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Study of physicochemical and biological characteristics of lakes from Shivaji University Campus, Kolhapur, Maharashtra

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ABSTRACT

Pollution of water bodies is one of the areas of major concern to environmentalists. For the present study, water samples were collected from three different lakes from Shivaji University campus, Kolhapur. Monthly changes in physical and chemical parameters such as Temperature, Transparency, Turbidity, Total Dissolved Solids, pH, Dissolved Oxygen, Free Carbon dioxide, Total Hardness, Chlorides, Alkalinity, Phosphate, Nitrates and MPN were analyzed for a period from September 2010 to February 2011. All parameters were within the permissible limits except BOD, COD and phosphates. The results indicate that the Rajaram Lake was more contaminated than remaining two lakes of Shivaji University campus, due to various anthropogenic activities.

Key Words: Physico-chemical characters, biological characters, lakes, Shivaji University, Kolhapur.

INTRODUCTION

Water is one of the most important components of the ecosystem. Better quality of water is described by its physical, chemical and biological characteristics. But some correlation is possible among these parameters and the significant one would be useful to indicate quality of water. Due to increased human population, industrialization, use of fertilizers in agriculture and many man-made activities, the natural aquatic resources are causing heavy and varied pollution. Wetlands are very productive ecosystems, which help in the regulation of biological cycles, maintenance of water quality, nutrient movement and support for food chains. In addition, they provide refuge for endangered species of plants, animals and economic benefits such as fish breeding. Wetlands reduce the impact of floods by acting as storage areas.

Lake and their surrounding are unique assets and valuable ecosystems of society and nature; these are of social, cultural, and aesthetic value [1] The accurate determination of trace element concentration and other physical, chemical parameters of lake waters are important for

controlling their pollution [2] Characteristic of water bodies influence the water quality individually and in combination with various pollutants ,thereby influencing the biota therein [3]. Sudden changes of parameters may be indicative of changing condition in the internal factors of water. On the other hand, includes events, which occur between and within bacterial and plankton population in the water body [4]. Seasonal variation will affect the parameters like temperature, DO, BOD and other parameters of lake [5&6]. It is well established that domestic sewage and industrial effluents falling into natural water bodies change the water quality and lead to eutrophication [3].

Kolhapur city is a prominent city of South Western Maharashtra, is rapidly emerging as a leading industrial and commercial centre. The development of city created directly or indirectly a number of water quality problems. The city once supposed to have 40 small and large lakes is presently left with only few [7]. Lakes in the Shivaji University campus are the sole source of water of gardening, laboratory use for various departments and hostels from the campus and these lakes has potential to sustain variety of biota. As the water from these lakes is used for drinking purpose, there is a need to study the physico-chemical and biological parameters. This study also has significance because one of the lake from these i.e. Rajaram lake is used for irrigation, domestic purpose by neighboring population. Increasing settlement near Rajaram Lake, idol immersion, washing of clothes, animals, vehicles is creating threat of pollution to Rajaram Lake.

MATERIALS AND METHODS

Study Area: - Shivaji University campus, Kolhapur

Shivaji University is situated between the latitude (16º40'31.81'') and longitude (74º15'12.10''). The University is tapping rain water that gets gathered on the terraces of buildings in the campus. The water tanks conserve water to the capacity of 1, 86,000 cubic feet. The University's program of rain water harvesting includes building of the campus, Nala construction, canal contours and resuscitating of water springs in the different wells. The daily water need of the University is 5.5 lakh liters and the University used to purchase water from the Municipal Corporation. Now, due to rain water harvesting program the campus is completely self-sufficient in the supply of water. The university is also constructing a water purification plant of one MLD capacity on the campus in order to provide clean and pure drinking water. The University campus has three lakes as Music Department Lake, Bhashabhavan Department Lake and Rajaram Lake. The present study is associated with physicochemical and biological parameters of lake water evaluated from three lakes of Shivaji University Campus, Kolhapur,

Sr. No.	Site	latitude	longitude
1	Music Department lake	16º40'59.44"	74º15'13.98"
2	Bhashabhavan Department lake	16º40'25.75"	74º15'13.70"
3	Rajaram lake	16º40'48.25"	74º15'49.90"

These lakes have been coded for study purpose as follow.

Sr. No.	Name of Lake	Code
1	Bhashabhavan department Lake	L_1
2	Music department Lake	L_2
3	Rajaram lake Lake	L_3

Music Department Lake:-

This lake is situated at latitude 16º40'59.44" N and longitude 74º15'13.98" E in the depression of north side of campus. The lake has catchment area of about 0.244 sq. km. It has maximum flood flow up to 6.51m^3/sec, total storage capacity of about 99.50 million cubic feet and total stored water 1.86 million cubic feet. The length of embracement of dam is 175 m and height is 6.55 m. This water is mainly used for ladies hostel use and staff quarters for bathrooms and toilets.

Bhashabhavan Department Lake:-

The lake is flowing from south to north and situated on the West of Language Department building at latitude 16º40'25.75"N and longitude 74º15'13.70'E. The lake has catchment area of about 0.45 sq. km with average rainfall of about 984 mm. 11.76 m^3/sec, total storage capacity of tank is about 104.50 m^3 and total water stored of about 8.52 million cubic feet. The length of embankments of dam is about 330m and height is about 11.16 m. This water is mainly used for drinking purpose after pumping into Sutar well from the University campus.

Rajaram Lake:-

This lake was constructed in the year 1928 in memories of Shri Rajaram Chhatrapati Maharaja of Kolhapur. This is situated at latitude 16º40'48.25"N and longitude 74º15'49.90"E, and near the national highway no.4. The tank was designed to store 38 million cubic feet of water. The lake water is basically used for irrigation, activities like bathing, washing of animals and idol immersion even though it is prohibited. The length of Rajaram tank is 1250 m and covers about 5400 acre area somewhat fan shaped with rocky shore line and depth of about 30 m.

Sampling:-

Water samples were collected from these three lakes for Physico-chemical and biological analysis. Samples were taken once every month from September 2010 to February 2011. Water samples were collected in one litre plastic bottles and collection was usually completed during morning hours between 8:00 A.M. to 10:00 A.M. For each sampling event, pH, temperature, were monitored and dissolved oxygen was fixed at the sampling sites while total dissolved solids, total alkalinity, total hardness, chloride and BOD were analyzed by methods described [8]and [10] in the laboratory.

RESULTS AND DISCUSSION

In the present study Physico-chemical and biological parameters of three lakes from Shivaji University campus were studied, for a period of six month and data is presented in Table No. 1 to 13 and Graph no 1-13.

Table 1 Monthly variation of temperature (˚C) in the University lakes

Sr. No.	Months	L_1	L_2	L_3
1	Sep	26.5 ± 0.13	25 ± 0.11	25± 0.12
2	Oct	27.5± 0.14	29.5± 0.16	29± 0.13
3	Nov	18± 0.18	17.5± 0.15	18± 0.12
4	Dec	15.5± 0.16	14.5± 0.14	15.33± 0.15
5	Jan	15.5± 0.16	13.5± 0.18	14.33± 0.14
6	Feb	18.5± 0.11	16± 0.12	16.33± 0.11

Graph 1 Monthly variation of temperature (˚C) in the University lakes

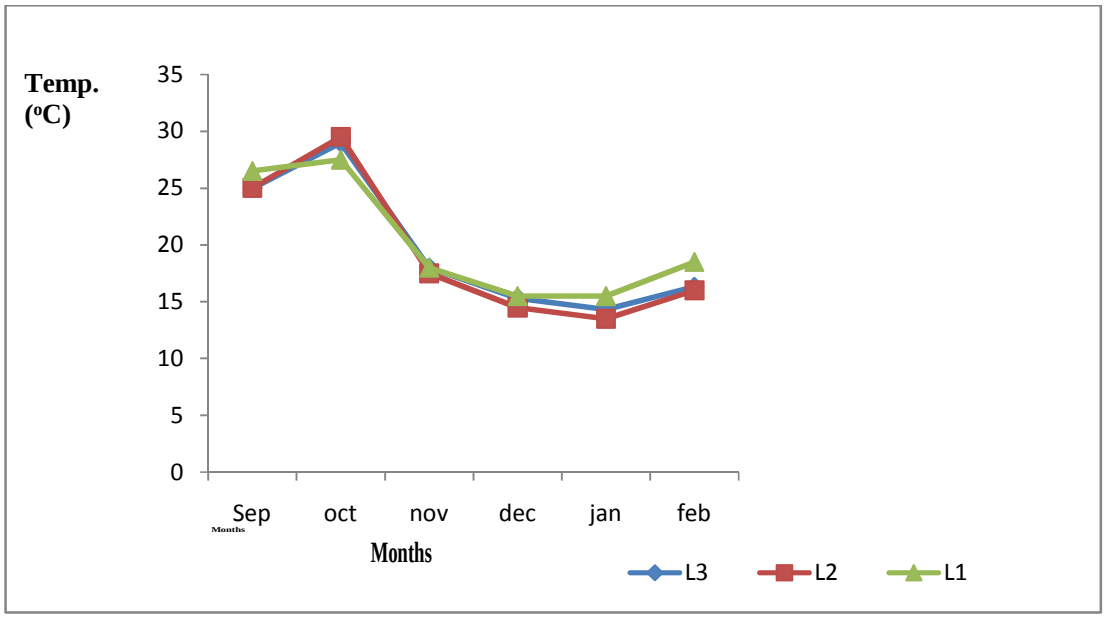


Table 2 Monthly variation of pH in the University lakes

Sr. No.	Months	L_1	L_2	L_3
1	Sep	6.25± 0.12	6.85± 0.12	7.69± 0.15
2	Oct	7.53± 0.11	7.69± 0.14	7.87± 0.14
3	Nov	7.09± 0.10	8.04± 0.15	8.3± 0.20
4	Dec	7.01± 0.11	7.9± 0.14	8.06± 0.16
5	Jan	7.05± 0.12	8.05± 0.13	8.1± 0.15
6	Feb	6.65± 0.10	7.3± 0.11	7.7± 0.13

Graph. 2 Monthly variation of pH in the University lakes

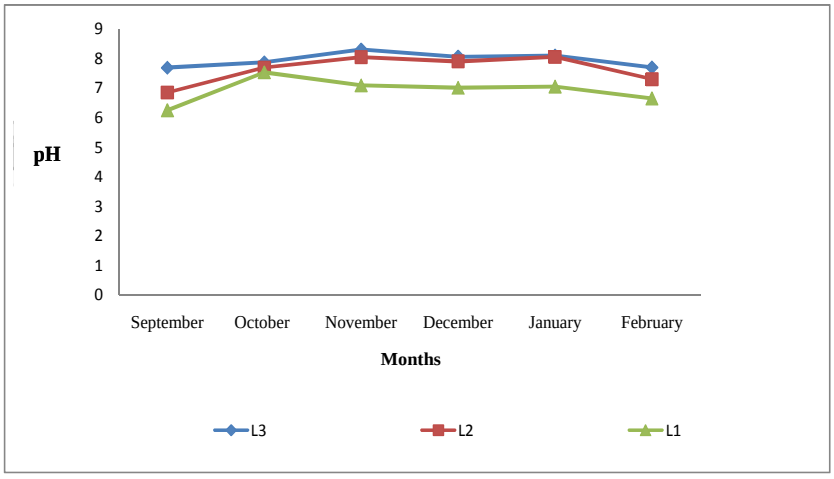
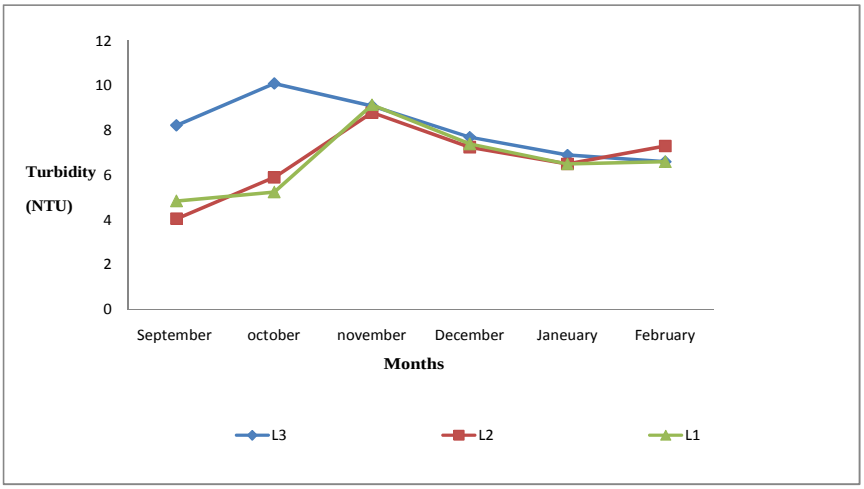


Table. 3:- Monthly variation of Turbidity (NTU) in the University lakes

Sr. No.	Months	L_1	L_2	L_3
1	Sep	4.85± 0.11	4.05± 0.16	8.23± 0.17
2	Oct	5.25± 0.14	5.9± 0.15	10.1± 0.18
3	Nov	9.15± 0.15	8.8± 0.14	9.1± 0.16
4	Dec	7.4± 0.13	7.25± 0.13	7.7± 0.15
5	Jan	6.5± 0.12	6.5± 0.12	6.9± 0.14
6	Feb	6.6± 0.11	7.3± 0.11	6.6± 0.13

Graph. 3:- Monthly variation of Turbidity (NTU) in the University lakes



Graph. 4:-. Monthly variation of Hardness (mg/l) in the University Lakes

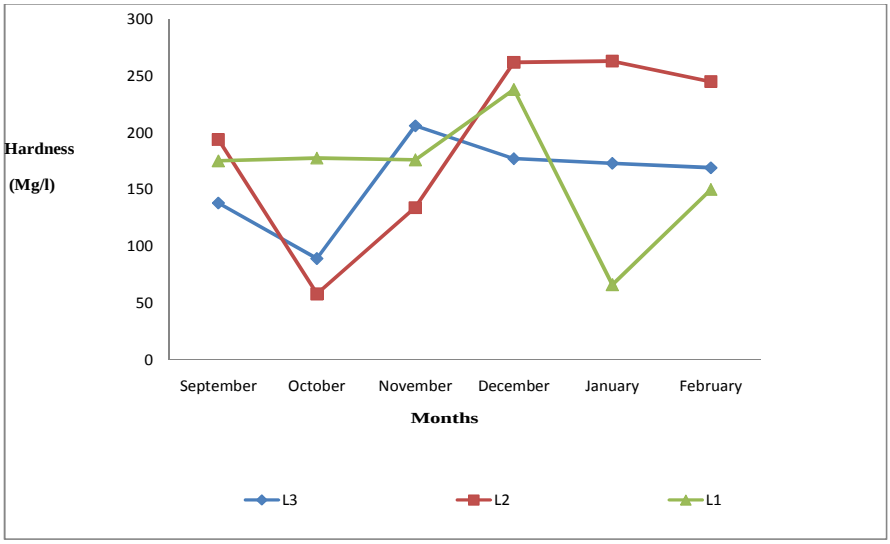


Table. 4:- Monthly variation of Hardness (mg/l) in the University lakes

Sr. No.	Months	L_1	L_2	L_3
1	Sep	175± 0.22	194± 0.18	138± 0.25
2	Oct	177.5± 0.20	58± 0.17	89± 0.21
3	Nov	176± 0.18	134± 0.16	206± 0.19
4	Dec	238± 0.17	262± 0.14	177± 0.18
5	Jan	66± 0.16	263± 0.13	173± 0.17
6	Feb	150± 0.16	245± 0.12	169± 0.17

Table .5:- Monthly variation in Alkalinity (mg/L) in University lakes

Sr. No.	Months	L_1	L_2	L_3
1	Sep	48 ± 0.14	56± 0.17	52± 0.18
2	Oct	140± 0.13	188± 0.15	161± 0.14
3	Nov	152± 0.13	175± 0.14	157± 0.14
4	Dec	126± 0.12	228± 0.13	152± 0.12
5	Jan	123± 0.11	221± 0.11	158± 0.11
6	Feb	121± 0.11	214± 0.10	136± 0.10

Graph.5:- Monthly variation in Alkalinity (mg/L) in University lakes

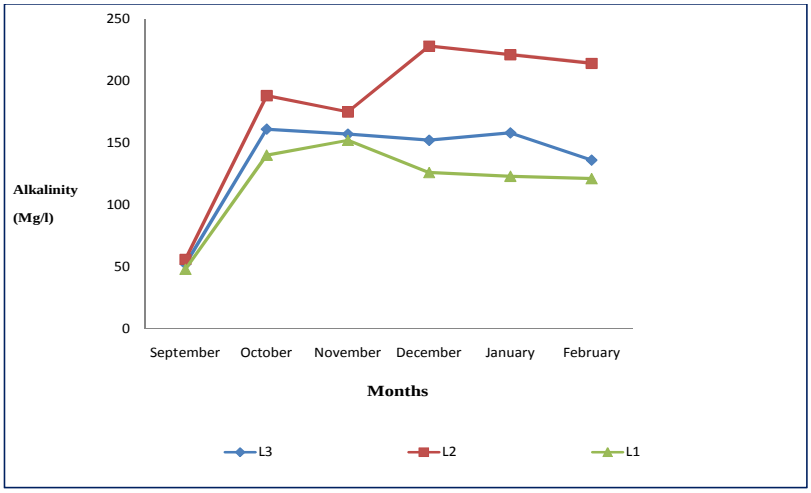


Table.6:- Monthly variation in Acidity (mg/l) in University lakes

Sr. No.	Months	L_1	L_2	L_3
1	Sep	16± 0.12	23.5± 0.12	32± 0.12
2	Oct	10± 0.11	20± 0.13	16± 0.13
3	Nov	16.5± 0.10	22.5± 0.14	32.6± 0.12
4	Dec	24± 0.12	16± 0.15	17.3± 0.12
5	Jan	22.5± 0.11	15± 0.14	15.6± 0.11
6	Feb	21± 0.10	15± 0.12	15.6± 0.10

Graph.6:- Monthly variation in Acidity (mg/l) in University lakes

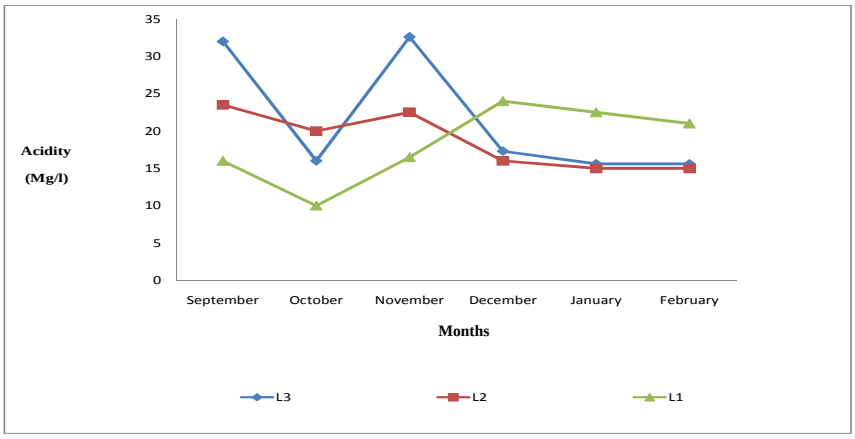
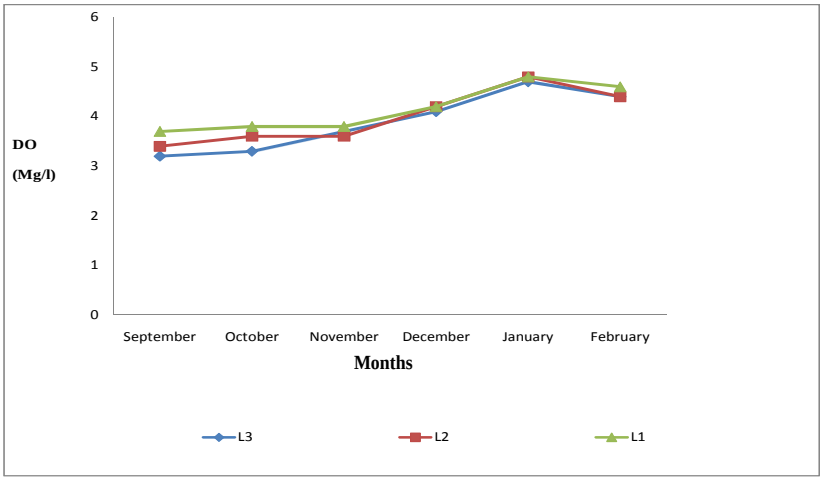


Table.7:- Monthly variation of DO (mg/l) in University lakes

Sr. No.	Months	L_1	L_2	L_3
1	Sep	3.7± 0.11	3.4± 0.16	3.2± 0.20
2	Oct	3.8± 0.12	3.6± 0.17	3.3± 0.21
3	Nov	3.8± 0.14	3.6± 0.18	3.7± 0.20
4	Dec	4.2± 0.15	4.2± 0.15	4.1± 0.18
5	Jan	4.8± 0.13	4.8± 0.14	4.7± 0.17
6	Feb	4.6± 0.12	4.4± 0.11	4.4± 0.15

Graph.7: – Monthly variation of DO (mg/l) in University lakes



The present study reveals that some of the parameters were above the permissible limits of surface water standard of BIS. Water temperature is an important factor for aquatic flora. The seasonal cycle of phytoplankton of a lake may be affected by temperature. It has some positive and negative effects on plant growth. The most suitable temperature for plant growth is 20°C-35°C. Temperature over 30°C cause regression in plant growth and decay in plant [2]. The average water temperatures of the lakes were ranging between 19°C to 20^{o}C during the study period. The maximum 30°C temperature was observed during month of October at Rajaram Lake

(L_3 site) and Music Department Lake (L_2 site), while minimum 14°C temperature was observed during the month of January at Rajaram Lake (L_3 site) and Music department lake. There was no significant change in average values of these three lakes. The maximum variation in temperature was from ±4.570 to ± 5.97°C and it may be due to change in season, and rainfall pattern. The temperature started falling from rainy season to winter season and then started increasing towards summer. A similar pattern was observed by [11].

Table.8:- Monthly variation in BOD (Mg / L) in University lakes

Sr. No.	Months	L_1	L_2	L_3
1	Sep	6.7± 0.18	6.5± 0.15	6.7± 0.25
2	Oct	6.9± 0.16	6.7± 0.14	6.8± 0.22
3	Nov	7.11± 0.17	6.6± 0.13	6.74± 0.20
4	Dec	6.82± 0.14	6.5± 0.12	7.01± 0.18
5	Jan	16.6± 0.13	16.78± 0.12	17.31± 0.16
6	Feb	32.87± 0.11	33.78± 0.11	33.71± 0.14

Graph.8:-Monthly variation in BOD (Mg / l) in University Lakes

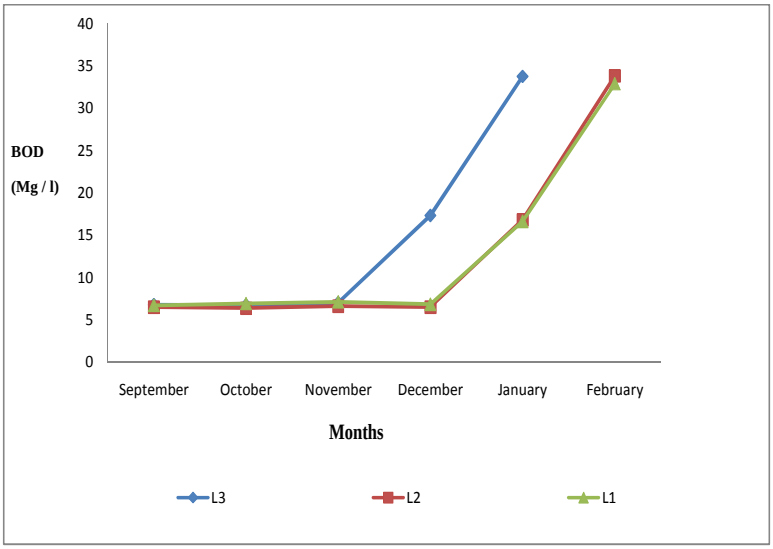


Table.9:- Monthly variation in COD (Mg / L) in University lakes

Sr. No.	Months	L_1	L_2	L_3
1	Sep	32.8± 0.20	34.6± 0.22	31.2± 0.26
2	Oct	34.8± 0.14	35.7± 0.21	32.6± 0.23
3	Nov	27.2± 0.18	26.9± 0.18	29.1± 0.20
4	Dec	25.7± 0.19	23.3± 0.17	24.2± 0.19
5	Jan	84.2± 0.20	75.9± 0.16	109.3± 0.18
6	Feb	132± 0.17	159± 0.13	152.3± 0.15

Graph.9:– Monthly variation in COD (Mg / L) in University Lakes

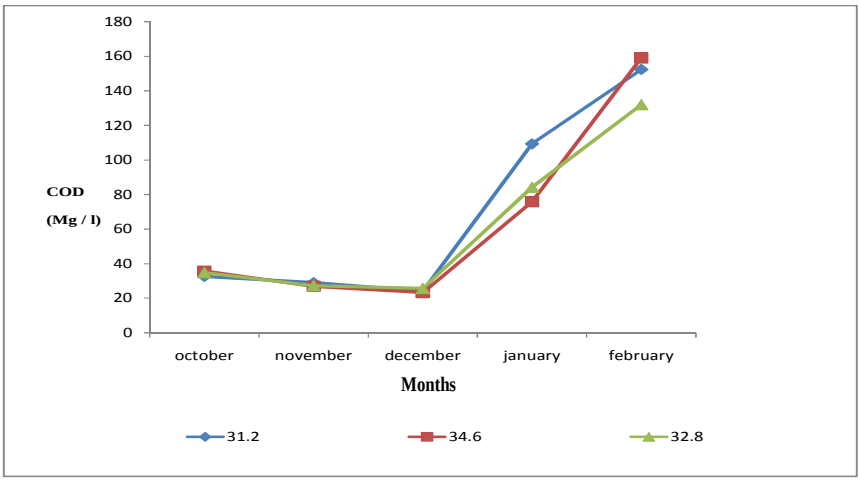


Table.10:- Monthly variation in Phosphate (mg/L) in University lakes

Sr. No.	Months	L_1	L_2	L_3
1	Sep	1.19± 0.18	1.47± 0.20	1.51± 0.19
2	Oct	1.19± 0.16	1.47± 0.17	1.51± 0.20
3	Nov	1.35± 0.18	1.56± 0.18	1.58± 0.22
4	Dec	1.51± 0.19	1.58± 0.16	1.56± 0.19
5	Jan	1.77± 0.15	2.63± 0.14	1.73± 0.17
6	Feb	1.6± 0.11	1.7± 0.12	1.66± 0.15

Graph 10 -Monthly variation in Phosphate (mg/L) in University Lakes

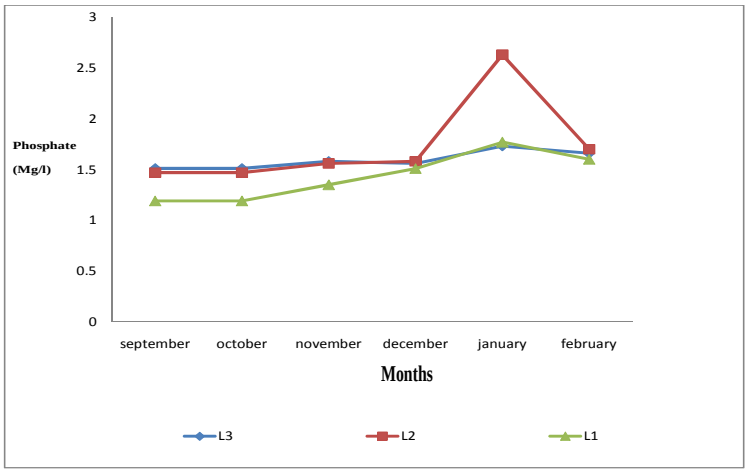
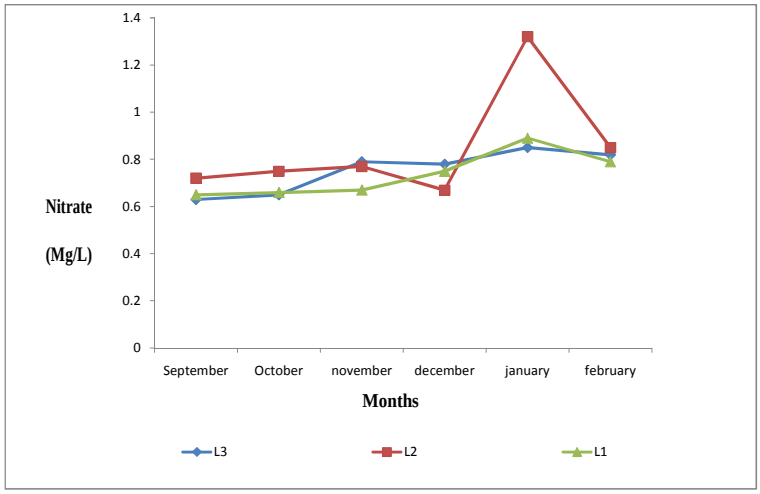


Table.11:- Monthly variation in Nitrate (mg/L) in University lakes

Sr. No.	Months	L_1	L_2	L_3
1	Sep	1.19± 0.19	1.47± 0.19	1.51± 0.21
2	Oct	1.19± 0.17	1.47± 0.14	1.51± 0.18
3	Nov	1.35± 0.15	1.56± 0.16	1.58± 0.17
4	Dec	1.51± 0.13	1.58± 0.18	1.56± 0.13
5	Jan	1.77± 0.11	2.63± 0.13	1.73± 0.15
6	Feb	1.6± 0.10	1.7± 0.11	1.66± 0.14

Graph 11: – Monthly variation in Nitrate (mg/L) in University lakes



Graph.12: – Monthly variation of Chloride (mg/l) in University lake

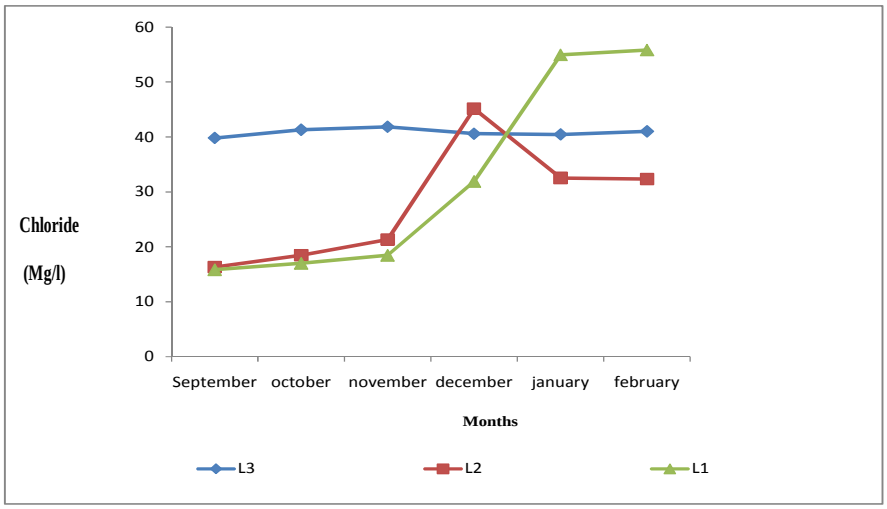


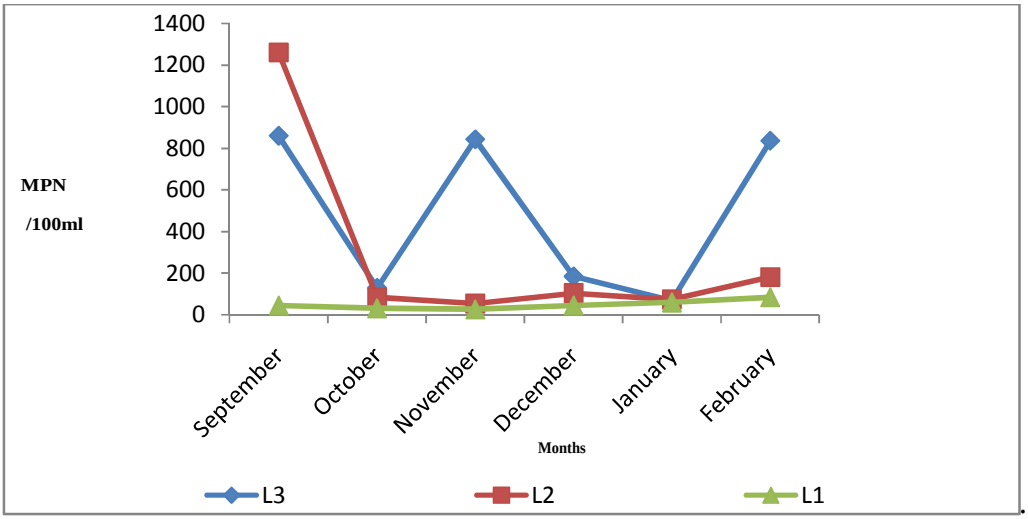
Table.12: – Monthly variation of Chloride (mg/l) in University lake

Sr. No.	Months	L_1	L_2	L_3
1	Sep	15.83± 0.18	16.3± 0.15	39.81± 0.21
2	Oct	17.01± 0.16	18.47± 0.16	41.3± 0.20
3	Nov	18.46± 0.17	21.3± 0.17	41.83± 0.21
4	Dec	31.92± 0.18	45.16± 0.18	40.58± 0.19
5	Jan	54.95± 0.19	32.56± 0.14	40.46± 0.17
6	Feb	55.85± 0.11	32.34± 0.12	41.01± 0.14

Table.13: – Monthly variation of MPN in University lake

Sr. No.	Months	L_1	L_2	L_3
1	Sep	45± 0.20	1260± 0.18	860± 0.21
2	Oct	32± 0.19	85± 0.16	130± 0.22
3	Nov	27± 0.17	55± 0.14	843± 0.25
4	Dec	45± 0.15	105± 0.13	185± 0.16
5	Jan	60± 0.16	75± 0.15	68± 0.17
6	Feb	85± 0.10	182± 0.11	836± 0.11

Graph.13: – Monthly variation of MPN in University lake



The pH value of water is important indication of water quality. pH determines the suitability of water for various purposes, including toxicity to animals and plants. Acidic pH will affect the aquatic ecosystem. Heavy metals are not toxic to aquatic life at alkaline pH. The pH of lakes was found to be alkaline during the month of September, 2010 to February, 2011, ranging from 6 to 7. Maximum average pH 7.7 was observed during September to February at Rajaram lake (L_3 site) west site while minimum pH were observed was 6.79 at Bhashabhavan lake (L_1 site) west site. pH of all the three lake water are within the acceptance range of BIS i.e. 6.5-8.5. pH of lakes becomes alkaline due to increasing concentration of domestic sewage from nearby area. These pH values are supporting the phytoplankton growth.

Clarity of water is important in determination of its condition and productivity. Turbidity of water is caused by suspended and colloidal matter. During study the turbidity values were ranged

between 3.9 to 14.0 NTU. Rajaram Lake (L_3 site) east side site is (14.0 NTU) and at Rajaram Lake (L_3 site) south side site is (11.5 NTU). Maximum fluctuation observed at Rajaram Lake (L_3 site) in the month of October. Maximum turbidity at Rajaram Lake (L_3 site) was recorded during October, 2010 i.e. 10.10 NTU whereas Music Department Lake showed (L_2 site) 5.90 NTU and Bhashabhavan (L_1 site) Lake i.e. 5.25 NTU. It may be due to particulate matter in suspension, clay, silt and organic matter, plankton diversity and aquatic weeds.

Hardness of the water is due to presence of calcium and magnesium ions. Water containing hardness concentration up to 60 mg/lit are called 'soft' water and those containing 120-180 mg/lit as 'hard' water. The hardness observed was in the range of 60 to 276 mg/lit. Maximum hardness was observed during the month of January at Music department behind hostel site was 278 mg/L and at Rajaram Lake (L_3 site) south site was 245 mg/l. Maximum average hardness recorded at Bhashabhavan Lake (L_3 site) during November, 2010 (238mg/l), Music Department lake (L_2 site) (134mg/l) and Rajaram lake (L_3 site) (206mg/l). It may be due to use of lake water for washing activities and public discharge [12]. All the values are within the limit of BIS (300 mg/l). Hardness shows seasonal variation, being minimum in winter and maximum during summer.

Alkalinity represents the buffering capacities of water; high alkalinity values are indicative of the entropic nature of the water bodies, and unsafe for ecosystem as well as for potable use. Alkalinity of lakes is ranging from 50 to195 mg/lit which was within the limits of BIS i.e. 200mg/lit. Maximum average alkalinity was highest at Music Department Lake (L_2 site) during December (228mg/l) than Rajaram Lake (L_3 site) as 152 mg/l and Bhashabhavan Lake (L_1 site) as 125 mg/l. The maximum fluctuation (± 54.46 to ± 68.95) in the values of alkalinity was reported from Music Department lake plantation site and music Department lake hostel site which was above the limit. It may be due to decrease in water level of the Lake. A lake water alkalinity may results due to waste discharge, microbial decomposition of organic matter in the water body [1].

Acidity is a measure of an aggregate property of water and can be interrupted in terms of specific substances only when the chemical composition of sample is known. Acidity values during September to February are ranging from 8 to 39 mg/lit. It is observed that acidity values were maximum during September (39 mg/lit) at Rajaram lake (L_3 site) south site and minimum (8mg/lit) during October at Bashabhavan lake site, The maximum average acidity was recorded at Rajaram lake (L_3 site) during November, 2010 (32.6 mg/l) as compared to Music Department lake (L_2 site) and Bhashabhavan lake (L_1 site). This suggests the change in season may affect the values of acidity.

Dissolved oxygen (DO) is an important indicator of ability of a water body to support aquatic life. Low DO concentration (< 3mg/lit) in fresh water aquatic system indicates higher pollution causing negative effects on aquatic ecosystem. The maximum DO observed (4.9 mg/lit) during month of January at Bhasha Bhavan lake (L_1 site) site and minimum DO observed (3.1 mg/lit) during September, at Rajaram Lake (L_3 site) west site. Maximum average value of DO recorded from Music Department lake (L_2 site) and Bhasha Bhavan lake (L_2 site) during January (4.8 mg/l) indicating the better water quality than Rajaram lake(L_3 site) . It may be due to change in

season and presence of more domestic sewage [13]. Average values of DO of all sites are slightly beyond the limits of BIS (4 mg/lit) except month of September and November.

Biological Oxygen Demand (BOD) is most important parameter used to assess the quality of water. It was applicable in measuring organic loading on water bodies. The BOD values indicate high concentration of biodegradable matter and high oxygen consumption by heterotrophic organism. The BOD values observed between the range of 6.8 to 36.55 mg/lit maximum which was above the limits of BIS (3 mg/lit). The values of BOD fluctuate from October to February at all sites of lakes in the range of (± 9.431 to ± 11.58 mg/l). Higher BOD values as compared to Music Department Lake (L_2 site) and Bhasha Bhavan Lake (L_1 site) was recorded at Rajaram Lake (L_3 site) during February (33 mg/l). It was observed that BOD values increased from September to February indicates change in season affect the values of BOD. These values increase with increase in the amount of ready metabolic organics present in the water [13].

Chemical Oxygen Demand (COD) is used as a measurement of pollutants in natural water. Both organic and inorganic component are to be analyzed by these method. The COD values are within the range of 21.41 mg/lit to184 mg/lit. Rajaram Lake (L_3 site) south site during the month of February, while minimum values observed was 21.41mg/l during the month of February. Maximum average COD values recorded during February 2011 at Music Department Lake (L_2 site) was (159 mg/l) which was higher than COD at Rajaram Lake (L_3 site) and Bhasha Bhavan Lake (L_1 site). COD fluctuating from October to February between the range of (± 41.18 to ± 66.02 mg/l), it may be due to seasonal change. The higher values of COD indicate pollution due to oxidisable organic matter [13].

Phosphate content in a lake may be due to release of phosphate from bottom sediment and organic load of the water; this helps in growth of the phytoplankton and weeds in the lake [12]. Phosphate values are near and more than 1mg/L during the month of September to February. Maximum values observed was 2.78 mg/l during the study period from Music department (L_2 site) site on the month of January and minimum 1.29 mg/l at Rajaram Lake (L_3 site) west site during the month of September, which was slightly above the permissible limits of BIS (1.0 mg/lt). The maximum average phosphate values recorded during January 2011 at Music Department Lake (2.78 mg/l) which was higher than Rajaram Lake (L_3 site) and Bhasha Bhavan Lake (L_1 site). Household detergents, domestic sewage leaching of phosphate fertilizer may be reason for phosphate level increase.

The concentration of Nitrates is indication of level of micronutrients in water bodies and has ability to support plant growth. Higher concentrations of Nitrate favored growth of phytoplankton. The nitrates observed during month of October to February were between the ranges of 0.7 to 0.9 mg/lit. Maximum nitrate observed was 1.39 mg/l during the month of January at Music Department (L_2 site) site and minimum values observed during month of November at Bhshabhavan Lake (L_1 site) west site. There was no significant change in nitrate values of all the three lakes during study period. These values are favorable for growth of phytoplankton [13]. No significant change in nitrate values was observed during study period. All the values of lakes studied were within BIS limit (100 mg/lit).

Chlorides observed during month of October to February were in the range of (16.0 - 60.05 mg/l). Chlorides show maximum fluctuation at Music Department Lake (L_2 site) site in the range of (± 70.18 to ± 80.86 mg/l). The maximum average values are recorded at Bhasha Bhavan Lake (L_1 site) (55.85 mg/l) during February, which was higher as compared to Rajaram Lake (L_3 site) and Music Department Lake (L_2 site). It was observed that chloride values were increasing from October to February with decrease in water level of water bodies during summer may be reason for increase in chloride concentration.

Fecal discharge from human and animals may transport a variety of human pathogenic microorganisms i.e. bacteria, viruses, protozoa. Most Probable Number (MPN) values were in the range of 35 to 2400 /100 ml. The maximum average MPN value observed was (1302/100ml) at Rajaram Lake (L_3 site) south site. Maximum fluctuation in MPN values was recorded at Rajaram lake (L_3 site) and average maximum value of MPN was observed at Music Department lake (L_2 site) (1260/100ml) during month of September, 2010 which was higher than Bhash Bhavan lake (L_1 site) and Rajaram lake, (L_3 site). It may be due to discharge of domestic sewage and organic pollution. The values of MPN shows that this water is not suitable for drinking as per limit zero MPN/100ml for drinking.

CONCLUSION

The main objective of study was to know Physico-chemical and biological characteristics of lakes from the University campus. Sample were collected and analyzed for different physico-chemical and biological parameter reveals that Rajaram Lake is polluted due to domestic sewage discharge, washing, bathing, and microbial decomposition of organic matter whereas in remaining two lakes these anthropogenic activities were strictly prohibited. The present study reveals that some of the parameters were above the permissible limits of surface water standard. The parameter like pH, alkalinity, acidity. DO, nitrate, chloride, hardness, turbidity are well within limit where as DO is high in Rajaram south and Music Department lake. Fecal contamination is observed during the study indicates that this water is not suitable for drinking purpose directly without proper treatment. Seasonal variation in some parameters was also observed for temperature, pH alkalinity, acidity, BOD, chloride in all three lakes during the study. Careful precautions should be taken before using this water for drinking purpose.

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