Comparative Study of Chemical, Physical and Biological Analysis of Some Pond Water Ecosystems in Valsad of the State Gujarat, India.

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Abstract

We all know that water is our most important life survival factor, but due to urbanization our surface water bodies are being polluted day by day. In order to maintain the water quality of any surface water body it requires accessing the physiochemical and biochemical aspects of water periodically. This investigation is one of the most overlooked aspects of pond management system too. Present study highlights the preliminary investigation of physiochemical characteristics of four pond ecosystems viz. Halar Talav, Nanakwada Talav, Rakhodiya Talav and Segvi Talav. From each pond randomly 11 samples were collected and mixed to make four better representative samples. These samples have been assessed on the basis of various qualitative parameters like pH, temperature, turbidity, electrical conductivity (EC), total dissolved solids (TDS), total suspended solids (TSS), total hardness (TH), Total Alkalinity (TA), Chloride (Cl), dissolved oxygen (DO), chemical oxygen demand (COD), biological oxygen demand (BOD). The results obtained from the present work indicate that there are some diverse contaminations and pollution in these ecosystems. Therefore it is unsafe to use directly for human uses and hence needs more attention for its sustainability factor.

Keywords: Environment, Surface water, Quality, Pond, Pollution.

1. Introduction

Anthropogenic development of any civilization depends on their fresh water resources. These water resources include surface water and ground water. As we all know that groundwater is the main source of irrigation and domestic water in the most part of the world. Here surface water is most responsible for maintaining ground water level and fresh water resources in the planet. But now a day, due to over exploitation of surface water, improper waste disposal and erratic nature of rainy season, there has been depletion of surface water quality level across the world. The utility of water is limited by its quality, which may make it unsuitable for a particular purpose. Therefore, assessment of surface water quality is an important aspect of water evaluation and the standard of living of the people.[1] Further the quality problems of drinking water – both due to geologic factors leading to chemical contamination like excess fluoride, arsenic, iron, salinity, nitrate, etc. and anthropogenic factors resulting in bacteriological contamination, pose serious public health problems surrounding to the area of pond water systems.[2]

Surface water assessment is part science and part careful observation of the causes of the measured conditions. Assessment begins with an examination of the water's chemical, physical and

biological condition, and the causality of the conditions observed. In present paper our study is limited to four stagnant water eco-systems Halar Talav which is situated in Valsad city area, Nankwada Talav and Segvi Talav which are situated in the boundary area of valsad city. In city area most of the people are using municipality water for the drinking purpose but some people are dependent on bore wells and hand pumps. But in surrounding area of Valsad city area people are using bore well, well and hand pumps. If the stagnant water systems like ponds are contaminated or become polluted than the surrounding area's ground water systems might be affected of such pollution which can be harmful to the people of those locality. The present studies has been carried out to asses and evaluate the physical, chemical and bio-chemical characteristics of all four selected water ecosystems.

2. Material and Method

2.1 Area of Study

Valsad City is the District Headquarter of Valsad district which is located at the southernmost tip of Gujarat; The city is located on 72.93^{o} east longitude and 20.63^{o} north latitude with an elevation of 14 meter above sea level near Gulf of Khambhat in the Arabian Sea. The district has 5 talukas, viz. Valsad, Pardi, Dharampur, Kaprada and Umargam, Valsad is well known for its production of mangoes. Focus industry sectors include chemicals, textiles, horticulture and paper industry. There are several lakes nearby Valsad city from these the selected study lakes are shown in the Google map images Figure 1.and photos Figure 2 to 5.

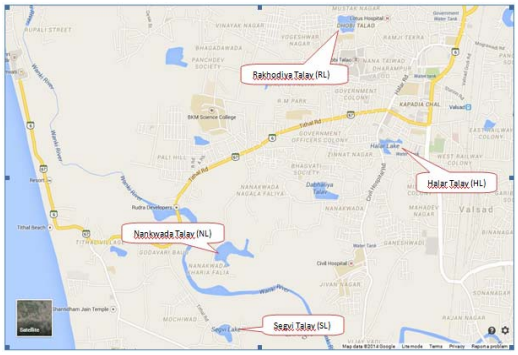

Figure 1: Google Map Image of Valsad showing four ystudy lake sites

Figure 2:Nankwad Talav(NL)

Figure 3: Segvi Talav (SL)

Figure 4: Rakhodiya Talav (RL)

Figure 5: Halar Talav (HL)

2.2 Sampling, Preservation and Methods of analysis

Total 44 water samples 11 from each pond were collected and mixed to make four better representative samples for all four ponds. The samples were collected in the month of October 2014. All samples were collected in high density plastic bottles. In all cases plastic bottles were cleaned properly, first with dilute nitric acid and then with double distilled water before their usage for collection of samples. During sampling sample bottles were cleaned with ambient water before taking the samples. During whole study AR grade chemicals were used. The analysis is based on APHA for examination of water and wastewater.[3] Parameters like pH, turbidity, and temperature were checked 15 to 17random points of the each site and considered the average for each site while rests of the parameters were checked in laboratory and methods for analyzing these parameters are shown in Table-1. Some standard preservative media was used to preserve the samples till it use for analysis in laboratory [4].

Table 1: Methods for water analysis parameters

Sr. No.	Parameters of Water	Analytical Methods
1	pH	Potentiometric
2	Temperature	Thermometric
3	Turbidity	Instrumental optometric
4	Electrical conductivity (EC)	Conductomettric
5	Total dissolved solids (TDS)	Gravimetric
6	Total suspended solids (TSS)	Gravimetric
7	Total hardness (TH)	Titrimetric
8	Total Alkalinity (TA)	Titrimetric
9	Chloride (Cl)	Titrimetric
10	Dissolved oxygen (DO)	Winkler Method
11	Chemical oxygen demand (COD)	Dichromate Reflux
12	Biological oxygen demand (BOD)	Std. Five-day Incubation

3. Results and Discussion

Summary results from our analysis of pond water samples are shown in Tables 2.

3.1 Temperature

Temperature is an important factor, which regulates the biogeochemical activities in the aquatic environment. The water temperatures ranged from 25 ^{o}C to 32^{o}C.

3.2 pH

The average pH of the four lakes ranged from 6.9-8.5. It is indicating alkalinity nature throughout the study period. High pH levels are undesirable since they may impart a bitter taste to the water. Furthermore, the high degree of mineralization associated with alkaline water will result in the encrustation of water pipes and water-using appliances. The combination of high alkalinity with low pH levels may be less corrosive than water with a combination of high pH, low alkalinity content. High pH levels also depress the effectiveness of disinfection by chlorination, thereby requiring the use of additional chlorine or longer contact times.[5]

3.3 Turbidity

In the present study water turbidity values ranged from 16 to 29 NTU. During rainy season silt, clay and other suspended particles contribute to the turbidity values, while during winter and summer seasons settlement of silt, clay results low turbidity.[6] Water founds turbid in monsoon season with yellow brown colour, while green colour in winter and transparent green colour is observed in summer season. The transparency of water is mainly due to factors such as biological productivity, suspended particles and water colour [7].

3.4 Electrical conductivity

Electrical conductivities recorded in current study in increasing order are 4.33 (SL), 5.23 (NL) 5.43 (HL) and 5.92 (RL) mhos/cm. Conductivity of water depends upon the concentration of ions and its nutrient status and variation in dissolve solid content. Seasonal variation in the conductivity is mostly due to increased concentration of salt because of evaporation. Similar type result was observed in Sursagar lake of Baroda [8-9-10].

3.5 Total dissolved solids

The TDS analyzed in this study area are from lowest 851 ppm (NL) to highest 1045 ppm (HL). This indicates that some how this figures are found higher. Total dissolved solids cause toxicity through increases in salinity, changes in the ionic composition of the water and toxicity of individual ions. Increases in salinity have been shown to cause shifts in biotic communities, limit biodiversity, exclude less-tolerant species and cause acute or chronic effects at specific life stages [11].

3.6 Total suspended solids

Suspended solids also provide adsorption surfaces and a route of transmission for many organic contaminants, heavy metals, and some nutrients. The greater the amount of total suspended solids higher the turbidity, thus suspended solids are having relation with clarity of water. Here the results of this study show a linear relation between turbidity and TSS. (Table-1)

3.7 Total hardness

Hardness of water is not a specific constituent but is a variable and complex mixture of cations and anions. It is caused by dissolved polyvalent-metallic ions. In water, the principle hardness causing ions are calcium and magnesium expressed as its $CaCO_3$ equivalent. High values of hardness are probably due to regular addition of large quantities of sewage and detergent into lakes from the nearby residential localities.[9, 12-13] The results show that the total hardness ranges between 488 (RL) ppm to 385(NL) ppm which is not so high according to BIS permutable limits.

3.8 Total Alkalinity

The total alkalinity analyzed at the four sites fluctuated between 198 (NL) to 266 (RL) ppm which indicates that the water bodies are having hard water. Das and Pandey [14] opined that high alkalinity indicates pollution. Excessive alkalinity may cause eye irritation in humans and chlorosis in plants. Alkalinity itself is not harmful to human beings; still water supply with less than 100 mg/l of alkalinity is desirable for domestic use.[15]

3.9 Chloride

Chloride is found widely distributed in nature in the form of salts of sodium, potassium and calcium. The chloride status in lake water is indicative of pollution, especially of animal origin.[16] In the present study chloride concentrations in lakes water was found ranging between minimum range of 117 ppm (NL) and maximum range of 187 ppm (HL). The high level of chlorine beyond 250mg/l affects the taste, palatability and corrosive effect of water. When combined with sodium, gives salty taste to drinking water and may increase the corrosiveness.[17]

4.0 Dissolved oxygen

The presence of dissolved oxygen is required to prevent odor and is suitable for use by aquatic plants and other life forms. Higher rate of decomposition of organic matter and limited flow of water leads to consumption of O_2 from water.[18] In the present study, concentrations of dissolved oxygen in all the study sites varied in between 2.94 to 5.33 ppm which according to BIS permutable limits.

4.1 Chemical oxygen demand

COD is an important parameter for establishing the quality of water. It determines the amount of oxygen required for chemical oxidation of organic and inorganic matter.[19] Organic matter and

anthropogenic activities are the main factors responsible for higher COD.[20-21] During the analysis, it was observed that the COD level was higher at 35 ppm (NL) and lower at 141 ppm (RL).

4.2 Biological oxygen demand

BOD is a test for measuring the amount of biodegradable organic material present in a sample of water. BOD is an index of organic pollution to measure the amount of DO required by microbial community in decomposing the organic matter present in a water sample by aerobic biochemical action.[22] During this study we found that the BOD level is between 1 ppm to 18 ppm. This result shows that there is significant water pollution in study area.

Tables 2: Results of analysis

Sr. No.	Parameters of Water	Unit	Halar Talav (HL)	Nanakwada Talav (NL)	Rakhodiya Talav (RL)	Segvi Talav (SL)
1	pH	-	8.4	7.6	8.1	7.4
2	Temperature	^{o}C	31	27	31	28
3	Turbidity	NTU	28	24	29	16
4	Electrical Conductivity (EC)	mhos /cm	5.42	5.23	5.92	4.33
5	Total Dissolved Solids (TDS)	ppm	1457	1070	1993	1124
6	Total Suspended Solids (TSS)	ppm	276	235	291	212
7	Total Hardness (TH)	ppm	398	375	488	378
8	Total Alkalinity (TA)	ppm	227	198	266	213
9	Chloride (Cl)	ppm	187	117	168	139
10	Dissolved Oxygen (DO)	ppm	5.33	4.40	2.94	5.15
11	Chemical Oxygen Demand (COD)	ppm	76	35	141	70
12	Biological Oxygen Demand (BOD)	ppm	7	1	18	8

4. Conclusion

The results obtained during the present study were compared with standards [27-29] and it was found that some number of parameters in all these four ponds were near to the limits or above desirable limits. Most of the results of Rakhodiya Talav (RL) are crossing the desirable limits. It can be concluded that the water quality of HL, NL, RL and SL lower than the demanded quality of water that is used for domestic purposes, bathing and recreational activities. Finally, the level of BOD and COD,

TDS, may have detrimental effects on the health of people in the vicinity of the ponds, particularly those that feed on fish and other organisms of the ponds, and those who use the water domestically without

treatment. The BOD level in the Rakhodiya pond is too high which indicates that this ecosystem is biologically highly polluted. The results obtained from the present investigation shall be useful in future anthropogenic management of these pond ecosystems.

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