Universal Journal of Environmental Research and Technology
 eISSN 2249 0256
Available Online at: **www.environmentaljournal.org**
2016 Volume 6, Issue 4: 180-194

Open Access **Research Article**

Physico-chemical and Microbial Analysis of Godavari Water during Pushkaram

[1]Yamuna Devi Siraparapu, [2]Bhaskara Venkata Prasad B, [3]Aruna Kumari S, [4]Padma U

[1, 3]Department of Chemistry, Aditya College of Engineering, ADB Road, Near Peddapuram, Aditya Nagar, Surampalem-533437, India
[2]Department of Chemistry, Daicel Chiral Technologies India Pvt. Ltd., Hyderabad-5000078, India
[4]Department of Environmental Science, Aditya Engineering College, ADB Road, Near Peddapuram, Aditya Nagar, Surampalem-533437, India

Corresponding Author: yamunasiraparapu@yahoo.com

Abstract:

The physico-chemical and microbial characteristics of river Godavari has been studied during Godavari Pushkaram 2015. Godavari is the second longest river in India. Pushkaram is the festival of Godavari which occurs once in 12 years. At this time of Godavari Pushkaram lakhs of people took bath in Godavari water. The present analysis on Godavari water was carried out for one year i.e., from January 2015 to December 2015 means before Pushkaram, during Pushkaram and after Pushkaram. For water quality analysis seven sampling stations were selected which are located at upstream, middle stream and downstream of east and west Godavari. The water samples were collected and analyzed as per the standard methods of APHA (1999). In this study Temperature, PH, Electrical Conductivity, Total Hardness, Total Alkalinity, Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Turbidity, Calcium, Magnesium, Iron, Fluoride, Chloride, Total Dissolved Solids (TDS), sulphate, E-Coli parameters were analyzed. The obtained results are compared with water quality standards given by World Health Organization, Environmental Protection Agency and Bureau of Indian Standards. During Pushkaram there are some deviations in physico chemical parameters, but there is drastic change in E-Coli. On the basis of various parameters studied during Pushkaram, Godavari water is polluted due to anthropogenic activities.

Keywords: Godavari Pushkaram, physico-chemical and microbial parameters, anthropogenic activities.

1.0 Introduction:

Water is the basic need for human beings. Rivers are the sources of water for drinking, for obtaining food etc. In terms of length, catchment area and discharge the Godavari River is the largest in peninsular India and had been dubbed as the Dakshina Ganga – The south Ganges River. Godavari originates at Triumbakam, Nasik District of Maharashtra state and flows through southern state of Andhra Pradesh and reaches the Bay of Bengal. Godavari water plays a key role in providing potable water, transportation, electricity, and dams' construction. Godavari Pushkaram is a festival of rivers pertains to 12 rivers in India which occurs once in 12 years. The Godavari Pushkaram held last time in the year 2003. During Godavari Pushkaram lakhs of people from all over the country took a dip and bath in the river Godavari. In the year 2015 from July 14th to 25th lakhs of people from different places of the country too bath in the river Godavari (Saksena, Garg and Rao, 2008). So in that time Godavari water quality is degraded due to anthropogenic activities. Water pollution affects the entire biosphere. In almost all cases the effect is being damaged not only to individual species and population but also the natural biological communities. The present study reveals how the Godavari water is contaminated during Pushkaram (Bawa kalpana and Gaikawad, 2013).

2.0 Materials and Methods:

In the present study the samples were collected from different places of East and West Godavari which covers the upstream, mid-stream and downstream of the Godavari River. The sampling stations are

i. Rajahmundry (S1) (N 17°0'1.94", E 81°48'14.52").
ii. Kovvur (S2) (N 17°0'45.08", E 81°43'36.24").

iii. Dowlaiswaram (S3) (N 16°56'5.11", E 81°47'17.65").
iv. Kumaradevam (S4) (N 17°3'57.55", E 81°42'32.21").
v. Seethanagaram (S5) (N 17°4'53.07", E 81°45'46.81").
vi. Muggaulla (S6) (N 17°8'52.49", E 81°42'22.36").
vii. Vadapalli (S7) (N 16°48'55.54", E 81°48'46.34").

The samples were collected at monthly intervals from January 2015 to December 2015, covering three seasons. Standard methods (APHA 1999) are used for sampling collection, preservation and estimation of physico chemical and microbial parameters like Temperature, PH, Electrical Conductivity, Total Hardness, Total Alkalinity, Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Turbidity, Calcium, Magnesium, Iron, Fluoride, Chloride, Total Dissolved Solids (TDS), sulphate, E-Coli (APHA 1999). One liter of samples was collected for physico chemical and microbial analysis from each station into pre sterilized bottles without air bubbles. All the samples are stored at low temperature which is less than 4°C and above freezing point. In order to minimize the volatilization or biodegradation between sampling and analysis, we kept the samples as cool as possible without freezing. Temperature, PH, turbidity, alkalinity, and electrical conductivity were analyzed immediately after sampling collection. In the present study for analyzing the iron in water, water samples were collected in a separate clean bottle and acidified with acid (Saksena, Garg and Rao, 2008).

3.0 Results and Discussion:

***Temperature*:** Temperature affects the dissolved oxygen percentage in water there by effects the aquatic life. Whenever temperature increases then BOD of water increases, change in taste, odor, colour and corrosion. The lowest temperature recorded in the month of October, November and December. Here the highest temperature is recorded in the month of May and June. The variation in temperature from Jan 2015– DEC 2015 is represented in table1 and average monthly variations in all stations are represented in figure a.

***PH*:** The natural PH range of a river is largely determined by the geology and soils of the area. The fluctuations in PH value of river water can affect the aquatic life. In the present study the lowest value of PH is recorded in the month of July i.e., 6.02 at station S1. This is due to anthropogenic activities during Pushkaram in Godavari River. The variations in PH from Jan 2015– DEC 2015 are represented in table 2 and average monthly variations in all stations are represented in figure b.

***Electrical Conductivity** (EC)*: The conductivity of water is an expression of its ability to conduct an electric current [EPA 2001]. Variations in temperature are greatly affected the conductivity of water. If there is change in chloride ion, sulphate ion, sodium, magnesium, calcium, iron affects the conductivity of water. In the present study the highest electrical conductivity is recorded in the month of July i.e., 561 µS/cm at station S1. This is because there lots of pollutants are discharged into the water during Pushkaram due to human activities. The variations in electrical conductivity from Jan 2015– DEC 2015 are represented in table 3 and average monthly variations in all stations are represented in figure c.

***Total Hardness** (TH):* The total hardness of water is due to presence of calcium, magnesium and some extent of iron. Because of human activities during Pushkaram there is a change in concentration of calcium, magnesium, iron, sulphate and chloride ions, this change intern increases the hardness of water. In the present study the highest value of total hardness is recorded in the month of July i.e., 665.2 mg/lit at S1. The variations in total hardness from Jan 2015– DEC 2015 are represented in table 4 and average monthly variations in all stations are represented in figure d.

***Total Alkalinity:** (TA)* The alkalinity of natural water is due to presence of carbonates and bicarbonates in water. Variation in alkalinity affects the taste of the water. In the present study the highest value of alkalinity is recorded in the month of August i.e., 112.5 mg/lit at S1. This increase in alkalinity indicates the presence of pollutants in water. The variations in alkalinity from Jan 2015– DEC 2015 are represented in table 5 and average monthly variations in all stations are represented in figure e.

***Dissolved Oxygen** (DO):* the dissolved oxygen content of water is influenced by the source i.e., raw water temperature, treatment and chemical and biological processes taking place in the

distribution system. Depletion of dissolved oxygen in water supplies can encourage the microbial reduction of nitrate to nitrite and sulphate to sulphide [WHO 2011]. In the present study the lowest value of D O is recorded in the month of July i.e., 4.5 mg/lit at S1. Because of human activities during Pushkaram, D O decreases and is below the permissible limit. This lower value of D O affects the aquatic life. The variations in D O from Jan 2015– DEC 2015 are represented in table 6 and average monthly variations in all stations are represented in figure f.

Biological Oxygen Demand *(BOD):* if the D O of water decreases then consequently BOD of water increases. High value of BOD represents the water gets polluted. In the present study the highest value of BOD is recorded in the month of July i.e., 54.5 mg/lit at S1. This elevated BOD values represents lots of pollutants are discharged into the water by human activities during Pushkaram. The variations in BOD from Jan 2015– DEC 2015 are represented in table 7 and average monthly variations in all stations are represented in figure g.

Chemical Oxygen Demand *(COD):* The decreased in the D O of water increases the COD. This affects the aquatic life. In the present study the highest value of COD is recorded in the month of July i.e., 56 mg/lit at S1. This is due to anthropogenic activities during Pushkaram. The variations in COD from Jan 2015– DEC 2015 are represented in table 8 and average monthly variations in all stations are represented in figure h.

Turbidity: Turbidity in water is caused by suspended particles or colloidal matter that obstructs light transmission through the water. It may be caused by inorganic or organic matter or a combination of the two [WHO 2011]. In the present study the highest value of turbidity is recorded in the month of July i.e., 15.8 NTU at S1 during Pushkaram. This may affect the aquatic life. The variations in turbidity from Jan 2015– DEC 2015 are represented in table 9 and average monthly variations in all stations are represented in figure i.

Calcium: The increase in concentration of calcium of water causes hardness. In the present study the highest value of calcium is recorded in the month of July i.e., 24.5 mg/lit at station S1 during Pushkaram. The variations in calcium from Jan 2015– DEC 2015 are represented in table 10 and average monthly variations in all stations are represented in figure j.

Magnesium: In the present study the highest value of magnesium is recorded in the month of July i.e., 146.7 mg/lit at station S1 during Pushkaram. This leads to increase in the hardness of water. The variations in magnesium from Jan 2015– DEC 2015 are represented in table 11 and average monthly variations in all stations are represented in figure k.

Iron**:** At levels above 0.3 mg/lit, iron stains laundry and plumbing features [WHO 2011]. In the present study the highest value of iron is recorded in the month of JULY i.e., 1.47 mg/lit at station S6 during Pushkaram. The variations in iron from Jan 2015– DEC 2015 are represented in table 12 and average monthly variations in all stations are represented in figure l.

Fluoride**:** Generally high concentrations of fluoride ion in water cause dental fluorosis. In the present study the highest value of fluoride is recorded in the month of July 1.81 mg/lit at S1. The variations in fluoride from Jan 2015– DEC 2015 are represented in table 13 and average monthly variations in all stations are represented in figure m.

Chloride: High concentration of chloride gives salty taste to water [WHO 2011]. The change in concentration of chloride ion influences the electrical conductivity and total hardness of water. In the present study the highest value of chloride is recorded in the month of July i.e., 78.5mg/lit at station S1. The variations in chloride from Jan 2015– DEC 2015 are represented in table 14 and average monthly variations in all stations are represented in figure n.

Table 1: Monthly variations in temperature

TEMPERATURE (°C)												
samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
S1	22	23	26	26	29	29	26	25	24	22	21	20
S2	22	23	26	26	28	28	26	25	22	21	20	20
S3	21	23	25	26	28	27	25	25	22	20	20	20
S4	21	22	25	26	28	27	25	25	21	20	20	20
S5	21	22	25	25	26	26	25	24	21	19	19	19
S6	21	21	24	25	26	25	24	24	21	19	19	19
S7	20	21	24	25	26	25	24	24	21	19	19	19
AVG	21.1	22.1	25	25.6	27.3	26.7	25	24.6	21.7	20	19.7	19.6

Table 2: Monthly variations in PH

PH												
samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
S1	6.91	7.18	7.54	7.53	6.89	6.3	6.02	6.12	6.34	6.64	7.25	7.5
S2	6.98	7.32	7.68	7.58	6.9	6.37	6.1	6.15	6.38	6.71	7.39	7.51
S3	7.02	7.49	7.69	7.59	6.9	6.39	6.28	6.21	6.41	6.8	7.43	7.52
S4	7.1	7.54	7.71	7.61	6.92	6.4	6.29	6.24	6.42	6.82	7.44	7.55
S5	7.1	7.56	7.72	7.62	7.2	6.41	6.3	6.3	6.44	6.82	7.5	7.59
S6	7.21	7.79	7.74	7.63	7.31	6.42	6.31	6.35	6.5	6.83	7.53	7.61
S7	7.42	7.88	7.77	7.64	7.32	6.43	6.31	6.36	6.51	6.98	7.56	7.73
AVG	7.1	7.5	7.7	7.6	7.1	6.4	6.2	6.2	6.4	6.8	7.4	7.6

Table 3: Monthly variation in Electrical Conductivity (EC)

Electrical Conductivity (µS/cm)												
samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
S1	224	280	321	306	346	418	561	440	263	199	182	179
S2	217	260	241	256	319	406	518	406	254	196	181	171
S3	213	253	222	289	302	392	503	422	257	194	180	173
S4	196	206	234	240	296	402	429	395	249	187	173	169
S5	195	211	207	238	284	369	448	340	235	194	175	169
S6	189	218	218	248	292	387	462	397	222	182	172	164
S7	174	210	190	261	264	374	494	382	205	179	171	161
AVG	201	234	233	263	300	393	488	397	241	190	176	169

Table 4: Monthly variation in Total Hardness (TH)

Total Hardness (mg/lit)												
samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
S1	342	317	320	399	462	602	665	652	521	453	402	341
S2	341	309	316	387	445	596	640	642	512	451	398	320
S3	312	295	318	379	453	579	611	624	506	438	392	295
S4	308	270	297	342	440	563	605	619	505	441	392	291
S5	294	250	273	358	413	542	597	612	453	436	372	283
S6	291	258	267	349	418	509	500	623	440	418	387	286
S7	297	258	248	323	408	499	502	603	469	421	385	215
AVG	312	280	291	362	434	556	589	625	487	437	390	290

Table 5: Monthly variation in Total Alkalinity (TA)

Total Alkalinity (mg/lit)												
samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
S1	54.1	53	53.8	62.4	60.2	85.1	110	113	86.5	75.4	69.4	50.5
S2	52.6	52.6	48.5	61.7	59.1	80.4	95	99.1	84.2	76.1	55.6	49.6
S3	49.6	51.7	51	63	58.4	76.3	98.1	98.4	82.3	72.4	54.8	53.4
S4	46	53.9	54.9	60.6	59.3	74.2	96.4	95.2	80.6	69.8	50.3	51.2
S5	48.2	52	47.3	59.8	58	70.5	94.2	96.3	81.1	65.4	49.2	50.6
S6	42.4	50.6	50	54.7	58.2	70.1	99.4	97.1	78	66.3	43.6	48
S7	41	49	54	46.3	56.5	68.2	93.5	94.2	78.5	62.1	48.4	46.3
AVG	47.7	51.8	51.4	58.4	58.5	75	98.1	99	81.6	69.6	53	49.9

Table 6: Monthly variation in Dissolved Oxygen (DO)

DO (mg/lit)												
samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
S1	10.1	10.2	9.9	9.6	9.1	4.8	4.5	4.6	5.8	6	7.1	8.7
S2	10.6	10.8	10.1	9.9	9.2	5.1	4.9	4.8	5	6.1	8.1	8.9
S3	11.3	11.9	10.5	10.1	9.6	5.2	5.3	5	5.1	6.3	8.2	9.2
S4	13.2	12.1	11	10.2	9.8	5.9	5.6	5.3	6.4	7.5	8.5	9.5
S5	13	12.7	11.6	10.5	10.4	5.1	5.4	5.5	6.4	7.5	9.9	9.8
S6	13.1	12.2	12.2	11.3	10.5	5.2	5.8	5.5	6.5	7.8	9	9.9
S7	13.3	12.8	12.5	11.7	10.9	5.4	5.1	5.9	6.8	8.1	9.2	9.3
AVG	12.1	11.8	11.1	10.5	9.93	5.24	5.23	5.23	6	7.04	8.57	9.33

Table 7: Monthly variation in Biological Oxygen Demand (BOD)

BOD (mg/lit)												
samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
S1	5.3	11	11.9	12.8	12.9	39.6	54.5	45.6	22.8	16.6	10.1	5.1
S2	5	10.5	11.7	12.5	12.4	38.4	52.3	45.4	22.5	14.2	9.6	5
S3	4.7	10.3	11.4	12.2	11.9	35.1	49.4	45.2	22.1	14.2	9.4	4.7
S4	4.5	9.8	11.2	12	11.8	32.1	48.5	43.1	21.8	14.1	9.1	4.6
S5	4.3	9.1	10.3	11.8	11.2	29.1	45.6	40.2	21.5	13.5	8.9	4.5
S6	4.1	7.3	9.4	10.6	11.2	28.3	42.3	39.1	21	12.4	8.5	4.1
S7	3.8	6.4	8.9	9.3	10.4	24.8	40.2	38.3	20.1	11.3	8.2	3.9
AVG	4.53	9.2	10.7	11.6	11.7	32.5	47.5	42.4	21.7	13.8	9.11	4.56

Table 8: Monthly variation in Chemical Oxygen Demand (COD)

COD (mg/lit)												
samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
S1	9.3	16.4	15.5	14.7	14.8	40.8	56	47	26.2	21.6	15.1	8.9
S2	8.9	15.9	15.4	14.6	14.4	40	49.3	47.3	26.2	18.7	14.6	8.9
S3	8.5	15.8	15.2	14.4	14	36.9	47	47.6	26	18.9	14.5	8.5
S4	8.3	15.3	15.1	14.3	14.1	34.1	46.6	45.9	24.5	19.1	14.2	8.5
S5	8.1	14.4	14.1	14.2	13.5	31.3	44.3	43.2	25.9	18.5	14.1	8.5
S6	7.9	11.8	13	13	13.7	30.8	41.5	42.5	25.6	17.2	13.7	7.9
S7	7.5	10.5	12.5	11.5	12.8	27.3	39.8	42.1	24.8	15.9	13.4	7.6
AVG	8.36	14.3	14.4	13.8	13.9	34.5	46.4	45.1	25.6	18.6	14.2	8.4

Table 9: Monthly variation in Turbidity

Turbidity (NTU)												
samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
S1	3.6	3.9	4	4.5	5.8	7.9	15.8	15.7	14.8	12.6	10.4	7.4
S2	3.3	3.5	3.8	4.3	5.6	7.6	14.9	15.2	14.6	11.8	9.8	7.1
S3	2.8	3.3	3.5	4.2	5.4	7.5	14.7	15	14.2	11.6	9.4	6.9
S4	2.7	3.2	3.4	4.1	5.3	7.4	14.4	14.9	14	11.3	9.3	6.8
S5	2.7	3.2	3.3	4.2	5.1	7.4	14.3	14.8	13.8	11.1	9.1	6.8
S6	2.6	3.1	3	4	5	7.2	14.1	14.7	13.6	10.9	9	5.6
S7	2.5	2.9	3	4	5.2	7.1	13.9	14.3	13.2	10.8	8.9	5.4
AVG	2.89	3.3	3.43	4.19	5.34	7.44	14.6	14.9	14	11.4	9.41	6.57

Table 10: Monthly variation in Calcium

Calcium (mg/lit)												
samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
S1	17.5	20	20.1	16.9	17.6	19	24.5	24.1	22.5	17.7	16.4	16.7
S2	18.2	19.4	19.2	17.1	18.3	19.1	23.7	24.1	24.1	18.8	17.2	16.2
S3	17.6	18.3	18.8	16.7	17.1	18.5	24.3	23.4	25.3	18.1	16.3	15.8
S4	18.3	17.8	18.2	16.4	17.5	18.9	21.2	21.4	19.1	17.3	16.4	15.9
S5	18.2	18.8	19.2	16.5	17.1	18.6	21.6	22.6	25	18.5	16.8	16.1
S6	17.2	19.1	18.6	16.8	17	18.2	22.5	23.8	23.1	17.9	16.8	15.4
S7	17.8	18.5	20.3	16.3	16.9	19.2	20.4	22.9	24.9	18.2	16.1	16
AVG	17.8	18.8	19.2	16.7	17.4	18.8	22.6	23.2	23.4	18.1	16.6	16

Table 11: Monthly variation in Magnesium

Magnesium (mg/lit)												
samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
S1	71.5	64	64.7	85.5	100	133	147	142	111	98.1	86.5	71.7
S2	70.9	62.6	64.3	82.5	95.9	132	140	140	109	96.9	85.2	67
S3	64.4	59.7	65.1	81	98.5	128	132	136	106	94.3	84.4	61.4
S4	63	54.1	60.3	72.3	95	124	133	136	110	95.5	84.3	60.3
S5	59.7	48.7	54.1	76.1	88.8	119	130	133	93.7	93.6	79.2	58.2
S6	59.6	50.5	52.8	73.7	90.2	111	107	135	91.8	89.6	82.6	59.5
S7	60.5	50.9	47.2	67.8	87.8	108	108	131	97.7	90.2	82.8	42
AVG	64.2	55.8	58.4	77	93.8	122	128	136	103	94	83.6	60

Table 12: Monthly variation in Iron

Iron (mg/lit)												
samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
S1	0.28	0.31	0.26	0.27	0.34	0.91	1.38	1.06	1.01	0.78	0.76	0.69
S2	0.26	0.25	0.24	0.28	0.35	0.89	1.4	1.16	0.91	0.81	0.77	0.65
S3	0.25	0.22	0.2	0.25	0.32	0.86	1.15	1.09	0.96	0.79	0.73	0.7
S4	0.21	0.21	0.21	0.25	0.31	0.87	1.29	1.13	0.98	0.83	0.75	0.69
S5	0.19	0.21	0.22	0.21	0.35	0.85	1.3	1.15	0.93	0.82	0.72	0.71
S6	0.2	0.2	0.23	0.23	0.33	0.88	1.47	1.04	0.89	0.81	0.74	0.65
S7	0.22	0.21	0.24	0.22	0.32	0.82	1.1	1.13	0.95	0.79	0.77	0.66
AVG	0.23	0.23	0.23	0.24	0.33	0.87	1.3	1.11	0.95	0.8	0.75	0.68

Table 13: Monthly variation in Fluoride

Fluoride (mg/lit)												
samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
S1	0.11	0.23	0.18	0.31	0.56	0.78	1.81	1.63	0.94	0.72.	0.41	0.39
S2	0.1	0.21	0.16	0.29	0.52	0.74	1.52	1.42	0.78	0.7	0.33	0.28
S3	0.08	0.18	0.15	0.27	0.51	0.72	1.33	1.21	0.69	0.69	0.32	0.27
S4	0.07	0.15	0.14	0.25	0.49	0.71	1.21	1.16	0.68	0.69	0.3	0.22
S5	0.07	0.17	0.14	0.22	0.47	0.69	1.12	1.05	0.57	0.56	0.29	0.21
S6	0.06	0.16	0.12	0.21	0.45	0.68	1.16	0.94	0.55	0.53	0.27	0.19
S7	0.06	0.13	0.11	0.21	0.42	0.65	1.08	0.83	0.51	0.5	0.24	0.18
AVG	0.08	0.18	0.14	0.25	0.49	0.71	1.32	1.18	0.67	0.61	0.31	0.25

Table 14: Monthly variation in Chloride

Chloride (mg/lit)												
samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
S1	29.1	31.6	33.5	34.6	34.4	66.4	78.5	72.7	58.6	54.3	52.6	49.5
S2	28.1	31.3	33.1	34.1	34	66.1	75.6	72.2	57.3	51.8	50.7	48.4
S3	27.8	30.1	32.6	33.8	33.9	64.5	74.2	71.4	57.1	51.2	50.1	48.1
S4	27.6	29.8	32.4	33.6	33.4	63.2	73.8	71	55.4	50.9	49.5	47.9
S5	27.5	29.6	32	32.9	33.1	62.1	73.4	70.3	54.8	49.7	48.3	47.2
S6	27.3	29.5	31.8	31.9	32.1	61.5	72.1	70.1	53.6	48.6	47.6	47
S7	27.1	28.8	31.4	31.9	32.1	59.8	71.9	69.6	53.3	48.1	47.2	45
AVG	27.8	30.1	32.4	33.3	33.3	63.4	74.2	71	55.7	50.7	49.4	47.6

Table 15: Monthly variation in Total Dissolved Solids (TDS)

TDS (mg/lit)												
samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
S1	143	179	205	196	221	267	359	282	168	127	116	115
S2	139	166	154	164	204	260	331	260	163	125	116	109
S3	136	162	152	185	193	251	322	270	164	124	115	111
S4	125	132	150	154	189	257	274	253	159	120	111	108
S5	125	135	132	152	182	236	287	218	150	124	112	108
S6	121	139	139	158	187	248	296	254	142	116	110	105
S7	111	134	122	167	169	239	316	244	131	115	109	103
AVG	129	150	151	168	192	251	312	254	154	122	113	108

Table 16: Monthly variation in Sulphate

Sulphate (mg/lit)												
samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
S1	19.2	20.1	27.9	27.6	27.5	28.5	44.5	41.9	39.6	35.7	31.3	30.7
S2	18.6	19.8	25.3	24.5	25.4	28.7	43.6	41.1	38.5	34.8	34.2	32.1
S3	18.4	19.5	24.7	24.3	21.3	25.9	44.8	40.8	34.9	34.2	32	31.5
S4	19.4	18.3	21.6	20.4	19.5	24.3	44	38.9	36.5	35.1	31.9	30.5
S5	18.9	18.4	20.8	20.6	19.9	21.4	42.1	39.1	35.6	33	31.7	29.6
S6	17.6	17.4	21.5	20.7	19.1	21	41.9	37.9	37.8	35.2	30.9	28.5
S7	18.5	17.6	24.5	20.6	19.7	20.9	42.6	38.9	31.8	30.2	29.5	25.7
AVG	18.7	18.7	23.8	22.7	21.8	24.4	43.4	39.8	36.4	34	31.6	29.8

Table 17: Monthly variation in E-Coli

E-COLI (colonies/ml)												
samples	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
S1	300	235	325	298	205	7500	10525	8500	7582	4985	3879	1589
S2	345	225	305	265	219	6523	9548	7569	7124	4478	3478	1689
S3	327	216	326	256	196	6589	8569	7584	7214	4932	3632	1578
S4	347	195	347	269	194	3478	4257	4123	3569	1458	965	655
S5	348	189	356	250	187	2485	4871	4563	3478	1145	895	547
S6	354	206	327	275	189	1596	3247	3569	3120	1789	765	550
S7	320	240	386	256	186	2458	3248	3241	3245	1365	852	459
AVG	334	215	339	267	197	4376	6324	5593	5047	2879	2067	1010

Table 18: Physico-chemical and microbial standards of water given by WHO (2011), EPA (2001), BIS (2012).

Sr.No.	Parameter	WHO (2011)	BIS(2012	EPA(2001)
1	pH	6.5-8.5	6.5-8.5	6.5-9.5
2	Electrical Conductivity(EC) (µs/Cm)	250	-	1000
3	Total Dissolved Solids (TDS) (mg/lit)	600	500	-
4	Total Hardness (mg/lit)	200	200	-
5	Calcium (mg/lit)	300	75	-
6	Magnesium (mg/lit)	-	30	-
7	Do (mg/lit)	-	-	-
8	Bod (mg/lit)	-	-	5
9	Cod (mg/lit)	-	-	40
10	Total Alkalinity (mg/lit)	-	200	-
11	Turbidity (NTU)	5	5	-
12	Fluoride (mg/lit)	1.5	1.5	-
13	Chloride (mg/lit)	250	250	250
14	Iron (mg/lit)	0.3	0.3	0.2
15	Sulphate (mg/lit)	250	200	250
16	E-Coli	-	-	-

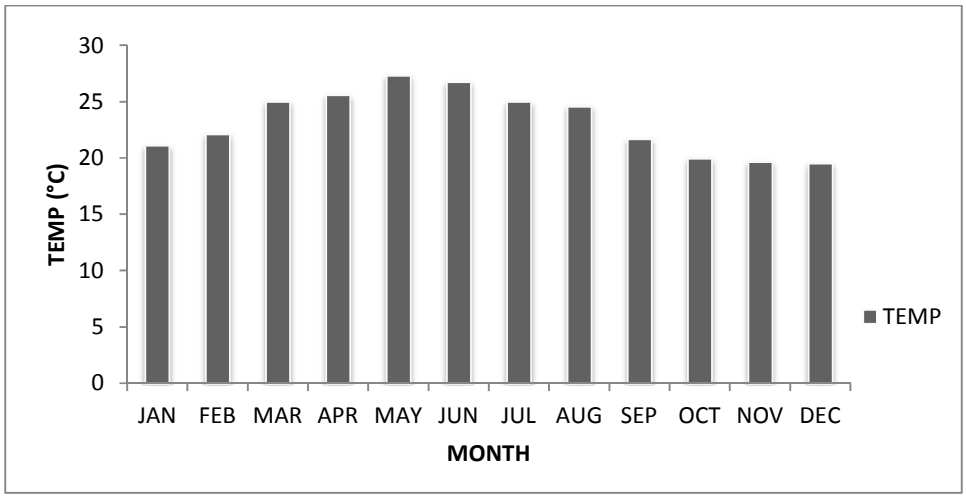

Fig a: Average Monthly variations of temperature (TEMP) in all stations

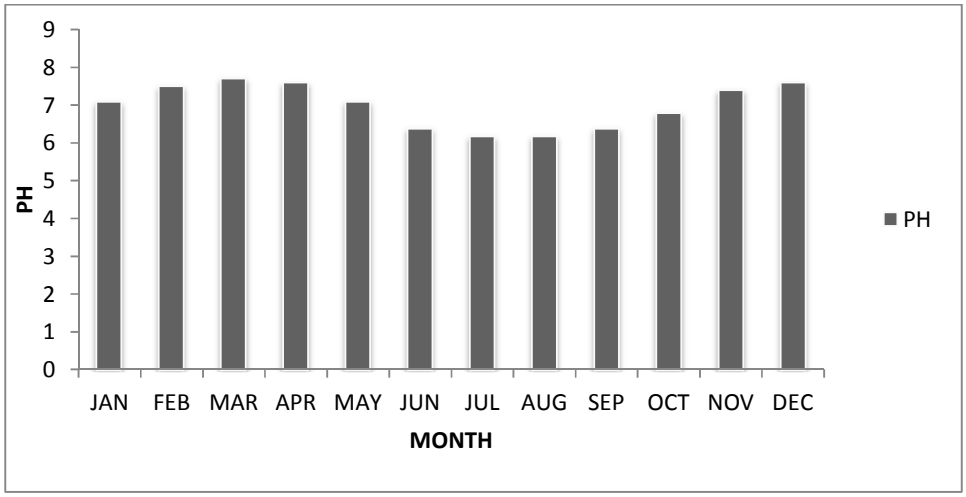

Fig b: Average of Monthly variations of PH in all stations.

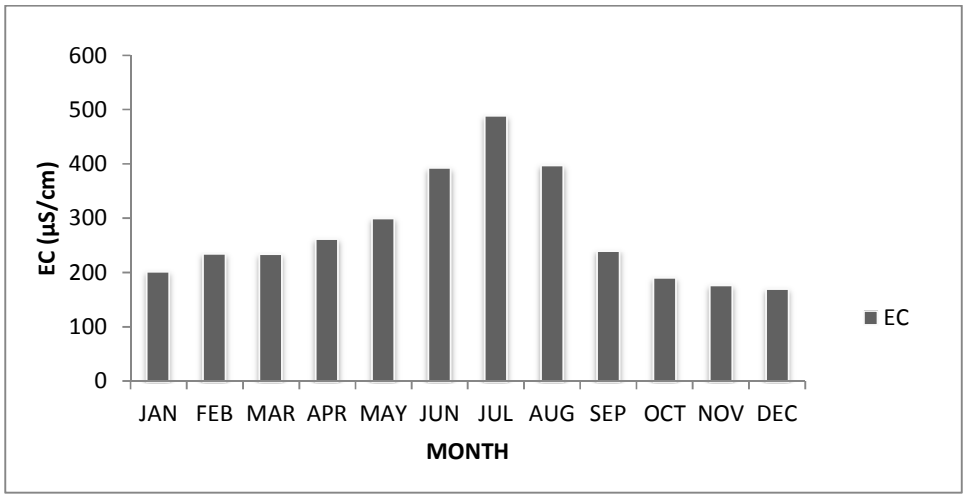

Fig c: Average Monthly variations of ELECTRICAL CONDUCTIVITY (EC) in all stations

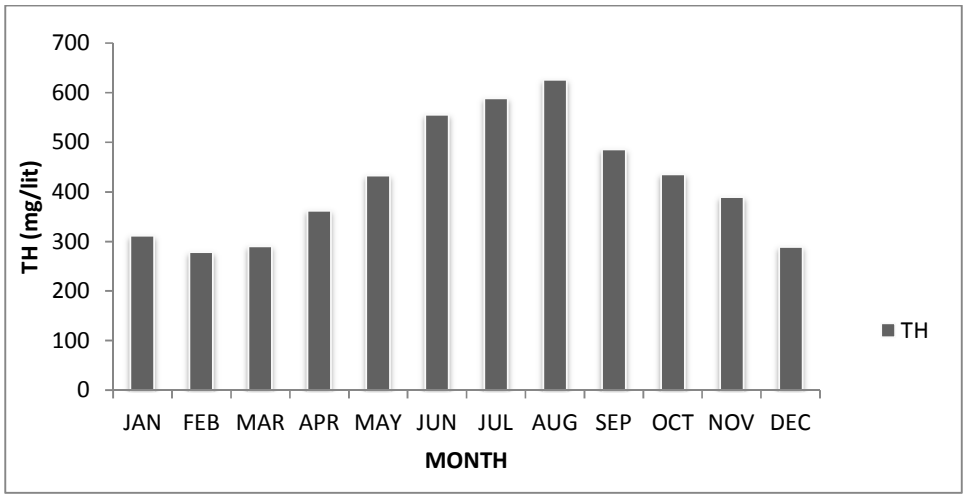

Fig d: Average Monthly variations of TOTAL HARDNESS (TH) in all stations.

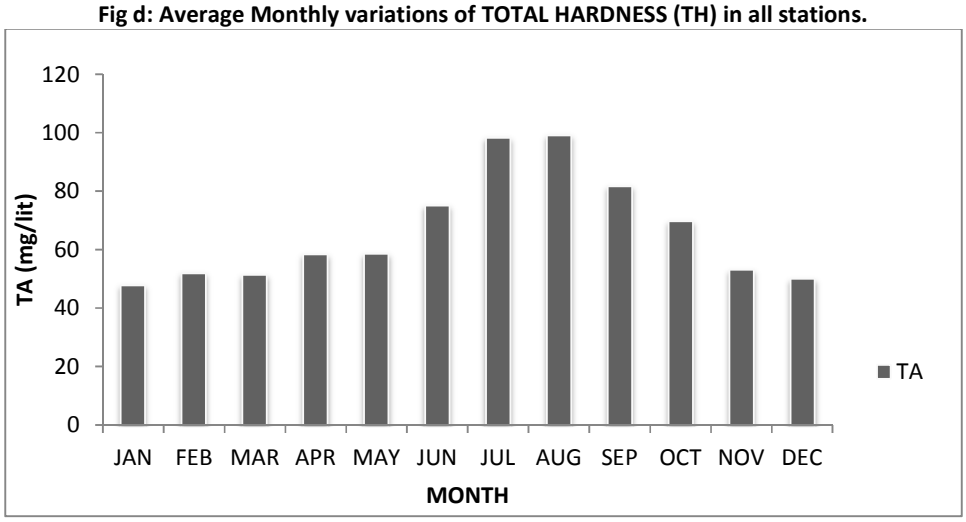

Fig e: Average Monthly variations of TOTAL ALKALINITY (TA) in all stations

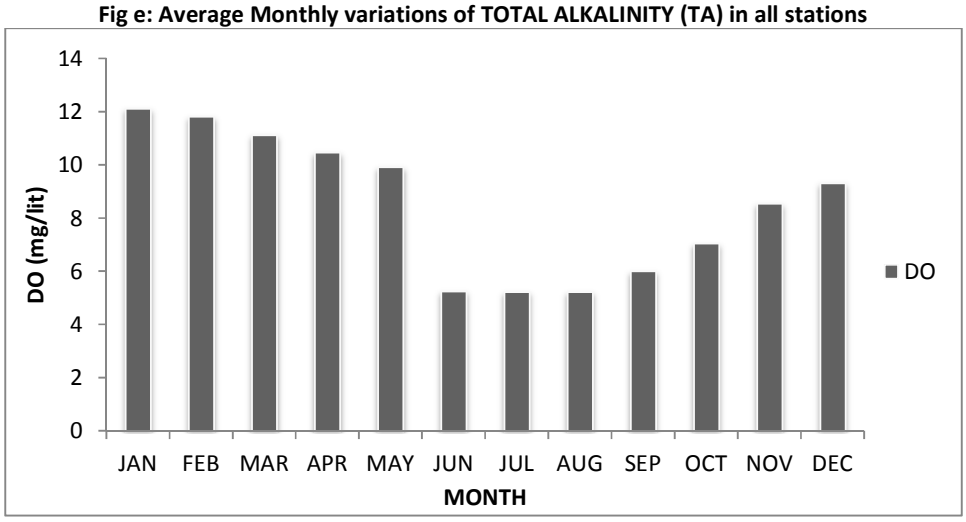

Fig f: Average Monthly variations of DISSOLVED OXYGEN (DO) in all stations

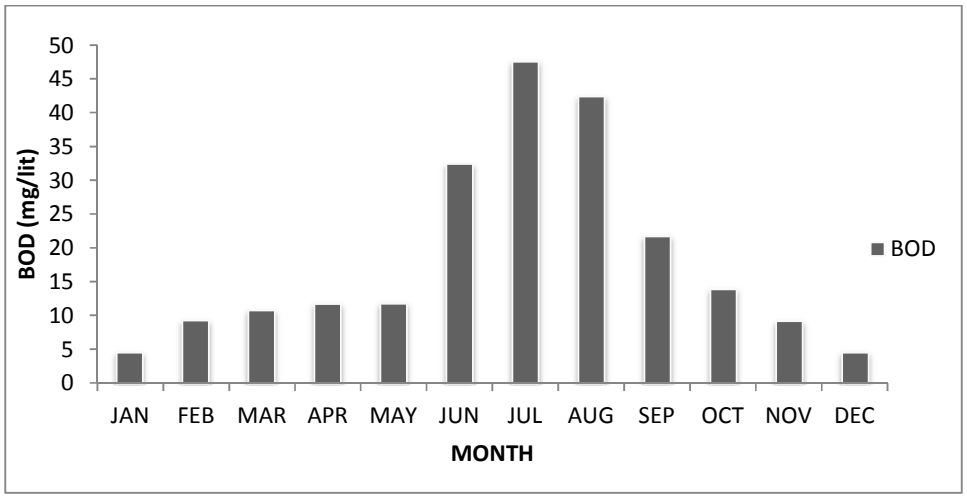

Fig g: Average Monthly variations of BIOLOGICAL OXYGEN DEMAND (BOD) in all stations

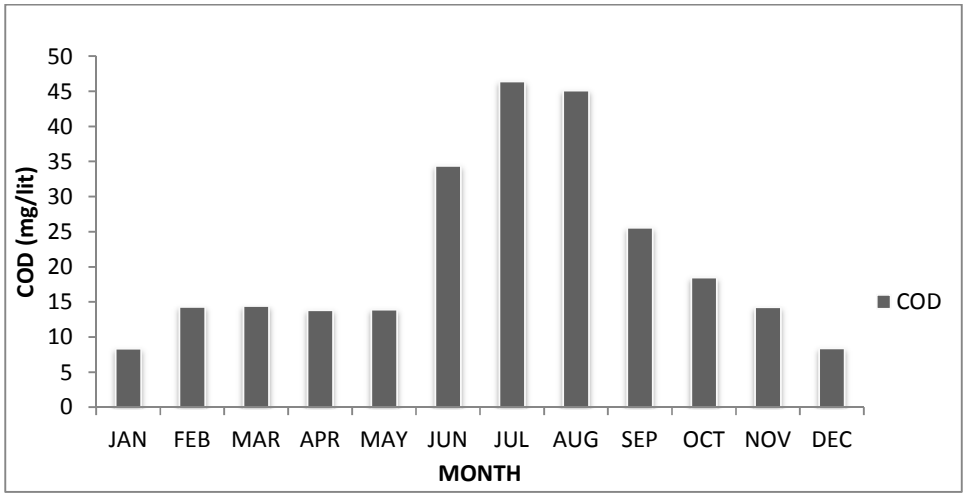

Fig h: Average Monthly variations of CHEMICAL OXYGEN DEMAND (COD) in all stations.

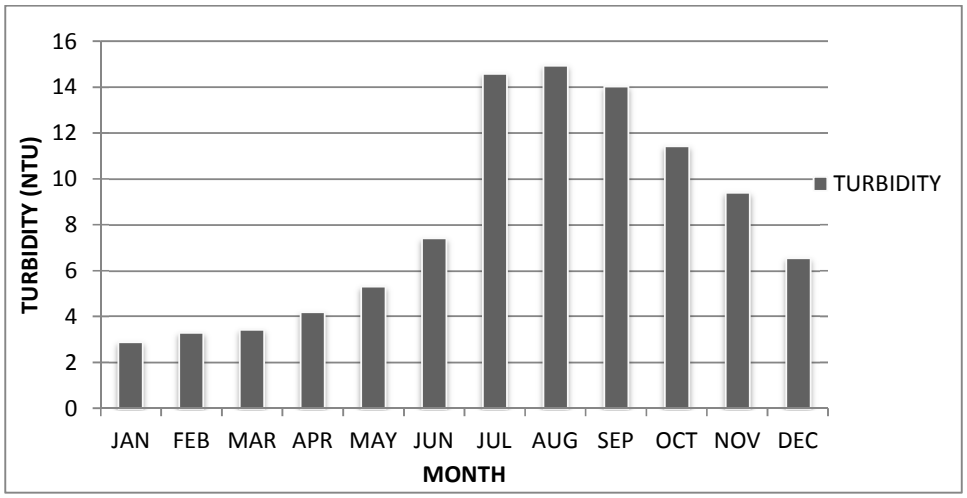

Fig i: Average Monthly variations of TURBIDITY in all stations.

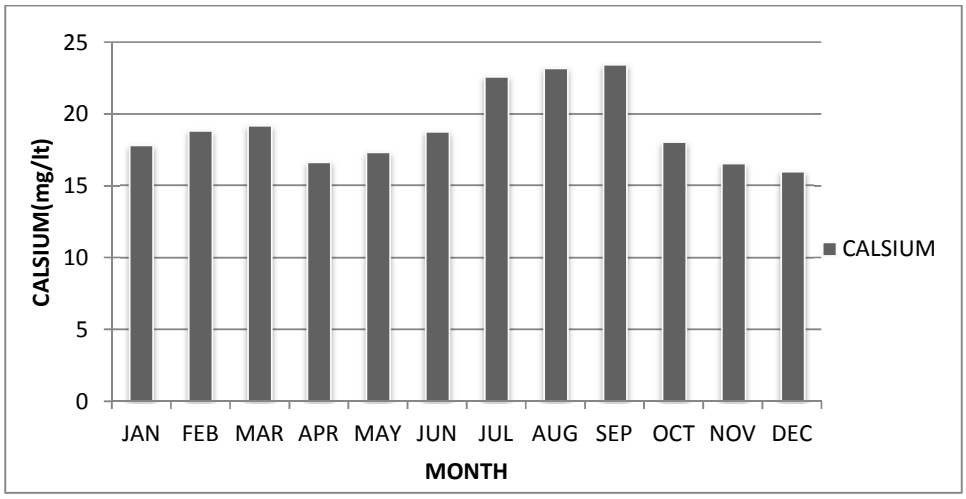

Fig j: Average Monthly variations of CALSIUM in all stations

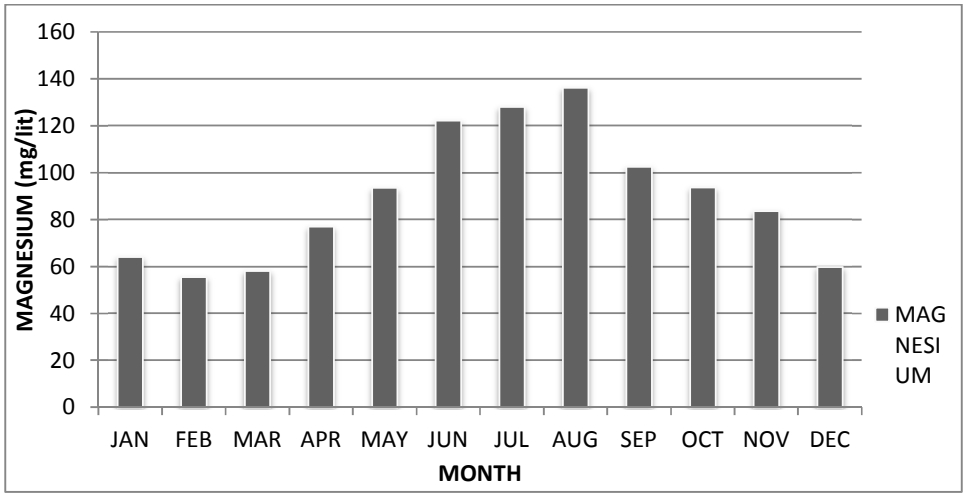

Fig k: Average Monthly variations of MAGNESIUM (Mg) in all stations

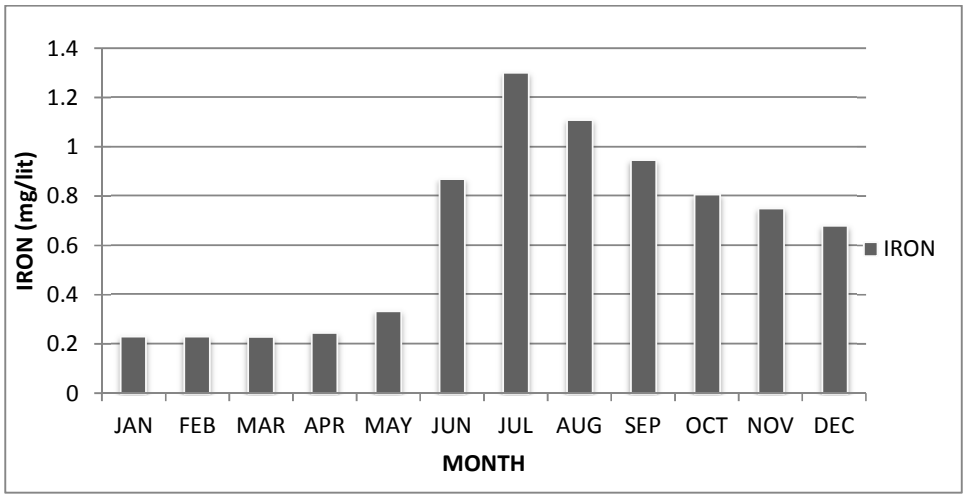

Fig l: Average Monthly variations of IRON in all stations.

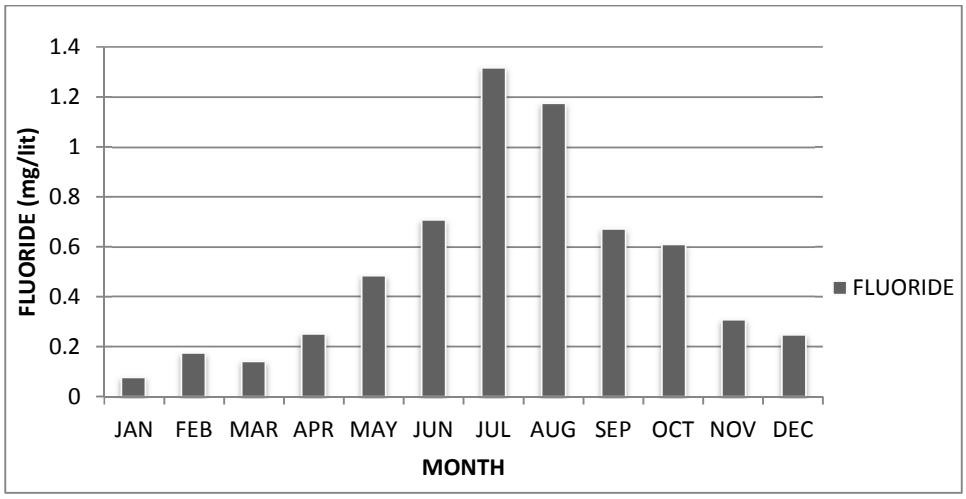

Fig m: Average Monthly variations of FLUORIDE (F^-) in all stations

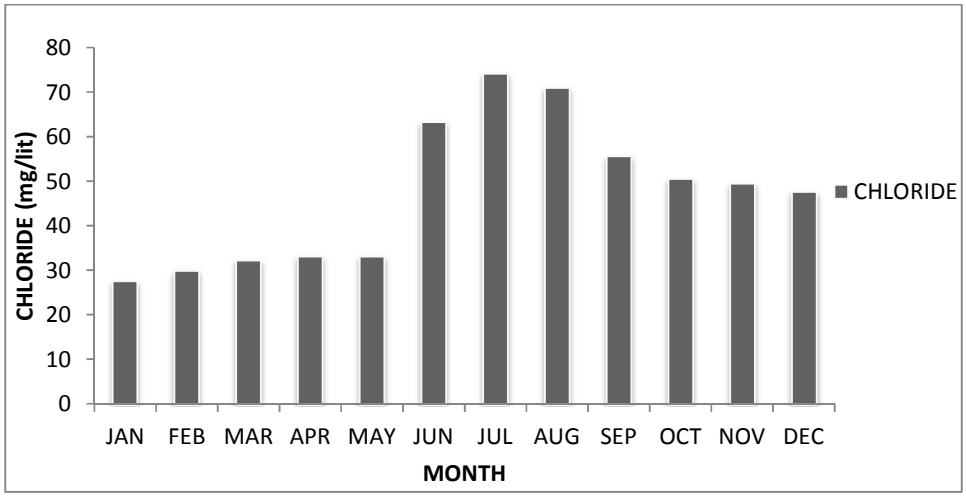

Fig n: Average Monthly variations of CHLORIDE (Cl^-) in all stations

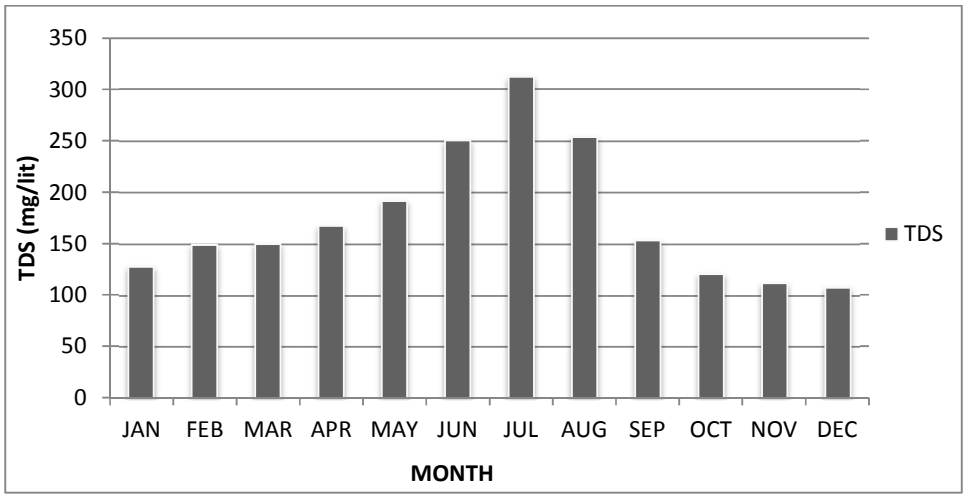

Fig o: Average Monthly variations of TOTAL DISSOLVED SOLIDS (TDS) in all stations

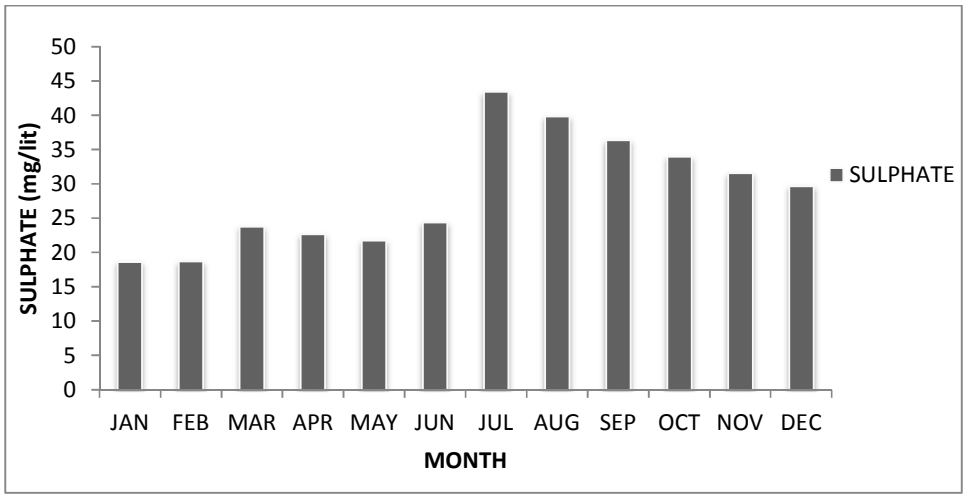

Fig p: Average Monthly variations of SULPHATE in all stations

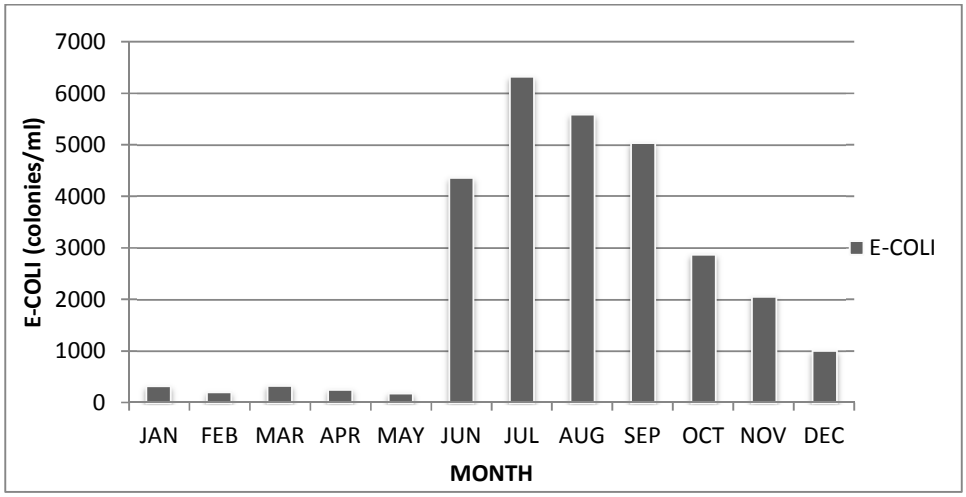

Fig q: Average Monthly variations of E-Coli in all stations

Total Dissolved Solids (TDS): TDS affects the taste of the water. Calcium, magnesium, chloride, sulphate etc. ions which are present in water is responsible for TDS. TDS also influence the conductivity of water. In the present study the highest value of TDS is recorded in the month o July i.e., 359mg/lit at station S1 during Pushkaram. The variations in TDS from Jan 2015– DEC 2015 are represented in table 15 and average monthly variations in all stations are represented in figure o.

Sulphate: The presence of sulphate in drinking water can cause noticeable taste and very high levels might cause a laxative effect [WHO 2011]**.** In the present study the highest value of sulphate is recorded in the month of July i.e., 44.8 at station S3. The variations in sulphate from Jan 2015– DEC 2015 are represented in table 16 and average monthly variations in all stations are represented in figure p.

E-Coli: E-Coli provide conclusive evidence of recent faecal pollution and should not be present in drinking water [WHO 2011]. High number of E-Coli in water affects the human health. In the present study the highest number of E-Coli is recorded in the month of July i.e., 10,525 colonies/ml at station S1 during Pushkaram. This drastic increase is because lakhs of people took bath in the Godavari water during Pushkaram and discharge lot of pollutants into the water. The variations in E-Coli from Jan 2015– DEC 2015 are represented in table 17 and average monthly variations in all stations are represented in figure q.

4.0 Conclusion:

In the present study all the measured physico chemical and microbial parameters are compared with standard values given by world health organization WHO (2011), environmental protection agency EPA (2001), bureau of Indian standards BIS (2012) shown in table 18. There is a deviation of PH, Electrical Conductivity, Total Hardness, Total Alkalinity, Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Turbidity, Calcium, Magnesium, Iron, Fluoride, Chloride, Total Dissolved Solids (TDS), sulphate from standard values during Pushkaram. But there is a drastic change in E-Coli which causes health problems. Due to different anthropogenic activities during Pushkaram there is a disturbance created in the physico chemical and microbial aspects of Godavari water causes health problems and creates imbalance in water ecosystem.

References:

1) American Public Health Association (APHA), (1999): Standard Methods for the Examination of Water and Waste Water.
2) Bawa Kalpana, V and Gaikawad V. B. (2013): Water Quality Assessment of Godavari River at Nasik, India: Impact of Sewage and Industrial Waste Water. International Journal of Environmental Research and Technology: 452-457.
3) Bureau of Indian Standards (BIS), Indian Standard Drinking Water- Specification (Second Revision), 2012.
4) Environmental Protection Agency (EPA) 2001, Parameters of Water Quality - Interpretation and Standard.
5) Environmental Protection Agency (EPA) 2001, Parameters of Water Quality - Interpretation and Standard, Conductivity PP.49.
6) Saksena, D.N., Garg, R.K. And Rao, R.J. (2008): Water Quality and Pollution Status of Chambal River in National Chambal Sanctuary, Madhya Pradesh. Journal of Environmental Biology. 28(5):701-710.
7) World Health Organization (WHO), Guidelines for Drinking-Water Quality, Fourth Edition, Acceptability Aspects, 2011.