N to 26°18' N and 72°57' E to 72°58'. Kaylana Lake is the only source of water supply for the Jodhpur city and it receives water from Hathi nahar which is further connected to the Indira Gandhi Canal and water level doesn't fluctuate much over the year. The Indira Gandhi Canal was previously known as Rajasthan Canal Project and it runs up to 445 km, starting from Punjab with a goal to provide water to The Great Indian Thar Desert and it came into existence during 1951 under the control of Central Water and Power Commission. The city of Jodhpur and all the surrounding towns and villages depend on Kaylana Lake as a source of drinking water.

Surface water bodies comprising rivers, lakes, tanks, ponds, creeks/sea water, canals & drains are monitored on monthly or quarterly basis, and half yearly basis in case of ground water. Kaylana Lake selected for trend analysis of surface water. Sample was collected each & every month in a year.

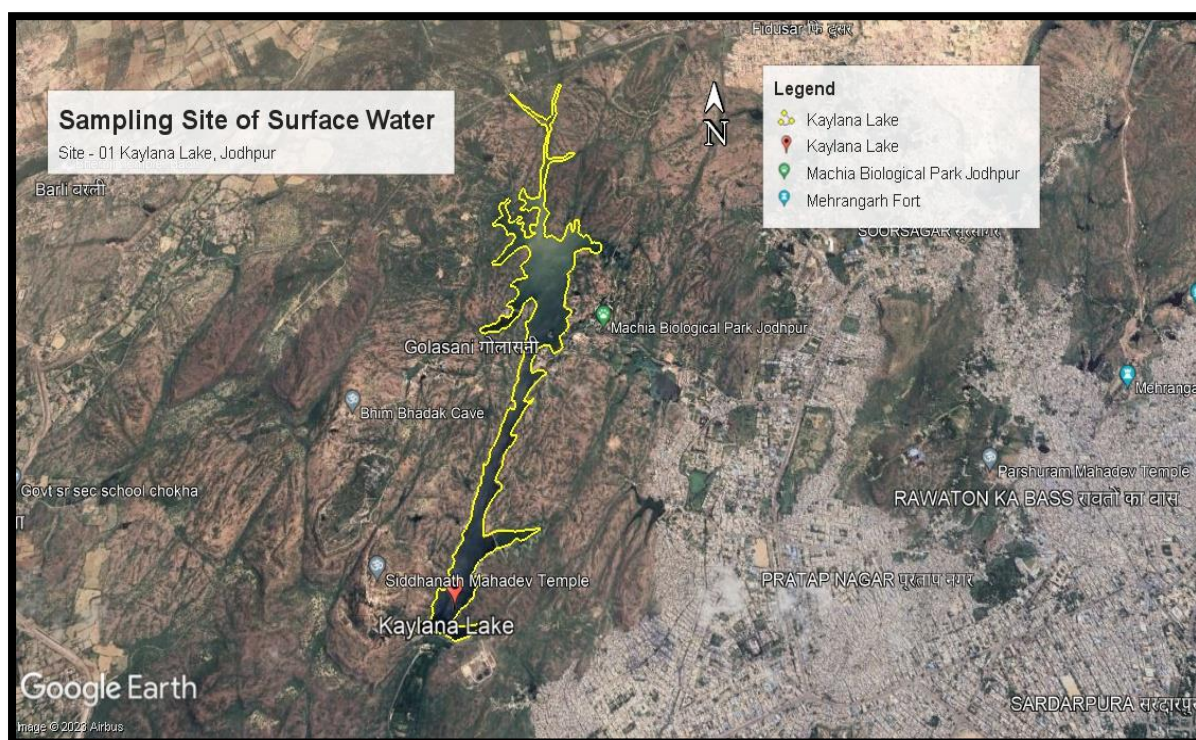


Figure. 9 Location Map of Sampling site of surface water (Kaylana Lake), Jodhpur

OBSERVATION TABLE OF SURFACE WATER

Table.6 Comparative table of different Parameter of surface water (Kaylana Lake).

S.N	Parameter	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	March
1.	pH	7.99	8.63	7.76	7.93	7.76	8.15	7.79	7.5	7.71	7.6	8.2	8.21
2.	Conductivity (µmho/cm)	290	338	331	268	331	286	296	298	328	343	269	209
3.	Turbidity (NTU)	1.7	2.1	2.2	2.3	2.8	1.9	1.3	1.67	1.68	1.62	1.34	1.65
4.	Total Dissolved Solids (mg/l)	220	220	215	174.5	215	208	198	200	220	230	180	140
5.	Total Hardness as CaCO ₃ (mg/l)	92	98.7	102.9	88	94	75.6	63	64	66	65	58	54
6.	Total Alkalinity (mg/l)	52	36	52	84	58	52	48	35	39	37	34	63
7.	Temperature (°C)	25	25	26.5	27.6	27	27	26	27	17	14	26.1	25.1
8.	C.O.D.(mg/l)	11.86	12	24	9.84	12	10	8	10	8	4	7	7
9.	Fecal Coliform (MPN/100ml)	63	75	84	66	34	25	7	11	2	2	2	2
10.	Chloride (mg/l)	43	28	25	22	19	16	35	11	14	10	21	17
11.	Fluoride As F (mg/l)	0.243	0.198	0.168	0.13	0.09	0.08	0.32	0.35	0.21	0.22	0.25	0.26
12.	Nitrate as N (mg/l)	2.2	1.98	2.1	2.2	1.68	1.52	2.4	2.5	2.6	2.4	1.8	2
13.	Nitrite As N (mg/l)	0.0055	0.0116	0.0114	0.0206	0.0102	0.0081	0.0071	0.0071	0.008	0.0077	0.0072	0.0068
14.	Phosphate As PO ₄ (mg/l)	0.3	0.32	0.38	0.26	0.24	0.22	0.1	0.2	0.1	0.2	0.2	0.21
15.	Potassium As K (mg/l)	2.1	2.2	2.1	3.8	3.2	2.6	2.3	2.4	2	0.5	3.6	4.4
16.	Sulphate (mg/l)	34.16	43	27	18	24	22	25	21	22	20	17	19

Note: Yellow colour showing the data which exceeded the prescribed Standard According to BIS Standard (IS 10500: 2012).

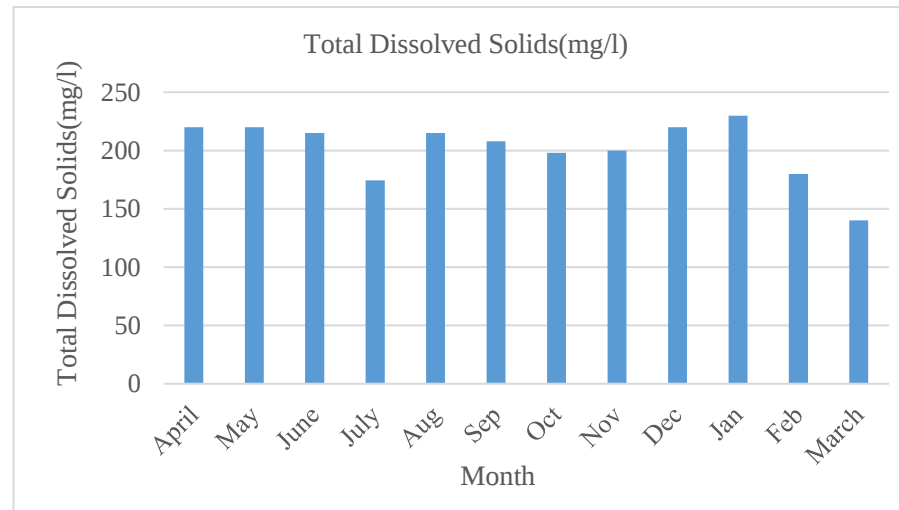
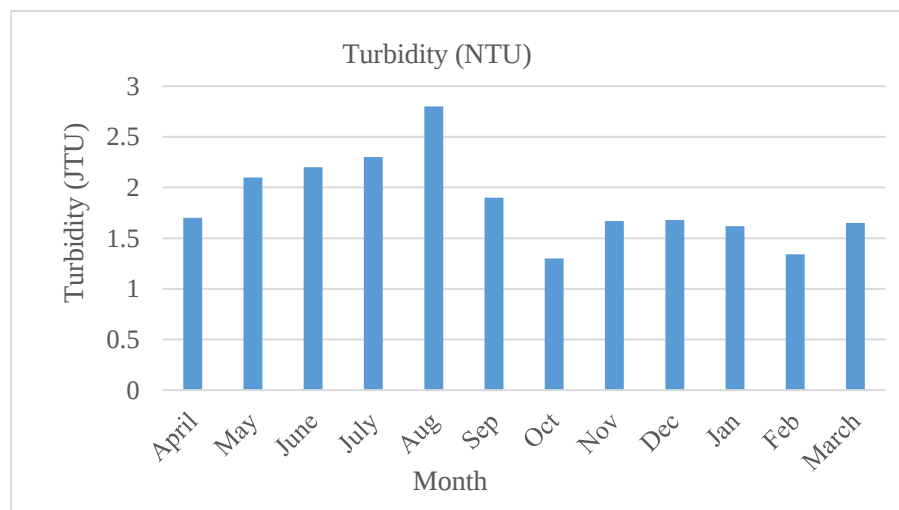
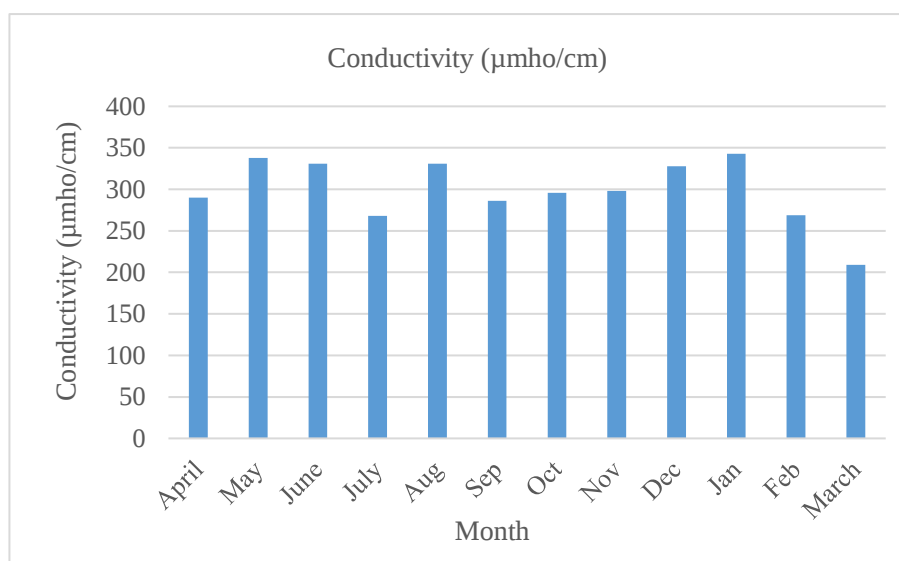
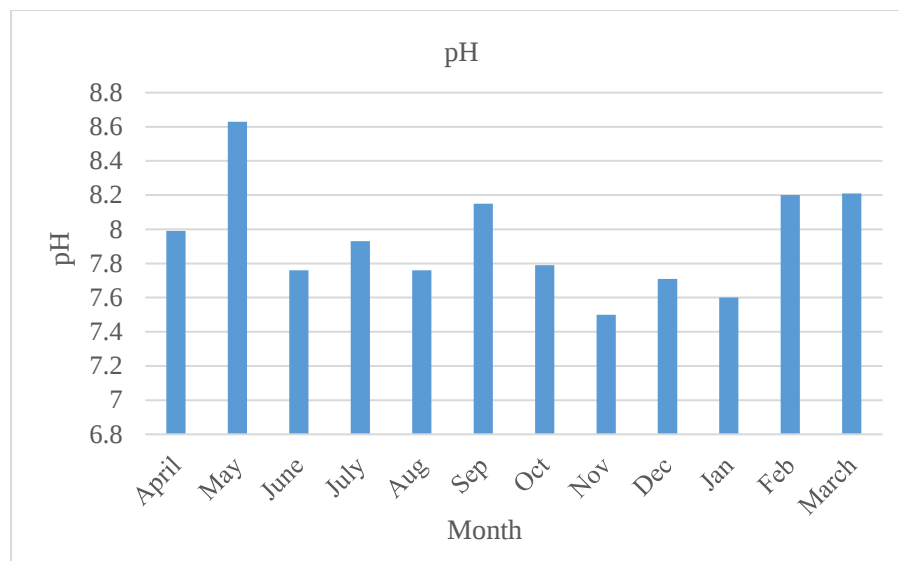


Figure. 10 pH, Conductivity, Turbidity and T.D.S of surface water (Kaylana Lake), Jodhpur

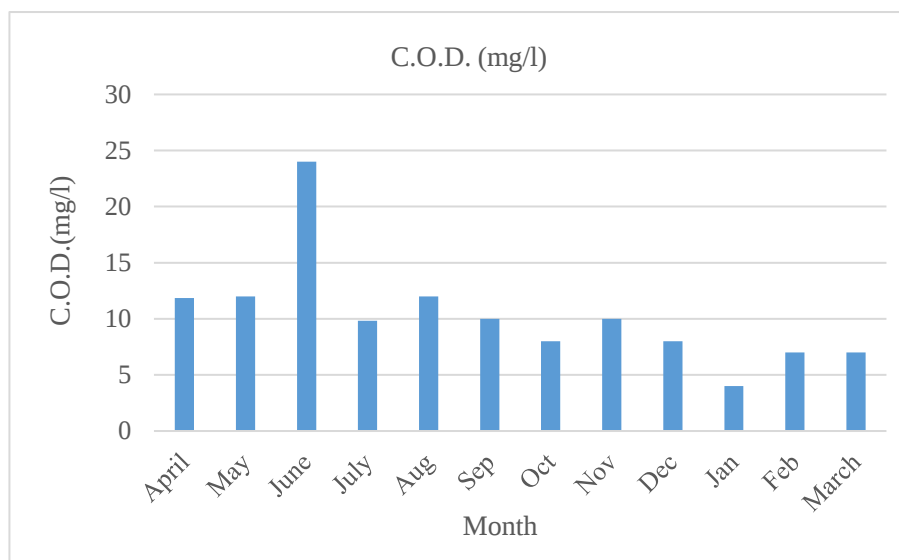
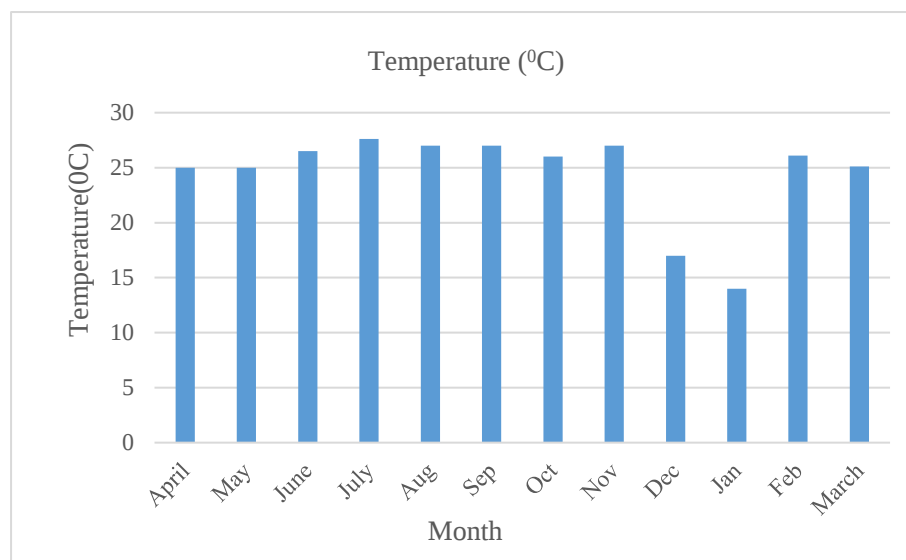
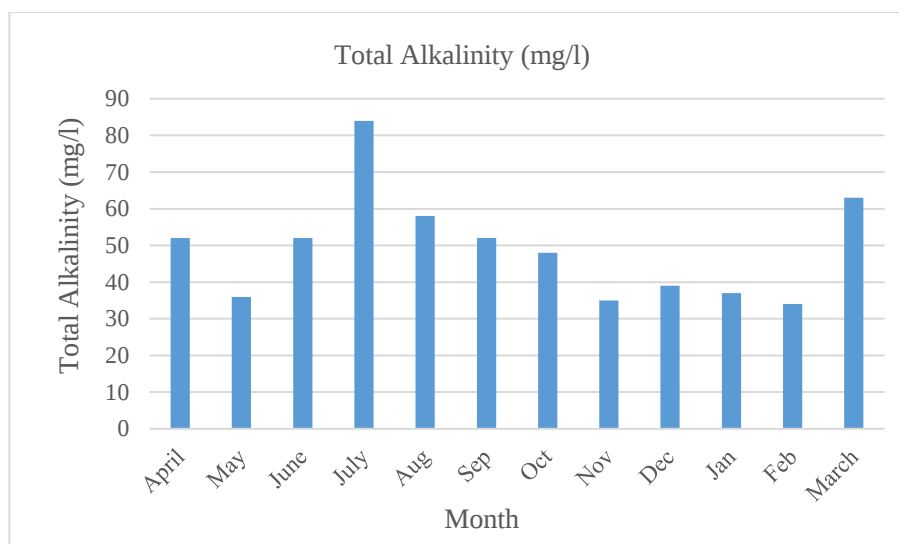
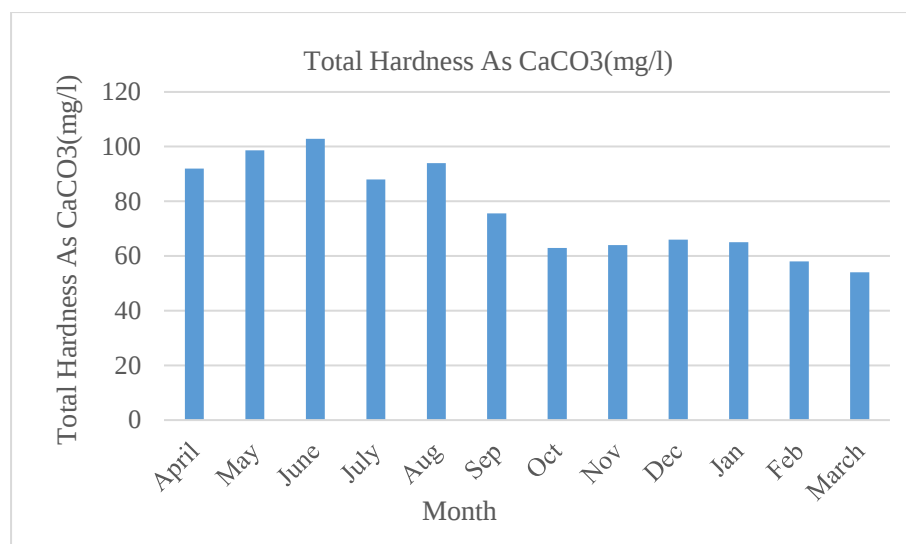


Figure. 11 Total Hardness, Total Alkalinity, Temperature and C.O.D of surface water (Kaylana Lake), Jodhpur

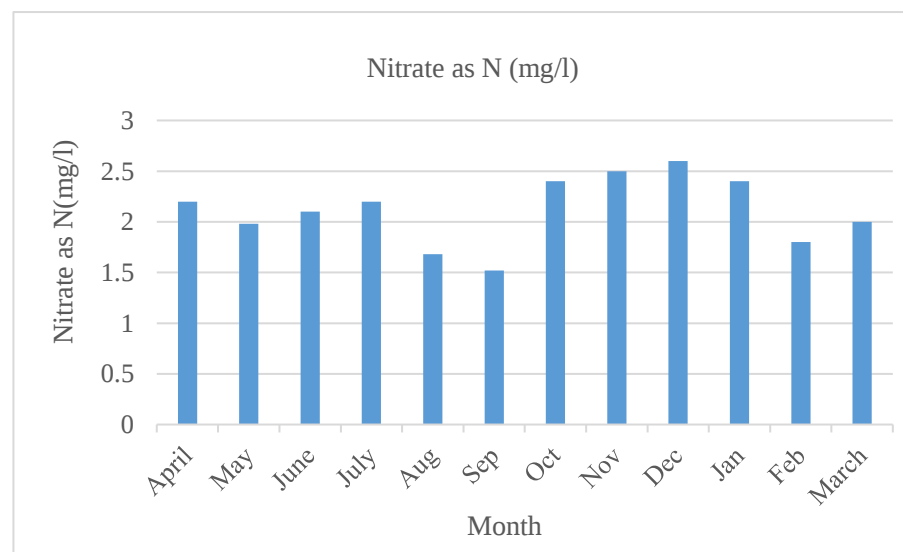
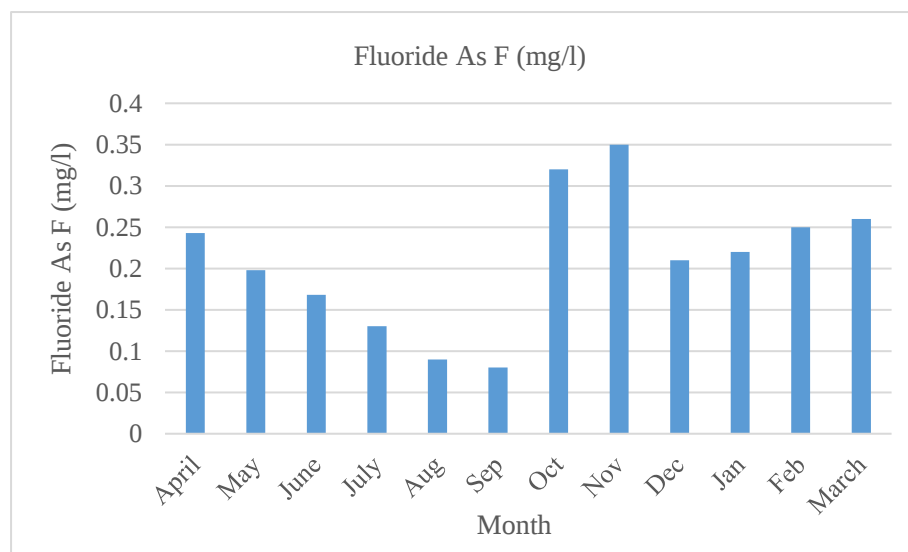
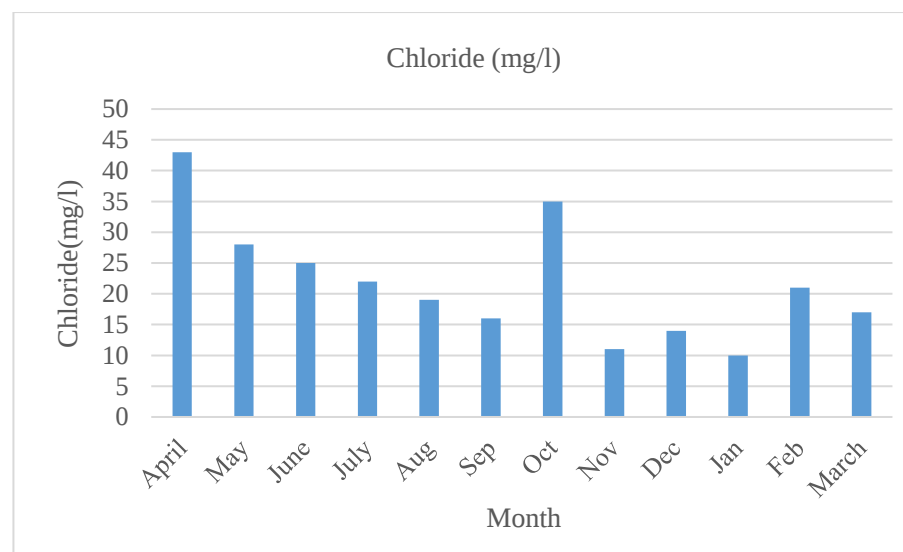
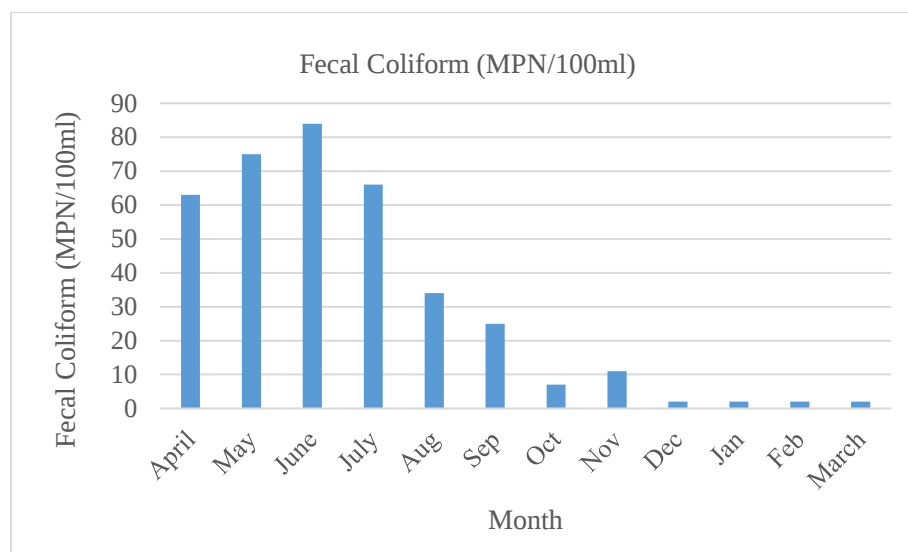


Figure. 12 Fecal Coliform, Chloride, Fluoride and Nitrate of surface water (Kaylana Lake), Jodhpur

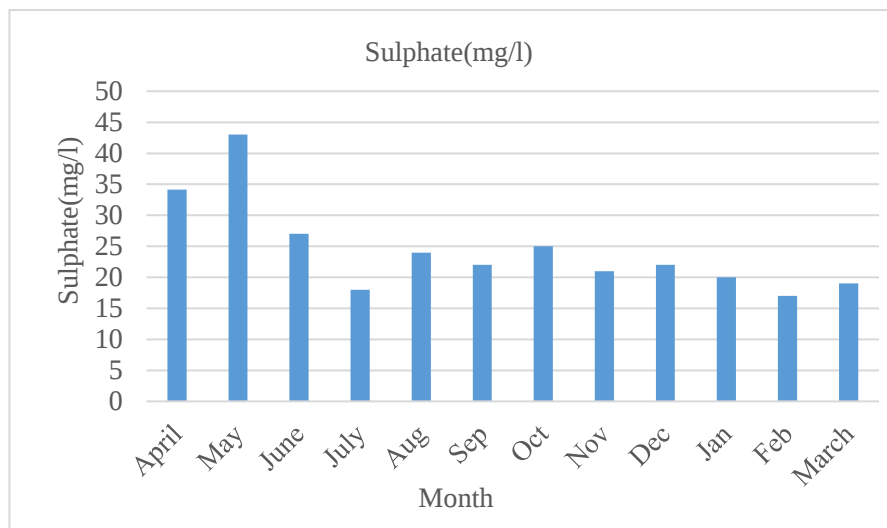
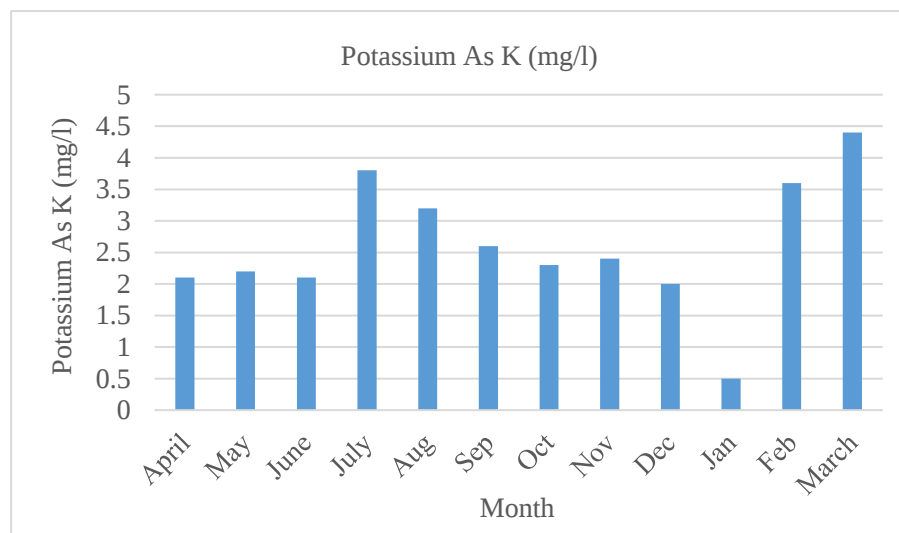
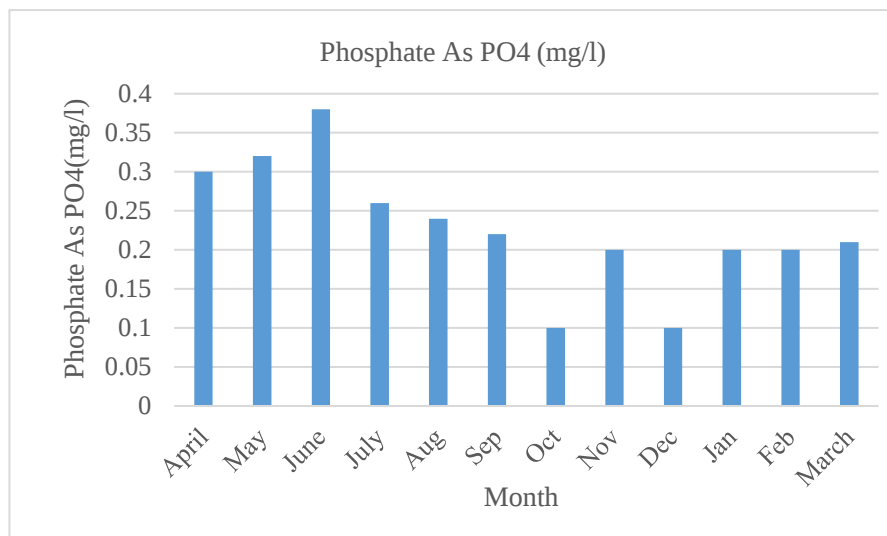
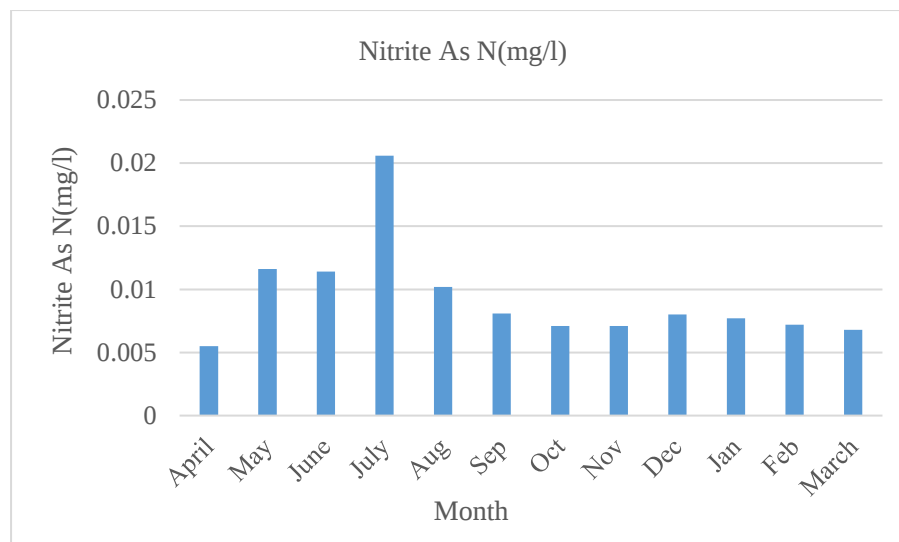


Figure. 13 Nitrite, Phosphate, Potassium and Sulphate of surface water (Kaylana Lake), Jodhpur

RESULT & DISCUSSION OF SURFACE WATER

1. **pH:** The minimum pH was observed in the month of November, 7.5 while the maximum pH was observed in the month of May, 8.63.
2. **Conductivity ($\mu\text{mho/cm}$):** The minimum conductivity was observed in the month of March, 209 $\mu\text{mho/cm}$, while the maximum conductivity was observed in the month of January, 343 $\mu\text{mho/cm}$.
3. **Turbidity (NTU):** The minimum turbidity was observed in the month of October, 1.3 NTU while the maximum turbidity was observed in the month of August, 2.8 NTU.
4. **Total Dissolved Solids (mg/l):** The minimum total dissolved solids was observed in the month of March, 140 mg/l, while the maximum total dissolved solids was observed in the month of January, 230 mg/l.
5. **Total Hardness as CaCO_3 (mg/l):** The minimum total hardness was observed in the month of March, 54 mg/l, while the maximum total hardness was observed in the month of June, 102.9 mg/l.
6. **Total Alkalinity (mg/l):** The minimum total alkalinity was observed in the month of February, 34 mg/l, while the maximum total alkalinity was observed in the month of July, 84 mg/l.
7. **Temperature ($^{\circ}\text{C}$):** The minimum temperature was observed in the month of January, 14 $^{\circ}\text{C}$, while the maximum temperature was observed in the month of July, 27.6 $^{\circ}\text{C}$.
8. **C.O.D. (mg/l):** The minimum C.O.D was observed in the month of January, 4 mg/l, while the maximum C.O.D was observed in the month of June, 24 mg/l.
9. **Fecal Coliform (MPN/100ml):** The minimum fecal coliform was observed in the month of December, January, February, March 2 MPN/100ml, while the maximum fecal coliform was observed in the month of June, 84 MPN/100ml.
10. **Chloride (mg/l):** The minimum chloride was observed in the month of January, 10 mg/l, while the maximum chloride was observed in the month of April, 43 mg/l.
11. **Fluoride as F (mg/l):** The minimum fluoride was observed in the month of September, 0.08 mg/l, while the maximum fluoride was observed in the month of November, 0.35 mg/l.
12. **Nitrate as N (mg/l):** The minimum nitrate was observed in the month of September, 1.52 mg/l, while the maximum nitrate was observed in the month of December, 2.6 mg/l.

13. Nitrite as N (mg/l): The minimum nitrite was observed in the month of April, 0.0055 mg/l, while the maximum nitrite was observed in the month of July, 0.0206 mg/l.

14. Phosphate as PO₄ (mg/l): The minimum phosphate was observed in the month of October & December, 0.1 mg/l, while the maximum phosphate was observed in the month of June, 0.38 mg/l.

15. Potassium as K (mg/l): The minimum potassium was observed in the month of January, 0.5 mg/l, while the maximum potassium was observed in the month of March, 4.4 mg/l.

16. Sulphate (mg/l): The minimum sulphate was observed in the month of February, 17 mg/l, while the lowest Sulphate was observed in the month of May, 43 mg/l.

Conclusion: In the Month of May pH found 8.63 which is exceed the range according to the BIS Standard (IS 10500: 2012). According to desirable value and permissible value the range of all over samples falls under the permissible value. Hence it is quite visible that water is suitable for drinking purposes of Kaylana Lake (Surface Water).

RECOMMENDATIONS & REMEDIAL MEASURES FOR CONTROL OF SURFACE & GROUND WATER POLLUTION

1. Industries should treat their wastes carefully before disposing of chemicals and other materials into water bodies directly. Sewage treatment plants and primary wastewater treatment plants must be established to treat the effluent generated during the process of dyeing, printing washing of clothes, steel rerolling mills process & other water-polluting industries.
2. The Authority should take immediate action against those dumping Municipal Solid Waste directly into the Jojari River.
3. Strict implementation of guidelines/orders issued by the Hon'ble Supreme Court, NGT, CPCB & RSPCB.
4. Regular inspection and sampling of water-polluting industries to check out the leakage (Bypass arrangement) for discharge of trade effluent into the RIICO drain/Sewage line.
5. ETP/STP should be mandatory for all types of wastewater-generating units.
6. The water of the Jojari River is used by the farmers for agricultural purposes. Consumption of such agricultural produce may cause harmful effects on the human body due to the presence of toxic heavy metals in the wastewater.
7. The efficiency of treatment plants at the primary level in the industries should be improved to achieve standards at the outlet of the Primary Effluent Treatment Plant (PETP).
8. More trees should be planted along the Jojari River because the plant has phytoremediation capability.
9. Farmers should use bio-fertilizers/organic fertilizers in place of chemical fertilizers.
10. Uses of Phytoremediation crops like Brassica Juncea (Mustard) and Helianthus Annuus (Sunflower) can remediate Cu, Cd, Cr, Ni, Pb and Zn from water but these are a health hazard for living organisms because the contamination enters into the food chain.
11. Development of Green Beach along with the Jojari River and growing of phytoremediation crops (Mustard, Sunflower) and plants (*Bambusa vulgaris* (Bamboo), *Acacia nilotica* (Babool), *Dalbergia sissoo* (Sisam)).
12. Growing plants which are used in the handicraft industry like *Dalbergia sissoo* because the contamination accumulates into the plant but does not enter into the food chain & web.

THE TEAM - PREPARATION OF NWMP REPORT (APRIL, 2022 TO MARCH, 2023)



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Designed & Published (EIACP HUB) RSPCB	Environmental Information, Awareness, Capacity Building and Livelihood Programme (EIACP), RSPCB, Jaipur

PHOTOGRAPHS DURING SAMPLING



Figure. 14 Collection of Water Sample from ground water and Surface water in Jodhpur City



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