



World Scientific News

An International Scientific Journal

WSN 114 (2018) 44-54

EISSN 2392-2192

Limnological study of Lentic Fresh Water Ecosystem during Summer Season: Nakki Lake-Mount Abu, Rajasthan, India

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ABSTRACT

Limnological parameter plays a key role in determining the ecological biodiversity. Planktonic diversity can be considered as a major key factor for determining the portability of water. Nakki Lake has the greatest importance amongst the localised. With a seasonal survey, the specific status of limnological characteristic and planktonic diversity in Nakki Lake have been studied through different weather cycles (2017) across three region based on the geography and in contact with human population over top and bottom water samples. With moderately alkaline water (pH 7.08), alkalinity of (102.16 mg/l) and other limnological parameters showed low mean values including TDS (161.83 mg/l), chloride (109.73 mg/l), and hardness (95.66 mg/l). The average dissolved oxygen levels were at 5.75 mg/l while average nitrate and sulphate levels were 31.19 mg/l and 123.73 mg/l respectively. Based on the results of quality parameters of water and soil, Nakki Lake is eutrophic.

Keywords: Limnology, Biodiversity, Plankton, Nakki-Lake, Lentic, Eutrophic

1. INTRODUCTION

Water is a precious natural resource and basic requirement of human so it is considered as an important asset. A physiochemical status of an aquatic body is directly proportional to the

biological production of that water body. Water quality of any water body ensures conservation of its habitat by suitably maintaining the physico-chemical of water within the acceptable limit. The seasonal variation in physico-chemical parameters like temperature, dissolved oxygen, COD, BOD, nitrate, phosphate, TDS, turbidity etc of water may provide countable information of water on its quality impacts on the productivity and biodiversity of the reservoir.

The most important criteria to assess the trophic structure of a lake remain to be primary productivity studies. To assess the trophic structure of a lake it is important to study the primary productivity of lake.

Limnological study by Sawanth et. al., (2010) at Atyal pond, Kolhapur, (Maharashtra), showed nutrients rich limnological parameter and pond was eutrophic. Aijyaz et. al., (2010) studied the diversity index of algal flora in Wular lake, Kashmir. They reported that diversity was significantly correlated with physico-chemical parameters. There was a positive correlation with conductivity, carbon dioxide, hardness and nitrate. Shinde et. al., (2010) studied seasonal variations in physico-chemical characteristics of Harssooli, Aurangabad and demonstrated that the water was suitable for fish culture.

Hosmani (2010) made extensive study phytoplankton diversity in lakes of Mysore district and reported that the algal species were uniformly distributed, but diversity within the population was low. Bhosale et. al., (2010) dealt with the diversity of plankton in water bodies of Miraj Tashie (Maharashtra). There were great variations in the physico-chemical complexes as well as the phytoplankton population.

Sharma et.al (2011) studied the Limnological Characteristic, Planktonic Diversity and Fishes (Species) in Lake Pichhola, Udaipur, Rajasthan (India). They studied through seasonal surveys in two annual cycles (2005-06 and 2006-07) and the result stated that the water remained moderately alkaline (pH 7.5) while electrical conductance (0.3958 mS/cm), TDS (237.5 mg/l), chloride (176 mg/l), hardness (174.33 mg/l) and alkalinity (207.16 mg/l) showed low mean values. Average dissolved oxygen levels were at 5.75mg/l while average nitrate and phosphate levels were 3.70 mg/l and 2.79 mg/l respectively. They also observed high rate of primary production (302.085 mgc/m/hr).

The trophic structure of a lake depends upon the primary productivity studies. The food chain in Lake Ecosystem is very simple comprising phytoplanktons, zooplanktons as well as secondary and tertiary consumers. As Mount Abu is blessed with Nakki Lake and known as "Arbudanchal". Every year lacs of tourist come globally to visit Mount Abu and lake provide water to the city dwellers. So study of limnological characteristics of Nakki Lake has high importance, the study of their trophic status may help in optimum utilization and conservation, therefore the present investigation attempt to study of Limnological parameter and their relationship, phytoplankton, zooplankton status in Nakki Lake, Mount Abu (Rajasthan) during the period.

2. MATERIALS AND METHODS

2.1. Study area

Nakki-Lake (Mount Abu) was choosed for research purpose. It is filled annually by rain water, situated at the highest peak of Aravali range "Mount Abu" (Arbudanchal) Rajasthan.

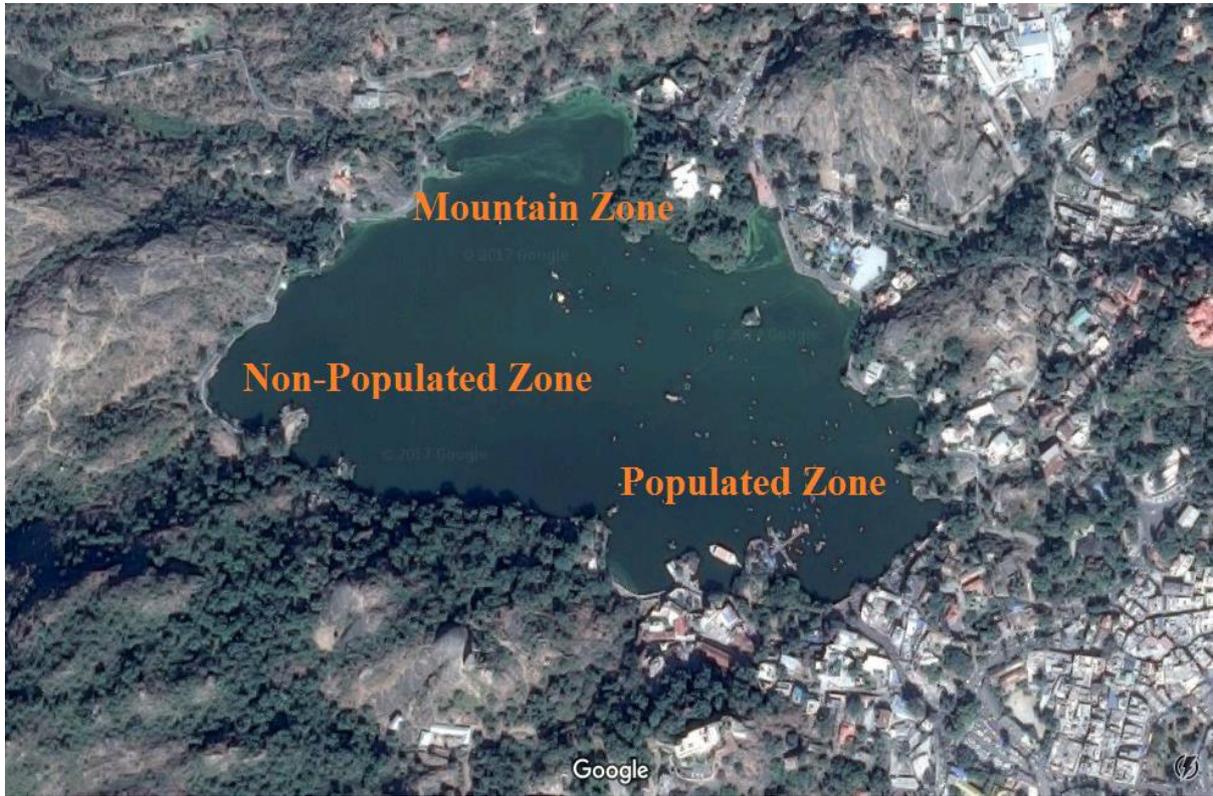


Fig. 1. Nakki Lake: GIS View



Fig. 2. Nakki Lake: Natural view

The lake having an importance in tourism of the city, provides annual drinking and other water needs for the localized and a million of tourist annually, also completes the need of water of herbivorous and carnivorous animals in that habitat.

Location: 24.596140° N, 72.703066° E

City: Mount Abu

State: Rajasthan

Country: India

Max. Depth: 45-50 ft. (Fig. 1-2)

2. 2. Sampling procedure and laboratory analysis:

Water samples were collected from pre-selected three sampling regions during the peak of season of the weather cycle. Water samples were collected in clean and rinsed polyethylene sampling bottles from surface and bottom area of the respective site; and were brought to the research laboratory for limnological analysis.

The important physico-chemical parameters of water including temperature, water temperature, transparency, color-hazen, turbidity (NTU), pH value, sechhi depth, Total alkalinity (mg/L), Total Hardness (CaCO₃, mg/L) Iron (Fe, mg/L) Chloride (Cl, mg/L) Fluoride (F, mg/L), Total Dissolved Solids mg/L, Calcium (Ca, mg/L) Magnesium (Mg, mg/L) Sulphate (SO₄, mg/L) Nitrate (NO₃ mg/L), Nitrate-N, Total Alkalinity mg/L, Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), were analyzed by the methods as per IS:3025 and APHA 22nd Edt.

3. RESULT AND DISCUSSION

3. 1. Physico-Chemical Analysis

Table 1. Limnological Study of Top Surface Water

S. No	Parameters	Populated_ Top	Non_Populated_ Top	Mountain_ Top	Average
1	Colour, Hazen	0.4	0.56	0.95	0.64
2	Turbidity, NTU	0.7	0.76	0.98	0.81
3	pH value	7.11	6.95	7.11	7.06
4	Secchi Depth (cm)	57.91	67.71	60.98	62.20
5	Total Alkalinity, mg/L	102	90	112	101.33
6	Total Hardness (as CaCO ₃), mg/L	89	105	89	94.33

7	Total Dissolved Solids, mg/L	142	146	193	160.33
8	Iron (as Fe, mg/L	0.022	0.025	0.02	0.02
9	Chloride (as Cl), mg/L	104.22	102.56	115.43	107.40
10	Fluoride (as F), mg/L	0.25	0.24	0.34	0.28
11	Calcium (as Ca), mg/L	60.2	53.29	53.65	55.71
12	Magnesium (as Mg), mg/L	20.4	18.68	21.3	20.13
13	Sulphate (as SO ₄), mg/L	120.4	122.4	128.4	123.73
14	Nitrate (as NO ₃), mg/L	32.1	30.56	30.67	31.11
15	Chemical Oxygen Demand	8.11	7.45	9.3	8.29
16	Biological Oxygen Demand	28.4	22.68	30.1	27.06

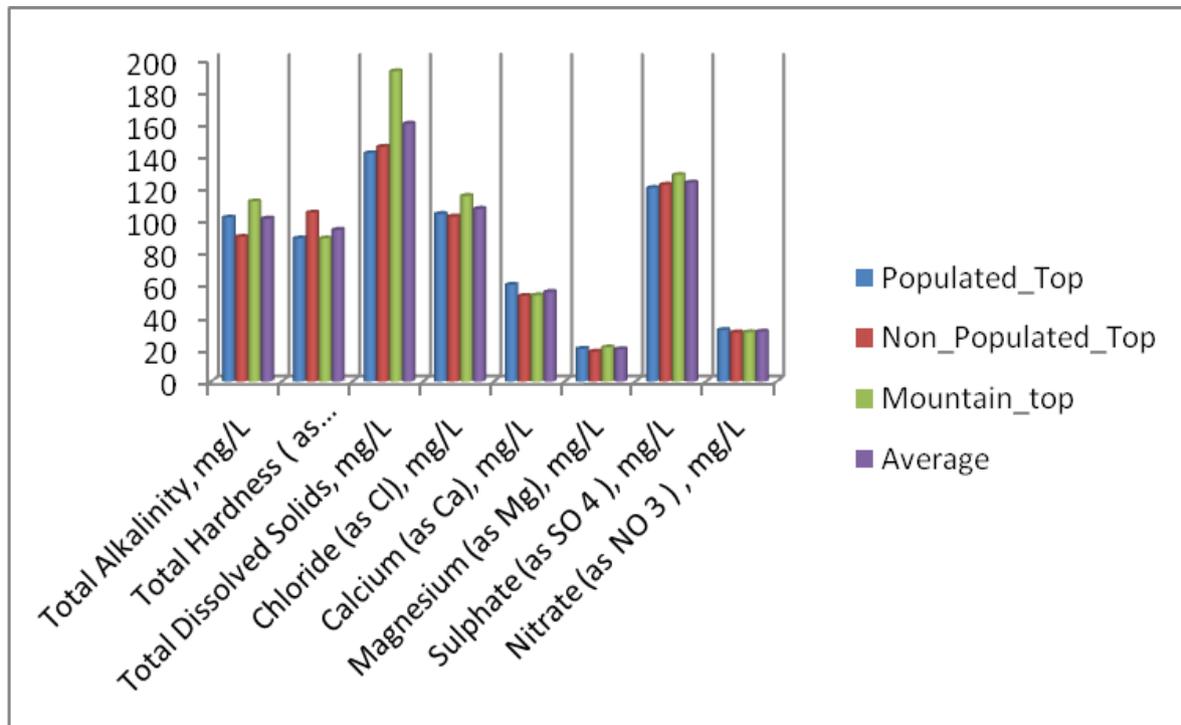
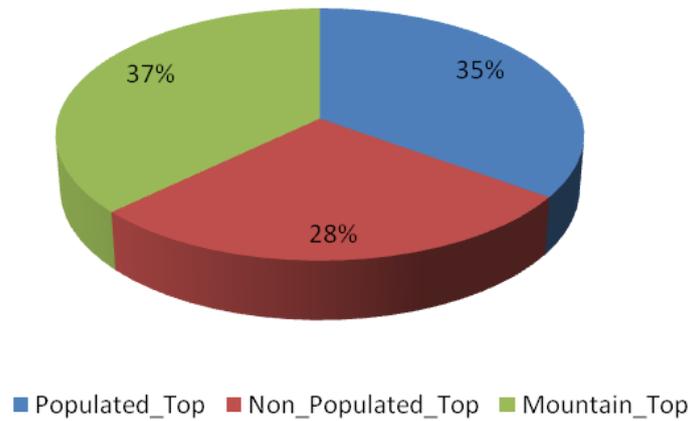


Fig. 3. Graphical Analysis of Limnological parameters (Top Surface Water)

Biological Oxygen Demand



Chemical Oxygen Demand

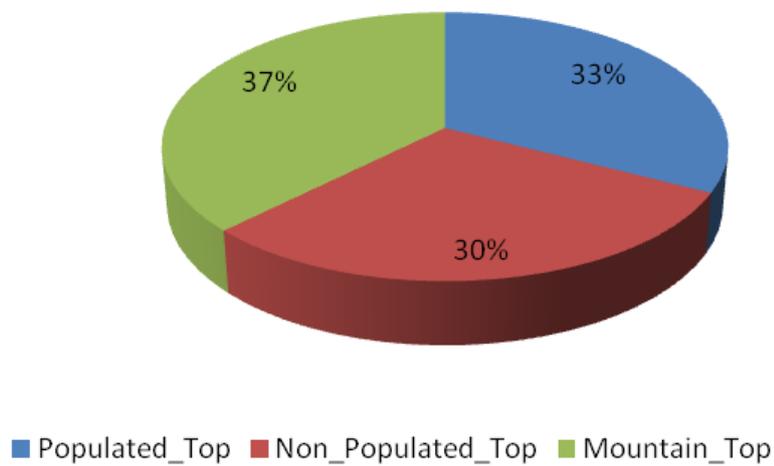


Fig. 4. Comparative Analysis of Limnological parameters (Top Surface Water)

Table 2. Limnological Study of Bottom Surface Water

S. No	Parameters	Populated_Deep	Non_Populated_Deep	Mountain_Deep	Average
1	Colour, Hazen	0.56	0.69	0.78	0.68
2	Turbidity, NTU	0.93	0.85	0.82	0.87
3	pH value	7.24	7.03	7.09	7.12

4	Total Alkalinity, mg/L	97	109	103	103.00
5	Total Hardness (as CaCO ₃), mg/L	95	102	94	97.00
6	Total Dissolved Solids, mg/L	165	142	183	163.33
7	Iron (as Fe, mg/L	0.029	0.022	0.027	0.03
8	Chloride (as Cl), mg/L	107.1	110.32	118.79	112.07
9	Fluoride (as F), mg/L	0.27	0.29	0.32	0.29
10	Calcium (as Ca), mg/L	58.4	50.4	40.65	49.82
11	Magnesium (as Mg), mg/L	19.3	20.54	22.65	20.83
12	Sulphate (as SO ₄), mg/L	123.3	126.35	123.67	124.44
13	Nitrate (as NO ₃), mg/L	31.42	29.84	32.56	31.27
14	Chemical Oxygen Demand	13.5	11.5	5.1	10.03
15	Biological Oxygen Demand	45.1	45.2	20.44	36.91

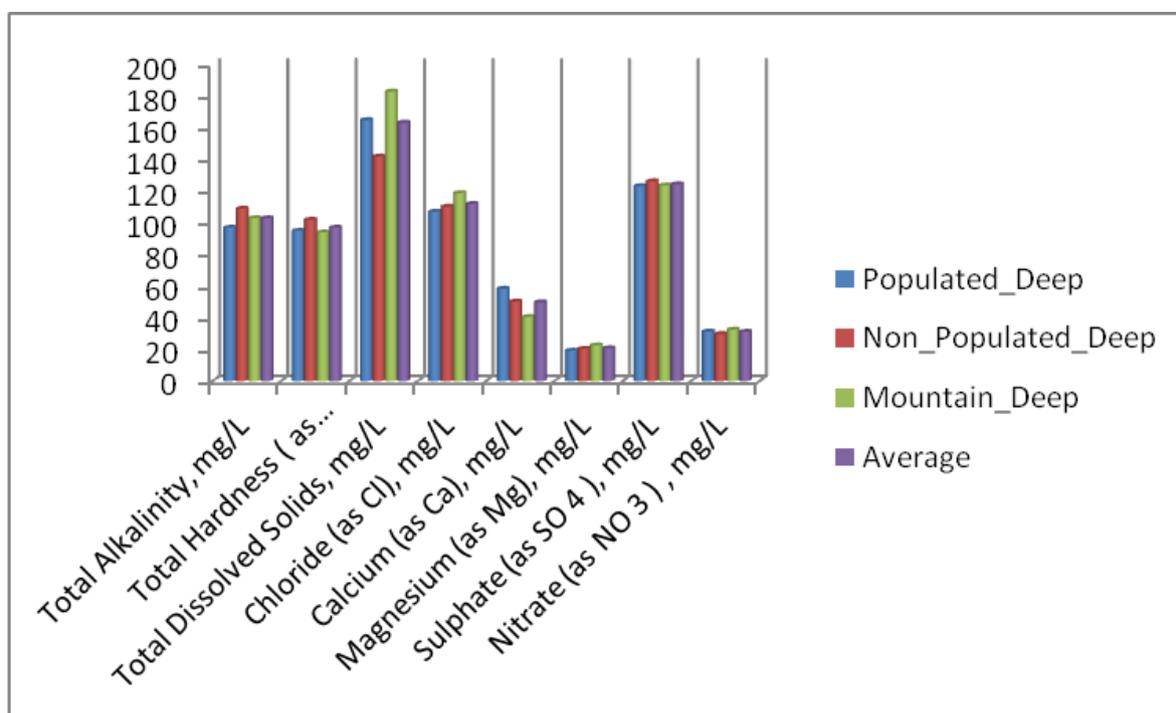
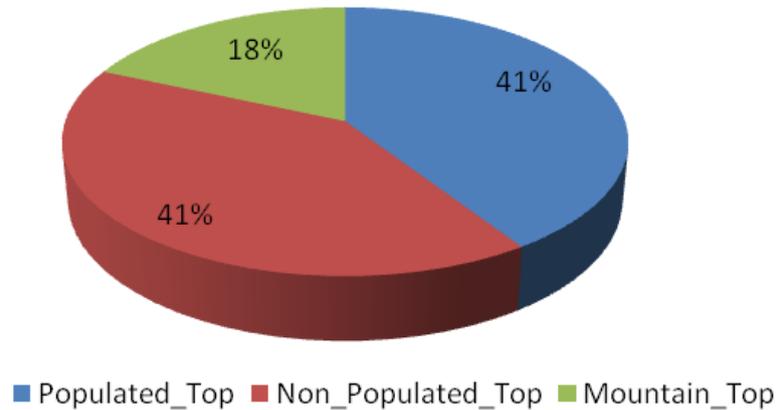


Fig. 5. Graphical Analysis of Limnological parameters (Bottom Surface Water)

Biological Oxygen Demand



Chemical Oxygen Demand

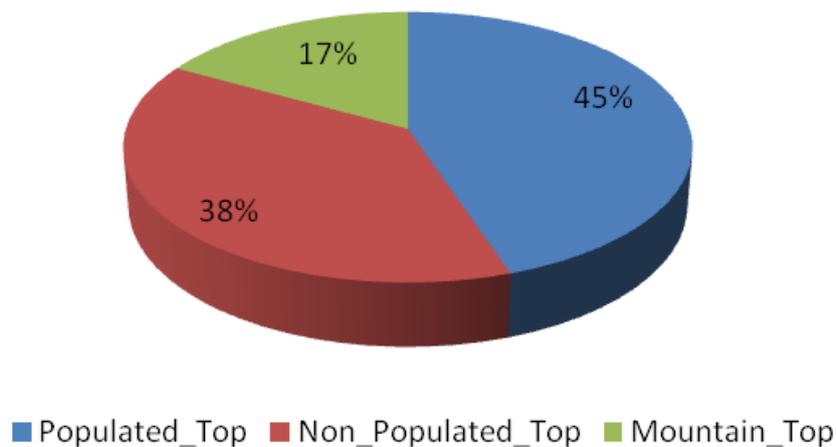


Fig. 6. Comparative Analysis of Limnological parameters (Bottom Surface Water)

The range of variation and there comparatively analysis are given in Table 1&2. The results shows the average pH of top surface water that was 7.06, whereas it was 7.12 at bottom surface. Maximum pH was found in populated region. The colour (Hazen) of top water sample varies among populated, non-populated and mountain top region that was 0.4 at populated top water, 0.5 at non populated top water and 0.95at mountain top water. Similarly the colour of water sample taken from bottom surface water also shows difference in colour that was 0.5 at populated deep water, 0.69 at non populated deep water and 0.78 at mountain deep water. The turbidity of both top and bottom water sample shows fluctuation in pH varies between 7.06 to 7.12. Secchi depth is 67.71 cm in Non-populated area, whereas it is 57.91 cm and 60.98cm in Populated and Mountain regions of Nakki-Lake. No pesticide residue found in water sample as there is any agriculture area nearby.

According to study, Nakki Lake was characterised by low level of total dissolve solid (TDS) 142 mg/L at populated top surface water, 146 mg/L at non populated top surface water, similarly the level of total dissolved solids at bottom surface water was quite low that was 165mg/L at populated deep water, 142 mg/L non populated deep water and 183 mg/L mountain deep water. During the study of total alkalinity, the highest value was 103 mg/L at bottom surface water, whereas 101.33 mg/L in top surface water. Total alkalinity shows a positive relationship with temperature, pH, hardness, TDS, conductivity, chloride, nitrate, phosphate, silicate. The average value of total hardness during study was 94.33 mg/L with upper surface water and 97 mg/L with lower surface water. This increase in total hardness during summer period is due to high rate of photosynthesis. In summer season the highest value of 36.91 in biological oxygen demand (BOD) was observed in deep water sample. In the present study, the value of fluoride shows similarities by an average value of 0.29 mg/L at both top and deep water surface. According to WHO (1997), permissible limit for fluoride in drinking water is 1.0 mg/L. The result shows that the average value of chloride, fluoride, sulphate, and nitrate for top level water sample is lower than the value from bottom level water sample.

A limnological study of Atyal pond in Kolhapur, Maharashtra, Sawanth et. al., (2010) reported that the pond is rich in nutrients and become eutrophic. Shinde et.al. (2010) studied seasonal variations in physico-chemical characteristics of Harssooli, Aurangabad and demonstrated that the water was suitable for fish culture. Borse and Bhawe (2000) reported that dissolved carbon dioxide was maximum in summer and minimum in winter and was dependent on carbonates and bicarbonates in water, Carbon-dioxide and pH of water also had an impact. Trophic State Indices for lakes of Mysore were calculated by Hosmani (2006) who inferred that values of 40-50 were considered mesotrophic (moderate pollution), more values than 50 were eutrophic (highly productive) and values less than 40 were considered oligotrophic.

Bhosale et. al., (2010) dealt with the diversity of plankton in water bodies of Miraj Tashie (Maharashtra). There were great variations in the physico-chemical complexes as well as the phytoplankton population. Aijyaz et. al., (2010) reported the diversity correlation with physico-chemical parameters at Wular lake, Kashmir. A positive correlation with conductivity, carbon dioxide, hardness and nitrate was observed there. Sharma et.al (2011) studied the Limnological Characteristic in Lake Pichhola, Udaipur, Rajasthan (India). They studied through seasonal surveys in two annual cycles (2005-06 and 2006-07) and the result stated that the water remained moderately alkaline (pH 7.5) while electrical conductance (0.3958 mS/cm), TDS (237.5 mg/l), chloride (176 mg/l), hardness (174.33 mg/l) and alkalinity (207.16 mg/l) showed low mean values. Average dissolved oxygen levels were at 5.75 mg/l while average nitrate and phosphate levels were 3.70 mg/l and 2.79 mg/l respectively. Balai et. al., (2016) studied limnological characteristics of Jaisamand Lake (Rajasthan), India and reports its suitability for aquaculture with presence of essential nutrients in adequate amount needed for primary producers.

4. CONCLUSION

The ecosystem of any place depends on location, fauna and flora there. Biodiversity also play an important role in human welfare such as food for good health security, social relationship, life and freedom for choice etc. The present study is relevant to limnological study

of Nakki-Lake Mount Abu, Rajasthan. This study explains that Nakki-Lake is eutrophic with rich in biodiversity and needs to conserve for future prospect.

Acknowledgment

The author is extremely thankful to Madhav University for providing research facility for success to this type of research work and Department of Bioscience for providing all facilities in laboratory.

Conflict of Interest

“The author declares that there is no conflict of interest.”

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