TREND ANANLYSIS OF GROUND WATER AND SURFACE WATER UNDER NWMP (FROM APRIL-2023 TO MARCH- 2024)

REGIONAL LABORATORY,

RAJASTHAN STATE POLLUTION CONTROL BOARD,
JODHPUR

TABLE OF CONTENT

Table of Content.....

List of Tables……..……

List of Figures…….....……

1. INTRODUCTION

Jodhpur is situated in Western part of Rajasthan, between 26° and 27°31' north latitudes and between 72°55' and 73°52' east longitude. It is bounded on the north by Bikaner and Jaisalmer district, on the south by Pali and Barmer districts, on the east by Pali and Nagaur districts and on the west by Jaisalmer district. According to the Census of 2011, the district of Jodhpur has a population of 36,87,165 out of which 19,23,928 are males and 17,63,237 are females. It accounts for 5.38 percent of the State population. The Geographical area of the district is 22,850 sq. km which is 6.68 percent of the total state area. The district ranks 2nd in terms of population and 4th in terms of area and 29th in terms of population density among all districts of the state. The sex ratio of Jodhpur district (916) is lower than the State sex ratio (928) and the literacy rate in Jodhpur district is 65.9 percent which is lower than the State Average (66.1 percent) and it ranks 15th among the other districts of the state. Gender Gap of the literacy rate is 27.2 percent in the district.

The western & north-western parts of district are characterized by sand dunes. Sand dunes of transverse, longitudinal and parabolic variety are present and attain a height of 10 to 40 m. There is only one important river in the district, viz., Luni, which enter the district near Bilara and flows for a distance of over 75 kms. Before entering in Barmer district. Jodhpur district lies in the arid western plain Agro-Climatic Zone, according to the classification by Department of Agriculture, Government of Rajasthan. Soils in this zone are desert soils and sand dunes aeolian soil, coarse sand in texture some places calcareous. Commonly grown crops in this zone in kharif season are Pearl millet, Moth bran and Sesame and in Rabi season are wheat, mustard and cumin.

The Finance and Appropriations Bill was presented by Rajasthan Government, March 17, 2023. Where a number of announcements were made. The recent announcement of 19 districts in Rajasthan is the largest announcement. As a result, Rajasthan will now have 50 districts. Jodhpur is also divided into two parts. Jodhpur East and Jodhpur West have been declared as two districts. Phalodi also created as a new district in Jodhpur.

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. Total twelve Sites are selected along with Jojari River 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 is to determine how much amount of contamination entered into the ground water. Kaylana Lake selected for trend analysis of surface water and 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	Nephlometric 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 CaCO3 mg/l	Conductometric Method
12	Chloride, as Cl mg/l	1. Argentometric Method 2. Macurimetric Method
13	Total Hardness as CaCO3 mg/l	EDTA Titrimetric Method
14	Calcium, as CaCO3 mg/l	EDTA Titrimetric Method
15	Magnesium as CaCO3 mg/l	By difference of 13 and 14

16	Alkalinity as CaCO3 mg/l Alkalinity – P as CaCO3 mg/l	1. Electrometric Method 2. Visual Titration Method
17	Sulphate as SO4 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 PO4 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**
Monitoring Protocol for Ground Water: **General Parameters:** 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
Monitoring Protocol for Surface Water: **General Parameters:** 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

2. GROUND WATER SAMPLING SITE

Total Twelve Sites are selected along with the Jojari River 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 is to determine how much amount of contamination entered into the ground water along with the Jojari River.

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

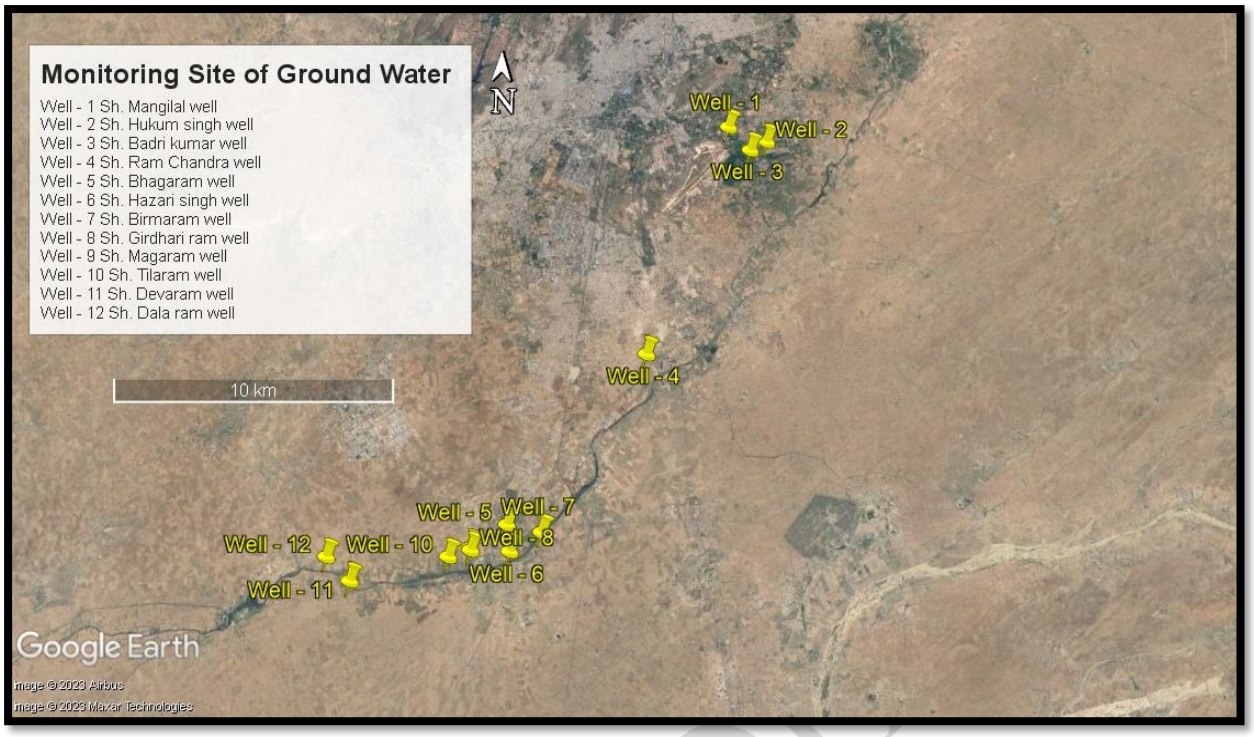


Figure. 2 Sampling Point of Ground water along with the Jojari River, Jodhpur

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 (NTU)	1 NTU
4.	T.D.S (mg/l)	500 mg/l
5.	Total Hardness (mg/l)	200 mg/l
6.	Total Alkalinity (mg/l)	200 mg/l
7.	Temperature (^{0}C)	-
8.	C.O.D (mg/l)	-
9.	T.S.S (mg/l)	-
10.	Chloride (mg/l)	250 mg/l
11.	Fluoride (mg/l)	1.0 mg/l
12.	Nitrate (mg/l)	45 mg/l
13.	Nitrite (mg/l)	-
14.	Phosphate (mg/l)	-
15.	Potassium (mg/l)	-
16.	Sulphate (mg/l)	200 mg/l

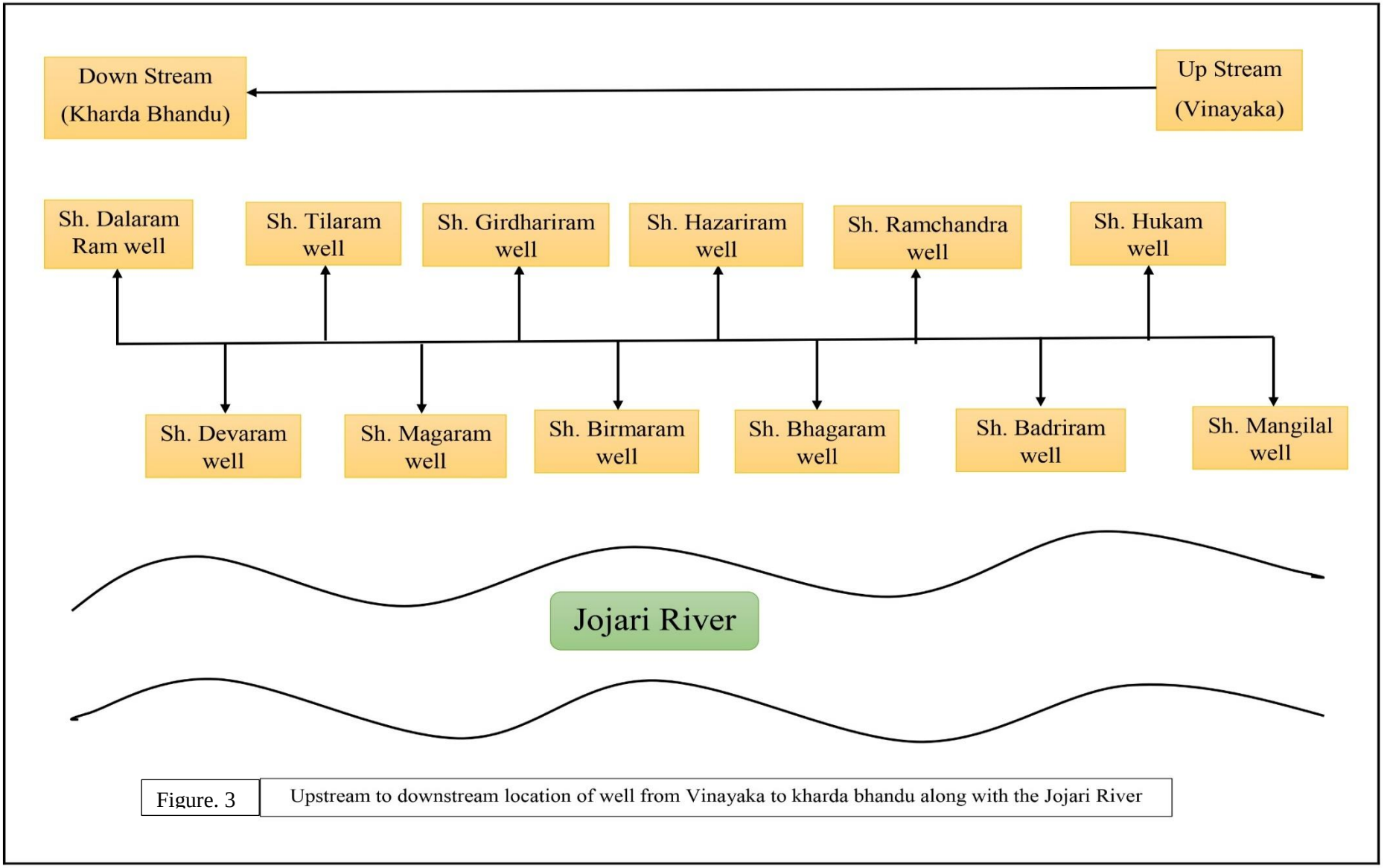


Figure. 3 Upstream to downstream location of well from Vinayaka to kharda bhandu along with the Jojari River

3. OBSERVATION TABLE OF GROUND WATER

Table. 5 Comparative Table of different Parameter of ground water along with the Jojari River, Jodhpur (April, 2023 to March, 2024)

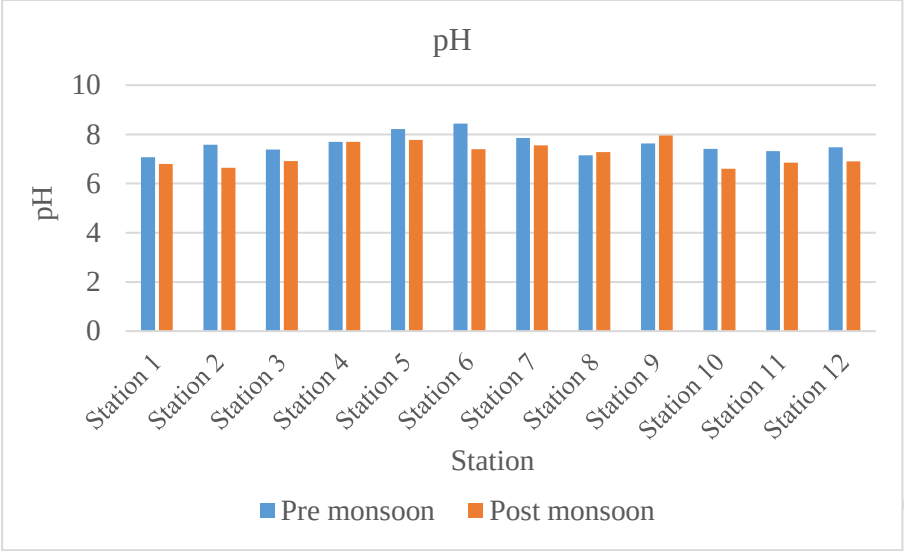
		pH		Conductivity (µmho/cm)		Turbidity (NTU)		Total Dissolved Solids (mg/l)		Total Hardness as CaCO3 (mg/l)	
S.N	Well	Pre monsoon	Post monsoon	Pre monsoon	Post monsoon	Pre monsoon	Post monsoon	Pre monsoon	Post monsoon	Pre monsoon	Post monsoon
1	Station 01	7.07	6.8	3813	3839	0.39	0.55	2550	2500	268.8	260.4
2	Station 02	7.58	6.64	8719	8851	0.51	0.88	5840	5860	835.8	550.2
3	Station 03	7.38	6.92	2845	2734	0.44	0.68	1870	1860	306.6	315
4	Station 04	7.7	7.7	23119	22000	2.58	4.44	15490	14740	730.8	705.6
5	Station 05	8.21	7.77	8500	9145	1.35	1.39	5690	6120	296.1	298.2
6	Station 06	8.44	7.4	2820	3627	2.64	2.56	1890	2430	165.9	386
7	Station 07	7.85	7.55	24530	19015	6.05	7.91	16430	12740	1415.4	932.4
8	Station 08	7.15	7.28	14313	12909	8.29	1.85	9580	8680	1633.8	1071
9	Station 09	7.63	7.95	17910	12433	7.00	3.97	12000	8290	1465.8	478.8
10	Station 10	7.41	6.6	8550	6649	14.16	10.22	5730	4450	1045.8	483
11	Station 11	7.32	6.85	10403	9881	1.25	4.7	6970	6860	1159.2	634.2
12	Station 12	7.47	6.9	5970	6336	5.12	2.74	4000	4240	552.3	688.8

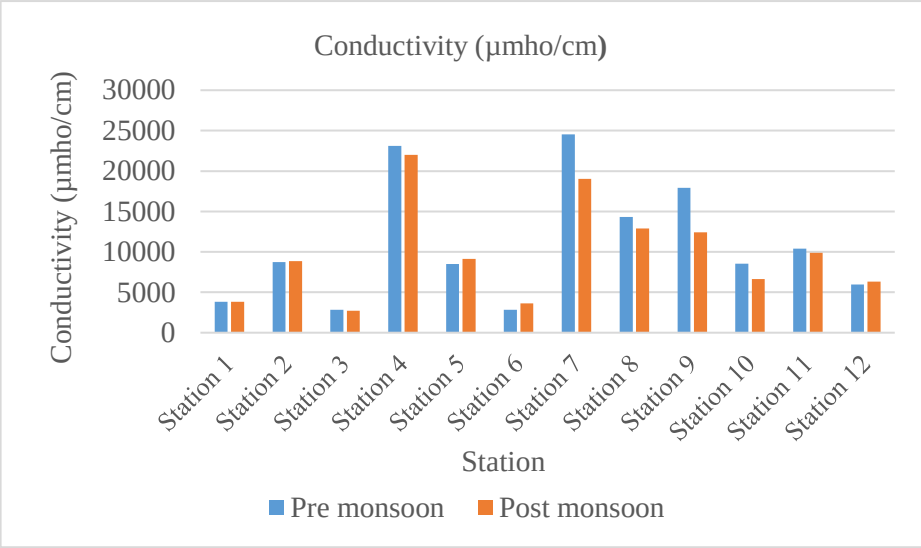
		Total Alkalinity (mg/l)		Temperature (^{0}C)		C.O.D. (mg/l)		Total Suspended Solid (mg/l)		Chloride As Cl (mg/l)	
S.N	Well	Pre monsoon	Post monsoon	Pre monsoon	Post monsoon	Pre monsoon	Pre monsoon	Pre monsoon	Post monsoon	Pre monsoon	Post monsoon
1	Station 01	606	564	28.4	27.2	4	11	12	14	340	390
2	Station 02	444	484	27.8	28.2	5	12	19	26	1874	2124
3	Station 03	428	416	26.5	26.6	4	6	8	12	200	300

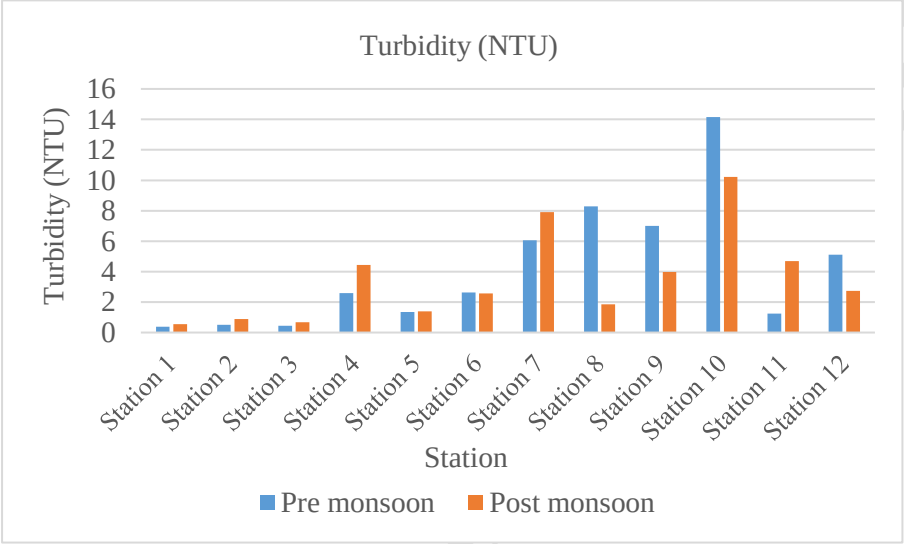
4	Station 04	800	724	28.2	24.9	8	31	90.6	36	6178	5708
5	Station 05	500	460	26.6	28.2	6	14	43	18	1649	2099
6	Station 06	180	404	24.9	29	4	5	15	12	580	515
7	Station 07	836	868	26.8	24.4	29	36	86	38	5678	4648
8	Station 08	382	372	26.6	25.7	10	13	56	30	2444	2719
9	Station 09	524	620	26.2	26.5	9	26	73	28	3389	3189
10	Station 10	582	900	26.1	27.3	4	18	29	20	1560	1360
11	Station 11	572	576	25.2	24.5	8	16	31.2	24	1734	2219
12	Station 12	676	532	24	26.1	11	15	45	32	895	1095

		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)**	
S.N	**Well**	**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	1.44	1.58	10.1	12.1	0.004	0.007	0.1	0.26	6.9	34	196	79
2	Station 02	1.51	1.59	17.8	19.3	0.015	0.012	0.28	0.41	17.2	35	275	413
3	Station 03	0.733	0.9	8.8	7.6	0.018	0.023	0.18	0.23	13	39	138	13
4	Station 04	2.07	1.89	15.5	18.6	0.0178	0.024	1.4	1.14	17.1	39	404	1600
5	Station 05	5.8	6.89	12.2	16.1	0.012	0.015	0.7	0.58	8.8	21	254	563
6	Station 06	0.32	0.28	11.2	11.8	0.016	0.019	0.26	0.22	7.2	12	83	363
7	Station 07	2.19	2.21	20.2	23.8	0.02	0.026	0.8	0.67	18	32	392	1404
8	Station 08	1.54	1.48	17.8	20.4	0.017	0.028	0.32	0.46	21	84	200	1654
9	Station 09	2.46	2.87	8.6	10.2	0.011	0.016	0.21	0.32	11.4	44	400	1296
10	Station 10	4.74	5.01	25.3	26.3	0.021	0.015	0.72	0.64	15	40	358	292
11	Station 11	2.01	2.39	14.2	16.1	0.013	0.018	0.2	0.28	13.2	16	413	1292
12	Station 12	4.35	3.85	13.2	15.7	0.017	0.021	0.3	0.35	13	19	225	454

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







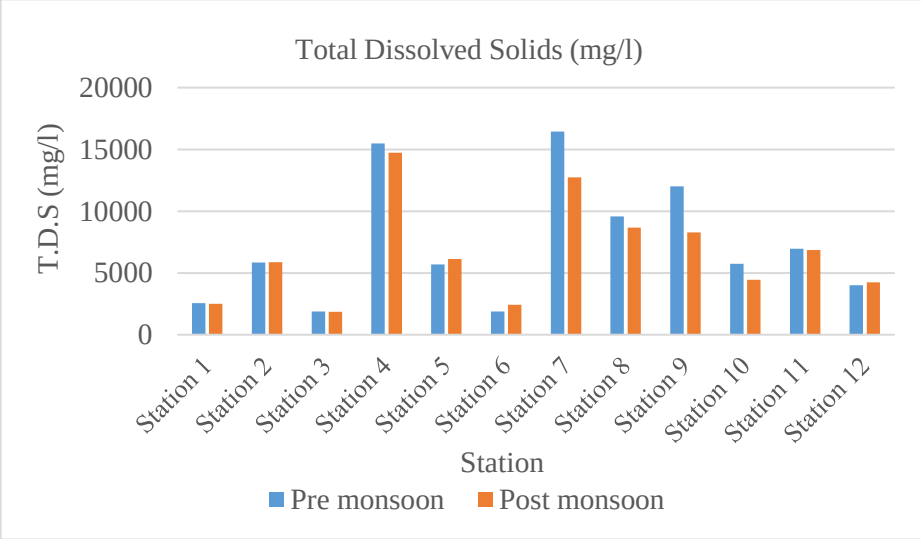
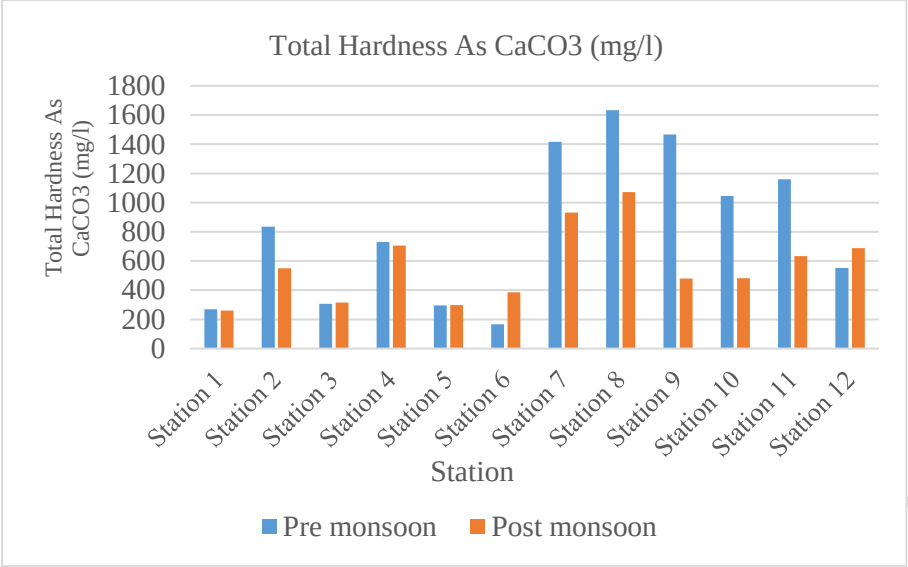
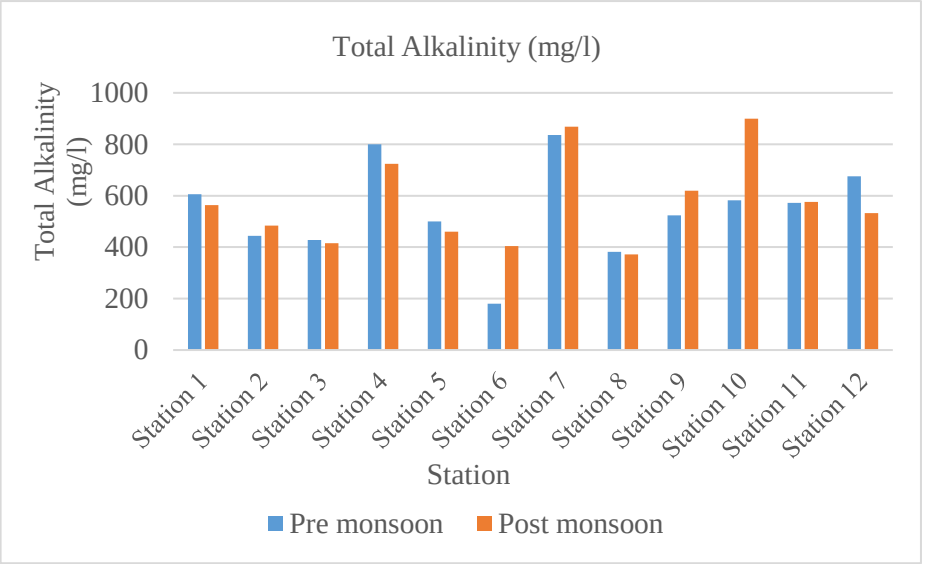
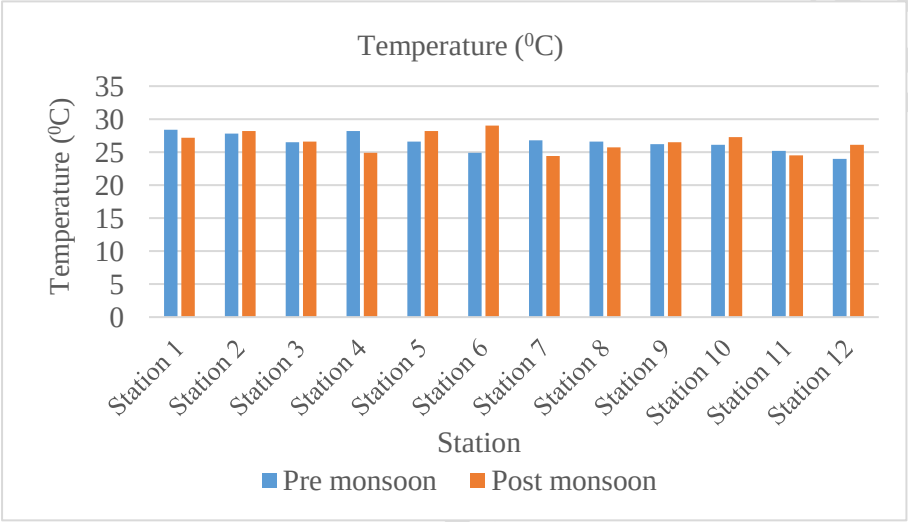


Figure. 4 pH, Conductivity, Turbidity and Total Dissolved Solids of ground water during pre - monsoon & post – monsoon along with the Jojari River.







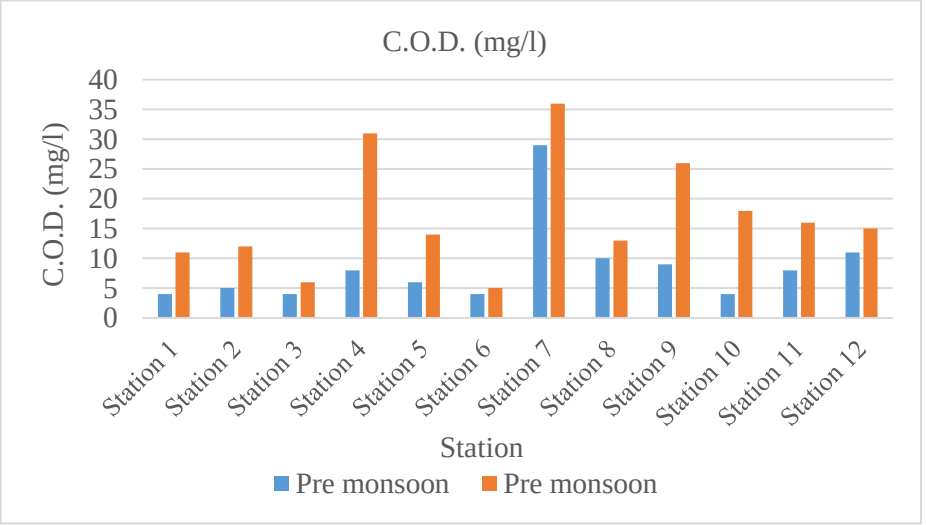


Figure. 5 Total hardness, Total Alkalinity, Temperature and C.O.D of ground water during pre - monsoon & post – monsoon along with the Jojari River.

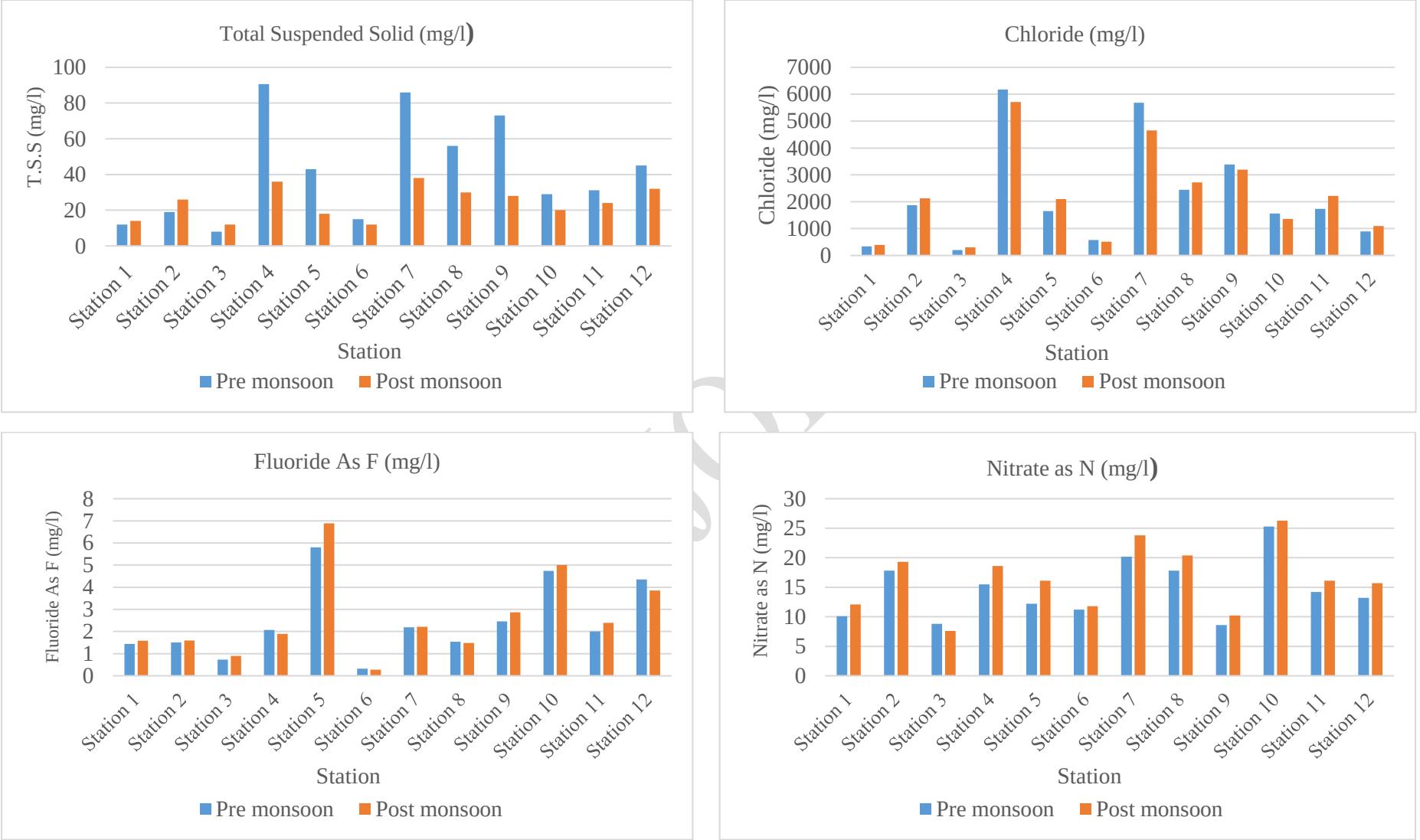
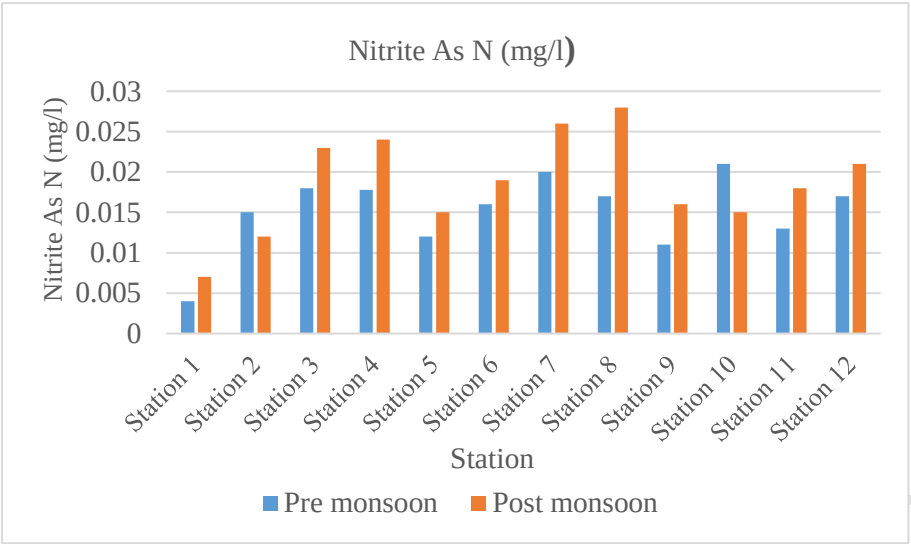
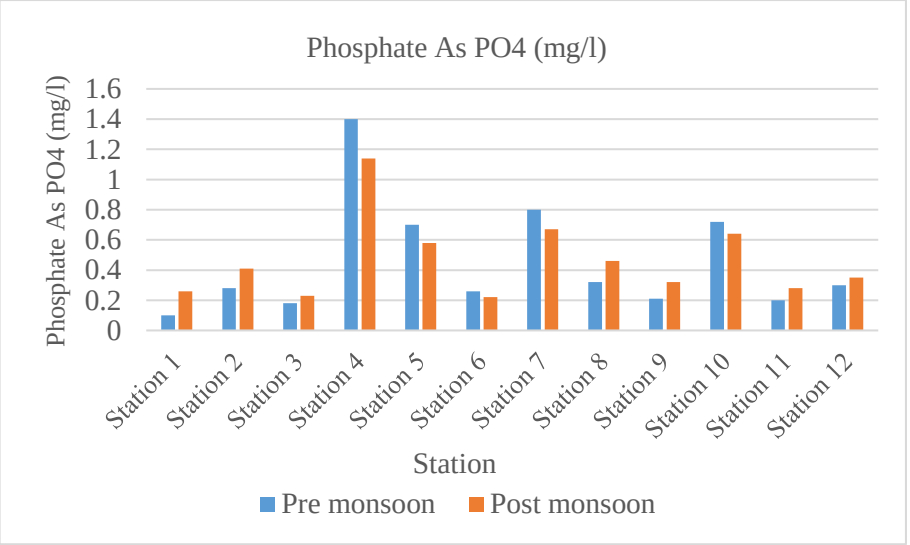
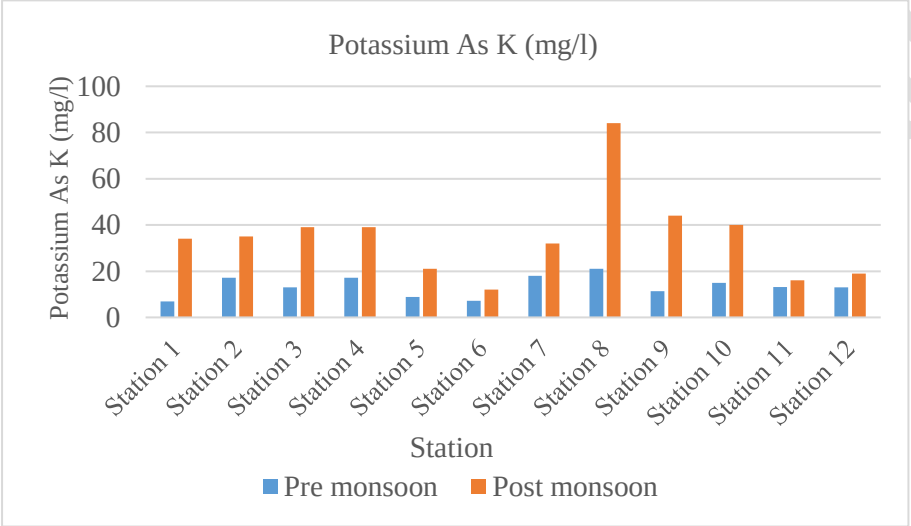


Figure. 6 T.S.S, Chloride, Fluoride and Nitrate as N of ground water during pre - monsoon & post – monsoon along with the Jojari River.







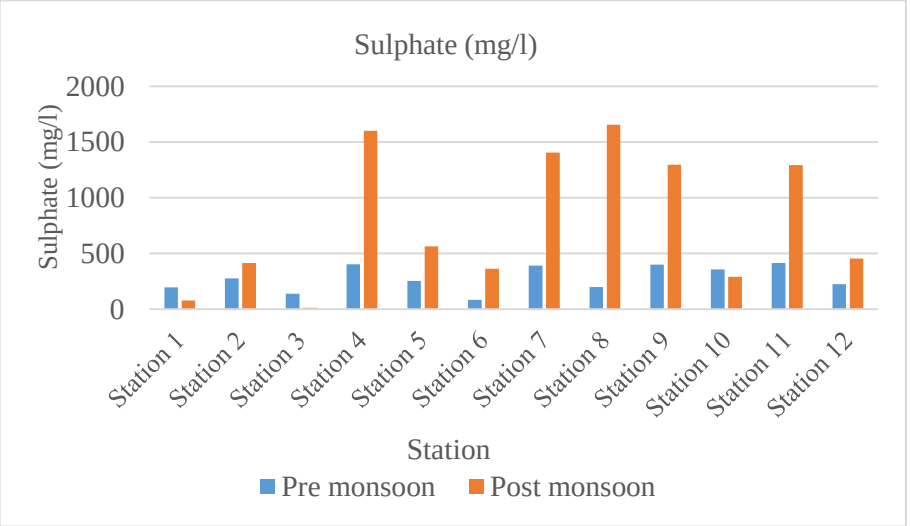


Figure. 7 Nitrite, Phosphate, Potassium and Sulphate of ground water during pre - monsoon & post – monsoon along with the Jojari River.

4. RESULT & DISCUSSION OF GROUND WATER

1. **pH:** The pH varied between 6.6 and 8.44. Pre-monsoon groundwater minimum and maximum pH values are 7.07 and 8.44, whereas post-monsoon groundwater minimum and maximum pH values are 6.60 and 7.95 respectively.
2. **Conductivity (µmho/cm):** Pre-monsoon groundwater minimum and maximum conductivity values are 2820 µmho/cm and 24530 µmho/cm, whereas post-monsoon groundwater minimum and maximum conductivity values are 2734 µmho/cm and 22000 µmho/cm respectively.
3. **Turbidity (NTU):** Pre-monsoon groundwater minimum and maximum turbidity values are 0.39 NTU and 14.16 NTU, whereas post-monsoon groundwater minimum and maximum turbidity values are 0.55 NTU and 10.22 NTU respectively.
4. **Total Dissolved Solids (mg/l):** Pre-monsoon groundwater minimum and maximum total dissolved solids values are 1870 mg/l and 16430 mg/l, whereas post-monsoon groundwater minimum and maximum total dissolved solids values are 1860 mg/l and 14740 mg/l respectively.
5. **Total Hardness as CaCO3 (mg/l):** Pre-monsoon groundwater minimum and maximum total hardness values are 165.9 mg/l and 1633.8 mg/l, whereas post-monsoon groundwater minimum and maximum total hardness values are 260.4 mg/l and 1071 mg/l.
6. **Total Alkalinity (mg/l):** Pre-monsoon groundwater minimum and maximum total alkalinity values are 180 mg/l and 836 mg/l, whereas post-monsoon groundwater minimum and maximum total alkalinity values are 372 mg/l and 900 mg/l.
7. **Temperature (^{0}C):** Pre-monsoon groundwater minimum and maximum temperature values are 24 ^{0}C and 28.4 ^{0}C, whereas post-monsoon groundwater minimum and maximum temperature values are 24.4 ^{0}C and 29 ^{0}C.
8. **C.O.D. (mg/l):** Pre-monsoon groundwater minimum and maximum C.O.D values are 4.0 mg/l and 29 mg/l, whereas post-monsoon groundwater minimum and maximum C.O.D values are 5 mg/l and 36 mg/l.
9. **Total Suspended Solid (mg/l):** Pre-monsoon groundwater minimum and maximum Total Suspended Solid values are 8.0 mg/l and 90.6 mg/l whereas post-monsoon groundwater minimum and maximum Total Suspended Solid values are 12 mg/l and 38 mg/l.

10. **Chloride (mg/l):** Pre-monsoon groundwater minimum and maximum chloride values are 200 mg/l and 6178 mg/l, whereas post-monsoon groundwater minimum and maximum chloride values are 300 mg/l and 5708 mg/l.
11. **Fluoride as F (mg/l):** Pre-monsoon groundwater minimum and maximum fluoride values are 0.32 mg/l and 5.8 mg/l, whereas post-monsoon groundwater minimum and maximum fluoride values are 0.28 mg/l and 6.89 mg/l.
12. **Nitrate as N (mg/l):** Pre-monsoon groundwater minimum and maximum nitrate values are 8.6 mg/l and 25.3 mg/l, whereas post-monsoon groundwater minimum and maximum nitrate values are 7.6 mg/l and 26.3 mg/l.
13. **Nitrite as N (mg/l):** Pre-monsoon groundwater minimum and maximum nitrite values are 0.004 mg/l and 0.021 mg/l, whereas post-monsoon groundwater minimum and maximum nitrite values are 0.007 mg/l and 0.028 mg/l.
14. **Phosphate as PO4 (mg/l):** Pre-monsoon groundwater minimum and maximum phosphate values are 0.1 mg/l and 1.4 mg/l, whereas post-monsoon groundwater minimum and maximum phosphate values are 0.22 mg/l and 1.14 mg/l.
15. **Potassium as K (mg/l):** Pre-monsoon groundwater minimum and maximum potassium values are 6.9 mg/l and 21 mg/l, whereas post-monsoon groundwater minimum and maximum potassium values are 12 mg/l and 84 mg/l.
16. **Sulphate (mg/l):** Pre-monsoon groundwater minimum and maximum sulphate values are 83 mg/l and 413 mg/l, whereas post-monsoon groundwater minimum and maximum sulphate values are 13 mg/l and 1654 mg/l.

5. CONCLUSION

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

6. TREND ANALYSIS OF GROUND WATER FROM UPSTREAM TO DOWNSTREAM

Up Stream (Vinayaka) → **Down Stream (Kharda Bhandu)**

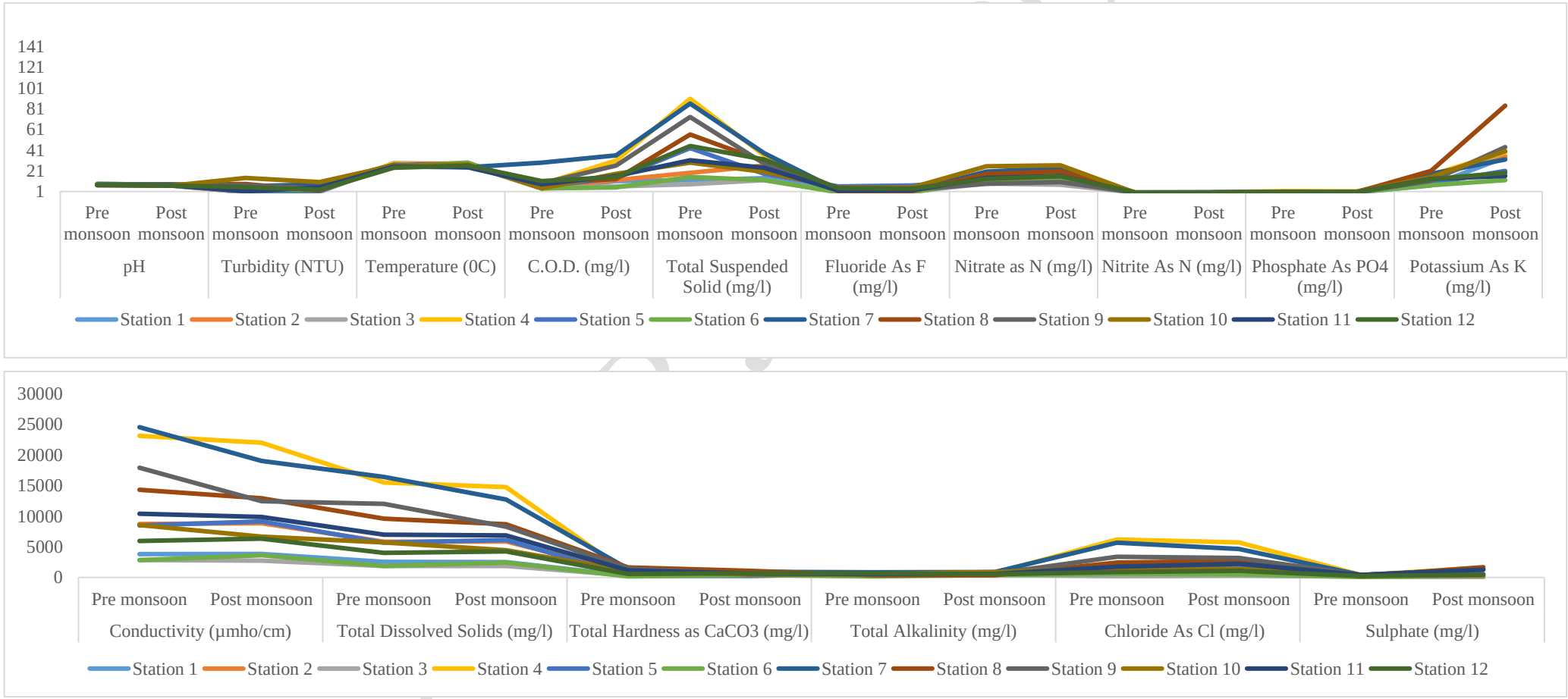


Figure. 8 Trend Analysis of Ground Water from Upstream to Downstream during Pre-monsoon & Post-monsoon along with the Jojari River, Jodhpur

7. SURFACE WATER SAMPLING SITE (KAYLANA LAKE), JODHPUR

Kaylana is one such freshwater artificial lake situated on the outskirt 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 Dessert 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.

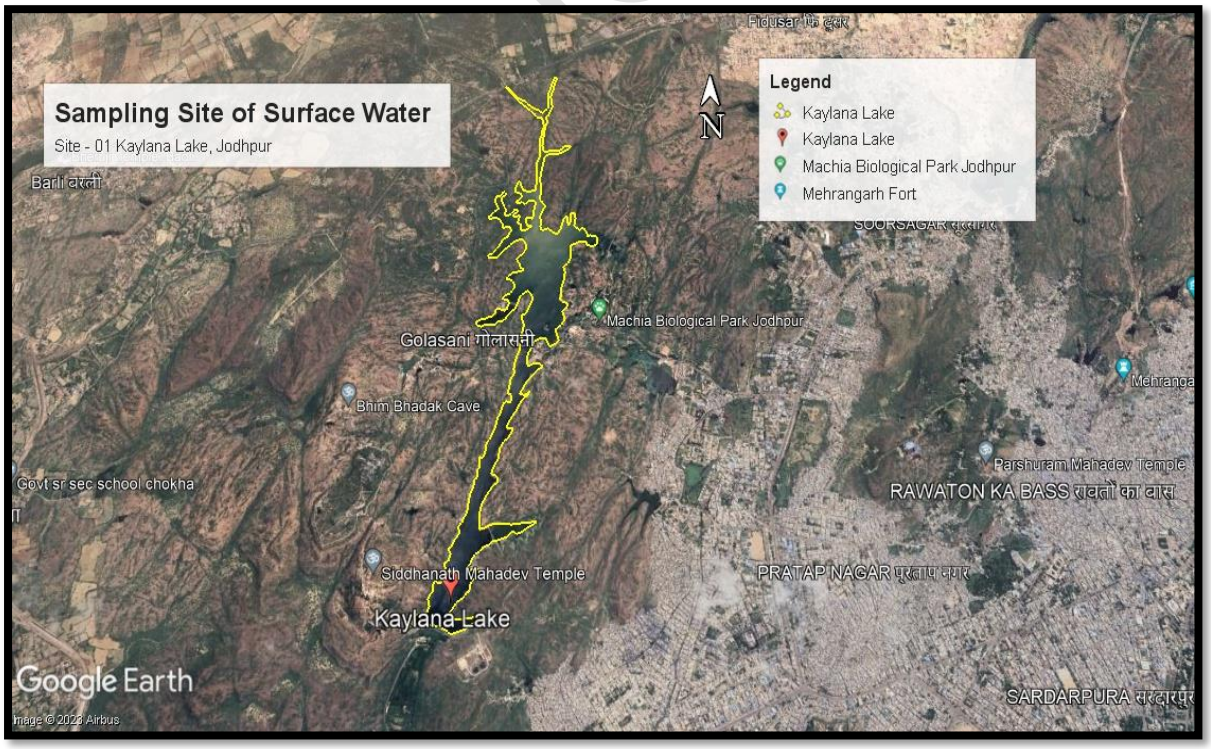


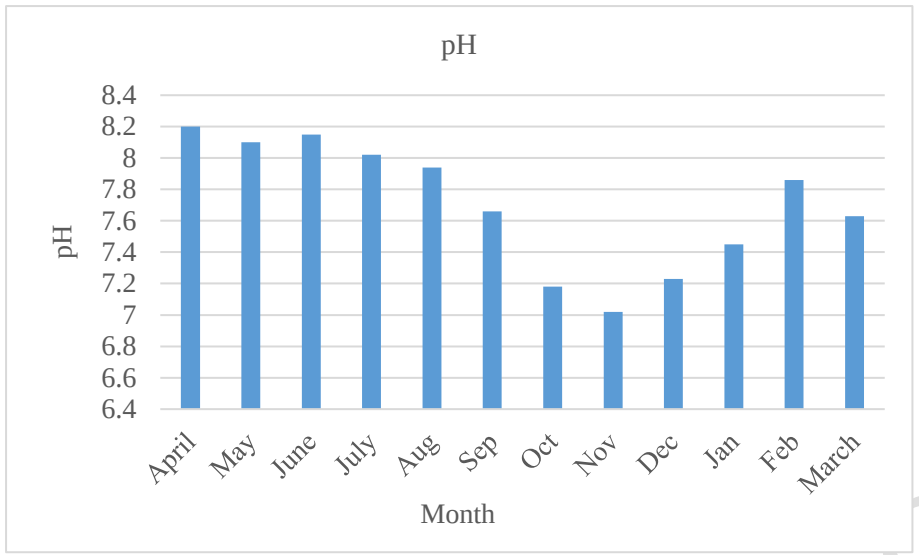
Figure. 9 Location Map of Sampling site of surface water (Kaylana Lake), Jodhpur

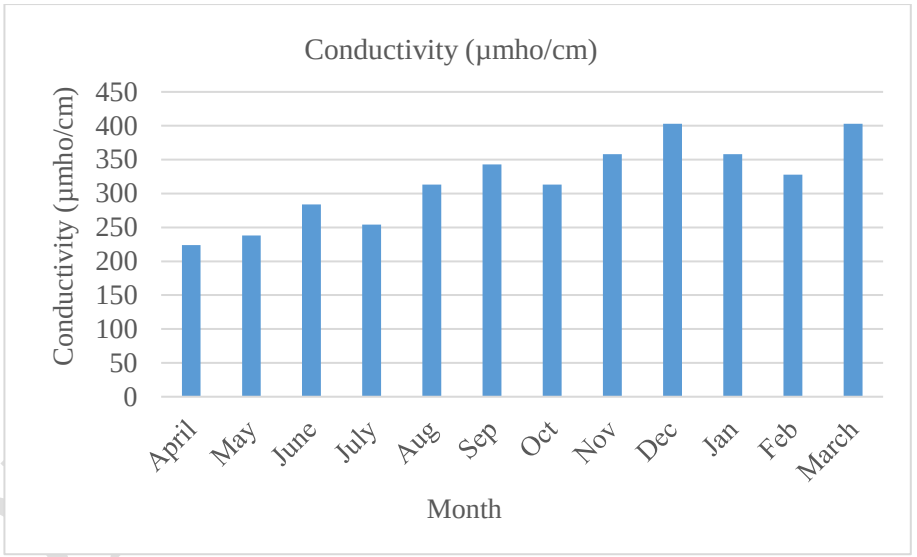
8. OBSERVATION TABLE OF SURFACE WATER

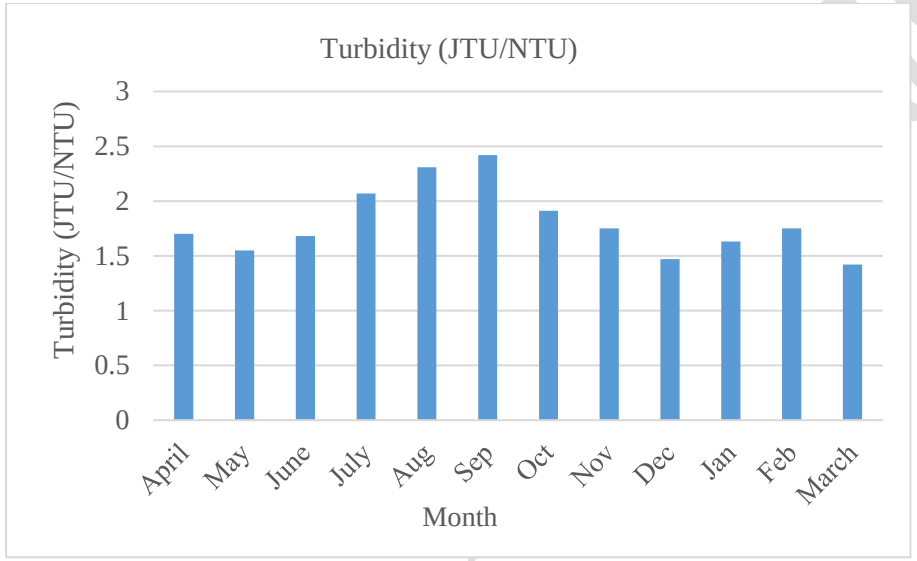
Table.6 Comparative table of different Parameter of surface water (Kaylana Lake) from April, 2023 to March, 2024.

S.N	Parameter	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	March
1.	pH	8.2	8.1	8.15	8.02	7.94	7.66	7.18	7.02	7.23	7.45	7.86	7.63
2.	Conductivity (µmho/cm)	224	238	284	254	313	343	313	358	403	358	328	403
3.	Turbidity (NTU)	1.7	1.55	1.68	2.07	2.31	2.42	1.91	1.75	1.47	1.63	1.75	1.42
4.	Total Dissolved Solids (mg/l)	150	160	190	170	210	230	210	240	270	240	220	270
5.	Total Hardness as CaCO3(mg/l)	52.5	54.6	58.8	52.5	57.75	54.6	50.4	54.6	52.5	54.6	56.7	63
6.	Total Alkalinity (mg/l)	68	85	91	70	62	54	48	41	44	35	41	52
7.	Temperature (^{0}C)	25.8	30.7	24	26	28	26.2	31	29.7	24	19	24	21.7
8.	C.O.D.(mg/l)	4	5	8	6	4	2	4	5	2	4	2	5
9.	Total Suspended Solids(mg/l)	12	14	18	22	19	21	25	21	16	21	15	22
10.	Chloride (mg/l)	14	18	21	20	24	27	31	28	23	16	11	16
11.	Fluoride As F (mg/l)	0.3	0.41	0.54	0.48	0.58	0.64	0.58	0.49	0.39	0.49	0.58	0.83
12.	Nitrate as N (mg/l)	2.3	2.25	2.81	2.02	2.14	2.3	2.01	1.91	1.54	1.36	1.71	1.45
13.	Nitrite As N (mg/l)	0.001	0.0082	0.0078	0.006	0.011	0.013	0.016	0.012	0.008	0.004	0.002	0.005
14.	Phosphate As PO4 (mg/l)	0.3	0.45	0.58	0.52	0.63	0.71	0.58	0.52	0.43	0.38	0.44	0.58
15.	Potassium As K (mg/l)	4.8	3.4	7.1	6.2	5.9	6.2	5.7	4.8	4.3	5.1	6.8	5.9
16.	Sulphate (mg/l)	21	24	30	24	29	32	23	21	18	22	15	20

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







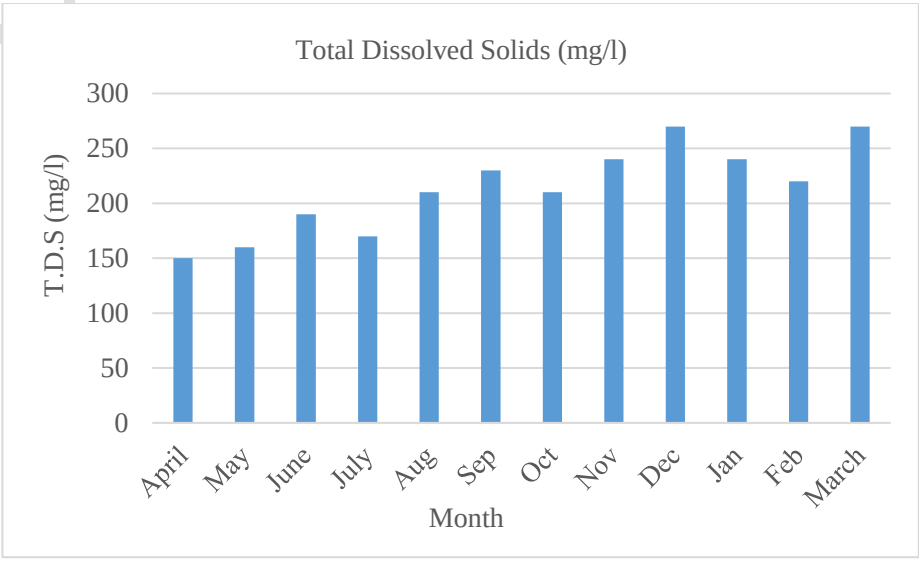
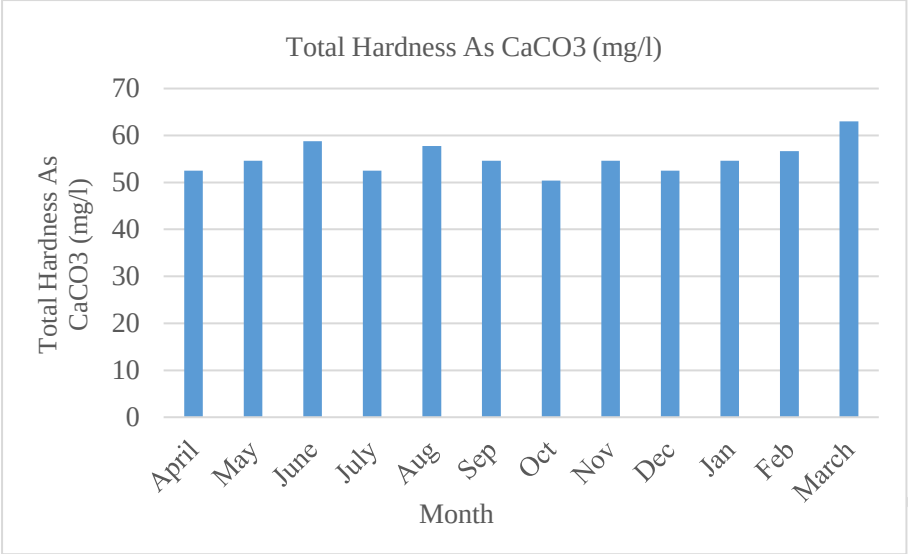
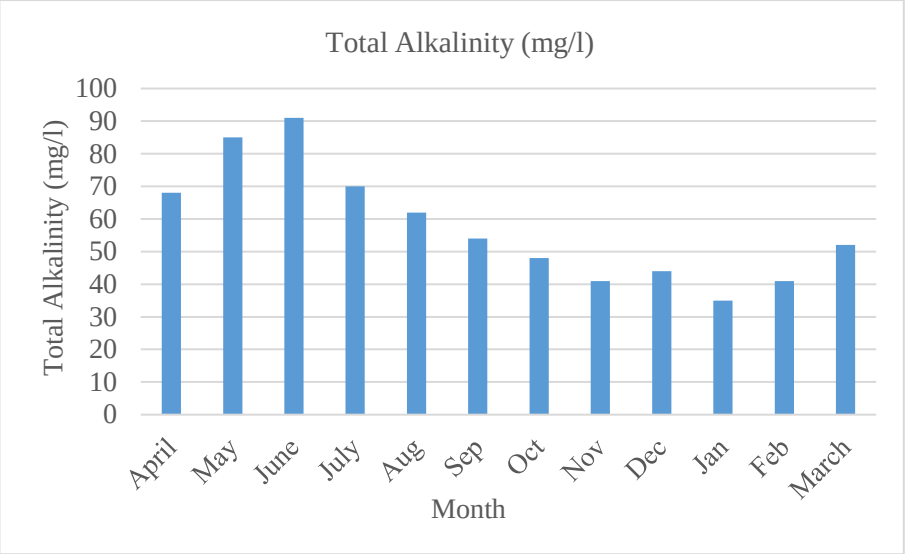
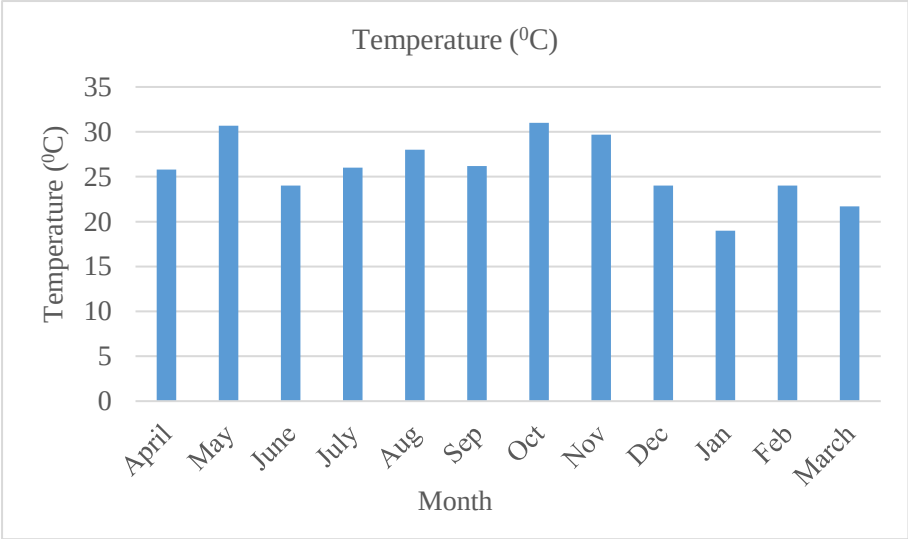


Figure. 10 pH, Conductivity, Turbidity and T.D.S of surface water (Kaylana Lake), Jodhpur







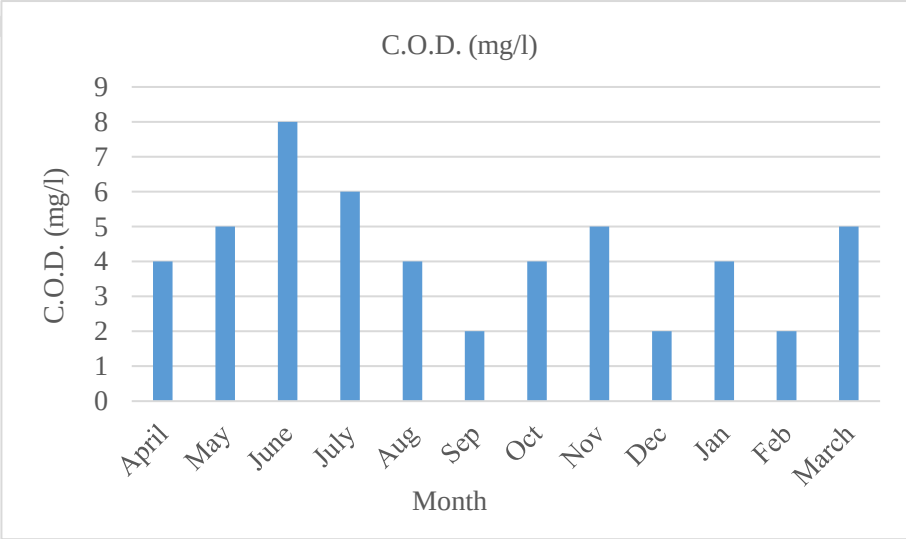
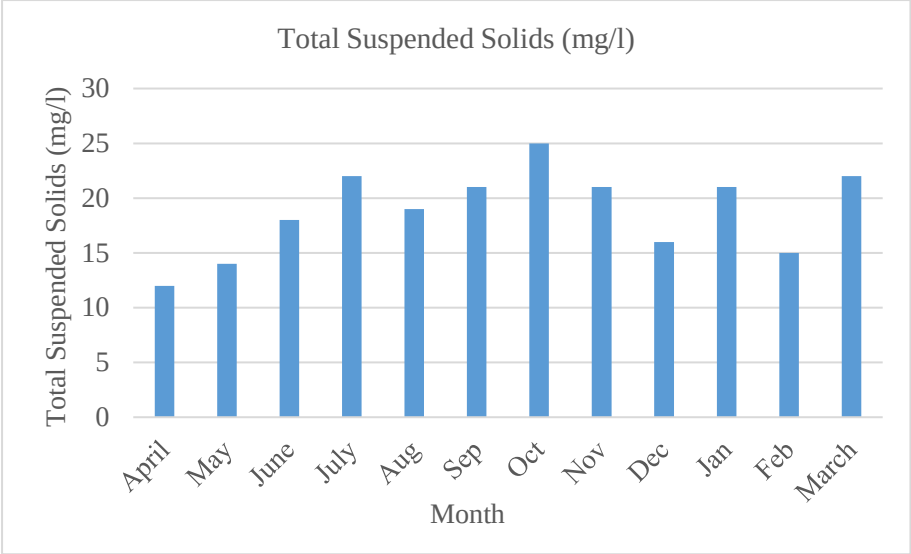
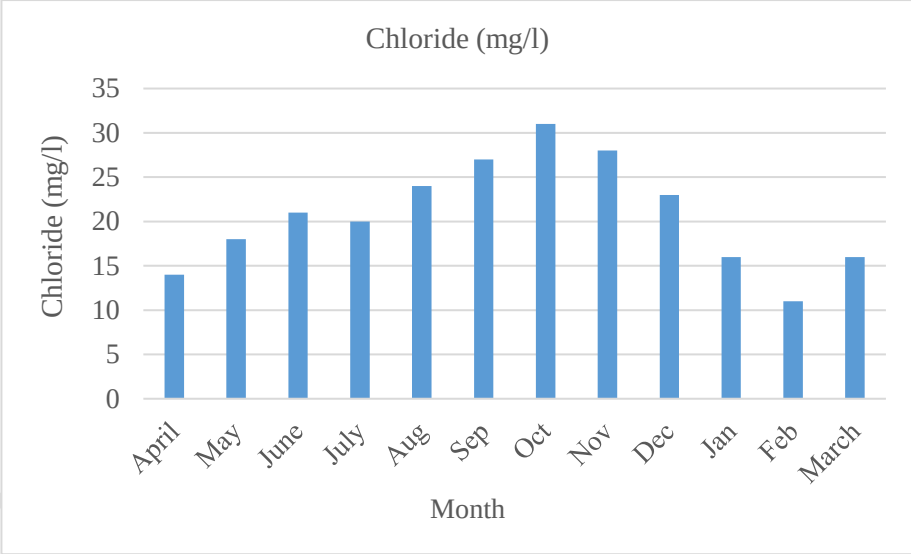
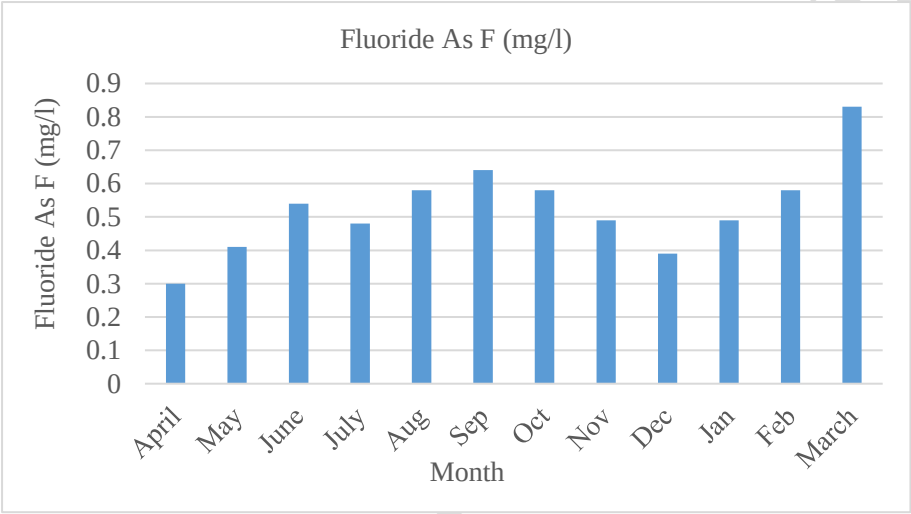


Figure. 11 Total Hardness, Total Alkalinity, Temperature and C.O.D of surface water (Kaylana Lake), Jodhpur







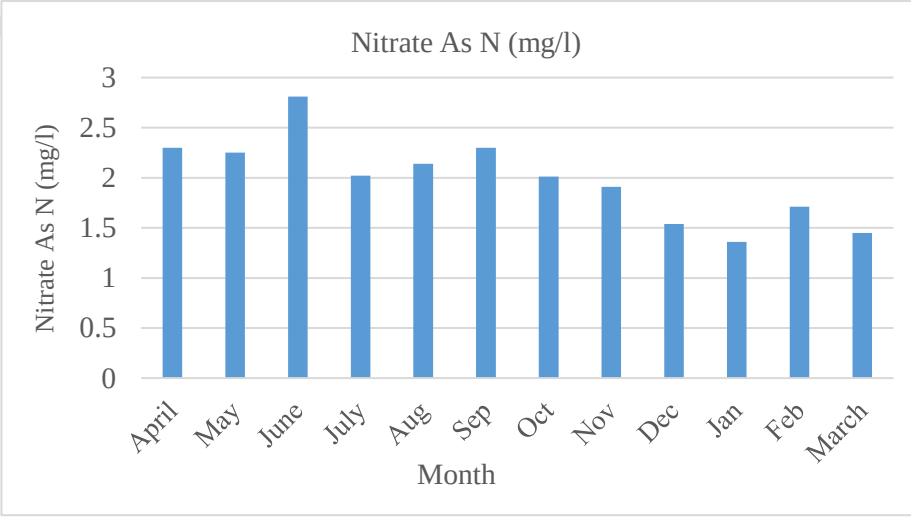


Figure. 12 T.S.S, Chloride, Fluoride and Nitrate as N of surface water (Kaylana Lake), Jodhpur

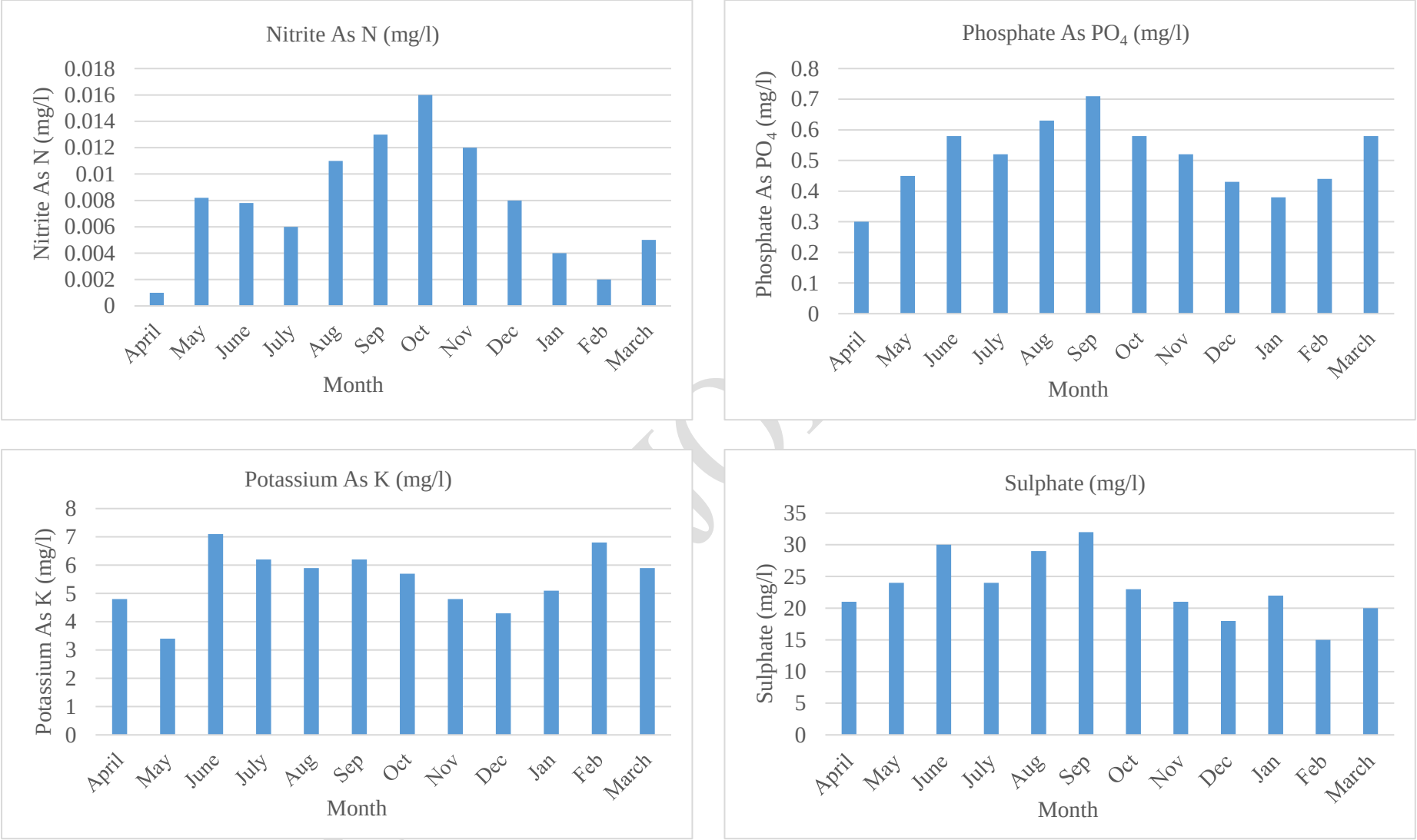


Figure. 13 Nitrite, Phosphate, Potassium and Sulphate of surface water (Kaylana Lake), Jodhpur

9. RESULT & DISCUSSION OF SURFACE WATER

1. **pH:** The minimum pH was observed in the month of November, 7.02 while the maximum pH was observed in the month of April, 8.2.
2. **Conductivity (µmho/cm):** The minimum conductivity was observed in the month of April, 224 µmho/cm, while the maximum conductivity was observed in the month of December**,** 403 µmho/cm.
3. **Turbidity (NTU):** The minimum turbidity was observed in the month of March, 1.42 NTU while the maximum turbidity was observed in the month of September**,** 2.42 NTU.
4. **Total Dissolved Solids (mg/l):** The minimum total dissolved solids was observed in the month of April, 150 mg/l, while the maximum total dissolved solids was observed in the month of December & March**,** 270 mg/l.
5. **Total Hardness as CaCO3 (mg/l):** The minimum total hardness was observed in the month of October, 50.4 mg/l, while the maximum total hardness was observed in the month of March**,** 63 mg/l.
6. **Total Alkalinity (mg/l):** The minimum total alkalinity was observed in the month of January, 35 mg/l, while the maximum total alkalinity was observed in the month of June**,** 91 mg/l.
7. **Temperature (^{0}C):** The minimum temperature was observed in the month of January, 19 ^{0}C, while the maximum temperature was observed in the month of October**,** 31 ^{0}C.
8. **C.O.D. (mg/l):** The minimum C.O.D was observed in the month of September, December & February, 2.0 mg/l, while the maximum C.O.D was observed in the month of June**,** 8.0 mg/l.
9. **Total Suspended Solid (mg/l):** The minimum Total Suspended Solid was observed in the month of April 12 mg/l, while the maximum Total Suspended Solid was observed in the month of October**,** 25 mg/l.
10. **Chloride (mg/l):** The minimum chloride was observed in the month of February, 11 mg/l, while the maximum chloride was observed in the month of October**,** 31 mg/l.
11. **Fluoride as F (mg/l):** The minimum fluoride was observed in the month of April, 0.3 mg/l, while the maximum fluoride was observed in the month of March**,** 0.83 mg/l.
12. **Nitrate as N (mg/l):** The minimum nitrate was observed in the month of January, 1.36 mg/l, while the maximum nitrate was observed in the month of June**,** 2.81 mg/l.

13. **Nitrite as N (mg/l):** The minimum nitrite was observed in the month of April, 0.001 mg/l, while the maximum nitrite was observed in the month of October**,** 0.016 mg/l.
14. **Phosphate as PO4 (mg/l):** The minimum phosphate was observed in the month of April, 0.3 mg/l, while the maximum phosphate was observed in the month of September**,** 0.71 mg/l.
15. **Potassium as K (mg/l):** The minimum potassium was observed in the month of May, 3.4 mg/l, while the maximum potassium was observed in the month of June**,** 7.1 mg/l.
16. **Sulphate (mg/l):** The minimum sulphate was observed in the month of February, 15 mg/l, while the lowest Sulphate was observed in the month of September, 32 mg/l.

10. CONCLUSION

Turbidity found above 1.0 NTU in all over month from April 2023 to March 2024, 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).

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

1. Industries should treat their waste water 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 Authorities (Municipal Corporation) 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 crops having 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.
13. Treated water of CETP/SCTPs are required to be use in Captive Power Plant.
14. ETP/CETP/CSTP sludge may also be used as a fuel in Captive Power Plant.
15. Cleaning of Kaylana Lake regularly required.
16. Rain water harvesting structure should be made in industrial areas.

12. THE TEAM - PREPARATION OF NWMP REPORT (APRIL, 2023 TO MARCH, 2024)

Name and Address of the Institution	Rajasthan State Pollution Control Board, M.I.A. 1st Phase, Basni, Basni, Jodhpur, Rajasthan
Regional Officer	Smt. Shilpi Sharma (Regional Officer, RSPCB, Jodhpur)
Lab Incharge	Sh. Deepak Ojha Supdt. Scientific Officer & Lab Incharge Regional Laboratory, Jodhpur
Report Writing, Data Compilation, Analysis and Tabulation	Sh. Deepak Ojha (Supdt. Scientific Officer) Sh. Devendra Singh Bikundia (Senior Scientific Officer) Sh. Jitendra Saraswat (Junior Scientific Officer) Smt. Ritu Sharma (Junior Scientific Officer) Smt. Kavita Charan (Junior Scientific Officer) Sh. Deepak Panwar (AOS) Sh. Narendra Kumar Kadela (Young Intern)
Supporting Staff	Sh. Kuldeep Singh (Scientific Assistant) Sh. Dileep Sankhala (Scientific Assistant) Sh. Nitin Joshi (Scientific Assistant) Sh. Rafikh Khan (Field Assistant) Sh. Rajendra Singh (Lab Attended) Sh. Umar Khan (Data Entry Operator) Sh. Shyam Giri (Field Assistant) & All NAMP field Staff.

13. PHOTOGRAPHS DURING WATER SAMPLING

Figure. 14 Collection of Water Sample from Ground water and Surface water and checking Ambient Temperature and Water Temperature by using Digital Thermometer in Jodhpur City, Rajasthan.