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Investigating Water Quality of Barua Sagar Lake, Jhansi, Uttar Pradesh

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Abstract: *Barua Sagar is a historical place located about 25km from Jhansi in UttarPradesh, India. It is situated on the bank of the betwa river , the place is named after the Barua Sagar Lake, the largest century old lake created by Raja Udit Singh of Orchha. In present investigation the physico-chemical characteristics, pollution studies of lake have been studied. Water samples have been collected from five different point of lake from January 2013 to June 2013. Monthly changes in physico- chemical parameters such as water , temperature, pH, turbidity, transparency, total dissolved solids, total hardness, chlorides, phosphate, nitrates, fluorides, total suspended solids, dissolved oxygen, biological oxygen demand and chemical oxygen demand were analyzed. The results indicated that physico-chemical parameters of the water were effected by the anthropogenic activities and can be used for domestic, irrigation, agriculture and pisciculture after proper management.*

Keywords: *Century old lake,Water quality, Physico-chemical characteristics, Pollution study.*

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I. Introduction

Water being a universal solvent has been and is being utilized by man kind time and now. Of the total amount of global water, only 2.4% is distributed on the main land, of which only a small portion can be utilized as fresh water. It is an essential requirement of human and industrial development and also it is one of the most delicate parts of the environment . Availability of clean and potable water has become a key issue in several developing countries. With the rapid development in agriculture, mining, urbanization, and industrialization activities, the river water contamination with hazardous waste and wastewater is becoming a common phenomenon. The water quality and human health are closely related. The domestic waste from each building along with the effluent of small scale industries is disposed off into the open drains and gutters which ultimately enter into the rivers. The quality of water is mainly deteriorated by human activities.

Aquatic ecosystem are not only source of water and resources, such as fish and crop for household and agro industrial uses, but are vital parts of natural environment on which economic systems are parasites and depend for their survival (Rai and Pal, 2001). Aquatic ecosystems are getting polluted day by day due to growth of the industrial corridor, nutrient loading and rapid anthropogenic activities especially in developing countries. Due to addition of domestic waste

(sewage), phosphate, nitrate etc. from wastes or their decomposition products in water bodies, they become rich in nutrients, especially phosphates and nitrate ions. Thus with the passage of these nutrients through such organic wastes, the water bodies become highly productive or eutrophic and the phenomenon as eutrophication in lake which is increasing day by day (Kumar and Pal, 2010). Concentration of pollutants more than their permissible limits in drinking water leads to health problems, such as water borne diseases, like fluorosis, typhoid, jaundice, cholera, premature baby and other problems, especially in infants. The present study was under taken to define the various point sources of pollutants in Barua Sagar Lake and to assess the quality of water samples with special reference to physicochemical properties in various months and stations.

II. Materials and Methods

Study Area

Jhansi is well known district of Bundelkhand region of Uttar Pradesh with a geographical area of 502.75 thousand hectare. The district is situated in the South West corner of the region at 24º11'- 25º57' N latitude and 78º10'-79 º 23' E longitudes. The average rainfall is 800-900 mm/year. Population of Jhansi is near about 4, 79,612. The western area of the district is covered with hillocks. Land is suitable for citrus species fruits. Crops include wheat, pulses, peas, oilseeds. Surface water is the main source of water in Jhansi. Betwa river, Pahuj river, Barua Sagar Lake ,Lakshmi Tal, Antiya Tal are the main source of water. After treatment, the

surface water is supplied to various areas through pipelines for municipal uses. Barua Sagar is a historical place located about 25 km from Jhansi in Uttar Pradesh, India. It is situated on the bank of the Betwa River, the place is named after the Barua Sagar Taal, a large lake created about 260 years ago when Raja Udit Singh of Orchha built the embankment. Area is 4.64 sq. Km; altitude is 210 mtrs above MSL. Monthly water sample have been collected from 4 different point of Barua Sagar Lake as fallow: Site1- East; Site 2– South; Site 3– West; Site 4– North respectively.

Analytical design

Water samples were collected from the lake, 10-15 cm below the surface during winter (January to June). The sampling locations were choosen carefully in order to get maximum representation of the diverse eco hydrological environments within the lake system. Sample containing bottles were placed in insulated wooden or plastic boxes and transported to the laboratory. Samples were stored at 4°C for further use. The analytical work of the collected samples was done by the HIMEDIA (WTO-23) Octo Aqua Test Kit (multi-parameter) as well as laboratory testing- used to APHA guideline 2005.

III. Result and Discussion

The result of the physicochemical characteristics of Barua Sagar lake water are summarized in the form of graphs and discussed below. A standard guidelines for best uses of different types of water has been given by Central Pollution Control Board, New Delhi has been presented in Table below.

1. Temperature:

Temperature is most important for fish and other aquatic life in lake. Temperature can vary greatly throughout the lake, with surface water affected more by air temperature than deeper water. Thus the top of the pond will be slightly warmer in the summer and colder in the winter than deeper portions of the pond. The temperature of all the five sites was found to be progressive with the advancement of summer season. With the increase in temperature of air, there was automatically corresponding increasein water temperature. In Barua Sagar Lake, average temperature was recorded 17.5°C in winter season and 23.5°C in summer season.

2. pH:

Ellis (1937) has observed that a pH range of 6.7 to 8.4 is suitable for the growth of aquatic biota. The pH of lake water is important for a number of lake uses. Different type of fish tolerates different pH levels but in general, most fish will do better in ponds with a pH near 7.0. Lake with a pH less than 6.0 may result in stunted or reduced fish population. Lake with a pH less than 5.0 or above 9.0 should not be used for dairy cows. In investigation barua sager lake pH was recorded range from 7.32 to 8.5. It shows the alkaline nature of the lake.

3. Hardness

Hardness is a measure of calcium and magnesium concentration in water and is controlled by the source of the lake water. During investigation of barua sager lake mean hardness at four sites were recorded 220.5mg/l during January, 222.3mg/l during February, 223.5mg/l during March, 224.2mg/l during April, 224.8mg/l during May and 225.7mg/l in June. Higher value of hardness is due to regular adittion of large quantities of sewage and detergents from the nearby residential localities.

4. Chloride

Chloride is found widely distributed in nature in the form of salt of sodium, potassium and calcium. Chlorides are least metabolically utilized because of their inert nature. Inland natural waters have low chloride concentration often less than that of bicarbonates and sulphates. In natural fresh waters high concentration of chlorides is regarded as an indicator of sewer pollution. In the present study, amount of chloride is recorded higher in the month of june 52.5mg/l while lower in the month of January 31.5mg/l.

5. Nitrate

Nitrate levels in drinking water for humans and livestock are a major concern. A high nitrate gives a sufficient indication of the deteriorating quality of water due to entry of waste water in river. Nitrate is the most highly oxidized and usually the most abundant form of combined inorganic nitrogen in surface water bodies. In barua sagar lake amount of nitrate was recorded between 3.24 – 8.4 mg/l. Nitrate content was high which can be attributed due to high rate of decomposition and anthropogenic pressure.

6. Dissolved Oxygen

Dissolved oxygen is of great important in all aquatic ecosystems as it regulates most of metabolic processes of organism and also the community architecture as a whole. The main sources of dissolved oxygen in

water are diffusion of oxygen from air and photosynthetic activity taking place in water. The diffusion of oxygen from air mainly dependent on temperature, salinity, total dissolved salt and water movements etc. During investigation of Barua sager lake dissolved oxygen was recorded maximum in February i.e.7.6mg/l and minimum in June i.e. 5.3mg/l.

7. Biochemical Oxygen Demand (BOD)

Biochemical Oxygen Demand (BOD) is an empirical test to provide a measure of the level of degradable organic material in a body of water. In barua sagar lake BOD was recorded maximum at site IV as compared to other sites i.e. 4.23mg/l. High BOD was unfavoured by zooplankton.

8. Chemical Oxygen Demand (COD)

Chemical Oxygen Demand gives us a reliable parameter for judging the extent of pollution in water (Shrivastava and Patil, 2002). COD is the measure of the oxygen required for chemical oxidation of organic matter. Maximum COD was recorded during June i.e.55.8mg/l while minimum during January i.e. 40.1 mg/l. This also provides a direct measure of state of pollution in water bodies (Kulshrestha and Sharma, 2006).

9. Fluoride

High fluoride intake over a period of time can lead to fluorosis. Excess fluoride intake with inadequate food supplement is responsible for dental and skeletal fluorosis, which is a serious health concern in many areas of the world. In our study, amount of fluoride was recorded high in the month of June i.e.0.56mg/l while lower in the month of January i.e.0.2mg/l which was under permissible limits.

10. TDS(Total Dissolved Solids)

Total dissolved solid is a measure of the combined content of all inorganic and organic substances contained in a liquid in molecular, ionized or micro granular suspended form (Sarvankumar and Ranjitkumar, 2011). TDS was recorded minimum in January i.e.44mg/l while maximum in June i.e 82mg/l.

11. Total Solids

Total solids are a measure of the suspended and dissolved solid in water suspended solids are those that can be retained on a water filter and are capable of settling out of the column into the stream bottom when stream velocities are low. They include silt, clay, plankton, drainage. Dissolved solid are those that pass through a water filter. They include some organic material, as well as salt, inorganic nutrients, and toxins. Total Solids was maximum in the month of June327mg/l and minimum in the month of January 257mg/l.

12. Turbidity:

Turbidity of water is actually the expression of optical property in which the light is scattered by the particles present in the water. Clay, slit, organic matter, and other microscopic organisms cause turbidity in water. High turbidity shows presence of large amount of suspended solids. Turbidity is usually measured in nephelometric turbidimeter. It is higher in the month of June i.e. 35NTU and lower in the month of January 22.8NTU.

13. Total Suspended Solid (TSS)

The suspended solids determination is particularly useful in the analysis of sewage and other waste waters and is as significant as BOD determination. Suspended Solids containing much organic matter may cause putrefaction and consequently the stream may be devoid of dissolved oxygen. The amount of Total Suspended Solid recorded maximum amount 245 mg/l in June and minimum 213mg/l in January.

IV. Conclusion

The objective of present work was to study the water quality of surface water of barua sagar lake, Jhansi so as to assess its suitability for domestic purpose. Surface water is main source of water in Jhansi. Betwa River, Pahuj River, Barua Sagar lake, Lakshmi Tal, Atiya Tal etc. are the source of surface water . After treatment, the surface water is supplied to various areas through pipelines for municipal uses. So, surface water is a very much valuable resource for this region. Both the quality and quantity of this resource should be maintained for better future of the local people. The result obtained during study was analyzed and it was found that maximum number of parameters were slightly above desirable limit which shows that Barua Sagar is slightly polluted and the main source of pollution is the bathing, laundering and agricultural runoff from the catchments areas. Without proper treatment it may not be useful directly for drinking purposes.If the similar condition continue for longer period, lake may soon become ecological inactive. So, it should be the prime responsibility of Jhansi Municipal Corporation to monitor the water quality of lake continuously, and should

take important steps along with the government and various NGO's so that the water quality of the lake should be maintained efficiently.

Table 1: shows monthly variation of water temperature(°C) at four sites of Barua Sagar Lake

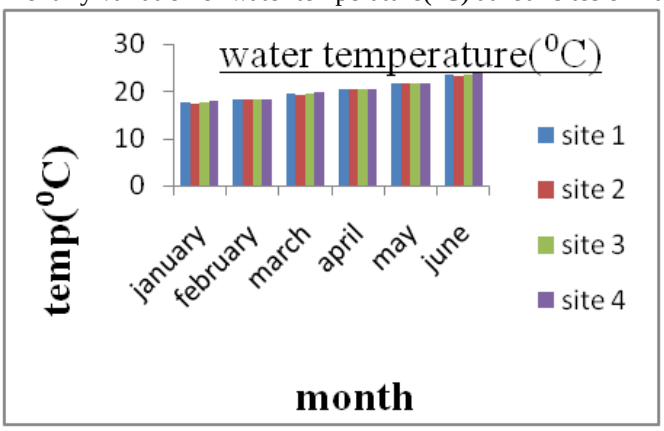


Table 2: shows monthly variation of water pH at four sites of Barua Sagar Lake

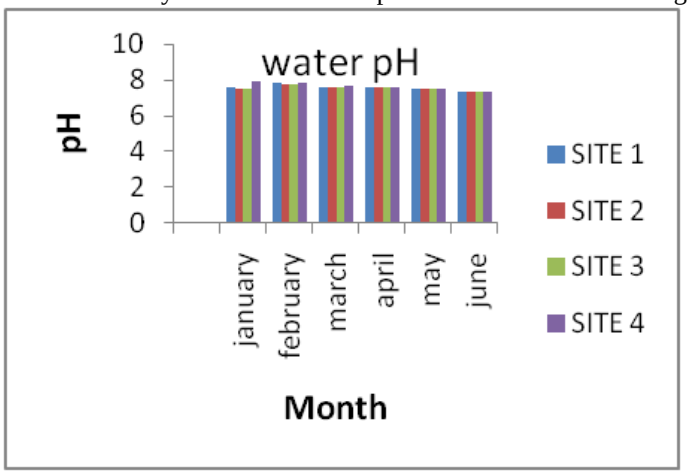


Table 3: shows monthly variation of water Hardness at four sites of Barua Sagar Lake

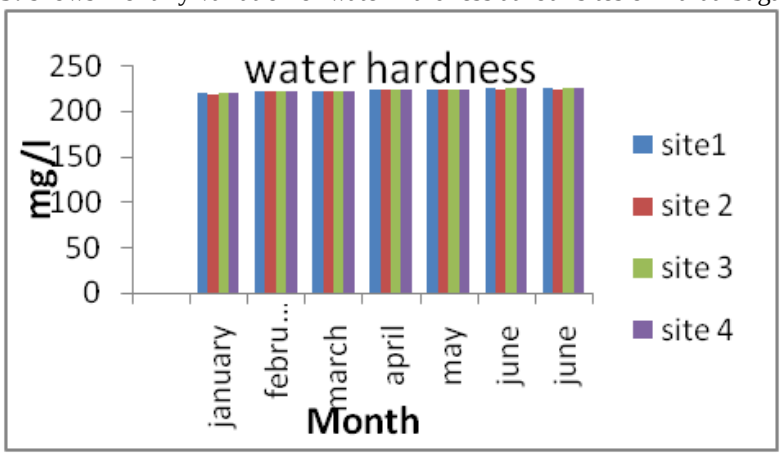


Table 4: shows monthly variation of Chloride content at four sites of Barua Sagar Lake

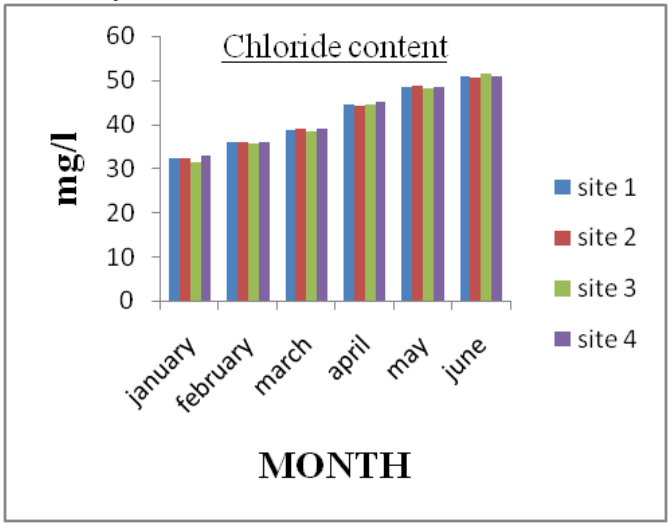


Table 5: shows monthly variation of Nitrate content at four sites of Barua Sagar Lake

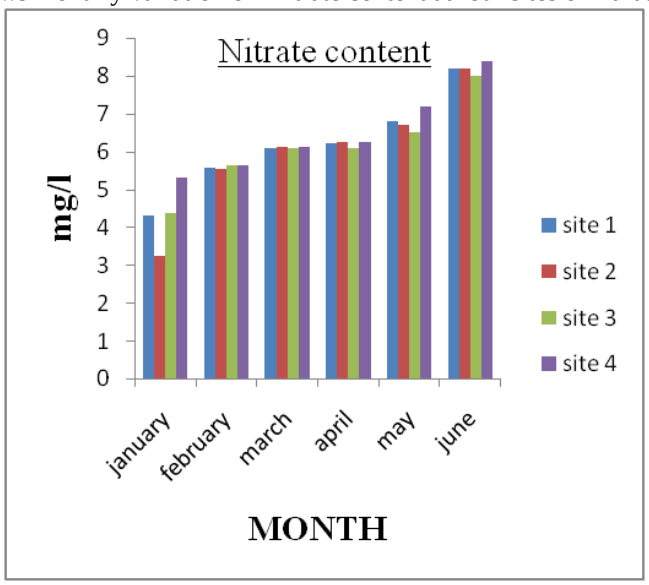


Table 6: shows monthly variation of Dissolved Oxygen at four sites of Barua Sagar Lake

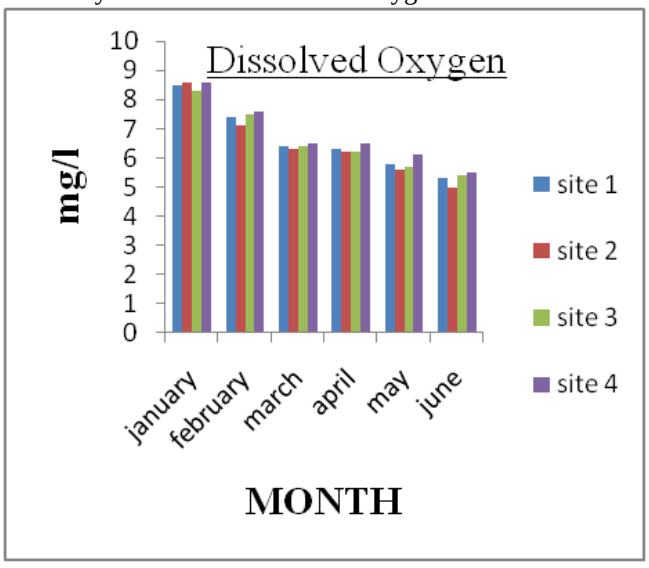


Table 7: shows monthly variation of Biochemical Oxygen Demand at four sites of Barua Sagar Lake

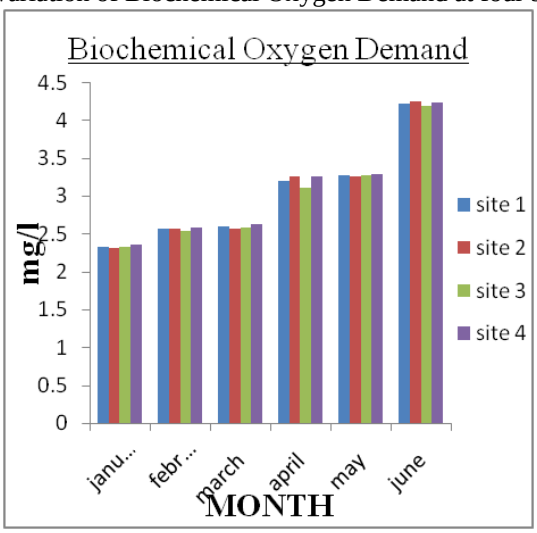


Table8: shows monthly variation of Chemical Oxygen Demand at four sites of Barua Sagar Lake

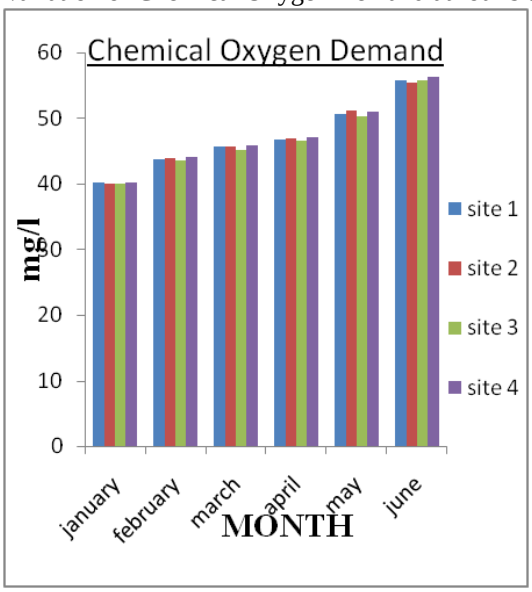


Table 9: shows monthly variation of Fluoride content at four sites of Barua Sagar Lake

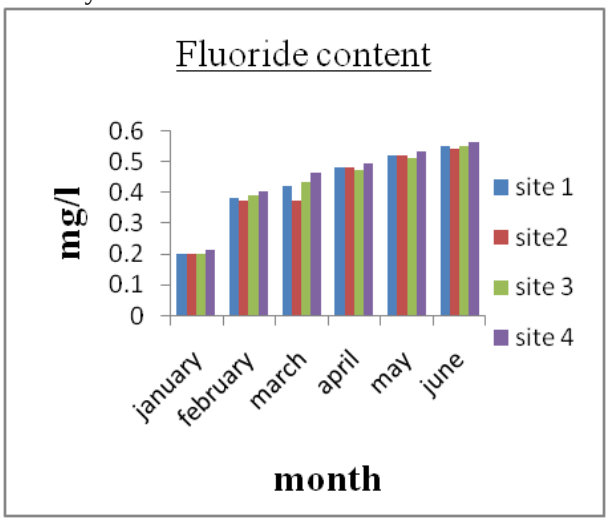


Table 10: shows monthly variation of Total Dissolved Solids at four sites of Barua Sagar Lake

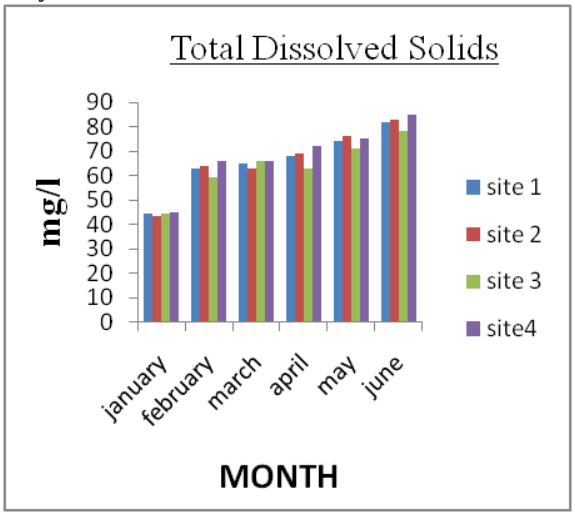


Table 11: shows monthly variation of Total Solids at four sites of Barua Sagar Lake

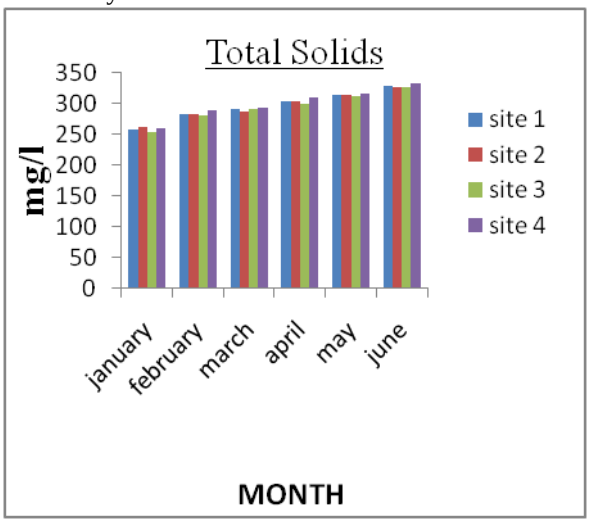


Table 12: shows monthly variation of Turbidity at four sites of Barua Sagar Lake

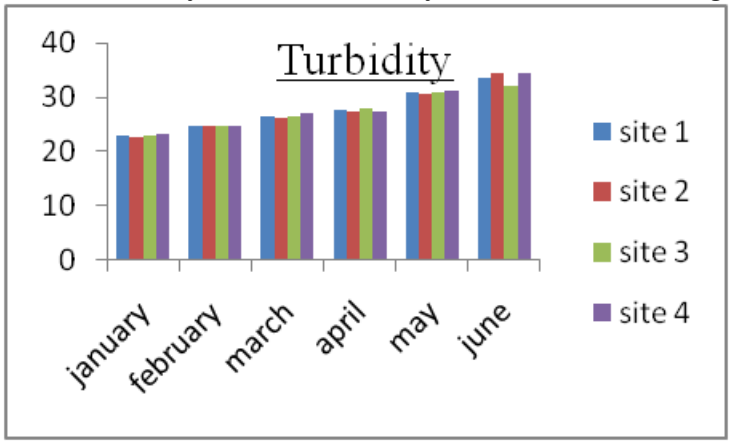
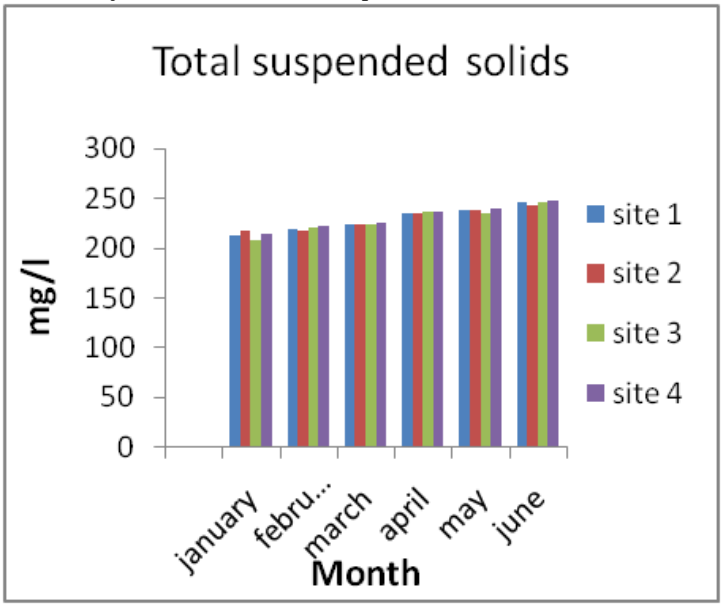


Table 13: shows monthly variation of Total Suspended Solids at four sites of Barua Sagar Lake



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Sitewise estimated values of water quality physicochemical Parameters with their W.H.O. Standards

S.NO.	PARAMETERS	SITE 1	SITE 2	SITE 3	SITE 4	WHO Standard
1.	temperature(°C)	20.1	19.9	20.1	20.3	-
2	pH	7.55	7.54	7.54	7.6	6.5-8.5
3.	Total Hardness (ppm)	223.5	223.2	223.4	223.7	100
4.	Chloride (ppm)	41.7	41.7	41.6	42.05	200
5.	Iron (ppm)	0.33	0.33	0.33	0.35	0.5
6.	Dissolved Oxygen	6.7	6.4	6.5	6.8	2-6
7	Total Solids (ppm)	246.8	294.6	292.1	298.6	500
8.	Total Dissolved Solids (ppm)	66	66.3	63.5	68.1	500
9.	BiochemicalOxygen Demand (ppm)	3.02	3.03	3	3.05	6
10.	Chemical Oxygen Demand (ppm)	47.1	47.1	46.8	47.4	10
11.	Nitrate (mg/L)	6.19	6	6.11	6.33	50
12.	Turbidity(NTU)	27.6	27.5	27.4	27.9	8-50
13.	Fluoride(mg/l)	0.42	0.41	0.42	0.44	Less than 0.5mg/l

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