Journal of Pollution Effects & Control
ISSN: 2375-4397

Umerfaruq and Solanki, J Pollut Eff Cont 2015, 3:2
DOI: 10.4172/2375-4397.1000134

Research Article Open Access

Physico-chemical Parameters of Water in Bibi Lake, Ahmedabad, Gujarat, India

Qureshimatva Umerfaruq M* and Solanki HA

Department of Botany, University School of Sciences, Gujarat University, Ahmedabad-380 009, Gujarat, India

Abstract

Water as a universal solvent has the capability to dissolve many substances including organic and inorganic compounds. The quality of water generally refers to the component of water present at the optimum level for suitable growth of plants and animals. Temperature, turbidity, nutrients, hardness, alkalinity, dissolved oxygen, etc. are some of the important factors that determines the growth of living organisms in the water body. The Bibi lake, a natural lake of Vatva taluka, Gujarat, India is completely surrounded by slum area whom discharge their domestic waste directly into the lake water creating environmental hazard. To understand the situation, water samples were collected monthly to analyze different physical and chemical parameters such as temperature, pH, electric conductivity, turbidity, alkalinity, dissolved oxygen, etc. The comparison of statistics with the standard values of W.H.O guidelines (1998) revealed the high level of turbidity, total dissolved solids, pH, hardness, alkalinity and phosphate in the water content. The accumulation of these pollutants poses a dangerous threat to both aquatic and human lives.

Keywords: Water pollution; Bibi lake; Gujarat; India; Physico-chemical parameters; Freshwater

Introduction

Water as a universal solvent has the capability to dissolve many substances including organic and inorganic compounds. This outstanding property of water can be ascertained to the inconceivability to take in water in its pure form [1]. The quality of water generally refers to the component of water present at the optimum level for suitable growth of plants and animals. Aquatic organisms need a healthy environment to live and adequate nutrients for their growth; the productivity depends on the physicochemical characteristics of the water body [2,3]. The maximum productivity can be obtained only when the physical and chemical parameters are present at optimum level. Water for human consumption must be free from organisms and chemical substances and such large concentrations may affect health [4].

The pollution of water is increased due to human population, industrialization, the use of fertilizers in agriculture and man-made activity. Parameters such as temperature, turbidity, nutrients, hardness, alkalinity, dissolved oxygen, etc. are some of the important factors that determines the growth of living organisms in the water body [5]. Hence, water quality assessment involves the analysis of physico-chemical, biological and microbiological parameters that reflect the biotic and abiotic status of the ecosystem [6].

Materials and Methods

Study area

The Bibi lake, a natural lake of Vatva taluka, Ahmedabad, Gujarat, India, entirely surrounded by slum area and masses from the surrounding area channelize their domestic waste straight into the lake water.

Location: Vatva-Narol road, Vatva, Ahmedabad

Latitude: 22057'38.65" N

Longitude: 72036'37.09" E

Area covered: 11,425 m^2

Maintained by: Ahmedabad Municipal Corporation, Govt. of Gujarat.

Selection of sample sites

The water samples were collected from five different points of the lake (Figure 1). The points can be classified into three types,

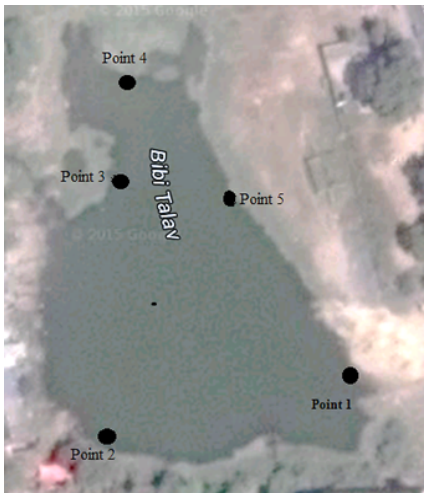

Figure 1: Satellite image of Bibi lake, Ahmedabad showing sampling sites denoted by dot.

***Corresponding author:** Qureshimatva Umerfaruq M, Department of Botany, University School of Sciences, Gujarat University, Ahmedabad-380 009, Gujarat, India, Tel: 07926301341; E-mail: ufmqureshi@yahoo.in

Received January 03, 2015; **Accepted** February 16, 2015; **Published** February 19, 2015

Citation: Umerfaruq MQ, Solanki HA (2015) Physico-chemical Parameters of Water in Bibi Lake, Ahmedabad, Gujarat, India. J Pollut Eff Cont 3: 134. doi:10.4172/2375-4397.1000134

1. Inlet point - The feeder region of the lake for domestic animals

2. Centre point - The point which represents the general water quality of the lake

3. Outlet point - The place where the overflows occur

In addition, two points were randomly selected to enhance the sampling procedure.

Collection of samples

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.

Physico-chemical parameters

To study the physico-chemical properties of the lake water content, water samples were collected from the lake surface in a clean polythin container for the period of one year, September 2013 to August 2014. Samples were collected during morning hours in between 8.00 to 10.00 a.m. using one litre container. The physical and chemical parameters were analyzed in the seasons of monsoon, winter and summer, respectively. Parameters including temperature, pH, electrical conductivity, turbidity, total dissolved solid, total alkalinity, total hardness, calcium, magnesium, dissolved oxygen, biochemical oxygen demand, chloride, sodium, nitrate and phosphate, were analyzed. We adopted standard guidelines of water sampling and physico-chemical parameters evaluation [7]. Parameters such as temperature, pH, electrical conductivity, dissolved oxygen and turbidity, were directly evaluated in the study area whereas other parameters were analyzed in laboratory.

Results and Discussions

The physico-chemical parameters such as temperature, pH, electric conductivity, turbidity, alkalinity, dissolved oxygen, total dissolved solid, calcium, magnesium, sodium, chloride, phosphate, biological oxygen demand, nitrate and total hardness of water were analysed in the water samples taken from Bibi lake, Ahmedabad, Gujarat, India. These parameters were taken seasonally at the five points of the lake. All parameters were reported in mean value of the data with standard errors (Table 1) and its variations across the seasons are graphically presented in Figure 2.

Temperature

The temperature plays an important role for controlling the physico-chemical and biological parameters of water and considered as one among the most important factors in the aquatic environment particularly for freshwater [8]. The highest temperature in summer was recorded 27°C and can be due to high solar radiation, low water level, clear atmosphere and high atmosphere temperature [9]. The lowest temperature was reported during winter season was 18°C (Figure 2.1) due to cold low ambient temperature and shorter photoperiod [10].

Electrical conductivity

Water capability to transmit electric current is known as electrical conductivity and served as a tool to assess the purity of water [11]. The highest electrical condutivity was reported during summer was 3.54 Ω/cm and lowest in winter observed was 3.08 Ω/cm (Figure 2.2). During summer, a high level of conductivity indicates the pollution status as well as trophic levels of the aquatic body [12].

Turbidity

The 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. The high turbidity value reported in summer was 24 NTU due to the growth of aquatic vegetation and lowered the volume of water [13]. The lowest turbidity was found during monsoon was 17 NTU (Figure 2.3) due to dilution of water resulting from monsoon showers and comparatively low run off from the lake.

Total dissolved solids (TDS)

The highest total dissolved solids (TDS) in summer was observed as 1246 mg/L due to the addition of dead organic substances contributed by the decomposition of aquatic plants and animals which may be related to the water dilution caused by evaporation at high temperature during summer. The rain water may have decreased the TDS concentration to 958 mg/L (lowest TDS in the data) during monsoon (Figure 2.4). The maximum limit for TDS as suggested by W.H.O is 500 mg/L [14] which indicated that the recorded TDS signifies the polluted

Average with standard error values of physico-chemical parameters of Bibi Lake (2013-14)					
S. No.	**Parameters**	**Monsoon**	**Winter**	**Summer**	**W.H.O. standards for Drinking water (annual max.)[a]**
1	Temperature (˚C)	23 ± 1.27	18 ± 1.2	27 ± 0.42	30-32
2	Electrical conductivity (Ω/cm)	3.15 ± 0.41	3.08 ± 0.15	3.54 ± 0.84	500
3	Turbidity (NTU)	17 ± 0.63	19 ± .25	24 ± 0.75	5
4	Total Dissolved Solid (mg/L)	958 ± 32.47	1073 ± 24.63	1246 ± 22.69	259-500
5	pH	8.9 ± 0.13	8.2 ± 0.84	9.3 ± 0.34	6.5-8.5
6	Alkalinity (mg/L)	242 ± 6.47	194 ± 4.15	274 ± 2.32	100
7	Total hardness (mg/L)	278 ± 6.10	255 ± 4.16	231 ± 3.15	200
8	Calcium (mg/L)	46 ± 0.36	37 ± 1.54	30 ± 0.86	75
9	Magnesium (mg/L)	33 ± 0.54	34 ± 2.58	31 ± 5.41	150
10	Dissolved oxygen (mg/L)	4.71 ± 0.47	5.41 ± 0.88	3.40 ± 1.63	7.5
11	Chloride (mg/L)	98 ± 4.1	99 ± 6.24	103 ± 4.63	200
12	Sodium (mg/L)	45 ± 2.47	41 ± 2.63	55 ± 2.12	200
13	Nitrate (mg/L)	8.7 ± 0.3	8.2 ± 0.24	7.5 ± 0.56	11
14	Phosphate (mg/L)	1.04 ± 0.73	0.96 ± 0.03	1.7 ± 0.08	0.5
15	Biochemical oxygen demand (mg/L)	1.18 ± 0.47	2.24 ± 0.66	2.41 ± 0.09	6.9

Table 1: Average with standard error values of physico-chemical parameters of Bibi Lake.

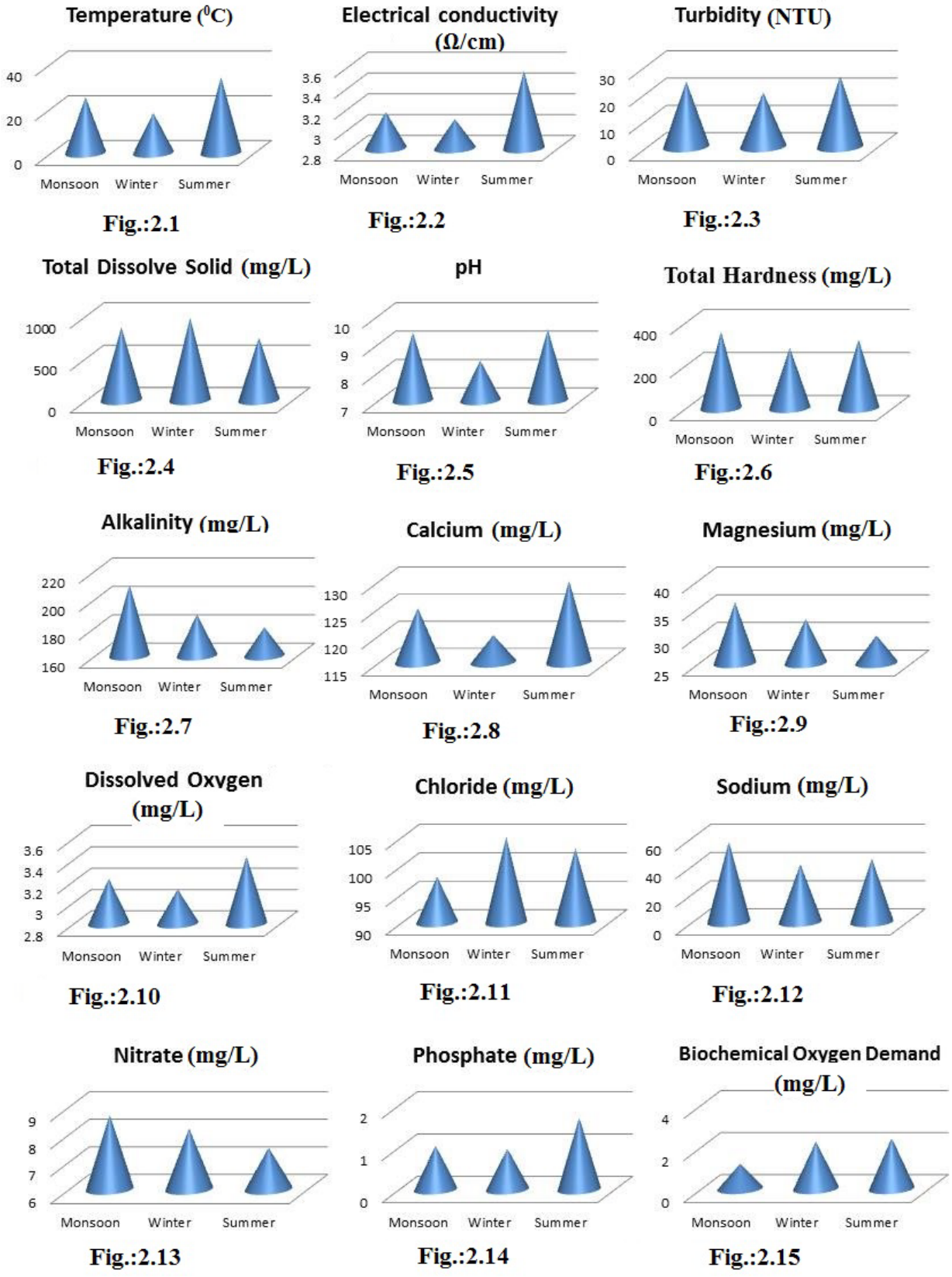

Figure 2: Graphs depicting the variations in physic-chemical parameters observed seasonally at Bibi lake, Ahmedabad, Gujarat, India during September 2013 to August 2014.

lake water. The contamination of domestic waste water, garbage and other related wastes in the surface water body can be one among the reasons for increase in TDS measure [8,9]. Our on-field observations were also similar in this case.

pH

We recorded a high pH of lake water (9.3) associated with the high decomposition activities of biotic and abiotic factors [15]. The low pH of 8.2 was noticed during winter (Figure 2.5) due to the production of CO_2 from biological oxidation process and may have ultimately contributed to the reduction of pH [16].

Alkalinity

The highest value of alkalinity was reported during summer was 274 mg/L due to the accumulation of organic matters produced by decay and decomposition of vegetation and in turn, added carbonate and bicarbonate concentrations in the lake water content [17]. The lowest alkalinity of 194 mg/L concentration was noticed during winter season (Figure 2.6) and can be related to the inflow of freshwater and dissolution of calcium carbonate ions in the water column [18].

Total hardness

The highest amount of total hardness in the water was recorded during monsoon as 278 mg/L due to the presence of high content of calcium and magnesium ions in addition to sulphate and nitrate in the sewage waste added during monsoon [19]. The lowest amount of total hardness was recorded during summer season as 231 mg/L (Figure 2.7) because of low volume of water and high rate of vegetation in the lake [20].

Calcium

The highest amount of calcium content in water was recorded during monsoon season as 46 mg/L by the addition of sewage waste which may be responsible for the increase in amount of calcium whereas the lowest amount of calcium was 30 mg/L (Figure 2.8) recorded during summer season due to calcium being absorbed by a large number of organisms. Jhingran suggested that calcium is one among the most abundant ions in freshwater and plays a pivotal role in shell construction, bone building and plant precipitation [21]. The magnesium act similar to calcium in ion exchange reaction and influence the absorption of sodium equally [22].

Magnesium

The highest amount of magnesium was 33 mg/L recorded during the winter season as the amount of magnesium is essential for chlorophyll bearing plant for photosynthesis and act as a limiting factor for the growth of phytoplankton [23]. The lowest value was 31 mg/L (Figure 2.9) estimated during the summer season.

Dissolved oxygen

The highest amount of dissolved oxygen recorded during the winter season was 5.41 mg/L because of the increased solubility of oxygen at lower temperature whereas the lowest dissolved oxygen was recorded as 3.40 (Figure 2.10) during the summer season which can be related to the high temperature and the addition of sewage and other wastes and drastically reduced the dissolved oxygen content.

Chloride

The highest chloride concentration of 103 mg/L was reported in summer due to frequent run-off loaded with contaminated water from the surrounding slum area and evaporation of water. The high chloride concentrations indicates the presence of organic matter, presumably of animal origin [24]. The lowest value of chloride was 98 mg/L (Figure 2.11) during monsoon season and can be connected to the dilution of lake by rain water. According to Solanki and Pandit, the concentration of chlorides can be related to purity or impurity of water [20].

Sodium

The highest amount of sodium was recorded during the summer season (55 mg/L) by the addition of waste water containing soap solution and detergent from the surrounding slum area [25]. The highest volume of sodium content during summer is due to shrinkage of water volume [26]. The lowest amount of 41 mg/L was recorded during winter season (Figure 2.12) because of bioaccumulation by living organisms.

Nitrate

The highest amount of nitrate was recorded during monsoon season (8.7 mg/L) due to the possible influx of nitrogen rich flood water into the lake water from the large amount of contaminated sewage water [27]. The lowest amount of nitrate in water was recorded during summer was 7.5 mg/L (Figure 2.13) and can be due to the utilization by plankton and aquatic plants for metabolic activities.

Phosphate

The highest amount of phosphate (1.7 mg/L) was recorded during summer season and associated by the entry of domestic sewage in the lake water. Similar result was observed by Benjamin et al., in the study of fish mortality in the lake waters of Bangalore, India [1]. Hastler observed that the constant addition of even low levels of nitrogen and phosphorous to an aquatic environment could greatly stimulate algal growth [28]. The lowest amount phosphate was recorded as 0.96 mg/L during winter season (Figure 2.14) due to increased uptake of phosphate for luxuriant growth of macrophytes.

Biochemical oxygen demand (BOD)

The highest biochemical oxygen demand was recorded during summer season as 2.41 mg/L which can be attributed to the high bacterial activity and heavy input of organic matter in the lake water [29]. The lowest demand of 1.18 mg/L was estimated during monsoon season (Figure 2.15) due to less vegetation and low decay of organic matter at low temperature.

The comparison of various physico-chemical parameters deduced from Bibi lake, Gujarat allowed us to study the pollution status of this water body. Quantities such as turbidity, total dissolved solids, alkalinity, pH, hardness and phosphate contents are significantly high. The comparison of estimated quantities from neighbour lake, Chandola lake, Ahmedabad [3] with the presented data revealed the content of magnesium and chloride ions and biological oxygen demand is high during the monsoon season. Verma et al., also noted that the Chandola lake is surrounded by industrial and slum areas and wastages from both of these places are deposited here [3]. During winter, electrical conductivity, turbidity, total dissolved solids and chloride, sodium, nitrate ions and biological oxygen demand are high according to Chandola lake statistics. The concentrations of chloride, nitrate and sodium ions and biological oxgen demand seems to decrease during summer monsoon. The pollution rate of Bibi lake is comparatively less than Chandola lake. This may be one among the reasons to implant cleaning water plant in the Bibi lake to procure drinking water to the local communities. The estimation of physic-chemical parameters at

par with the W.H.O guidelines [14] may guide the civic authorities to modify the sustainable techniques to enhance the water quality.

Conclusion

The statistics obtained from the physic-chemical analysis of the water quality in the Bibi lake, Ahmedabad 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. This present situation may drastically affect the aquatic and terrestrial organism growth in the water repository and significant pollutants emerge from domestic sections pose an additional threat to the water quality in the near future. To sustain the ecology and aquatic life in the lake, certain measures and planning must be taken by the civic body to combat the pollution rate in the lake.

References

1. Benjamin R, Chakrapani BK, Devashish K, Nagarathna AV, Ramachandra TV, et al. (1996) Fish mortality in Bangalore lakes, India. Electronic Green Journal, 6. Retrieved from http://egj.lib.uidaho.edu/egj06/ramachandra.html.
2. Agbaire PO and OBI CG (2009) Seasonal Variation of some physico-chemical properties of River Ethiope water in Abraka, Nigeria. Journal of Applied Sciences and Environmental Management 13: 55-57.
3. Verma P, Chandawat D, Gupta U, Solanki HA (2012) Water quality analysis of an organically polluted lake by investigating different physical and chemical parameters. International Journal of Research in Chemistry and Environment 2: 105-112.
4. Uduma AU (2014) Physicochemical analysis of the quality of sachet water consumed in kano metropolis. American Journal of Environment, Energy and Power Research 2: 1-10.
5. Smitha (2013) Physico-chemical analysis of the freshwater at River Kapila, Nanjangudu Industrial Area, Mysore, India. International Research Journal of Environment Sciences 2: 59-65.
6. Verma PU, Purohit AR, Patel NJ (2012) Pollution status of Chandlodia Lake located in Ahmedabad Gujarat. International Journal of Engineering Research and Applications 2: 1600-1610.
7. Reasoner DJ (2004) Heterotrophic plate count methodology in the United States. Int J Food Microbiol 92: 307-315.
8. Singh RP, Mathur P (2005) Investigation of variations in physicochemical characteristics of a fresh water reservoir of Ajmer city, Rajesthan. Indian Journal Environmental Sciences 9: 57-61.
9. Swarnalatha N, Narasingrao A (1998) Ecological studies of Banjaralake with reference to water pollution. Journal of Environmental Biology, 19: 179-186.
10. Bohra OP, Bhargava SC (1977) Abiotic factor, chlorophyll pigment and primary production in two lakes of Jodhpur. Geobios 4: 215-216.
11. Murugesan A, Ramu A, Kannan N (2006) Water quality assessment from Uthamapalayam municipality in Theni District, Tamil Nadu, India. Pollution Research 25: 163-166.
12. Ahluwalia AA (1999) Limnological Study of wetlands under SardarSarovar command area. Ph.D. Thesis, Gujarat University, Ahmedabad.
13. Kumar SM, Ravindranath S (1998) Water Studies-methods for monitoring water quality. Center for Environment Education (CEE), Banglore, Karnataka, India, 191.
14. World Health Organization (W.H.O.) (1998) Guideline for drinking water quality. Health criteria and other supporting information (2ndedn) Geneva, 2: 231 -270.
15. Chaudhary S, Anuradha, Sastry KV (2004) Pollution of River Yammuna at Faridabad Hariyana. Pollution Research 23: 749-756.
16. Solanki HA (2007) Ecological studies of phytoplankton of Mini Mahi River, Gujarat, India. Vidya 2: 47-57.
17. Jain CK, Bhatica KKS, Vijay T (1997) Ground water quality in coastal region of Andraapradesh. Indian Journal of Environmental Health 39: 182-190.
18. Padma S, Periakali P (1999) Physicochemical and geochemical studies in Pulicatlake, east coast of India. Indian Journal of Geo-Marine Sciences 28: 434-437.
19. Angadi SB, Shiddamallayya N, Patil PC (2005) Limnological studies of Papnash pond, Bidar (Karnataka). J Environ Biol 26: 213-216.
20. Solanki, Pandit BR (2006) Trophic status of lentic waters of ponds water of Vadodara, Gujarat state, India. Inernational Journal of Bioscience Reporter 4: 191-198.
21. Jhingran VG (1975) Fish and Fisheries of India. Hindustan Publication Corporation, New Delhi, 954.
22. Paliwal PV, Yadav BR (1976) Irrigation water quality and crop management in the union territory of Delhi report. Water Technology Centre, IART, New Delhi.
23. Dagaonkar A, Saksena DN (1992) Physicochemical and biological characterization of a temple tank, Kaila Sagar, Gwalior, Madhya Pradesh. Hydrobiologia, 8: 11-19.
24. Tresh JC, Suckling EV, Beale JF (1944) Chemical and zoopklankton studies of lentic habitats in North Eastern New South Wales. Australian Journal Marine Freshwater Research, 21: 11-33.
25. Mishra SR, Saxena DN (1991) Pollution ecology with reference to physciochemical characteristics of Morar (Kalpi) river Gwalior (M.P). In: Shastree NK (ed.), Current Trends in Limnology 159-184.
26. Solanki HA (2001) Study on pollution of soils and water reservoirs near industrial areas of Baroda. Ph.D Thesis submitted to Bhavnagar University, Bhavnagar.
27. Zimba PV, Khoo L, Gaunt PS, Brittain S, Carmichael WW (2001) Confirmation of cat fish, IctaluruspunciatusRalfinesque, mortality from microcystis toxins. Journal of Fish Diseases 24: 41-47.
28. Hastler AD (1947) Eutrophication of lakes by domestic drainage. Journal of Ecology, 28: 383-395.
29. Campbell IC (1978) A biological investigation of an organically polluted urban stream in Victoria. Australian Journal of Marine & Freshwater Research 29: 275-291.