Ground Water Quality Analysis of Srikakulam District Andhra Pradesh, India for Domestication and Agricultural Practice
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Ground Water Quality Analysis of Srikakulam District Andhra Pradesh, India for Domestication and Agricultural Practice

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ABSTRACT

The present investigation focused on water samples collected from different places in Srikakulam District and analyzed for various physicochemical parameters. Such as water Temperature, Turbidity, Total Dissolved Solids, pH, Dissolved Oxygen, Free Carbon dioxide and Total Hardness, Chlorides, Alkalinity, Phosphate and Nitrates were analyzed for a period of two years from pre and post monsoon 2019 to 2020. All the Parameters were within the permissible limits. The results indicate that the samples were Non-polluted and can be used for Domestic, Irrigation and Fisheries.

Key Words: Physico-Chemical Parameters, Temperature, Turbidity, Total Dissolved Solids, Dissolved Oxygen, Free Carbon dioxide, Total Hardness, Chlorides, Alkalinity

INTRODUCTION:

Ground water has long been considered as one of the purest forms of water available in nature and meets the overall demand of rural and semi-urban people (Fienen and Arshad, (2016)). Large scale industrial growth has caused serious concern regarding the susceptibility of

ground water contamination due to waste materials (Peiyue Li, Karunanidhi, and Subramani, *et al.,* 2021). Waste materials at the factories when subjected to reaction with percolating rain water and reach the aquifer system and hence degrade the ground water quality (Navarro Ferronato and Vincenzo Torretta, (2019), Richard Espinoza. (2020)). Heavy metals constitute a very heterogenous group of elements widely varied in their chemical properties and biological functions (Vhahangwele Masindi and Khathutshelo Muedi, (2018)). They are persistant in nature, therefore get accumulated in soil and plants (Mahima Begum *et al.,* 2021). Dietary intake of many heavy metals through consumption of plants and drinking water has long term detrimental effect on human health (Obasi and Akudinobi (2020)). The transmission of water borne disease has been a matter of concern for many years (Kumar, Srivastava and Banerjee, (2022)). Hence bacteriological examination is also very important in the assessment.

Water is one of the abundantly available substances in nature. It is an essential constituent of all animal and vegetable matter and forms about 75% of the matter of earth's crust (Nicholas Le Pan; Bruno Venditti (2021)). It is also an essential ingredient of animal and plant life. Water is distributed in nature in different forms such as rainwater, river water, spring water and mineral water.

Man needs about 500 to 700 liters of water every day for domestic needs such as drinking, cooking, washing, bathing, flushing toilets, besides recreational purposes, commercial purposes, industrial needs and firefighting etc. At the same time water is a potential carrier of pathogenic microorganisms which can endanger human health and life. Water that is free of disease producing microorganisms and chemical substances deleterious to health is called potable water. In this universe it is the only inorganic fluid with a relative density of unity (EPA, United states Environmental protection Agency 2022). It is mainly because of this magical substance the earth's temperature is maintained reasonably uniform at an average of 16^0C, in the absence of which its temperature would have varied as on moon where it is 100^0C during daytime and -130^0C during nights. Man can survive for five weeks without food but cannot live more than 5 days without water (Tim Sharp and Doris Elin Urrutia (2022)). 75% of human body is water because of which only his/her specific gravity is about unity. 80% of milk, 87% of apples, 80% of fish, 77% of beef, 75% of potatoes and 66% of eggs are water (Sruthi M and Pallavi Suyog Uttekar (2021)). It is the only naturally occurring liquid compound on the surface of earth and is called universal solvent. Though its universally known chemical formula is H_2O, it has an unusual property of expanding on freezing and has

maximum density at 3.98^0C. about seventy percent of the World's surface area is covered with water. According to United States Geological Survey (USGS) most of the fresh water (84.9 Percent) is locked up as ice in glaciers, of the balance 14.16 percent constitutes ground water, while that in lakes and reservoirs amount to 0.55 percent, besides a little amount in the form of soil moisture and atmospheric water vapour. Thus, only a very small fraction of fresh water, viz.., 0.004 percent flows through rivers and streams. The volume of sea water is fifteen times greater than that of fresh water (Water Science School (2019)).

In order to check the quality of water, the samples for various parameters like pH, electrical conductance (EC), Dissolved oxygen (D O) Biological Oxygen Demand (BOD) Chemical Oxygen Demand (COD) alkalinity, hardness, chloride, sulphate, nitrate, phosphate and iron are collected from Different stations in the study area. However, on the selected water samples Heavy metals examination is also conducted.

MATERIALS AND METHODS

The Water Samples collected from various places in the Srikakulam District in the morning hours between 10 to 12 am in Polythene bottle regularly for every month. The Water samples were immediately brought into Laboratory for the Estimation of various Physico-chemical parameters, and pH were recorded at the time of sample collection by using Thermometer and Pocket Digital pH Meter. While other Parameters Such as DO, TDS, Free CO_2, Hardness, Alkalinity, Chlorides, Phosphate and Nitrate were estimated in the Laboratory by using Indian Standard Procedures (Titration method and Spectrophotometer (AAS) ThermoM5Model) (Trivedi and Goel,1986, APHA 1985).

RESULTS AND DISCUSSION

The toxicity evaluation is needed to evaluate the nature and degree of adverse effects of heavy metals on the organisms. The main aim behind any toxicity test is to determine the concentration of test material that can influence a group of test organisms during a period of exposure. The information generated on toxicity of the compound may be useful in protecting aquatic ecosystem and valuable aquatic life. In the present study, the acute toxicity effect of heavy metals, Cadmium and Lead were evaluated. The water used for acclimatization of fish and experimental purpose was the clear and unchlorinated ground water. The hydrographical properties of water are presented in

Table-1.

Normal range of water quality parameters according to the WHO: Table-1

Substances and characteristics	Acceptable concentration	Maximum Permissible unit
Colour	5 units	25 units
Odour	Unobjectionable	Unobjectionable
Taste	Unobjectionable	Unobjectionable
Turbidity	5 units	5 units
Dissolved solids	500 mg/L	1500 mg/L
Alkalinity	200	600 mg/L
pH range	7.0–8.5	----
Total Hardness	300 mg/L	600 mg/L
Chloride	250 mg/L	1000 mg/L
Sulphate	200 mg/L	400 mg/L
Nitrate	20 mg/L	45 mg/L
D O	5.0	-------
B O D	5.0	--------
C O D	10.0	------
Iron	0.1 mg/L	1.0 mg/L
Calcium	75.00	---
Magnesium	30.00	---
Fluoride	1.00	---
Electrical Conductivity(EC)	2000.00	---
Total dissolved Solids(TDS)	500.00	---
Total Hardness as $CaCO_3$	200 mg/L	---

Temperature and pH of water: Temperature of water samples taken at the time of collection ware in the range of 24 to 26°C. The maximum permitted standard of drinking water is 25°C. The pH value of water samples collected from well and bore well water were in the range of 7.34 to 8.61 reported for post monsoon 2019 samples.

Total Dissolved Solids (TDS): The maximum TDS range for water was found to be 842 mg/L and minimum was 112 mg/L and maximum TDS for 5th sample shown maximum levels of 842 mg/L and minimum was with 8th sample shown 112 mg/L (Table 2) for post monsoon 2019 samples.

Electrical Conductivity: The conductivity of water samples has shown in the results tables in both pre and post monsoon of 2019 to 2020. The results reveal that obtained value, the maximum EC range found for 20th sample 1862 mg/L and minimum was 512 mg/L 5th sample for post-monsoon 2019 samples.

Total Hardness: In the present investigation, maximum and minimum total hardness for collected water samples had shown in the pre and post monsoon 2019 501mg/L and gradually increased total hardness was reported and shown in post monsoon 2020 was 1200. The total hardness of collected water samples of 2019 both pre and post monsoon in comparison with post and pre monsoon 2020 were more. These high values may be due to the addition of calcium and magnesium salts.

COD and BOD: Chemical Oxygen Demands (COD) and Biochemical Oxygen Demand (BOD) is important parameters for oxygen required to degradation of organic matter. Acceptable levels were reported.

Alkalinity: The alkalinity range set by WHO is 500mg/L. Our results showed that alkalinity of given samples of both post and pre monsoon of 2019 and 2020 was not accordance with standard data.

Chlorides and DO: Chloride found high value for both the water samples. In the 2019 pre and post monsoon samples had shown 500 mg/L. It is reported that the higher value of chloride is associated with increased level of pollution and reported as 1362 in the post monsoon 2020. Dissolved oxygen is a most important aquatic parameter, whose existence is essential to aquatic fauna. It plays an important role in life process of animals. In this study DO values found 2.8 to 5.9 mg/L range found in the both the cases of pre and post monsoon of 2019 and 2020 collected samples were shown.

CONCLUSION: From physical and chemical properties of water samples collected from different places in Srikakulam District, Andhra Pradesh, India. Samples collected from in and around of 20 stations of Srikakulam district were analysed for water quality and utilization purpose both domestic and irrigation practice. The analysis reveals that the ground water of the area needs some degree of treatment before consumption.

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Tables and Graphs

Post-monsoon-water analysis-2020

Table 1

Sl.No	pH	Conductivity	TDS	HCO_3	TH
1	7.58	2690	441.6	550	1260
2	8.82	400	2688	100	660
3	9.14	350	3864	240	300
4	8.77	1060	1290	280	400
5	8.29	1580	809	440	1220
6	6.82	4200	2609	780	1060
7	8.78	1510	324	90	580
8	8.59	1908	2160	590	1460
9	8.77	2280	859	170	880
10	8.5	1210	1340	40	260
11	8.46	1450	2980	90	780
12	8.47	1420	268	330	860
13	8.17	1580	371	120	1140
14	8.94	2900	1016	250	1000
15	8.69	1850	144	180	420
16	8.14	1440	201	190	760
17	8.49	1580	371	420	860
18	7.95	2600	664	320	480
19	7.9	2009	280	490	180
20	7.44	1210	198	150	120

Table 2

Sl.No	Cl	F	NO_3	SO_4	Na	K	Ca	Mg
1	150	0.44	25.38	128	42.64	5.16	72	29.45
2	710	0.53	33.21	192	657.6	12.2	168	131.3
3	260	0.66	20.18	156	109.9	52.6	180	48.62
4	290	0.99	16.84	156	108.1	260.9	188	43.76

5	240	0.89	19.85	194	98.65	11.9	104	63.21
6	710	0.81	42.84	122	657.6	12.2	168	131.3
7	160	0.26	41.45	171	44.98	11.3	140	29.45
8	470	0.94	22.22	147	218	20.8	112	68.07
9	290	0.76	28.33	125	125.8	16.3	156	58.34
10	130	0.52	34.18	99	24.6	10.53	116	24.86
11	170	0.72	40.21	121	19.1	16.2	132	24.31
12	130	0.36	31.53	157	27.24	10.68	148	19.72
13	190	0.88	11.29	176	85.84	11.34	124	19.45
14	400	0.79	21	163	189.3	172.4	188	43.76
15	100	0.51	2.37	120	90.62	39.88	132	34.03
16	140	0.82	13.35	158	29.86	10.86	140	34.59
17	160	0.48	41.38	146	54.4	23.98	132	39.45
18	420	0.62	12.33	212	402.6	178.8	164	53.48
19	400	0.6	47.56	197	208.6	140	138	260
20	140	0.57	30.18	110	28.16	10.94	124	39.72

Pre-Monsoon-water analysis-2020

Table 3

S.No.	**pH**	**Conductivity**	**TDS**	**HCO_3**	**TH**
1	8.92	1100	784	290	80
2	8.96	1700	648	126	4.7
3	8.87	1600	184	280	340
4	8.85	1010	170	60	80
5	8.9	1350	424	100	240
6	8.99	1800	640	140	240
7	8.73	4200	2248	220	920
8	8.55	1500	860	280	320
9	8.61	550	260	120	140
10	8.19	2400	886	60	260

11	8.51	800	156	180	280
12	8.06	700	412	40	220
13	7.98	3800	284	60	140
14	8.49	2400	996	110	240
15	7.98	300	284	60	100
16	8.77	700	584	70	140
17	8.65	930	167	140	251
18	8.52	2980	1228	220	120
19	8.64	2080	1980	130	280
20	8.93	520	505	160	220

Table 4

Sl.No	**Cl**	**F**	**NO_3**	**SO_4**	**Na**	**K**	**Ca**	**Mg**
1	192.19	0.88	14.76	154	8.51	2.2	56	36
2	156.73	1.17	45.64	120	20.4	0.76	74	13.6
3	156.73	0.41	2.836	110	25.83	0.9	52	32.4
4	114.18	1.03	13.06	110	5.05	4.12	58	27.2
5	128.36	0.58	1.673	124	0.85	1.4	52	14.4
6	192.19	0.86	10.65	134	6	17.5	52	24.4
7	496.44	0.38	37.53	185	3.42	14.4	54	90
8	212.76	0.58	25.24	109	8.51	11.9	66	43.2
9	135.46	1.4	10.95	110	0.78	10.8	68	28
10	177.3	1.02	25.13	165	4.62	30.9	62	28
11	128.37	0.45	20.25	17	8.44	1.94	82	32.4
12	142.55	0.31	13.71	17	12.93	1.84	70	21.6
13	170.92	0.13	11.53	18	15.58	0.66	68	25.2
14	177.3	0.41	8.873	159	9.72	3.5	52	32.4
15	199.29	1.02	14.18	126	17.91	9.22	56	20.8
16	135.46	0.49	30.22	116	10	0.86	46	27.2
17	190	0.21	13.1	163	63.06	1.14	64	24.31
18	354.6	0.25	10.43	117	9.11	114	66	46.8

19	425.52	0.46	18.65	124	98.8	1.25	68	43.2
20	121.27	0.34	11.82	186	11.02	4	42	25.2

Post-Monsoon-water analysis-2019

Table 5

S.No.	pH	EC(µs/m)	TDS(mg/l)	HCO_3mg/l)	TH(mg/l)
1	8.55	794	607	250	60
2	8.45	745	476	10	20
3	7.54	681	335	40	40
4	8.02	330	111	60	20
5	8.56	528	338	70	240
6	8.69	1021	597	100	304
7	8.19	830	931	170	200
8	7.58	1023	254	10.4	240
9	8.04	1320	544	10.028	200
10	8.28	683	337	65	40
11	8.04	696	345	40	80
12	8.08	722	262	0	120
13	8.88	683	337	65	40
14	8.36	1559	698	80	480
15	8.33	739	673	53	80
16	8.22	389	148	1.3	60
17	8.09	439	180	70	390
18	7.89	2025	896	30	220
19	7.88	1657	260	300	502
20	7.89	1330	451	135	320

Table 6

Sl.No	Cl	F	NO_3	SO_4	Na	K	Ca	Mg

	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
1	155.3	0.89	0.42	133	138	0.8	29	39
2	110	0.14	1.82	62	73.96	1.2	28	176
3	147	0.79	1.68	129	31	3.2	49	200
4	130	0.28	4	130	14	0.78	62	104
5	160	0.15	6	45.82	6.9	0.39	59	224
6	100	0.38	38.4	104	73.28	1.56	89.6	258.4
7	154	0.89	11.6	62	87	35	45	160
8	43.4	0.38	1.8	139	135	1.2	45	200
9	122	0.67	18.2	249	188	2.7	39	168
10	76	1.3	12.8	76.8	48	1.56	49	100
11	57	0.48	4.2	153	60	1.6	48	132
12	82	0.39	8.4	86	96	2.3	74	96
13	76	1.36	12.8	76.8	48	1.56	64	100
14	130	0.49	17	182	110	35	112	368
15	102	0.66	3.4	144	116	25	58	72
16	70	0.42	5.6	57	21	0.39	64	136
17	136	0.81	3.64	57	21	10	48	252
18	500	0.25	6.02	110	215	160	44	280
19	170	0.16	18	154	131	3.1	100	400
20	165	0.82	25.7	152	129	42	66	304

Pre-Monsoon-Water Analysis-2019

Table 7

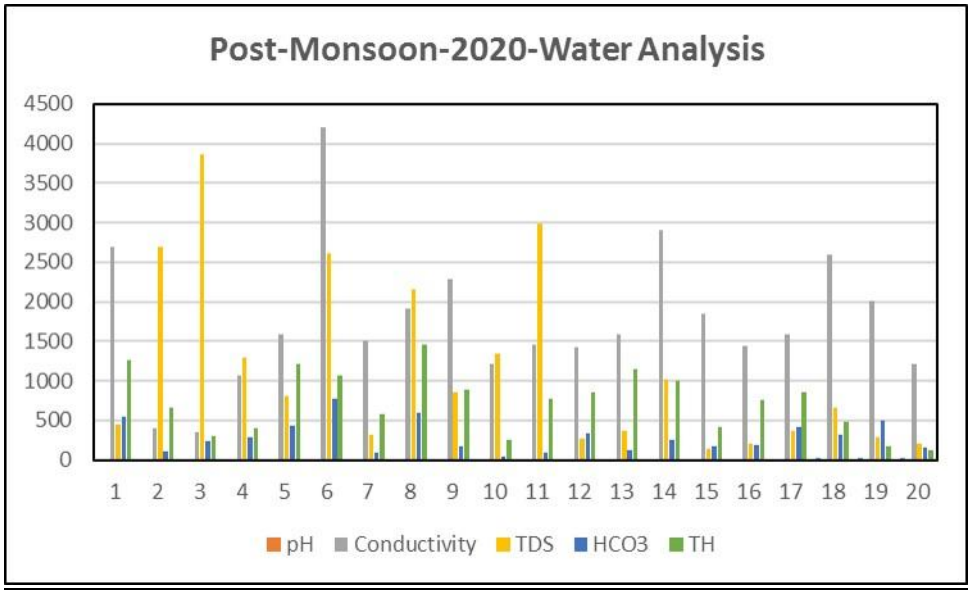
S.No.	pH	EC(µs/m)	TDS(mg/l)	HCO_3 (mg/l)	TH(mg/l)
1	7.95	1649	943	216	222
2	7.74	846	532	184	158
3	8.91	512	212	195	151
4	8.61	1548	824	362	155

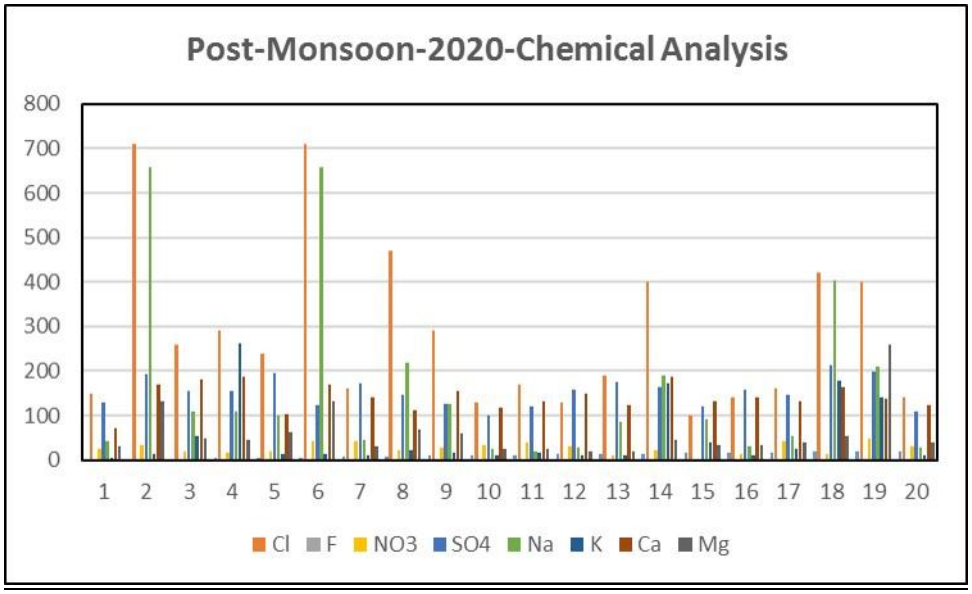
5	8.12	1284	642	164	560
6	8.49	948	431	221	158
7	8.72	946	384	184	164
8	8.14	1486	1000	198	228
9	8.27	948	528	221	294
10	7.99	647	284	184	154
11	8.29	1184	824	192	421
12	8.36	849	462	138	201
13	8.26	948	394	124	165
14	8.06	1346	955	286	201
15	8.22	624	384	168	191
16	8.38	856	198	194	164
17	8.14	948	328	251	201
18	8.01	1238	884	196	164
19	8.34	946	489	301	184
20	8.61	1862	1262	234	194

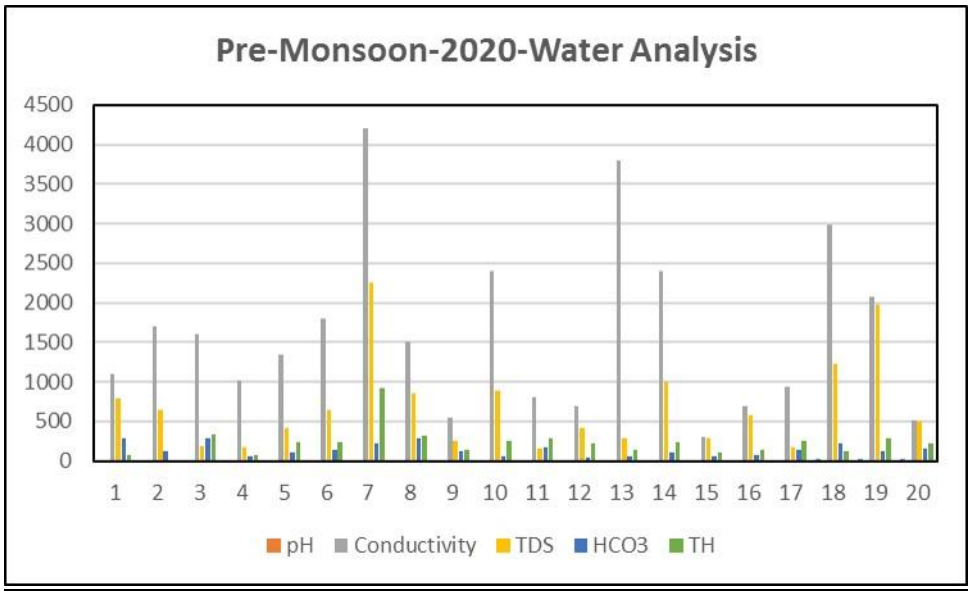
Table 8

Sl.No	**Cl (mg/l)**	**F (mg/l)**	**NO_3 (mg/l)**	**SO_4 (mg/l)**	**Na (mg/l)**	**K (mg/l)**	**Ca (mg/l)**	**Mg (mg/l)**
1	165	0.14	32.16	138	206	38.16	28	101
2	195	0.42	7.52	131	51.02	2.64	42	123
3	112	0.48	8.12	141	801	8.46	21	21
4	141	0.31	14.67	184	92	38	201	501
5	168	0.52	31.65	101	301.24	6.94	191	301
6	152	0.32	23.49	112	18.64	3.84	132	1176
7	127	0.41	9.84	158	91	72	41	84
8	238	0.26	16.84	194	213	34	58	184
9	109	0.43	8.26	159	56	32.54	39	98
10	143	0.26	24.62	154	21.34	6.84	121	154
11	306	0.32	16.84	158	201	464	132	182
12	169	0.21	58.02	124	74.62	12.84	84	112
13	176	0.23	32.08	112	42.54	32.57	62	89
14	186	0.12	51.04	181	124.61	26	121	154

15	109.62	0.32	12.84	126	62.71	32	28	89
16	164	0.16	8.62	19	34.08	17.84	41	48
17	172	0.26	58.64	128	34.01	8.46	54	132
18	212	0.31	37.46	161	164.85	94.62	67	154
19	289	0.11	19.56	112	112	10.51	126	167
20	301	0.41	32.64	212	234	8.42	121	364



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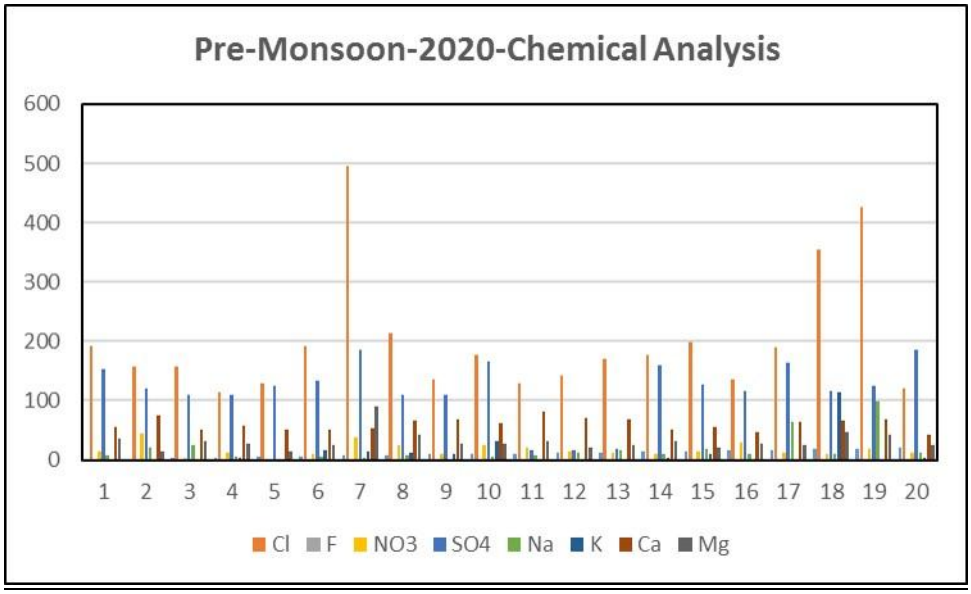
pH
Conductivity
TDS
HCO3
TH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400
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200
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F
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SO4
Na
K
Ca
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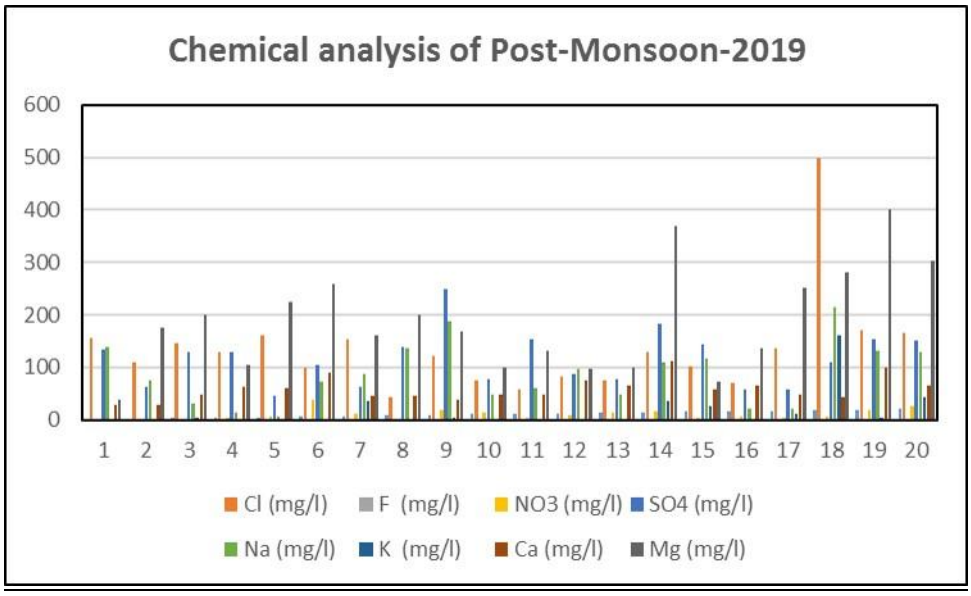
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300
200
100
0
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Cl (mg/l)
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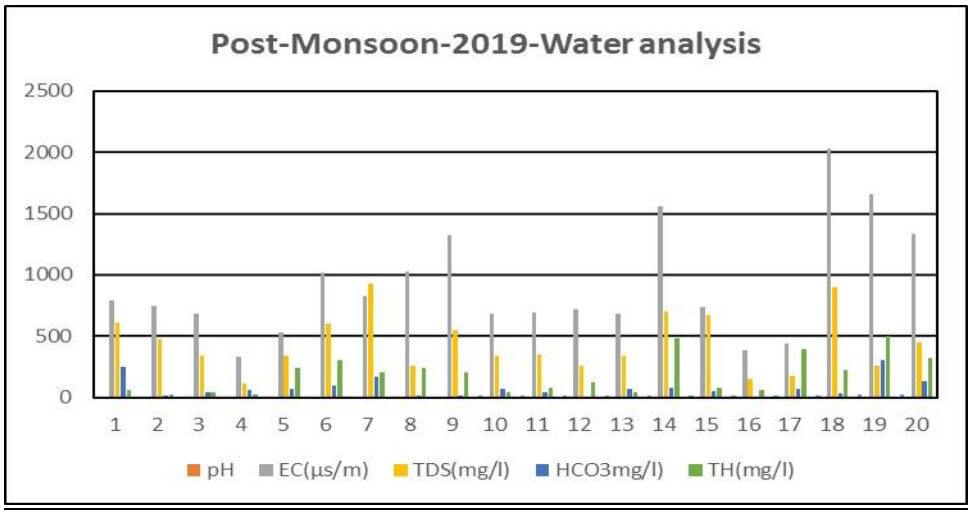
Na (mg/l)
K (mg/l)
Ca (mg/l)
Mg (mg/l)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1000
500
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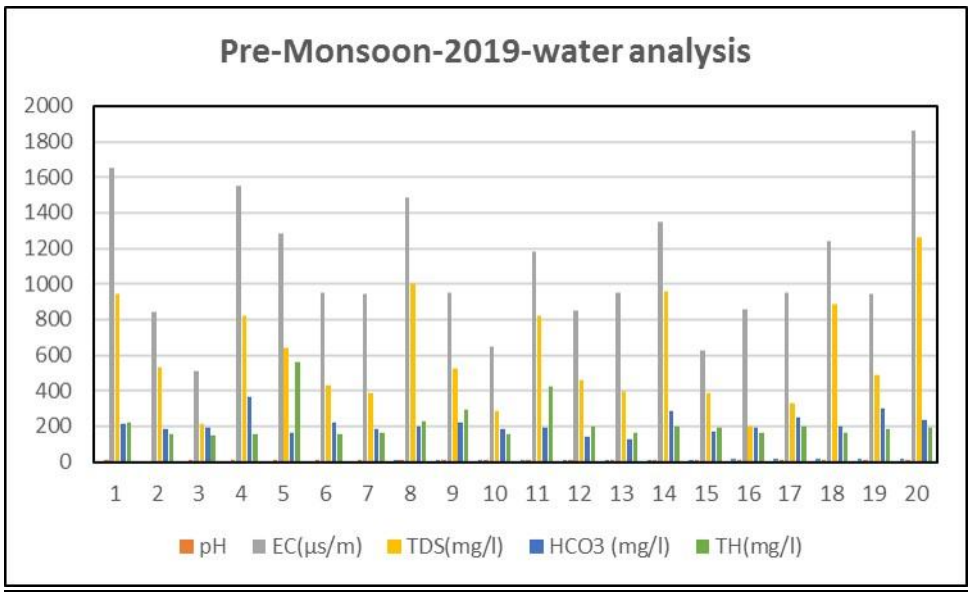
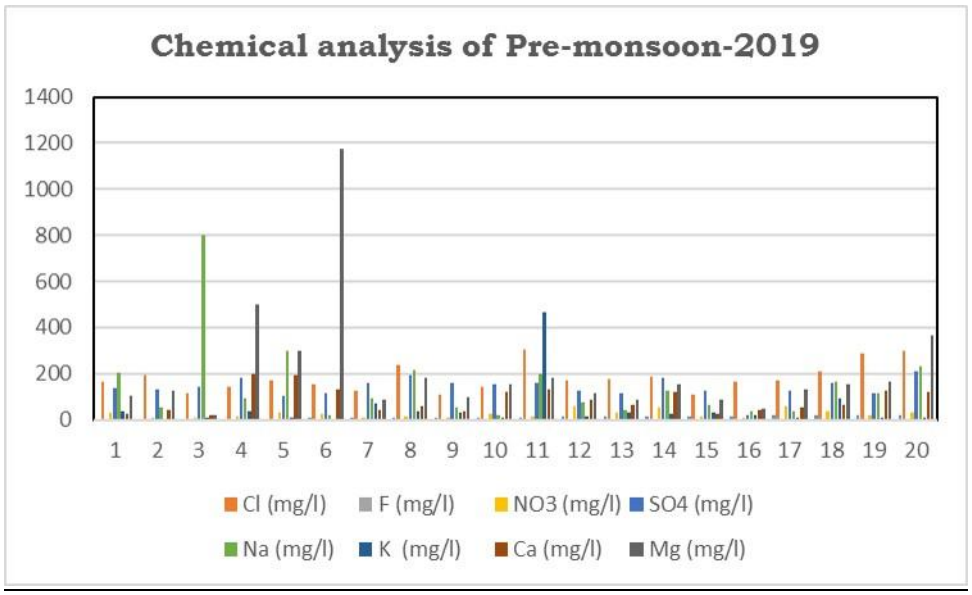
EC(µs/m)
TDS(mg/l)
HCO3mg/l)
TH(mg/l)


Pre-Monsoon-2019-water analysis
2000
1800
1600
1400
1200
1000
800
600
400
200
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
pH
EC(µs/m)
TDS(mg/l)
HCO3 (mg/l)
TH(mg/l)


Chemical analysis of Pre-monsoon-2019
1400
1200
1000
800
600
400
200
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Cl (mg/l)
F (mg/l)
NO3 (mg/l)
SO4 (mg/l)
Na (mg/l)
K (mg/l)
Ca (mg/l)
Mg (mg/l)