Research Paper

ISSN: 2321-1520

Physico-Chemical Parameters of Water in WadhwanaWetland, Vadodara,Gujarat.

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Received Date: 9-1-2019

Published Date: 15-3-2019

Abstract

Present study deals with the physico-chemical parameters of water quality of well-known man-made inland wetland of Central Gujarat viz. Wadhwana. This study was conducted to ascertain its overall water quality status and to understand seasonal was assessed by taking various water quality parameters. To understand water quality profile of the Wadhwana wetland, water samples periodically in each for analysing 15 physico-chemical parameters during the three seasons (monsoon,winter and summer) in the years 2011,2012. The parameters included temperature,pH, Electrical conductivity, turbidity,total dissolved solids(TDS), Biological oxygen demand (BOD), alkalinity, total hardness, chlorides, salinity and some nutrients like nitrates and phosphate which were analysed by standard methods.

Keywords: Wetland, physico-chemical, Wadhwana, Gujarat

Introduction

Wetlands are "lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water." Its features were (a) at least intermittently, the land supports chiefly hydrophytes (b) the substrate is chiefly undrained hydric soil (c) the substrate is non-soil and is saturated with water at some time throughout the growing season of the year. Though, these ecosystems have been a mystery to scientists because they are too difficult to describe exactly, not because of their boundless geographical extent, but because of the wide diversity of hydrologic conditions in which they are found. The evaluation of the wetland range in the world is difficult and depends on precise definition (Cowardin, 1979). Available knowledge or information for some wetlands are at the most basic level, as information on physical and ecological features, values and benefits, land tenure and uses, threats and disturbances, monitoring and restoration of all wetlands is not available (Mitsch and Gosselink, 2000). The wise use and conservation of wetlands will be partly needful on a greatly expanded information base. Data on the ecological character of wetlands, which is the amount of wetland loss and degradation, conservation measures and the success of monitoring strategies will be required. Moreover, this information base requires linkage and integration with executive processes. Classification and account of wetlands are processes designed to deliver a key point on wetlands and their resources (Finlayson, 1999; Ramsar Convention Secretariat, 2013; Singh and Mathur, 2005).

As per Salim Ali Centre for Ornithology and Natural History (SACON')'s country-wide prioritization of wetlands of India.Wadhwana is a Rank-1 (i.e., top-ranking)wetland from the biodiversity view-point 2 (Islam and Rahmani, 2004; Anonymous, 2016).The Wetland has a historic value as it was constructed over 100 years ago in the year 1909-1910 by Shrimant Maharaja sir SayajiraoGaekwad III of erstwhile state of Baroda, with the purpose of providing irrigation water to the agricultural fields. Wadhwana wetland is an Irrigation Reservoir. Thus, it is a man-made wetland having freshwater.Considering these factors, this wetland was selected for assessment of water quality.

Materials and Methods

Study area:

Wadhwana wetland is located in Baroda District (22° 09' 42.2"N and 73° 28' 32.9"E). It covers an area of about 10 sq. km. The major inlet of the wetland is Mahi and Narmada canals that are feeder canals of the lake. The maximum depth of the wetland measured during study was 20 ft. The total length of lake is 17.60 km. As this is a freshwater irrigation reservoir, the main socio-economic dependency is for irrigated agriculture. Thus, it is water source for nearby villages. The water is also supplied to Vadodara city when the critical need arises. The reservoir is also used for commercial fishing, some locals also harvest wetland dependent emergent hydrophytes (*Typha*, Sedges, etc.) to use them as fodder.

Water sampling and Physico-Chemical Analysis:

The water samples were collected in the polyethylene bottles. Initially, the prewashed bottles were rinsed with sample water. The closed bottle was dipped in the lake at the depth of 0.5 m, and then a bottle was opened inside and was closed again to bring it out at the surface. The samples collected in three replicates from five different points were mixed together to prepare an integrated sample. The sampling/in situ water quality assessment was done between 2011 and 2012. The physical and chemical parameters were analysed in the seasons of monsoon, winter and summer, respectively. Water samples were analysed by standard guidelines APHA and AWWA (1992) of water sampling and physico-chemical parameters for evaluation. Parameters such as temperature, pH, electrical conductivity, dissolved oxygen and turbidity, were directly evaluated in the study area whereas other parameters were analysed in laboratory, as per standard methods

Result and Discussion

The physico-chemical parameters such as temperature, pH, electric conductivity, turbidity, alkalinity, total dissolve solid, total hardness, calcium, magnesium, sodium, chloride, phosphate, nitrate and biological oxygen demand of water were analysed for the Wadhwana wetland and results are shown in Table No. 1. These parameters were taken seasonal at the different places of the wetland. The values of all the parameters were compared by the stranded values of the drinking

water set by the WHO 2011.

pH:

pH is one of the very significant chemical characteristicsof all waters, which explains certain significant biotic and abiotic ecological characteristics of aquatic systemsin general.The pH of the Wadhwana reservoir surface water ranged from 8.00 to 8.12 i.e., pH range 8.12 during the monsoon/summer season (2011) and 8.00 during the winter season (2012). The reservoir remained alkaline throughout the study. Thevalue of pH during winter may be due to the high biological activity and can also be by the uptake of CO_2 by photosynthesizing organisms.

According to WHO water quality standards the pH level should be between 6.5 to 8.5 for the propagation of wildlife and fisheries. All the sites for Wadhwana wetlands fall under WHO standards.

Water Temperature:

The temperature plays an important role for controlling thephysico-chemical and biological parameters of water and considered as one among the most important factors in the aquatic environment particularly for freshwater. Variations in water temperature are usually governed by the climatic conditions. Increasing temperature positively influences the growth and survival of aquatic organisms.

In the present study the highest temperature recorded was 27 °C in summer during 2012 which might be due to high solar radiation, low water level, clear atmosphere and high atmosphere temperature. Lowest temperature recorded 18 °C in winter during 2012, which might be due tocold low ambient temperature and shorter photoperiod.

Turbidity:

Turbidity of water can be related to the expression of optical property and reflects the intensity of light scattered by the particles present in the water body which decreases the passage of light through the water (Qureshimatva and Solanki, 2015). The high turbidity values

Table No. 1: Physico-chemical parameters of water collected from Vadhvana wetland

		2011			2012		
Sr No	**Physico-chemical parameter**	**Summer**	**Monsoon**	**Winter**	**Summer**	**Monsoon**	**Winter**
1	Temperature ^{o}C	26	21	20	27	20	18
2	Turbidity NTU	2.1	2.6	2.1	4	4.6	2.4
3	Total Dissolve solids mg/L	464	370	333	458	433	430
4	pH	8.12	8.12	8	8.25	8	8
5	Total hardness mg/L	280	212	211	152	200	220
6	Calcium mg/L	43	37	38	24	32	38
7	Magnesium mg/L	41	29	32	22	24	29
8	Chloride mg/L	88	48	61	88	66	72
9	Nitrate (as NO_3) mg/L	17.08	3.08	12	12.96	16	12
10	Alkalinity mg/L	264	164	162	232	110	100
11	Sodium (mg/L)	44	60	48	50	66	66
12	Electro conductivity (Ω/cm)	381	401	426	400	450	455
13	BOD	4	5	5	5	5	4
14	Phosphate mg/L	0.049	0.055	0.061	0.45	0.49	0.52

2.6 NTU was recorded in Wadhwana wetland in 2012 due to decomposing mat of submerged aquatic vegetation i.e. Hydrilla, Najas, Vallisneria, etc. The low turbidity value 2.6 NTU was recorded during winter in 2011 due to trapping of turbidity particles by luxuriant underwater hydrophytic vegetation in the open water area of this wetland.

Electrical Conductivity (EC):

Water capability to transmit electric current is known as electricalconductivity and serves as a tool to assess the purity of water (Solanki, 2001). Thehighest electrical conductivity reported during winter was 426 Ù/cm in 2012and lowest in summer observed was 381 Ù/cm in 2011. During winter, a high level of conductivity indicates the pollution status aswell as trophic levels of the aquatic body. Conductivity is affected by temperature: the warmer the water, the higher the conductivity (Qureshimatva et. al., 2015).

Total Dissolved Solids (TDS):

The highest total dissolved solids (TDS) in summer was observed as 464 mg/L in 2011 due to the addition of dead organic substances contributed by the decomposition of aquatic plants and animals. The rain water may have decreased the TDS concentration to333 mg/L (lowest TDS in the data) during monsoon in 2011. The maximum limit for TDS as suggested by W.H.O is 500 mg/L which indicated that the recorded TDS signifies the polluted water.

Biochemical oxygen demand (BOD):

The highest biochemical oxygen demand was recorded during monsoon and winter season as 5 mg/L in 2011 but in 2012 highest biochemical oxygen demand was recorded during summer and monsoon season as 5 mg/L which can be attributed to the highbacterial activity and heavy input of organic matter in the lake water. The lowest demand of 4 mg/L was estimated during Summerseason in 2011 but in 2012 the lowest demand of 4 mg/L was estimated during winter season due to less vegetation and low decay oforganicmatter at low temperature.

As per WHO water quality standards for propagation of wildlife and fisheries the DO level of 4 mg/L or above is safe for aquatic life as well as drinking.

Alkalinity:

Alkalinity of water is due to the presence of certainions: carbonates, bicarbonates, and hydroxides

in water. The highest value of alkalinity was reported during summer was 264mg/L and 232 mg/L in 2011 and 2012 respectively. The value of alkalinity was high due to the accumulation of organic matters produced bydecay and decomposition of vegetation and in turn, added carbonateand bicarbonate concentrations in the surface water content. Thelowest alkalinity was reported during winter was 162 mg/L and 100 mg/L in 2011 and 2012 respectively. It can be related to the inflow of freshwater anddissolution of calcium carbonate ions in the water column.

Chlorides:

The highest amount (88 mg/L) of chloride was recorded in Summer in both years due to frequent run-off loaded with contaminated water fromthe surrounding slum area and evaporation of water (Solanki, 2007). The high chloride quantity in freshwater is an important indicator suggesting organic pollution like presence of organic matter, presumably of animal origin. The lowest value of chloride was 48 mg/Lduring monsoon season in 2011. It can be connected to the dilution of lake by rainwater.

Total Hardness:

Total Hardness of water is mainly due to the presence of calcium and magnesium ions and is an important indicator of the toxic effect of poisonous elements (Kumar and Ravindranath, 1998). Highest value of total hardness was recorded during summer as 280 mg/L in 2011 but in 2012 highest value oftotal hardness was recorded during winter as 220 mg/L. Low values 211 mg/l and 152 mg/l of total hardness wasrecorded during winter and summer season in both years respectively.

Calcium:

High concentration of calcium content in water was recorded 43 mg/l during summer season in 2011. Calcium concentration might have increased due to the addition of sewage whereas the lowest amount of calcium was 24 mg/L recorded during summer season in 2012 due to calcium being absorbed by many organisms (Wetzel, 1983).

Magnesium:

Magnesium is essential forphotosynthesis of chlorophyll bearing plants and therefore it canact as a limiting factor for the growth of phytoplankton. Thehighest value for magnesium hardness (41 mg/

L) was recordedduring the summer season in 2011. The lowest concentration of magnesium was 22 mg/L that was also recorded during the summer season in 2012.

Nitrates:

Nitrates are oxidation products of organic nitrogen by bacteria present in soil and water where sufficient oxygen is present. High level of nitrates 17.8mg/L during summer in 2011. Higher concentrations of nitrates represent higher pollution loadand higher chances of eutrophication. Most of the nitrate might have been derived from the decomposition of organic wastes. The lowest amount of nitrate in water was recorded during winter 12 mg/L in both years and can be due to the utilization by plankton and aquatic plants for metabolic activities.

Phosphates:

Phosphates are one of the major nutrients responsible for eutrophication of wetlands, as it is the primary initiating factor.In 2012 highest amount of phosphate (0.52 mg/L) was recorded during winter season and associated by the entry of domestic sewage in thewater.Singh and Mathur (2005) observed that the constant addition of even low levels of nitrogenand phosphorous to an aquatic environment could greatly stimulatealgal growth. The lowest amount phosphate was recorded as 0.049mg/L during summer seasonin 2011 due to increased uptake ofphosphate for luxuriant growth of macrophytes.

Sodium:

The highest amount of sodium (66 mg/L) was recorded during the winter season in 2012 due to enhance the nutrient status of a wetland that results into their eutrophication. Thehighest volume of sodium content during winteris due to shrinkageof water volume. The lowest amount of 44 mg/L was recordedduring summer season in 2011 because of bioaccumulation byliving organisms. Sodium is an important factor in determining many aspects of the chemistry of natural waters and of biological processes within it (Solanki and Pandit, 2006).

Conclusion

Wadhwana wetland is included in national wetland conservation program. The comparative study of the physico-chemical characteristics of the two years *viz.*2011 and 2012reveals that as the season changes there is a fluctuation in the physico-chemical characteristics of the water of both

years.The statistics obtained from the physico-chemical analysis of the water quality in the Wadhwana wetland, Vadodara clearly indicates that most of the important quantities such as turbidity, total dissolved solids, pH, hardness, alkalinity and phosphate contents in the lake water are above the upper threshold of the W.H.O guidelines. To sustain the ecology and aquatic life in the lake, certain measures and planning must be taken by the forest department to combat the pollution rate. This study may be helpful

for proper management and optimum utilization.

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