



Physico-chemical Properties of Water of Ottu Reservoir in District Sirsa, Haryana, India

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Abstract

Of all the natural resources, water is unarguably the most essential and precious. Life began in water and life is nurtured by water. Physico-chemical properties of water are very important for understanding the metabolic events in aquatic ecosystem. Present investigation were carried out physico-chemical properties of water of Ottu Reservoir in district Sirsa (Haryana) India. Water sample were collected for a period of April 2012 to June 2013 using plastic container. The sampling points were selected on the basis of their importance. water samples were taken to the laboratory and analyzed. The analysis was done for the parameters like Atmospheric temperature, Water temperature, transparency, turbidity, pH, total dissolved solids, electrical conductivity, total hardness, DO, FREECO₂, BOD, COD, total alkalinity, chloride, nitrate, sulphate, phosphate. pH shows that Ottu Reservoir water is alkaline in nature. pH, Total hardness, EC, chloride, nitrate and sulphate was found with in the WHO permissible limits.

Keyword: Ottu Reservoir, physico – chemical, irrigation, BOD, TDS etc.

Introduction

Water resources are of critical importance to natural ecosystem, artificial or man made ecosystem and human development. In man made ecosystem Reservoirs are provide water for irrigation, industries and drinking purpose. Human being can not make or generate either of these basic elements of life in a form in which those are needed. Good quality of water resources depends on a large number of physico-chemical parameters and biological characteristics. To asses that monitoring of these parameters is essential to identify magnitude and source of any pollution load. These characteristics can identify certain condition for the ecology of living organisms and suggest appropriate conservation and management strategies. Many researches are being carried out till present¹⁻⁷. In order to assess water quality parameters we have carried out the physico-chemical properties of water of Ottu Reservoir in district Sirsa, Haryana, India. The aim of the study is investigation of physico-chemical characteristics of water, the pollution status and use of their water. Ottureservoir is a water body of the Ghaggar river and the river water is blocked at weir, as such the river does not have any water downstream. All river water was diverted to canal in Haryana. The Ottu Reservoir is situated in the mid south of Sirsa (Haryana) state (figure-1 and figure-2) between 29.29'21" North latitude and 74.53' 38" East longitudes. Water bodies is situated about 10 km. from centre east-west of Sirsa city. The maximum Depth of the water bodies is 2.2 m and area of water body is about 67400 m². For experimentation, water samples were taken from A bank of reservoir, Water sampling were done

between 9:00 to 11:00 hrs in morning for a period of 15 months from April 2012 to June-2013. The reservoir Water is already used for irrigations, fishery and domestic purpose so the aim of present study observe informative datato understand the water quality of Ottu reservoir for irrigation and drinking purpose.

Material and Methods

The water samples were collected from the marginal areas at 0.5 to 1.0 m depth from three sides of the Ottu Reservoir with the help of sampler. The water samples were collected in dried plastic cans of 2 Lt. capacity and brought to the laboratory and immediately analyzed. The sample collection was made during the morning hours between 9.00 to 11.00 am. The samples were collected every month for the period of 15 month i.e. April 2012 to June 2013. The recorded data was yearly segregated in three seasons, winter (November to February), summer (March to June) and Monsoon (July to October). During the monitoring, physico-chemical parameter like atmospheric and water temperature was measured using Mercury thermometer, pH was determined using pH meter and transparency by using Secchi disc at the sampling spot. The conductivity of water was measured using conductivity meter. The dissolved oxygen was measured using modified Winkler's method. Free CO₂, alkalinity, chloride and hardness were measured by titrometric methods described in APHA. BOD was estimated using APHA while the COD distillery assembly was used to measure the COD. Phosphate, sulphate and nitrate were recorded in the laboratory following the standard methods of Trivedi and Goel and APHA and compared with standard values⁸⁻¹¹.

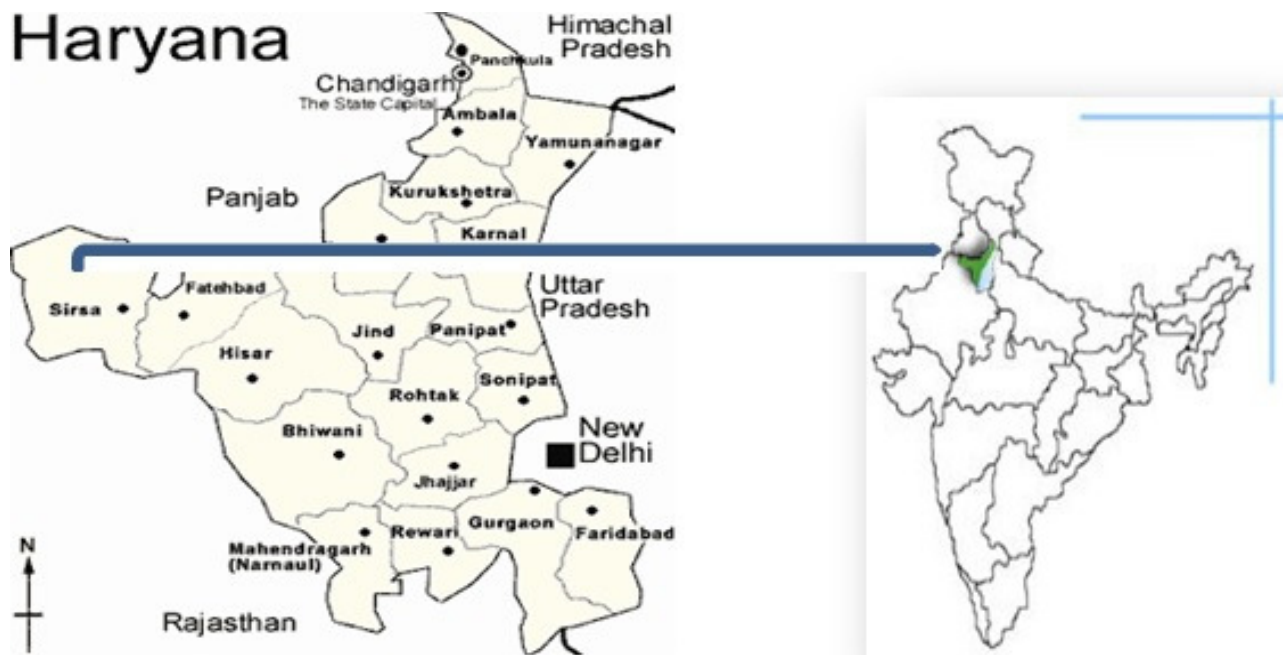


Figure-1
Map of India and Haryana showing the study site

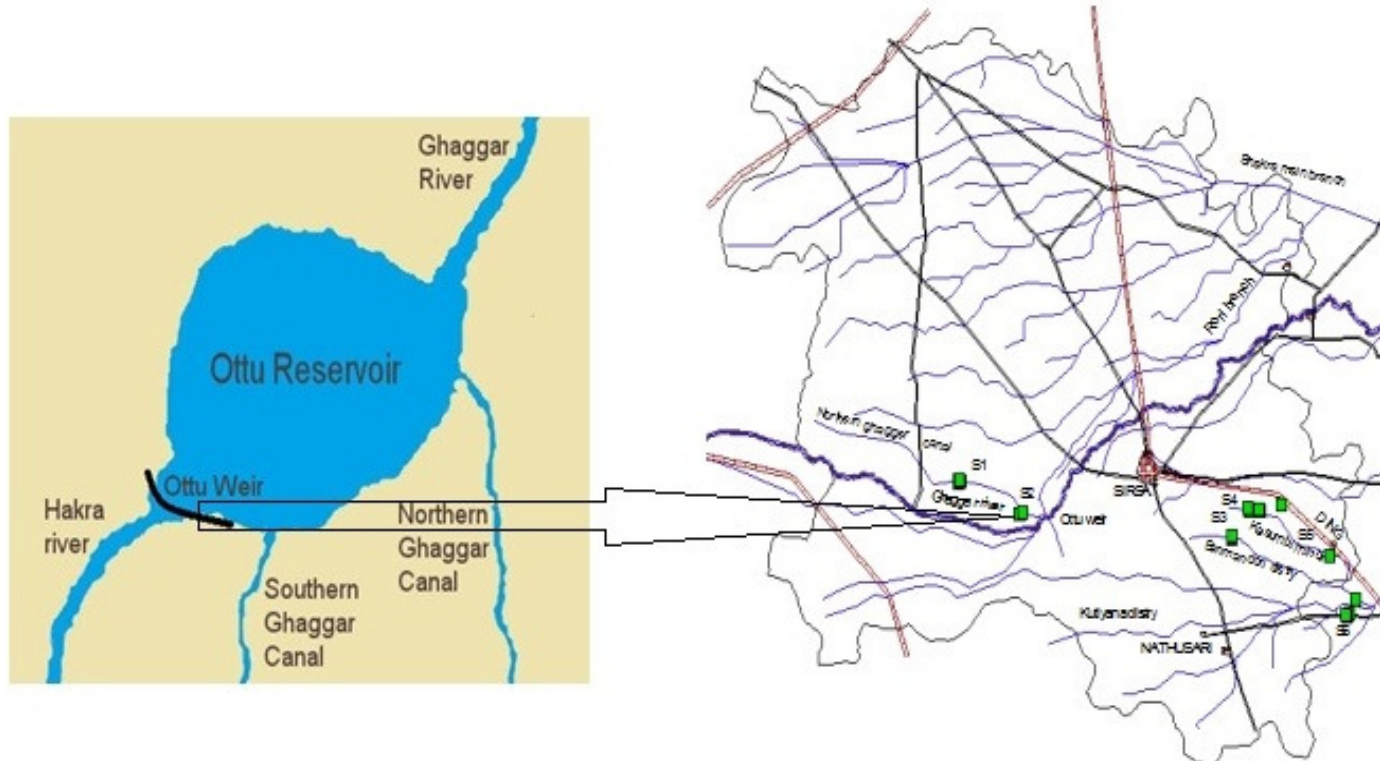


Figure-2
Map of the study area showing the sampling stations

Results and Discussion

Physico-chemical parameters are presented in Table-1, Table-2 and Table-3

Temperature: Temperature of reservoir water ranged found between 18.90°C to 36.09°C respectively in January and June

(table-1,2,3 and figure-3). It was high due to low water level, high air temp. and clean atmosphere. Many workers observed similar trends while working on different water bodies^{12,13}. Temperature changes produce characteristic patterns of circulation which greatly influence the aquatic life.

Table-1
Physico-chemical parameters of monthly value of Ottu Reservoir during April 2012- June 2013

S.R.	Parameters	April	May	June	July	Aug	Sep	Oct	Nov	Dec
1.	Atmo.Temp.(OC.)	35.24	41.90	42.73	36.79	34.52	33.55	32.19	26.32	22.80
2.	Water Temp.(OC.)	26.32	34.25	35.09	32.51	29.67	27.33	27.25	22.73	19.69
3.	PH	7.49	7.71	7.92	7.10	7.41	7.62	7.02	7.09	7.60
4.	Turbidity(NTU)	16.24	18.24	19.10	24.13	22.15	20.60	15.93	16.05	13.78
5.	Tranperency (cm.)	29.17	25.85	24.10	23.20	22.15	26.18	40.70	41.60	43.42
6.	E.C. (µs/cm)	356.45	377.9	397.2	366.5	347.76	332.4	320.21	312.2	291.5
7.	Total alkinity (mg/l)	160	182	168	161	155	149	138	136	128
8.	TDS(mg/l)	913	933	974	992	760	718	670	650	540
9.	Total hardness (mg/l)	120.28	116.14	115.20	113.15	117.15	106.15	85.21	63.50	72.17
10.	Free CO2 (mg/l)	7.12	6.21	5.43	4.20	4.45	3.87	2.67	2.45	1.55
11.	DO (mg/l)	3.10	2.90	2.70	2.83	2.86	2.95	3.18	3.29	4.50
12.	COD (mg/l)	19.50	20.57	21.24	18.50	17.33	15.23	13.20	12.50	11.21
13.	BOD (mg/l)	10.85	11.35	12.23	11.37	10.50	8.10	6.40	5.23	5.78
14.	Chloride (mg/l)	35.40	36.10	37.20	35.15	13.98	11.85	15.87	18.15	15.16
15.	Nitrate (mg/l)	1.30	1.43	1.67	1.47	1.43	1.32	1.28	1.22	1.16
16.	Sulphate (mg/l)	5.82	7.62	6.20	5.89	5.89	6.41	7.31	4.12	5.12
17.	Phosphate (mg/l)	1.65	1.82	2.12	1.93	1.82	1.73	1.62	1.46	1.25

Table-2
Physico-chemical properties of monthly value, minima, maxima and average value of Ottu Reservoir during April 2012- June 2013

S.R.	Parameters	Jan	Feb	Mar	April	May	June	Minima	Maxima	Average
1.	Atmo.Temp.(OC.)	20.15	28.72	31.85	36.85	42.10	44.10	20.15	44.10	33.99
2.	Water Temp.(OC.)	18.90	21.66	26.67	30.67	34.25	36.09	18.90	36.09	28.205
3.	PH	7.90	7.35	7.62	7.89	8.02	8.12	7.02	8.12	7.59
4.	Turbidity(NTU)	15.68	16.35	17.10	18.18	19.18	20.25	13.78	24.13	18.2
5.	Tranperency (cm.)	42.75	38.60	35.93	31.20	28.27	26.20	22.15	43.42	31.95
6.	E.C. (µs/cm)	281.7	290.45	320.55	344.54	356.2	391.6	281.7	397.2	339.14
7.	Total alkinity (mg/l)	134	143	150	156	192	178	128	192	155.33
8.	TDS(mg/l)	765	810	860	930	962	953	540	992	828.67
9.	Total hardness (mg/l)	88.11	106.11	110.72	118.42	114.40	110.5	63.50	120.28	103.81
10.	Free CO2 (mg/l)	1.45	2.64	4.44	7.09	6.31	5.82	1.45	7.12	4.38
11.	DO (mg/l)	4.47	4.06	3.98	3.70	3.16	2.80	2.70	4.50	3.36
12.	COD (mg/l)	11.47	13.25	15.24	19.94	20.34	21.52	11.21	21.52	16.74
13.	BOD (mg/l)	7.50	8.50	10.50	10.65	11.20	11.88	5.23	12.23	9.47
14.	Chloride (mg/l)	23.60	28.65	31.38	35.08	36.33	39.50	11.85	39.50	27.56
15.	Nitrate (mg/l)	1.18	1.22	1.30	1.57	1.62	1.80	1.16	1.80	1.40
16.	Sulphate (mg/l)	4.87	4.49	4.22	5.23	8.86	5.51	4.12	8.86	5.84
17.	Phosphate (mg/l)	0.93	1.10	1.36	1.58	1.77	1.85	0.93	2.12	1.59

Table-3

Minima, maxima and average values are compare with WHO standards of Ottu Reservoir during April 2012- June 2013

S.R.	Parameters	Minima	Month	Maxima	Month	Average	WHO standards	result
1.	Atmo.Temp.(OC.)	20.15	January	44.10	June	33.99	--	Normal
2.	Water Temp.(OC.)	18.90	January	36.09	June	28.205	--	Normal
3.	PH	7.02	October	8.12	June	7.59	6.5-8.5	Normal
4.	Turbidity(NTU)	13.78	December	24.13	July	18.2	<5.0	High
5.	Trancrency (cm.)	22.15	August	43.42	December	31.95	--	Normal
6.	E.C. (µs/cm)	281.7	January	397.2	June	339.14	<600	Normal
7.	Total alkinity (mg/l)	128	December	192	May	155.33	<200	Normal
8.	TDS(mg/l)	540	December	992	July	828.67	<500	High
9.	Total hardness (mg/l)	63.50	November	120.28	April	103.81	<300	Normal
10.	Free CO2 (mg/l)	1.45	January	7.12	April	4.38	0.5-2.0	High
11.	DO (mg/l)	2.70	June	4.50	December	3.36	4.0-6.0	Low
12.	COD (mg/l)	11.21	December	21.52	June	16.74	10	High
13.	BOD (mg/l)	5.23	November	12.23	June	9.47	<2.0	High
14.	Chloride (mg/l)	11.85	September	39.50	June	27.56	500	Normal
15.	Nitrate (mg/l)	1.16	December	1.80	June	1.40	<45	Normal
16.	Sulphate (mg/l)	4.12	November	8.86	May	5.84	<200	Normal
17.	Phosphate (mg/l)	0.93	January	2.12	June	1.59	<0.5	High

EC = Electric conductivity, DO = Dissolved oxygen, Temp. = Temperature, TDS = Total Dissolved Solids, COD= Chemical oxygen demand, BOD = Biological oxygen demand

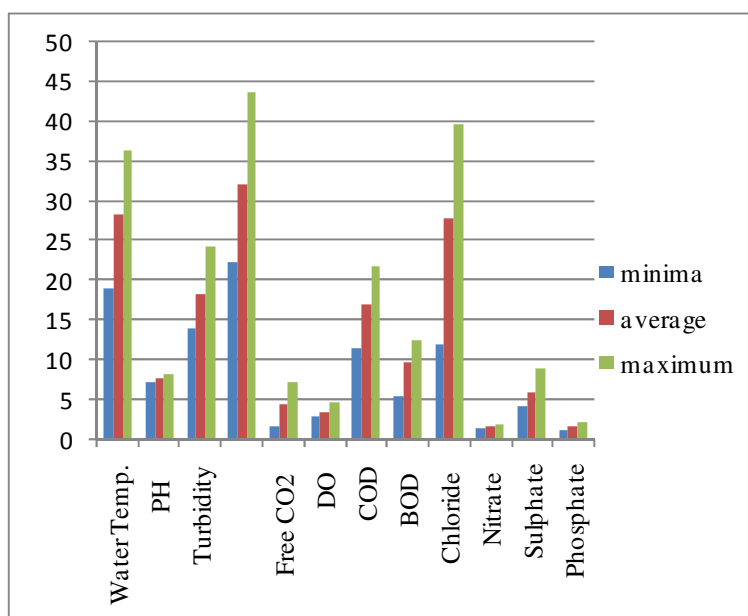


Figure-3

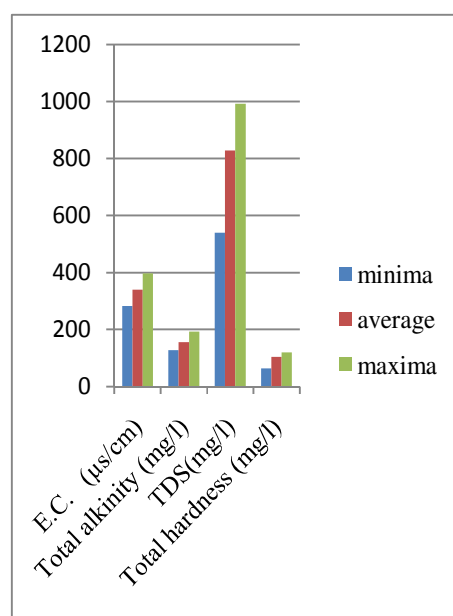


Figure-4

Figure-3 and Figure-4

Physico-chemical properties in minima, maxima and average value of Ottu Reservoir during April 2012- June 2013

pH: The pH values were found ranged between 7.02 to 8.12. Water is alkaline nature throughout the study period (Table-1,2,3 and figure-3). The pH of water was relatively high in the summer (June) and low in the monsoon (October). pH value is very important for plankton growth¹⁴. This investigation is also in close conformity with the reports¹⁵⁻¹⁷.

Turbidity: Water turbidity values ranged from maximum (24.13 NTU) in monsoon (July) season and minimum (13.78 NTU) in winter (December) (table-1,2,3 and figure-3)¹⁸. During rainy season clay, silt and other suspended particles maze contribute to the turbidity values, while during winter and summer seasons settlement of clay, silt and other suspended particles so results low turbidity.

Electric Conductivity: The conductivity of water depends on the concentration of ions and its nutrient statuses. While the maximum value of conductivity was 397.2 $\mu\text{s}/\text{cm}$ recorded in the month of June (summer) and the minimum value was 281.7 $\mu\text{s}/\text{cm}$ in the month of January (winter) (table-1,2,3 and figure-4). The fluctuations in Electric Conductivity are due to fluctuation in total dissolved solids and salinity¹⁹.

Transparency: Suspended materials in water produce turbidity and reduce light penetration. Transparency is inversely proportional to the turbidity of water. In the present study water transparency of higher value (43.45 cm) was reported in winter (December) season while the lower value (22.15 cm) in monsoon (August) season (table-1,2,3 and figure-3). Which indicates productivity of this water on the basis of clarity values²⁰.

Total dissolved solids: ISI prescribed the desirable limit of Total dissolved solids is 500 mg/L in drinking water and maximum permissible level is 2000 mg/L. In the present study Total dissolved solids value of water varied higher value 992 mg/L was reported in summer (July) season while the lower value 540 mg/L in winter (December) season (table-1,2,3 and figure-4). Higher values of TDS in summer season may be due to evaporation of water, contamination of domestic waste water, garbage and fertilizers etc²¹. TDS analysis has great implications in the control of biological and physical waste water treatment processes. Total solids in the most of the cases are organic in nature and pose serious problems of pollution^{21,22}.

Total hardness: In the freshwater, hardness is imparted by the calcium and magnesium ions which are in combination with bicarbonates and carbonates apart from sulphates, chlorides and nitrates. In the present study total hardness higher value (120.28 mg/L) was found in summer (April) season while the lower value (63.50 mg/L) in winter (November) season (table-1,2,3 and figure-4). The increase in hardness can be attributed to the decrease in water volume and increase in the rate of evaporation at high temperature²³. This may be due to the presence of high values may be due to the addition of calcium and magnesium salts.

Chloride: Chloride values in the present study were found ranging between maximum value (39.50 mg/l) was noticed in summer (June) season and the minimum value (11.85 mg/l) in monsoon (September) season (table-1,2,3 and figure-3). Higher concentration of chloride is association with increased level of pollution²⁴.

Phosphate: It is one of the most important nutrient and a limiting factor in the maintenance of reservoir fertility. important source of phosphate depends on geochemical condition and surface runoff from surrounding field. The high concentration of phosphate give rise to an algal bloom and it also brings eutrophication. In the study period the phosphate values varied from 0.93 to 2.13 mg/l was found maximum

during summer (June) season and it falls down during the winter (January) season²⁴ (table-1,2,3 and figure-3).

Nitrate: In the present study nitrate concentration varied from higher value (1.67 mg/L) was observed in summer (June) season while the lower value (1.12 mg/L) in winter (January) season (table-1,2,3 and figure-3). All organisms require nitrogen for growth and reproduction. High concentration of nitrate in drinking water is toxic.

Dissolved oxygen (DO): Dissolved Oxygen (DO) is essential to all forms of aquatic life including the organisms that break down man-made pollutants. It is one of the most important aquatic parameter, whose presence is vital to aquatic fauna. It plays crucial role in life processes of animals. In the present study the Dissolved Oxygen values found varied from 2.70 mg/l to 4.50 mg/l (table-1,2,3 and figure-3). The dissolved oxygen of water samples was found maximum during the winter (December) season and minimum in the summer (June) season²⁴. also reported lower values of Dissolved oxygen in summer season due to higher rate of decomposition of organic matter due to high temperature.

Chemical oxygen demand (COD): The maximum permissible limit for COD is 250 mg/l. The maximum COD was 21.52 mg/l recorded in the month June (summer) and minimum value was 11.21 mg/l in December (winter) (table-1,2,3 and figure-3). All the value of COD falls within the prescribe limits²⁵. The other factor responsible for increased COD concentration might be the establishment of human activities at the bank of reservoir who are responsible for adding domestic pollutant thus resulting in higher COD²⁶.

Biochemical oxygen demand (BOD): Biological oxygen Demand has been used as a parameter of the amount of organic mater in water. The maximum BOD was 12.67 mg/l recorded in the month June (summer) and minimum value was 5.23 mg/l in November (winter) (table-1,2,3 and figure-3). High BOD value is unflavored with zooplankton^{27,28}. Desirable limit for BOD is 4.0 mg/l and permissible limit is 6.0 mg/l according to Indian standards. BOD demand below 3 mg/l or less is required for the best use. the high value of BOD encountered in Ottu Reservoir, above the permissible limit of WHO (<2 mg/l), indicates the pollution by biochemically degradable organic wastes from various sources.

Total Alkalinity: The value of alkalinity in water provides an idea of natural salts present in water. The maximum permissible level of alkalinity is 200 mg/L of drinking water. Maximum alkalinity of water was 192 mg/l recorded in the month of May (summer) and minimum alkalinity 128 in month of December (winter) (table-1,2,3 and figure-4).

Free carbon dioxide: In the present study lowest value of free carbon dioxide (1.45 mg/L) was recorded in winter (January) season whereas the highest value (7.12 mg/L) in summer (April)

season (table-1,2,3 and figure-3). Carbon dioxide level increase during summer may be due to decay and decomposition of organic matter. The addition of drainage was the main causal factor for increase in carbon dioxide in the water bodies²⁸.

Sulphate: Sulphate has never been a limiting factor in aquatic ecosystems. In the present study lowest value (4.12 mg/L) of sulphate was recorded in winter (November) season whereas the highest value (8.86 mg/L) in summer (may) season²⁹ (table-1,2,3) and (figure-3).

Conclusion

This study provides an informative data and helps to understand the water quality of Ottu reservoir. The seasonal physico-chemical parameters of Reservoir exhibit cyclical variations. These observations clearly reflect that water of Ottureservoir was less polluted. So water of Ottureservoir suitable for agricultural, Industrial, cooling ,and domestic uses but TDS and BOD value was high so not suitable for drinking purpose. As per the water quality criteria given by Central Pollution Control Board (CPCB), the water quality of Ottu reservoir comes under C class of water which is not suitable for drinking and outdoor bathing, suitable for propagation of wildlife and fisheries, irrigation and industrial cooling. Study indicates the main cause of this pollution some anthropogenic activities like disposal of treated and untreated waste effluents from industries. Agricultural wastes, runoff and human wastes may result in deterioration of water quality of Ottu reservoir. It is suggested that the water of the study area should either be treated before its use or be used intermittently for drinking.

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