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Comparative study of two Urban Ponds of Vadodara city with special reference to their chemical parameters

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Abstract

In the present study two ponds of Vadodara City, Gujarat were selected for analysis of the chemical properties of their water. Both the ponds were almost equally surrounded by human settlements. Mahadev Pond was having a constructed boundary where as Bapod Pond had a natural boundary with inward slope. The chemical parameters selected for analysis were Dissolved Oxygen, pH, Chloride, Total Hardness, Phosphate and Nitrate. Dissolved Oxygen of the waters in both the Ponds was found to be as good as to support healthy aquatic life forms. The results showed that the pH of water of both the ponds was found to be alkaline throughout the study period and was similar in both the ponds. Dissolved Oxygen, pH and Total Hardness were almost similar in both the ponds. In the case of Chloride, Nitrate and Phosphate the Bapod Pond which is having a natural boundary showed very high concentration in comparison to Mahadev Pond. The analysis also showed that the constructed boundary of Mahadev Pond was helpful in restricting the entry of water soluble ions which would make their way by the runoff from adjoining areas. The higher concentrations of Chloride, Phosphate and Nitrate can be attributed to the natural boundary which leads to unrestricted inflow of sewage from adjoining human settlements.

Keywords:

Introduction

Water is associated with almost every aspect of life on our planet. It governs many of the environmental processes and plays a central role in deciding the fate of life on Earth. Almost 3/4th of the Earth's surface is covered with water in the form of oceans. If the water resources of Earth are classified on the basis of its utility, then nearly 97% of the water resources are in the form of Salt water having very limited utilities such as transportation, release of heat, fishery etc. However, these waters are not suitable for consumption due to very high salt content. Out of the remaining 3% freshwater, most of the volumes are either locked in polar ice caps or present as ground water having conditional accessibility. Finally, the surface fresh water that is directly accessible for human utilization is only a small fraction of water resources that is approximately 0.33% which fulfills most of the human requirements of freshwater. However, haphazard utilization without sustainable development of these resources (viz., lakes, ponds, rivers and streams) causes their degradation at a very faster rate. There is not any mechanism which strongly and effectively restricts the contamination of these water resources caused by human activities which ultimately limits the utility of these resources for further consumption. Many of the ponds and lakes of the developing countries are polluted to a level from where their redevelopment is not possible and ultimately these water bodies are lost forever.

To analyse the contamination status and the effect of contaminants coming from the human settlements, two ponds of Vadodara city, Gujarat were selected out of which one was having a constructed boundary and the other was having a natural boundary with inward slope. It was presumed that the pond with a constructed boundary limits the inflow of waters to some extent which drain into the pond from adjoining human population. The parameters selected for the study were Dissolved Oxygen, pH, Chloride, Total Hardness, Phosphate and Nitrate. The subsequent analysis of the result would enable to decide if the constructed boundary affects the level of contamination.

Materials and Methods

Mahadev Pond: Mahadev Pond is located at latitude 22˚17' N and longitude 73˚13' E in Vadodara city (Figure- 01). The water body has constructed boundary of cement and bricks. At the centre of the pond there is a community hall where various celebrations take place. So there are frequent chances of organic waste disposal in the pond. Apart from this the most common activities seen are fishing and washing of cloths which in turn add nutrients to the waters. The dimensions of the pond are as follows: i. Perimeter: 1138.08 m, ii. Area: 36,448.86 m^2

Bapod Pond: Bapod Pond has natural boundary and is located at latitude 22˚18' N and 73˚14' E longitude (Figure- 02). Due to the natural boundary human activities and surface runoff of sewage water might be affecting the water quality. Activities at the temple situated at the boundary of the pond also affect the water quality as disposal of waste takes in the pond. These materials include flowers, coconut shells, polythene bags etc.

Other than this, the common activities are bathing, washing of cloths and washing of animals. All these activities alter the natural quality of water. The dimensions of the pond are as follows: i. Perimeter: 712.43 m, ii. Area: 21,933.95 m^2

Figure–01
Sampling sites of Mahadev Pond (Constructed Boundary)

Figure–02
Sampling sites of Bapod Pond (Natural Boundary)

For the purpose of analysis, water samples from both the ponds were collected between 7:00 am to 8:00 am from the pre decided sampling points (Figure-01 and 02). The selected parameters were analysed using available standard methods[1]. The Dissolved Oxygen of the samples was fixed on the site before further analysis to reduce error. For rest of the water parameters, the samples were collected in one liter air tight plastic bottles and analysed within 4 hours of sample collection (Table-01).

Table-1
Methods used for analysis of water parameters

Sr. No.	Parameter studied	Method used
1	Dissolved Oxygen	Alkaline azide - Titrimetric
2	pH	pH probe
3	Chloride	Titrimetric
4	Total Hardness	Titrimetric Method – Erichrome black T indicator
5	Nitrate	Colorimetric
6	Phosphate	Colorimetric

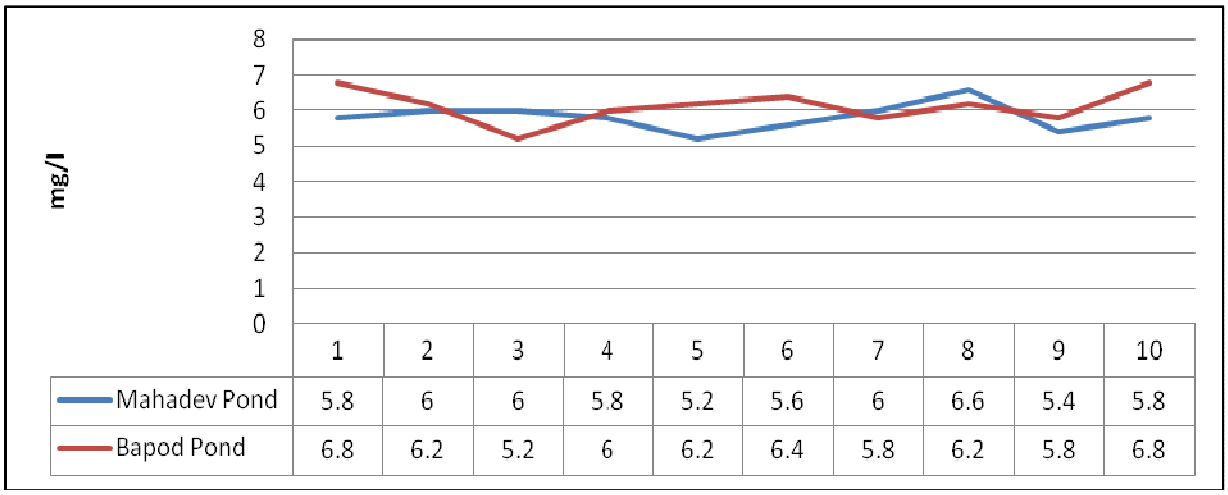
Result and Discussion

Analysis of the water samples drawn from the Mahadev Pond showed the following results. The Dissolved Oxygen (DO) level (Figure-03) of the Bapod Pond was found to be higher than the Mahadev Pond. Surface Diffusion of gases plays a major role in maintaining the levels of Dissolved Gases in a surface water body like Pond[2]. Moreover, comparatively smaller amounts of DO are produced by the photosynthetic organisms residing in the pond as a result of their photosynthetic activities. With a balance in the natural ecosystem, the pond which has aquatic plants will have slightly more DO in comparison to the pond having scarce aquatic flora. Although the aquatic vegetation is important to maintain the productivity of a pond ecosystem; their growth may be accelerated with continuous addition of nutrients. If this growth remains unchecked, it leads to formation of a mat of floating algae which eventually covers the whole surface of the water body. This does not allow the surface diffusion of gases leading to depleted oxygen levels in the water causing death and decay of aquatic organisms in anoxic condition. Some of the aquatic plants, when decomposed in anaerobic conditions are known to be producing toxic chemicals such as “Strychnine” which are not only harmful to the aquatic organisms but also to cattle and other organisms including aquatic birds that rely on the pond[3]. Although it was not part of the study, due to its much importance in a pond ecosystem some of the information was gathered regarding blue green algae. In many of the studies, it is observed that the Secondary Metabolites of Blue Green Algae (Cyanobacteria) are harmful and are known to be having deleterious impact on aquatic plants, aquatic animals as well as cattle and birds dependent on it[4,5].

The pH of both the water bodies was found to be on alkaline side of the scale throughout the study period[6]. The average pH of Mahadev Pond was 8.53 and that of Bapod Pond was 8.41. In the case of Mahadev Pond the pH fluctuated between 7.89 and 8.89 (Figure- 04). Out of 10 samples, in 6 of the samples pH value was found to be more than 8.5 which is beyond the desirable limit for drinking purpose[7]. Beyond this value the water affects the mucous membrane of the human digestive

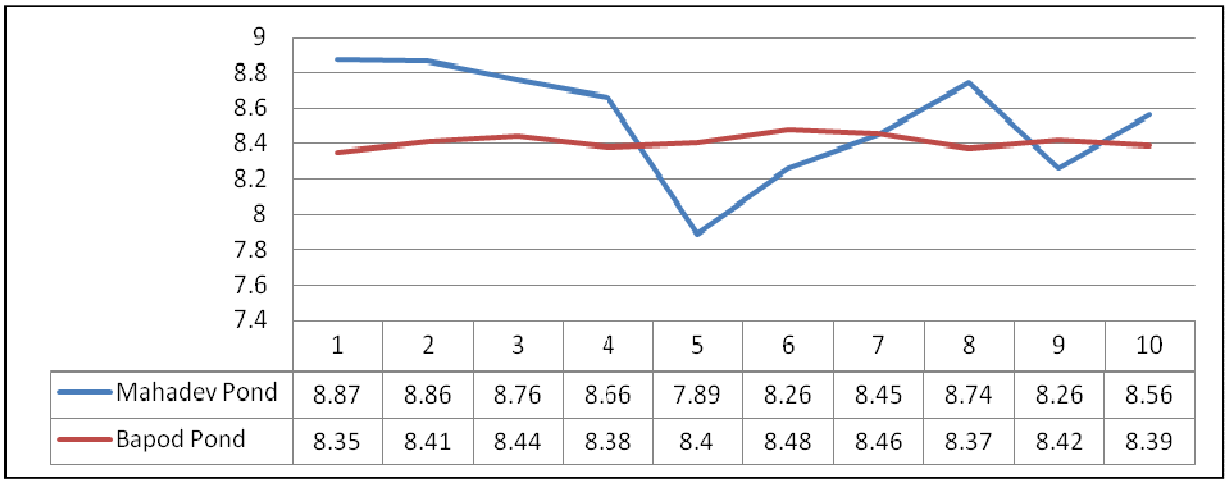
system. pH values of Bapod Pond did not show much fluctuations. The pH values ranged from 8.35 to 8.48 only throughout the sampling duration which was well within the permissible limit. The results of pH analysis show that Mahadev Pond which is having the constructed boundary showed comparatively higher pH value in spite of limited entry of the water from the surrounding areas. Many soft bodied aquatic organisms and the Anurans (Toads and Frogs) are very fragile to changes in pH. The optimum pH range for most aquatic organisms is 6.5 – 8.0. Further changes in this range at both the ends may cause harmful effect in the body and raise the question of their survival in the same habitat. The toxic compounds present as deposits at the bottom may be liberated if the pH decreases. Apart from this, much higher or lower ranges of pH may also interact with other Physico-chemical parameters of the pond and may adversely affect the utility value of the water[8]. So, pH is a very important chemical property of water which has greater influence on the health of the Pond Ecosystem.

The average chloride value for Mahadev Pond water sample was found to be 162.35 mg/l where as Bapod Pond water contained chlorides as high as 352.3 mg/l which more than double than that of Mahadev Pond (Figure-05). The higher chloride concentrations in the pond water can be attributed to the sewage disposal, the surface runoff as well as agricultural runoff. The chloride in Mahadev Pond water samples was found to be below desirable limit throughout the study period but in the case of Bapod Pond it showed a very high concentration of Chloride which was exceeding the desirable limits of 250 mg/l[7]. The comparative lower levels of chloride in Mahadev Pond can be due to restricted entry of the sewage runoff from the streets due to the constructed boundary. The inward sloping boundary of Bapod Pond might have failed to restrict the entry of surface runoff which leads to substantially higher levels of chlorides in the waters. Open defecation near the pond boundary may also have lead to increased chloride levels.



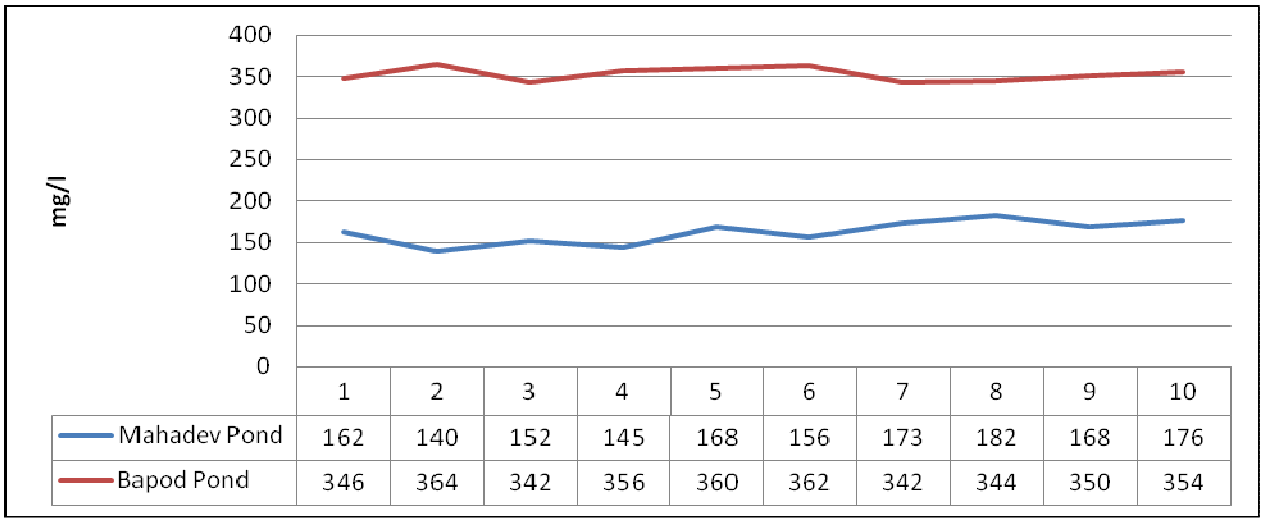
	1	2	3	4	5	6	7	8	9	10
Mahadev Pond	5.8	6	6	5.8	5.2	5.6	6	6.6	5.4	5.8
Bapod Pond	6.8	6.2	5.2	6	6.2	6.4	5.8	6.2	5.8	6.8

Figure–03
Comparison of Dissolved Oxygen between Mahadev Pond and Bapod Pond

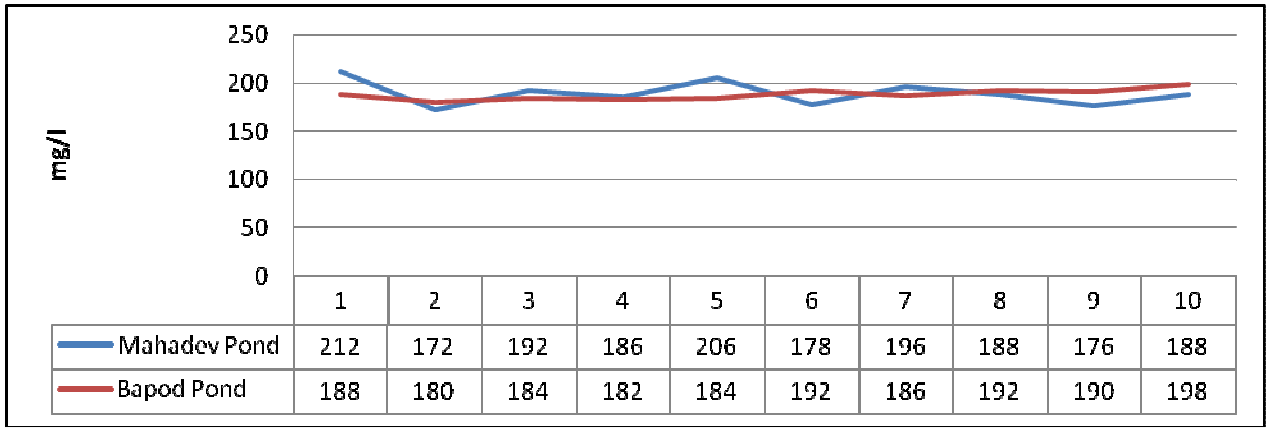


	1	2	3	4	5	6	7	8	9	10
Mahadev Pond	8.87	8.86	8.76	8.66	7.89	8.26	8.45	8.74	8.26	8.56
Bapod Pond	8.35	8.41	8.44	8.38	8.4	8.48	8.46	8.37	8.42	8.39

Figure–04
Comparison of pH between Mahadev Pond and Bapod Pond



Figure–05
Comparison of Chloride between Mahadev Pond and Bapod Pond



Figure–06
Comparison of Total Hardness between Mahadev Pond and Bapod Pond

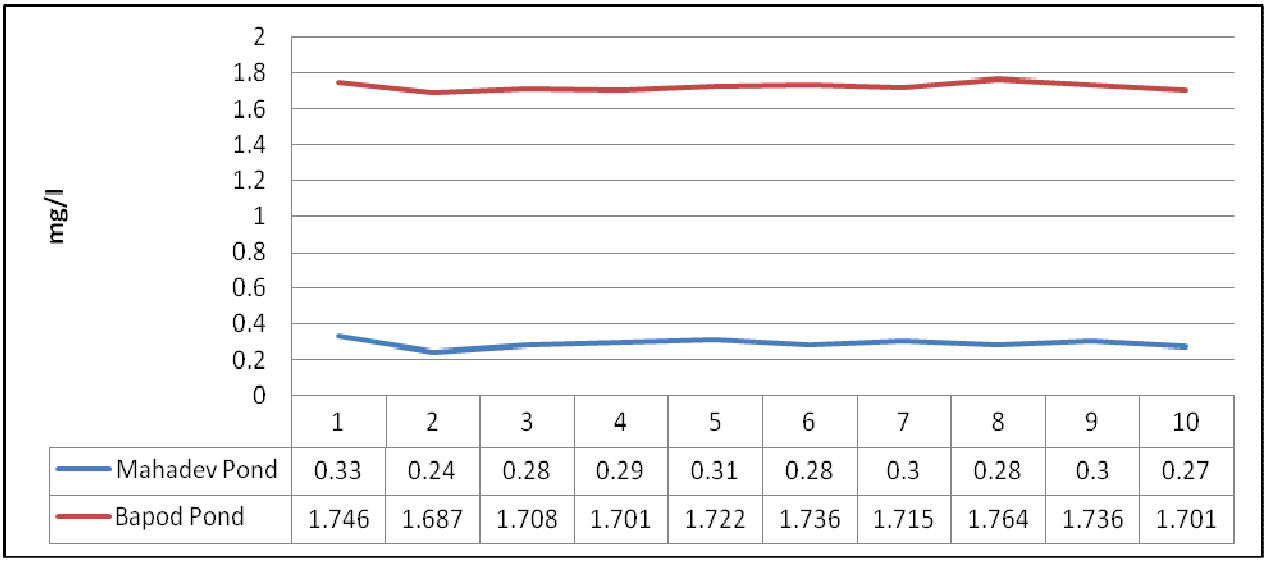
The average Total Hardness values of Mahadev Pond and Bapod Pond was found to be 189.4 mg/l and 187.6 mg/l respectively. The Total Hardness of both the ponds was below the desirable limits for drinking water i.e. 300 mg/l[7]. In the case of Bapod Pond, however, there were consistent higher values Total Hardness in the last three observations where there was initiation of summer months. This indicates that the increased evaporation rate may have lead to higher salt concentration and subsequent higher total hardness of water in summers than in winters[9].

In the case of dissolved nutrients, the average Phosphate levels of Mahadev Pond and Bapod Pond were found to be 0.28 mg/l and 1.72 mg/l respectively and average Nitrate levels were 3.13 mg/l and 5.26 mg/l respectively (Table-02). It was observed that the water of Bapod Pond contained much higher values of dissolved Phosphates and Nitrates in comparison to Mahadev Pond (Figure- 07, Figure- 08). The inward sloping boundary of Bapod Pond allows sewage and surface runoff from adjoining areas which can be held responsible for much higher values of these nutrients in the Pond, similar observation is marked at Danteshwar pond also[10]. The Phosphate and Nitrate can be considered to be major nutrients for aquatic plants. When the levels of these nutrients increase there is an increase in the primary productivity of the pond, provided rest of the environmental conditions are favorable. The natural sources of Phosphate are the geological deposits which contain phosphorous in soluble as well as insoluble form. These phosphate releases due to natural processes of weathering and erosion which ultimately enters into the ecosystem and the aquatic plants utilizes them for growth and development. Urban ponds receive excess of nutrients from house hold sewage, waste water from nearby shops and lorries, street runoff etc[11]. This ultimately results into Eutrophication of the pond and as this is caused by human activities and not by natural processes, it is called "Cultural Eutrophication"[12]. In a study of Lake Washington it was observed that when the Phosphate levels exceeded the value of 57 µg/l, it caused the nuisance of Algal

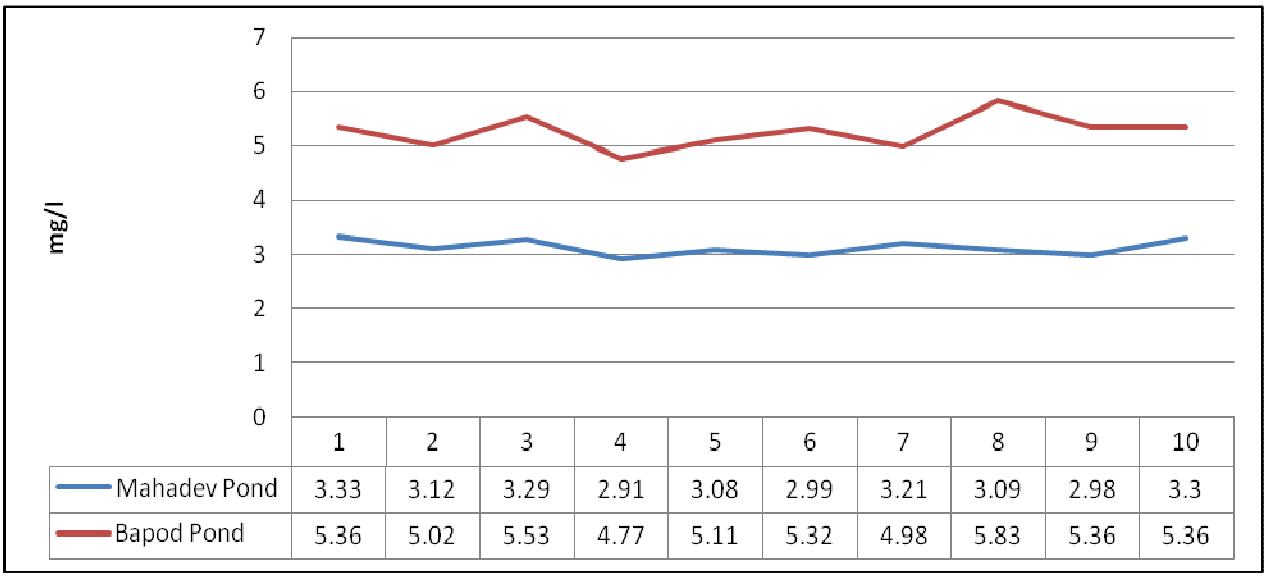
Bloom[13]. If the phosphate concentration in the pond increases beyond the requirement of organisms present in the aquatic environment, they tend to uptake more than their normal requirement. If this happens, the pond will continue to show algal blooming due to presence of already stored nutrient even if the ambient phosphate level drops[14]. If the continuous entry of nutrients cannot be restricted due to the natural boundary such as in the case of Bapod Pond, some methodology has to be developed to combat algal bloom in such ponds[15]. If some biological or chemical agent developed to reduce or restrict the growth of Cyanobacteria, the issue of Eutrophication of Urban Ponds can be checked and ecological balance can be sustained.

Table-2
Average Values of Parameter studied

	D.O (mg/l)	pH	Chloride (mg/l)	Total Hardness (mg/l)	Nitrate (mg/l)	Phosphate (mg/l)
Bapod Pond	6.14	8.41	352.3	187.6	5.26	1.72
Mahadev Pond	5.82	8.53	162.3	189.4	3.13	0.28



Figure–07
Comparison of Phosphate between Mahadev Pond and Bapod Pond



Figure–08
Comparison of Nitrate between Mahadev Pond and Bapod Pond

Conclusion

From the above results it can be concluded that the pond having natural boundary was receiving more contaminants in comparison to the pond with constructed boundary. Mahadev Pond with constructed boundary showed very low levels of Chlorides, Phosphate and Nitrates when compared with Bapod Pond. From the study it can be coined that the constructed boundary has, although to some extent, helped to restrict the entry of contaminants into the Pond. The same type of mitigatory measures should be taken to combat the issue of Health of the Urban Ponds.

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References

1. APHA, Standard Methods for examination of Water and Wastewater. 20th edn. American Public Health Association, New York, (**1992)**

2. Parikh Ankita N. and Mankodi P.C., Limnology of Sama Pond, Vadodara City, Gujarat, *Res. J. Recent Sci.*, **1(1),** 16-21, (**2012)**

3. Sharma P.D., Ecology and Environment, Tenth edition, Rastogi Publications, Meerut, India, (**2009)**

4. Yoo, Richard Scott. Cyanobacterial (blue-green algal) toxins: a resource guide. American Water Works Association, (**1995)**

5. Love A.H., Cyanobacterial Harmful Algal Blooms: Chapter 18: Determining Important Parameters Related to Cyanobacterial Alkaloid Toxin Exposure, US Environmental Protection Agency Papers, 453–463 (**2008**)

6. Tailor M.A. and Mankodi P.C., Physico-chemical status of Danteshwar pond of Vadodara City, Gujarat and its Environmental Implications, *I. Res. J. Environmen Sci.,* Accepted for publication, October **(2013)**

7. World Health Organization (WHO), Guidelines for drinking water quality, Geneva WHO, **(2008)**

8. Mangukiya R., Bhattacharya T. and Chakraborty S., Quality Characterization of Groundwater using Water Quality Index in Surat city, Gujarat, India, *I. Res. J. Environmen Sci.,* **1(4),** 14-23 **(2012)**

9. Agarwal, Ashok K. and Govind S. Rajwar, Physico-chemical and microbiological study of Tehri dam reservoir, Garhwal Himalaya, India, *Journal of American Science* **6.6**, 65-71 (**2010)**

10. Pathak Neelam B. and Mankodi P.C., Hydrological status of Danteshwar pond, Vadodara, Gujarat, India, *Int. Res. J. Environment Sci*., **2 (1)**, 43-38 **(2013**)

11. Goswami A.P. and Mankodi P.C., Study on Zooplankton of Fresh Water Reservoir Nyari – II Rajkot district, Gujarat, India, *ISCA J. Biological Sci.*, **1(1),** 30-34 (**2012**)

12. Welch E.B. and T. Lindell., Ecological effects of wastewater, Cambridge University Press, 337, (**1980**)

13. Edmondson W.T. and Lehman J.T., The effect of changes in the nutrient income on the condition of Lake Washington, *Limnol. Oceanogr* **26(1),** 1- 29 **(1981)**

14. Gerloff, Gerald C. and Folke Skoog, Nitrogen as a limiting factor for the growth of Microcystis aeruginosa in southern Wisconsin lakes, *Ecology,* **38(4)**, 556-561 **(1957)**

15. Shapiro J., Lamarra V.A. and Lynch M., Biomanipulation: an ecosystem approach to lake restoration, (**1975)**