PHYSICOCHEMICA ASSESSMENT OF WATER QUALITY PARAMETERS

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Abstract- In order to understand the water quality of **Powai and Vihar Lake Mumbai**, Physicochemical parameters were studied and analysed. Various physicochemical parameters, such as water temperature, air temperature, pH, humidity, conductivity, free Co2, total solid, dissolved oxygen, Total alkalinity, Total hardness, caco3, ca++, mg++ were studied. The results revealed that there was significant seasonal variation in some physicochemical parameters and most of the parameters were in normal range and indicated better quality of lake water. Water is the most important in shaping the land and regulating the climate. It is one of the most important compounds that profoundly influence life. The quality of water usually described according to its physical, chemical and biological characteristics. Rapid industrialization and indiscriminate use of chemical fertilizers and pesticides in agriculture are causing heavy and varied pollution in aquatic environment leading to deterioration of water quality and depletion of aquatic biota. Due to use of contaminated water, human population suffers from water borne diseases. It is therefore to check the water quality at regular interval of time.

Keywords: Alkalinity, Dissolved Oxygen (D.O.), Eutrophication, Biochemical Oxygen Demand (BOD), Water Quality Index (WQI)

1. INTRODUCTION

India is facing a serious problem of natural resource scarcity, especially that of water in view of population growth and economic development. Most of fresh water bodies all over the world are getting polluted, thus decreasing the portability of water. All life is depend on water and exists in nature in many forms like ocean, river, lake, clouds, rain, snow and fog etc. However, strictly speaking chemically pure water does not exist for any appreciable length of time in nature. A lake is a large body of water surrounded by land, inhabited by various aquatic life forms, for all practical purpose, pure water is considered to that which has low dissolved or suspended solids and obnoxious gases as well low in biological life.

1.1 Lake water

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1.2 Ground Water Scenario in Pune District

1.2.1 Hydrogeology

The entire area of the district is underlain by the basaltic lava flows of upper Cretaceous to lower Eocene age. The shallow alluvial formation of Recentage also occurs as narrow stretch along the major rivers flowing in the area.

1.2.2 Deccan Trap Basalt

Basaltic lava flows occupies more than 95% of the area of the district. These flows are normally horizontally disposed over a wide stretch and give rise to table land type of topography also known a plateau. These flows occur in layered sequences ranging in thickness from 7 to 45 m and represented by 6 massive unit at the bottom and vesicular unit at the top of the flow. These flows are separated from each other by marker bed known as „bole bed". The water bearing properties of these flows depend upon the intensity of weathering, fracturing and jointing which provides availability of open space within the rock for storage and movement of ground water.

1.2.3 Soft Rock Formations

Alluvium: Alluvium occurs in small areas along banks and flood plains of major rivers like Bhima, Ghod, Mula, Mutha and their tributaries. In alluvium the granular detrital material like sand and gravel usually occurring as thin layer in the district yields water. But due to its limited extent the ground water potential in this formation is negligible.

1.2.4. Depth to Water Level – Pre monsoon:

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1.2.5 Depth to Water Level – Post monsoon

The depth to water level during post monsoon (Nov. 2007) ranges between 1.00 m bgland 15.60 m bgl. Spatial variation in post monsoon depth to water level is shown in Figure 3. The water levels between 2 and 5 m bgl have been observed in major parts of the district in the south, south

eastern, central and north western parts occupying almost entire Purandar, Bhor, Mulshi, Maval and Khedtalukas and parts of Daund, Baramati, Velhe and Shirur. The water levels in 5 to 10 m bgl range are mainly seen in three isolated pockets i.e., in northern, central and south eastern parts of the district in parts of Junnar, Ambegaon, Haveli, Daund and Indapur talukas. Very shallow water levels of less than 2 m bgl are observed in isolated patch in central part of the district. .

1.3 Ground water resources:

Central Ground Water Board and Ground Water Survey and Development Agency (GSDA) have jointly estimated the ground water resources of Pune district .Ground water resources estimation was carried out for 13072.60 sq.km. Area out of which 2436.60 sq.km. Is under command and 10351.78 sq.km. is non-command, whereas 284.22 sq.km. area is of poor ground water quality. Taluka wise ground water resources are shown in Figure 4.

1.4 Necessity:

The contamination and pollution of water is of great concern in the world for the developing countries like India. Water of good quality is required for living organism. Basically quality of water is described according to it is physical, chemical, biological parameters. The physico chemical methods are used to detect the effect of pollution on the water quality. Changes in the water quality are reflected in the biotic community structure. Now days the Water quality of Katraj lake is severely degraded due to the polluted water. The present investigation reveals the physicochemical characteristics of Katraj lake which is being polluted from surrounding areas directly entering the lake .Lake is silted and covered by vegetationity status of the lake water during the pre-monsoon and post monsoon period to frame the policy and management plan for the protecting it from the contamination and further detoration of water quality. The correlation and regression analysis will help to develop the relationship amongst the various water quality parameters, which can used for developing the regression equation between the highly correlated parameters. These equations will provide the tool for prediction and forecasting the water quality in future without going through the lengthy analysis procedures.

1.5Objectives of the project work:

1. To do Sampling of lake water for two seasons i.e. post monsoon and pre monsoon.
2. To assess the physico -chemical characterization of lake water
3. To apply WQI methods for experimental results.
4. To find out regression correlation model.
5. To seek the solution for alarming situations.

2. LITERATURE REVIEW

Current Chapter is dealing with the various different papers which are focusing on lake water quality assessment of various regions of India and other countries. Water Quality Status of lake water by NSF Water Quality Index has been studied in few papers. Moreover, Correlation and regression analysis of lake water quality parameters and use of this technique to forecast and predict the lake water quality is effectively studied and used for various other regions is also highlighted in this chapter.

Puri et.al. [1] In present study, water quality index (WQI) has been calculated for different surface water resources especially lakes, in Nagpur city, Maharashtra, (India), for the session January to December 2008; comprising of three seasons, summer, winter and rainy season.

Tandel et.al. [2] The water quality index is a single number that expresses the quality of water by integrating the water quality variables. Its purpose is to provide a simple and concise method for expressing the water quality for different usage. The present work deals with the monitoring of variation of seasonal water quality index of some strategically selected surface water bodies. The index improves the comprehension of general water quality issues, communicates water quality status and illustrates the need for and the effectiveness of protective practices.

Chandra et.al. [3] Lake water is a source of drinking and domestic use water for rural and urban population of India. The main goal of the present study was to assess drinking water quality of various lakes i.e . Porur lake Chennai, Hussain Sager Hydrabad Vihar lake Mumbai in India.

Pradhan et.al. [4] Water quality of Chilika Lake was determined during the month of January 2012. It was observed that all the parameters are above permissible limit except at the sample site S2. The results are discussed in the light of findings of other workers.

Mahesh et.al. [5] A water quality index(WQI) developed by the Canadian Council of Ministers of the Environment(CCME) was applied to Hebbal lake of Mysore, Karnataka State, India, to study its impact on aquatic life, livestock and to know whether it is suitable for recreation, irrigation and drinking.

Islam et.al. [6] The purpose of this study was to assess the hydrological properties and water quality characteristics of Chini Lake in Pahang, Malaysia. A total of seven sampling stations were established at the main Feeder Rivers of Chini Lake for measurement of stream flow. A total of 10 monitoring stations covering the study area were selected for water sampling. Fourteen water quality parameters were analyzed based on in-situ and ex-situ analysis for two seasons and laboratory analyses were carried out according to the HACH and APHA methods. Stream flow from the seven Feeder Rivers into the Chini Lake was relatively slow, ranging from 0.001 to 1.31 m/s 3 or an average of 0.21 m /s.

Sasane et.al. [7] The present work is aimed at assessing the water quality of the groundwater in and around Lonar Lake. Water quality has been determined by collecting groundwater samples and subjecting the samples to a comprehensive physiochemical analysis.

Thitame et.al. [8] In present investigation an attempt was made for assessment of Seasonal Variation in Physico-chemical Characteristics and Quality of Pravara River Water for Irrigation during year 2008. The study reveals that most of the physicochemical parameters of river water at five selected sites show moderate variation in their concentration for all seasons.

Pejaver et.al. [9] The two lakes namely Kalwa and Jail lake of Thane city are eutrophicated and hence the study were done to find the quality of water for the period of 6 months for various physico-chemical parameters to study the pollution status of the lakes. The Jail lake is found to be relatively more organically polluted and greater degree of eutrophication the Kalwa lake.

Khan et.al. [10] In order to understand the water quality of Triveni Lake, Physicochemical parameters were studied and analysed for the period of one year i.e. December 2010 to November 2011. Various physicochemical parameters, such as water temperature, air temperature, pH, humidity, conductivity, free Co2, total solid, dissolved oxygen, Total alkalinity, Total hardness, caco3, ca++, mg++ were studied. The results revealed that there was significant seasonal variation in some physicochemical parameters and most of the parameters were in normal range and indicated better quality of lake water. It has been found that the water is best for drinking purpose in winter and summer seasons.

Shama et.al. [11] Physico-chemical characteristics and eight heavy metals (Fe, Mn, Cu, Co, Cr, Ni, Pb and Cd) of Wadi El Rayan Lakes water were evaluated from summer 2009 to spring 2010. Salinity (TDS) and major ions show highly significant difference between the two lakes. On the other side, station 1 in 1st lake (infront El Wadi Drain) exhibits the highest content of nutrient salts and heavy metals.

Kankal et.al. [12] Present communication deals with a study of Physico-chemical parameters such as pH, Temperature, Total Suspended Solids, Turbidity, Dissolved Oxygen, Biochemical Oxygen Demand, Nitrate, Phosphate and Fecal coliform in water samples of rivers, lake and canal in Gujarat state of India. The water quality of the samples was compared with standard values given by World Health Organization (WHO) and United State Salinity Laboratory for drinking and irrigation purposes.

3. MATERIALS AND METHODS

3.1 Study Area: Pune, the seventh largest city in India by population, covering approximately 243.84 km2 area, lies between latitudes 18022'N & 18035'N and longitudes 73050' E & 740 E with an average altitude of 559 m above the mean sea level. Katraj lake is one of the important lakes from Pune city. It is situated in south area of Pune covering near about 80-82 hectares. The lattitudanal & longitudanal directions of the lake are as 18°27′13″N , 73°51′42″E. It is the combination of two lakes. The first one is acting as sedimentation tank and water comes from the first lake into the Katraj lake. Both the dams have gates at the bottom level, which can be used to release excess water into the Ambil Odha. In the period of Peshwas, the Katraj lake was used to supply water through an underground canal to the city of Pune. After the formation of Pune Municipal Corporation, the corporation was supplying water to the city and from that period, the use of Katraj lake water is decreased.

The samples were collected from lake during the pre monsoon and post monsoon period i.e.(March 2014 to Oct.2014) collected samples were analyzed for various water quality parameters viz. pH, Alkalinity , Total Hardness , Dissolved oxygen, Sulphates COD,BOD , Chloride, & TDS etc.

Figure 3.1: Location Map of Haveli Taluka

3.1.1 Characterization of lake water

There are many causes of water pollution. Some sources include effluent outfalls from factories, refineries, wastewater treatment plants etc. that emits fluids of varying quality directly into urban water supplies. Some sources include contaminants that enter the water supply from soils / ground water systems and from the atmosphere via rainwater. Soils and ground water contains the residue of human agricultural practices (fertilizers, pesticides etc.) and improperly disposal of industrial wastes.

3.1.2 Selection of Water Quality parameters:

The choice of sampling stations was influence by the various uses of the water and their locations, relative magnitude and importance. The water sample of the present lake was collected for four different stations of the lake for physico-chemical analysis before and after monsoon in the year 2014. The samples for analysis were collected in sterilized bottles using Standard procedure in accordance with the Standard method of American Public health Association. In this study surface water samples are collected. Collected samples were analyzed within 24 hrs.

Figure 3.2: Sampling locations of Katraj Lake

3.2 Methods of Analysis:

Physio-chemical method of analysis recommended by APHA is used for finding the amount of constituents present in water from lake.

Following parameters were analyzed as per the standard methods as follows-

3.2.1. Gravimetric Analysis: Gravimetric method depends on weighing solids obtained from the samples by evaporation, filtration or precipitation and generally used for micro analysis. Total Dissolved Solids in the water are found out by this method. An analytical balance capable of weighing up to .0001 gm is used.

4. RESULTS AND DISCUSSION (CASE STUDY)

CASE STUDY

Case study on State of Water Quality of Two Tropical Urban Powai & Vihar Lakes Located at Mumbai Megacity

4.1. Introduction

Aquatic ecosystems contribute to biodiversity on the earth's surface. The quality of aquatic systems has now become a serious concern due to its direct effects on aquatic and human health. Lake water is a source for drinking and domestic purposes for both rural and urban population of India . The rapidly expanding human population within the catchment area of lakes has brought about a series of changes in its biotic components. Unplanned urbanization, rapid industrialization and indiscriminate use of chemicals as fertilizers are causing substantial pollution in aquatic environments, leading to the deterioration of water quality and depletion of aquatic biota. Eutrophication, a result of high-nutrient loadings (mainly phosphorus and nitrogen), is the major concern in lake systems. A previous study which was carried out in Powai Lake, Mumbai, concluded the positive correlations between productivity and physico-chemical properties of water. Hence, the rigorous monitoring and periodic assessment of water quality is relevant in adopting proper management measures for environmental problems. The planktonic study is a very useful biological tool for the assessment of water quality in any type of water body and it also contributes to the understanding of the basic nature and general ecology of the lake. Algae are useful for the estimation of the environmental impact on aquatic ecosystems due to the quick response to changes in the environmental condition enabling a quick assessment of the prevailing water quality. The analysis of physico-chemical parameters can infer better results if the data are adequately processed. In this study, we used factor analysis, a multivariate statistical method in which, the initial set of variables is substituted by a smaller group of factors or hypothetical variables, which preserve as much information contained in the original variables as possible. The lakes and surface water bodies often face the threat of reduction in their area due to developmental activities. This reduction in lake volume can affect the assimilative capacity of lakes for various pollutants. Thus, the present situation demands a rigorous investigation of water quality status of the lakes in order to generate baseline information for its sustainable usage. Therefore, this study was carried out in two lakes located at Mumbai to assess the status of water quality on the basis of physico-chemical parameters and algal indices.

4.2. Materials and Methods

4.2.1 Study area

Mumbai, situated in the state of Maharashtra along the west coast of India, is a coastal megacity (with population more than 10 million), as well as the commercial capital of the country. Powai and Vihar are two artificial lakes situated in northern Mumbai. Both the lakes were created for drinking water purpose by constructing dams between two hillocks across Mithi River. Powai- Kanheri hill range forms the catchment area for both the lakes. Powai Lake is situated in the suburban area and the water is used only for non-potable purposes, i.e., gardening and industrial purposes as the water quality has deteriorated. Vihar Lake is located near Vihar village within the precincts of the Borivali National Park, also called the Sanjay Gandhi National Park, and so protected. The information on the sampling points from these two lakes is given in Figure 1 and Table 1

Table 1: Summary of sampling area selected for the study

Attribute	Vihar Lake	Powoi Lake
Location	Sanjay Gandhi National Park, Mumbai	Northern suburb of Mumbai
State	Maharashtra	Maharashtra
Lake type	Reservoir, Fresh water	Reservoir, Fresh water
Construction year	1859	1891
Primary inflow	Mithi River	Mithi River

Catchment area	18.96 km2	6.61 km2
Maximum depth	34 m	12 m
Surface elevation	80.42 m	58.5 m

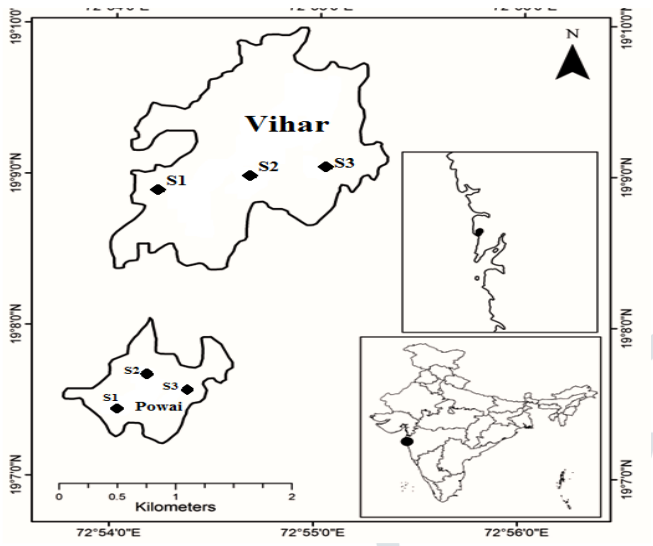

Figure 4.1: Sampling stations selected from Powai and Vihar Lake

4.2.2 Collection and Analysis of Samples

Monthly sampling was carried out to measure selected water quality parameters and for phytoplankton analysis from the three selected sampling stations of each lake; water samples were collected during the morning hours in triplicate.

4.3 Algal Indices

Phytoplankton is the primary producers in the aquatic ecosystems. Based on the assessment of algae, the extent of pollution in a water body can be evaluated on the basis of algal pollution indices. In the present study, an attempt was made to evaluate the water quality of both the lakes using Nygaard's algal index and Palmer's indices.

4.3.1 Nygaard's Index (compound quotient)

Nygaard proposed five indices to evaluate the organic pollution of water bodies based on various groups of planktonic algae. The oligotrophic or eutrophic status is based on the calculation of these indices proposed by Nygaard. The formula (1) used for calculating Nygaard's compound quotient, CQ is the following:

$$CQ = \frac{N_{CN}+N_{BA}+N_{CH}+N_{EU}}{N_{DS}} \quad \text{..... (1)}$$

Where, NCN = Number of cyanophyceans

NBA = Number of bacillariophyceans

NCH = Number of chlorophyceans

NEU = Number of euglenophyceans

NDS = Number of desmidaceans

The underlying assumption about CQ in estimating the trophic state of a lake follows: CQ ≤ 2 is oligotrophic, CQ between 2 to 6 is weakly eutrophic, CQ > 6 is eutrophic

4.3.2 Palmer's Index

Palmer's Index is based on the presence or absence of selected taxa of algae in the water sample. A definite score is assigned to each taxon and depending upon the total score, the water bodies are classified as oligotrophic, mesotrophic or eutrophic. A pollution index score of 1 to 5 has been assigned to each of the 20 types of algae that are most tolerant to organic pollution. The most organic pollution-tolerant algal types were assigned a score of 5. The scores obtained for individual algal taxon are presented in Table 2.

Table 2: Score card for palmer's pollution index

Name Of Taxton	Score
Ankistrodesmus	2
Chlamydomonas	4
Chlorella	3
Closterium	1
Cyclotella	1
Euglena	5
Gomphonema	1
Melosira	1
Navicula	3
Nitzschia	3
Oscillatoria	5
Pandorina	1
Phacus	2
Phormidium	1
Scenedesmus	4
Stigeoclonium	2
Synedra	2

4.4. Results and Discussion

The water temperature and transparency were observed to be high in Vihar Lake than in Powai while Powai always showed higher pH and EC in comparison with Vihar during the study period. DO was observed to be high in Vihar and

BOD was higher in Powai. High levels of alkalinity were observed in Powai during the sampling period in comparison with Vihar. The organic matter in water bodies resulting from metabolism and from external sources such as waste water contributes to the decrease in DO and increase in BOD in the water column. The leveling of hills near Powai Lake for residential purpose and urbanization lead to soil erosion and siltation, and disposal of untreated sewage and solid waste into the lake. But Vihar is comparatively less disturbed by anthropogenic activities since it is located inside the national park. The samples from Powai showed higher values of reactive phosphorus, nitrate-nitrogen, ammonia-nitrogen, TC, TOC, sodium and calcium in comparison with Vihar whereas potassium concentration showed higher range in Vihar Lake.Organically polluted waters have normally higher concentrations of ammonia, which is a product of ammonification of organic matter. TOC provides an important role in quantifying the amount of organic contamination in water. With reference to ammonia and TOC, Powai was showing

Higher organic load in comparison with Vihar. Higher concentrations of iron, copper, chromium, nickel and lead were observed in Vihar Lake compared to Powai. However, the concentrations of all the trace metals studied were found to be below the critical limits and national standards in both the lakes. The minimum value, maximum value and the mean value of all the water quality parameters analyzed from both the lakes during the study period are shown in Table 3

Table 3: Water quality parameter data

No.	**Parameter**		**Powoi Lake**			**Vihar Lake**	
		Minimum	**Maximum**	**Mean**	**Minimum**	**M aximum**	**Mean**
1	Water temp (ºC)	20.33±0.33	26.33±0.33	22.96	21.33±0.33	27.67±0.33	23.78
2	Transparency (cm)	59.33±0.33	84.33±0.33	73.87	83.00±1.52	109.33±0.70	92.65
3	pH (no unit)	7.8±0	8.4±0	8.01	7.50±0	7.9±0	7.71
4	EC (mS/cm)	0.30±0	0.43±0	0.35	0.10±0	0.24±0	0.14
5	DO*	3.58±0.023	7.19±0.27	5.04	5.6±0.14	8.8±0.12	6.65
6	BOD*	1.77±0.067	4.68±0.24	3.05	0.92±0.05	2.11±0.08	1.46
7	Total alkalinity*	136.10±2.01	159.00±2.52	144.95	46.47±1.10	66.50±0.97	54.06
8	Reactive phosphorus*	0.087±0.002	0.210±0.01	0.1370	0.010±0.001	0.182±0.001	0.1044
9	Nitrate-nitrogen*	0.366±0.005	0.622±0.003	0.4971	0.123±0.006	0.321±0.005	0.2331
10	Ammonia-nitrogen*	0.061±0.002	0.556±0.010	0.2696	0.037±0.002	0.332±0.007	0.1211
11	Sodium*	10.13±0.384	24.23±0.145	20.48	1.47±0.07	9.30±0.60	5.50
12	Potassium*	6.33±0.088	11.07±0.033	8.36	10.90±0.06	12.30±0.058	11.33
13	Calcium*	14.21±0.116	31.47±0.088	25.55	1.73±0.21	7.13±0.07	4.29
14	Magnesium*	2.78±0.003	10.32±0.031	6.71	3.91±0.0109	12.17±0.030	6.58
15	Total carbon*	56.52±0.14	88.04±0.43	65.89	17.83±0.29	32.79±0.67	23.39
16	TOC*	24.04±0.99	47.85±0.42	30.36	6.31±0.17	22.57±0.58	11.97
17	Copper*	0.004±0.0003	0.015±0.0003	0.0066	0.0027±0.0003	0.0377±0.0262	0.0195
18	Chromium*	0.001±0.0006	0.004±0.0006	0.0027	0.0037±0.0009	0.0197±0.0015	0.0081
19	Iron*	0.114±0.001	0.485±0.001	0.2826	0.106±0.0032	0.844±0.0279	0.4512
20	Nickel*	0.0213±0.002	0.0357±0.002	0.0312	0.0187±0.0037	0.043±0.0015	0.0269
21	Lead*	0.0035±0	0.0053±0	0.0044	0.0038±0	0.0054±0	0.0048

***represents mg/l**

It was noticed that even though the plankton diversity was more in Vihar Lake, the plankton density was found to be

more in Powai and the most dominant species in Powai were the pollution-tolerant ones. The pollution-tolerant algal communities are used as bioindicators of organic pollution. In Powai, the major groups observed were Cyanophycea (44%), Chlorophycea (29%), Bacillariophycea (13%),Euglenophycea (13%) and Dinophycea (1%) and in Vihar, the major groups were Chlorophycea (46%), Cyanophycea (27%), Bacillariophycea with (18%), Dinophycea with (7%) and Euglenophycea (2%). The species of phytoplankton which were abundant in Powai Lake are pollution tolerant, which indicates organic pollution in the lake. Both the phytoplankton indices yielded higher values for Powai Lake compared to Vihar Lake (Table 6).

Table 4: Algal pollution indices of Powai and Vihar lakes

Attribute	**Algal pollution index**	
	Nygaard's Index (CQ)	Palmer's index
Powai Lake	9(>6 is Eutrophic)	32 (>20 means high organic pollution)
Vihar Lake	4.85 (2 to 6 is weakly eutrophic)	15 (>15 means probable organic pollution)

The catchment of the lake has also been affected badly due to unplanned quarrying activities. Appreciating the problem of silting, growth of aquatic weeds likes water hyacinth and eutrophication of the lake, the Indian

Institute of Technology - Bombay's Class of 1980 launched "Revitalization of Powai Lake" with the objective of restoring the lake to its original pristine and sustainable form by adopting eco-friendly designs and materials for the restoration works. In 1995, the National Lake Conservation Plan of the Ministry of Environment and Forests, Government of India, reviewed the condition of Powai Lake and included the lake in its list of ten major lakes in the country for revival and improvements. The present study showed that in spite of all these initiatives, Powai is presently facing organic pollution threats due to the accelerated growth of residential, commercial and industrial areas around the lake. The calculated areas for Powai and Vihar lakes in 1973 and 2014 are presented in Table 7.

Table 5: Change in area of lakes from 1973 to 2014

	Powai Lake		**Vihar Lake**	
Year	1973	2014	1973	2014
Area(Sq Km)	1.264556	0.963217	3.310656	3.775545
Satellite Sensor	Landsat MSS	Landsat 8	Landsat MSS	Landsat 8
Resolution (m)	60	30	60	30

The results indicate substantial reduction in the Powai lake area in recent years. There is 26% decrease in the lake area by 2014 when compared to 1973. This might also be the reason for the increased pollution state of the lake as shown by the prevailing physico-chemical parameters. Vihar Lake shows not much differences and some increment in lake area has been observed in recent years (Fig. 4).

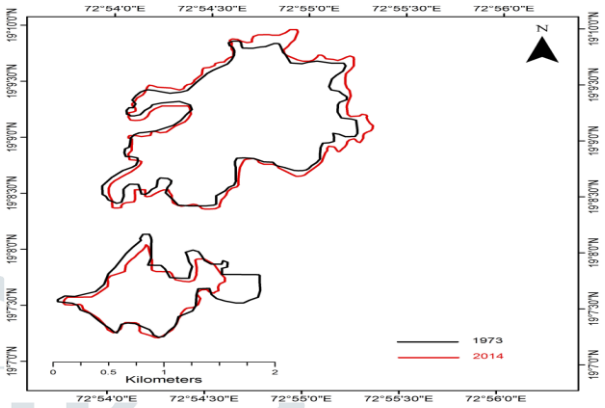

Figure 4.2: Change in area of lakes from 1973 to 2014

The physico-chemical and biological parameters thus revealed the present pollution level and trophic status of the lakes. Powai Lake is polluted mainly by sewage disposal, growth, death and decay of aquatic weeds, and blooms in the lake. Regular cleaning of the macrophytes, enhancing public awareness, scavenging of polluted sediments, bioremediation, proper regulatory measures for anthropogenic waste disposal and strict measures to prevent further encroachment to the catchment area are needed for the restoration of Powai Lake. Vihar Lake is comparatively less polluted and is suitable for public water supply. However, Vihar Lake has reached the threshold level of water quality and requires concerted efforts to maintain the quality. The future approaches can focus on improving the water quality status of Powai and maintaining the present quality in Vihar.

CONCLUSION

1. Factor analysis showed significant separation of Powai and Vihar lakes based on factors extracted from different physico-chemical parameters. The parameters showed significant loadings on the first factor with high coefficients 62.75% for Powai in comparison to Vihar.

2. Algal Indices -

A) Nygaards Index(CQ):
CQ<=2 is Oligotrophic
CQ Between 2 to 6 is Weakly Eutrophic
CQ> 6 is Eutrophic

B) Palmers Index : The most organic pollution tolerant algal types are assigned a score 5.

3. The analysis of the algal community indicates the mesotrophic condition of Vihar Lake and eutrophic condition of Powai Lake.

4. The area of Powoi Lake has decreased during recent years which can also affect the Assimilative capacity of the lake for various pollutants.

5. The higher values of the Powai Lake signal the future threat of water quality deterioration unless proper water quality management actions are initiated.
6. Moreover, in the case of Vihar Lake, which is an important source of drinking water, more focus should be given on water quality management.
7. The present approach can be used in water quality studies to understand the integrated water quality status for different water bodies, especially with regard to pollution.

CONCLUDING REMARK

Water quality is dependent on the type of the pollutant added and the nature of self-purification of water.

The seasonal values of WQI indicate that during summer season, lake water is more affected than during winter. This could be due to the fact that the microbial activity get reduced due to low temperature, thereby keeping DO level at a very satisfactory range during entire winter season.

1. The suggested measures to improve the lake water quality includes total ban on the activities that causes pollution.
2. Carlson's Trophic State Index is a useful measure of overall trophic state in Indian lakes.
3. Result of water quality trends clearly showed that most of the water quality parameters slightly higher in the wet season than in the dry season.

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