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Physico-Chemical Analysis of Wetland Water Around Ahmedabad, India for Ecological Conservation Perspective

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Abstract: ***Wetlands are considered as unique ecosystems and need to be conserved for their hydrological, socio-economic, biodiversity and recreation values. Management of any such wetland ecosystem needs proper scientific data. This has lead to carry out the research work on highly potential but neglected wetlands of Adhana, Lavarpur and Goblaj villages around Ahmedabad city of Gujarat state, India. These wetlands are shallow water reservoirs and popular habited of birds around Ahmedabad. Many globally threatened bird species have been recorded here in the recent past including the Sarus Crane (Grus antigone). The study area is situated at 23°06'35.3"N72°23'45.1"E Adhana village, 23°10'46.5"N 72°41'54.3"E Lavarpur village and 22°48'1"N72°36'38"E Goblej village. It falls in the international migration route of birds.***

Seasonal field visits were conducted to collect the water samples from all the research sites. Physico-chemical parameters covered for analysis namely: Water depth, Vertical transparency, Color test, Temperature, pH, Total suspended solids, Total dissolved solids, Alkalinity, Dissolved oxygen, Chemical Oxygen Demand, Nitrate, Chloride, Sodium, Potassium, Phosphate and Pesticide presence. Research methods followed based on Standard Methods for the Examination of Water and Waste water by American Public Health Association (APHA) 22nd edition 2013, American Water Works Association (AWWA) and Bureau of Indian Standards. Analyses were made for all the sample sites and tabular data is prepared for their interpretation. Result is discussed based on data analysis. It is concluded with comparisons of all research sample sites; whether are they satisfy the requirement for the use of various purposes like domestic, agricultural, industrial etc. The paper discusses on seasonal environmental parameters for water analysis. The findings would be useful to construct conservation strategy and create better management practice for these wetlands.

Keywords: Water, physico-chemical analysis, ecology, conservation

I. INTRODUCTION

"Much of the current concern with regards to environmental quality is focused on water because of its importance in maintaining the human health and health of the ecosystem. Fresh water is finite resource, essential for agriculture, industry and even human existence, without fresh water of adequate quantity and quality, sustainable development will not be possible"[13]"Water resource is becoming day-by-day at the faster rate of deterioration of the water quality is now a global problem."[4]"Drinking water quality directly influences people's health and is determined by many factors including environment." [1]"Owing to the human activities, the ponds have become dumping ground of domestic wastes and other refuge of the society."[14]"The knowledge of extent of pollution and the status of water become essential in order to preserve the valuable sources of water for future generation."[12]Wetlands are considered as unique ecosystems and need to be conserved for their hydrological, socio-economic, biodiversity and recreation values. Management of any such wetland ecosystem needs proper scientific data. This has leaded the author to carry out the research work on highly potential but neglected wetlands of Adhana, Lavarpur and Goblaj villages. These wetlands are shallow water reservoirs and popular habited of birds places near Ahmedabad, India.

Geographical Locations

The study area is situated at 23°06'35.3"N72°23'45.1"E Adhana village, Lavarpur village 23°10'46.5"N 72°41'54.3"E and 22°48'1"N72°36'38"E Goblej village. Geographically this area is situated in the western part of India in the central part of Gujarat province. These wetlands are seasonal to semi perennial in nature and attract avifauna and surrounded by populated villages.

II. MATERIALS AND METHODS

PHYSICOCHEMICAL ANALYSIS: The samples were put to examination in the laboratory to determine some physical, chemical, and biological parameters. Analysis was carried out for various water quality parameters such as pH, TDS, TSS, Total alkalinity, COD, BOD, Alkalinity, sulphate, Chloride, etc using standard method. The reagents used for the analysis were AR

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grade and double distilled water was used for preparation of solutions. The samples were analyzed as per the standard procedure of APHA. [3]Results were compared with the Drinking Water Standards of BIS (IS: 10500: 1991) of India. [11]

III. RESULT AND DISCUSSION:

Sr. No.	Test parameter	ADHANA	GOBLEJ	LAVARPUR	Desirable	Permissible
1	Temperature	27.8	27.3	28.2	-- ---	--- ---
2	pH	7.4	6.9	8.2	6.5 to 8.5	No relexation
3	Colour	30.5	4.5	47.2	5Hz	25Hz
4	Odour	0.0	0.0		Unobjectionable	Unobjectionable
5	Total dissolved solids	456.3	342.5	562.0	500 mg/l	2000 mg/l
6	Total Suspended Solids	79.0	52.5	89.3		100mg/l
7	Total Alkanity	255.0	248.8	325.0	200 mg/l	600 mg/l
8	Total Hardness as CaCO3	111.0	231.3	79.7	300 mg/l	600 mg/l
9	Sulphate	43.3	55.0	27.0	200 mg/l	400 mg/l
10	Chlorides	137.6	102.0	154.2	250 mg/l	1000 mg/l
11	Electric conductivity	652.0	479.0	777.3	250mu.mhos/cm	2250mu.mhos/cm
12	Turbidity	40.7	11.3	38.1	5mg/l	10mg/l
13	Calcium	21.4	53.3	17.3	75mg/l	200mg/l
14	Magnesium	14.0	24.0	8.8	30mg/l	100mg/l
15	BOD (27 c @3day)	53.5	29.4	53.1		40mg/l
16	Chemical oxygen demand	214.3	98.1	239.9		120mg/l
17	Pesticides	nil	nil	nil	nil	nil

Table 1. Results of various physico-chemical analysis of sample sites.

pH:

In case of Lavarpur pond water, pH values out of all the three ponds were found to be high. The maximum value was 8.2 (Table-1). In Lavarpur and Adhana ponds, pH is found alkaline. The photosynthetic activity of dense phytoplankton cause of higher pH value and alkaline nature of water might be due to high temperature that reduces the solubility of CO2. During the present investigation a pattern of pH change was noticed.

Total Dissolved Solid (TDS):

In water, total dissolved solids are composed of mainly of carbonates, bicarbonates, chlorides, phosphates and nitrates of calcium, magnesium, sodium, potassium and manganese, organic matter, salt and other particles. The total dissolved solids of all these sites water ranged from a minimum of 342.5 mg/lit to a maximum of 562 mg/lit(Table-1).Their minimum values were recorded in Goblej pond; whereas the maximum value of TDS was recorded at Lavarpur pond site which reflects the pollution. Though all there sample sites are within the permissible limit as Indian standards.

Total Suspended Solids (TSS):

The total suspended solids of sample sites water varied from a minimum of 52.5 mg/lit to a maximum of 82.3 mg/lit (Table-1). Water with high in suspended solid may be aesthetically unsatisfactory for bathing. The total suspended solids are composed of carbonates, bicarbonates, chlorides, phosphates and nitrates of calcium, magnesium, sodium, potassium, manganese, organic matter, salt and other particles. The effect of presence of total suspended solids is the turbidity due to silt and organic matter.The higher amount of total solids was perhaps due to run off from many bathing ghats, local solid garbage dump and other wastages. The higher concentration of total suspended solid is an indicator of the pollution.

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Alkalinity:

Total alkalinity of sample site water ranged from a minimum of 248.8 mg/lit to a maximum of 325 mg/lit (Table:1).The maximum value was 325 mg/lit at Lavarpur and the minimum value was 248.8 mg/lit atGoblej site. The alkalinity of water is caused mainly due to OH, CO3, HCO3 ions. Alkalinity is an estimate of the ability of water to resist change in pH upon addition of acid. The maximum alkalinity of water may be due to lower temperature bringing down the rate of decomposition of salts to a minimum there by increasing the alkalinity. Though, all sample sites, the alkalinity which does not exceed the highest desirable limit but within maximum permissible limit as per ICMR specification.

Total Hardness as CaCO3:

When water passes through or over deposits such as limestone, the levels of Ca2+, Mg2+, and HCO3 – ions present in the water can greatly increase and cause the water to be classified as hard water. The total hardness of waters of different sample sites water ranged from a minimum of 79.7 mg/lit to a maximum of 231.3 mg/lit. As Shown in the hardness classification (Table 2), Water of Lavarpur seems to be moderately hard whereas water of Adhana falls under hard water categories. But the water from Goblej is found very hard. The American Water Works Association indicates that ideal quality water should not contain more than 80 mg/L of total hardness as CaCO3. High levels of total hardness are not considered a health concern.

Concentration of Hardness Milligrams per Liter (mg/L)	Relative Hardness Level
60	Soft
60 to 120	Moderately Hard
120 to 180	Hard
180 and above	Very Hard

Table 2: Water hardness classification [11]

Sulfate:

The sulfate content of sample sites water ranged from a minimum of 27 mg/lit to a maximum of 55 mg/lit. Sulfates are not considered toxic to plants or animals at normal concentrations. In humans, concentrations of 500 - 750 mg/L cause a temporary laxative effect. At very high concentrations sulfates are toxic to cattle. Problems caused by sulfates are most often related to their ability to form strong acids which changes the pH. [7]

Chloride:

The chloride content of sample sites water ranged from a minimum of 102 mg/lit to a maximum of 154.2 mg/lit. (Table 1) The maximum chloride content was found to be in Lavarpur and the minimum chloride content was found in Goblej. The higher content of chloride in ponds may be due to animal origin like human faces and sewage inflow. Chloride increases with the increasing degree of eutrophication. The maximum chloride was found in Lavarpur which indicates that higher amount of pollutants present in the pond.

Electric conductivity:

Conductivity of water is important because it reveals water's salinity and the concentration of other minerals and contaminants. [8]The conductivity depends on the value of the pH, temperature and the amount of CO2 which has been dissolved in the water to form ions. The conductivity is also affected by the concentration of ions already present in the water such as chlorides, sodium and ammounium. Chemicals composition of water determines its conductivity. Hence this becomes the most widely used measure of the purity of water.[5]

The electric conductivity of sample sites water ranged from a minimum of 479 mu.mhos/cm to a maximum of 777.3 mu.mhos/cm.

Turbidity:

The Turbidity of sample sites water ranged from a minimum of 11.3 mg/lit to a maximum of 40.7 mg/lit.Turbidity is an important indicator of the amount of suspended sediment in water, which can have many negative effects on aquatic life. The suspended sediments that cause turbidity can block light to aquatic plants, smother aquatic organisms, and carry contaminants and pathogens, such as lead, mercury, and bacteria. [6]

Calcium and Magnesium:

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Calcium is naturally present in water. It may dissolve from rocks such as limestone, marbel, calcite, dolomite, gypsum, fluorite and apatite. Calcium is determinant of water hardness because it can be found in water as Ca+2 ions. Magnesium is the other hardness determinant. [10]The calcium of sample sites water ranged from a minimum of 17 mg/lit to a maximum of 53.3 mg/lit.The magnesium content of sample sites water ranged from a minimum of 8.8 mg/lit to a maximum of 24 mg/lit.

BOD (27 c @3day):

BOD represents the quantity of oxygen which is consumed in the course of aerobic processes of decomposition of organic materials, caused by microorganisms. A high BOD indicates a high content of easily degradable, organic material in the sample. A low BOD indicates a low volume of organic materials, substances which are difficult to break down or other measuring problems. [2][9]The BOD of sample sites water ranged from a minimum of 29.4 mg/lit to a maximum of 53.5 mg/lit.

Chemical Oxygen Demand (COD):

Chemical oxygen demand determines the oxygen required for chemical oxidation of organic matter. COD values convey the amount of dissolved oxidisable organic matter including the non-biodegradable matters present in it. The COD of sample sites water ranged from a minimum of 98.1 mg/lit to a maximum of 239.9 mg/lit (Table 1). The minimum values of COD in Goblej water might be due to low organic matter. While the maximum value in Lavarpur water might be due to high concentration of pollutants and organic matter.

IV. CONCLUSION

The study carried out to assess the water quality for three water bodies around Ahmedabad. A comparative study surface water bodies was carried out by taking certain important parameters like pH, total dissolved solid, total suspended solid, alkalinity, total hardness, sulphate, chloride, electric conductivity, turbidity, calcium, magnesium, BOD, COD, and pestisides. In this present survey it was found that the maximum parameters were not at the level of pollution except few parameters like TSS and turbidity in water samples. So,all water sample sites satisfy the requirement for the use in various purposes. But the study of Lavarpur water bodies indicated that this community pondis polluted and unsafe for human use. The otherwater bodiesare comparatively less polluted than Lavarpur community pond. All three ponds need to be conserved for its biotic importance in ecosystem. The proper management plan to be implemented for its conservation otherwise these ponds will lose its natural health which will in turn affects the human population and wildlife as well.

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