International Journal of Innovation and Applied Studies
ISSN 2028-9324 Vol. 3 No. 2 June 2013, pp. 504-510

http://www.issr-journals.org/ijias/

Cultural Eutrophication of Lonar Lake, Maharashtra, India

Vyankatesh B. Yannawar and Arjun B. Bhosle

School of Earth Sciences, Swami Ramanand Teerth Marathwada University,
Vishnupuri, Nanded 431606 (Maharashtra),
India

ABSTRACT: Lonar is one of the youngest Lake and is unique in the world for its alkalinity and salinity of the water. But its alkalinity, pH and salinity go on decrease day by day. An attempt has been made to examine environmental analysis of Lonar Lake. *Objective*: This papers aims at improving the water quality in the lakes from hyper-eutrophic to minor eutrophic conditions. *Methods*: The physical and chemical parameters were analyzed as per APHA. *Results*: It is found that major *Spirulina* species of algae was found in lake water. This species Spirulina having medicinal value for human body. This species occupied the Lonar lake water phytoplankton about 90.0% and above. Rests of 10 % are other members of Chlorophyceae, Cynophyceae and Bacillariophyceae also found in this lake. Lonar lake water was found to be very rich in mineral nutrient contents. No fish species was recorded in the same water body. *Conclusions*: Hence this World heritage lake should be preserved for its alkalinity and salinity. Use of agrochemicals on crater floor; nuisance of tourists; sewage disposal in the lake; constructions on the crater rim; etc. are some of the problems requiring attention. The lake urgently needs to take immediate protection from pollution and save and preserve for future generations.

KEYWORDS: Alkalinity, Salinity, Lonar Lake, Spirulina, Nutrient Enrichment, Cultural Eutrophication.

1 INTRODUCTION

Lakes are generally defined stagnant water body surrounded by land. Eutrophic lakes are shallow, murky bodies of water with concentrations of plant nutrients causing excessive production of algae. Eutrophication is the slow aging process during which a lake, estuary, or bay evolves into a bog or marsh and eventually disappears [1]. Eutrophication is the process of enrichment of nutrients in an aquatic ecosystem [2]. Cultural eutrophication (excessive plant growth resulting from nutrient enrichment by human activity) is the primary problem facing most surface waters today. It is one of the most visible examples of human changes to the biosphere [24, 25].

Cultural eutrophication is a universal phenomenon and no inland water body is spared from this serious ecological stress. This is a natural crater lake created by meteorite impact, receiving water by underground channels. Water conservation projects in the vicinity of the lake are a cause of concern, since seepage of water from reservoirs is changing the water quality of the lake and, in turn, affecting its unique limnology. A once-sleepy village is undergoing urbanization, with problems of non-point sources of sewage pollution leading to Lake Eutrophication impacts [4].

The process whereby a body of water becomes rich in dissolved nutrients through natural or man-made processes. This often results in a deficiency of dissolved oxygen, producing an environment that favors plant over animal life [5]. Eutrophication often results from nutrient enrichment sewage, fertilizer runoff; even decomposing leaves in street gutters can produce a human-caused increase in biological productivity called cultural eutrophication [6]. In the last 2 – 3 decades the environmental degradation of most of the micro or sub ecosystem of Lonar Lake alarms the environmentalists. If steps are not taken to protect the area, tomorrow will be too late [7]. In India many researchers have worked on physicochemical and biological characteristics of reservoir's and rivers [8], [9], [10], and [11].

Corresponding Author: Vyankatesh B. Yannawar (vbyannawar@gmail.com)

Lonar Lake is the third largest natural salt water lake in the world. The Lonar Lake is a deep crater-like hollow or basin in the basalt-plateau of the Deccan, in the district of Buldhana. The depression is about 300 feet in depth and about a mile in diameter. It is surrounded on all sides by a rim formed of blocks of basalts. The depression contains at the bottom a shallow lake of saline water. The chief constituent of the salt water is sodium carbonate, together with a small quantity of sodium chloride. These salts are thought to have been derived from the surrounding trap country by the chemical solution of the disintegrated product of the traps and subsequent concentration [12].

The aim of the present study deals with Physic-chemical analysis of water is to determine the nutrient status of the water with reference to eutrophication. Hence the water parameters which focus on the Lake as a saline and eutrophicated had been mentioned in this paper. All the results point out that the Lonar Lake is getting polluted day- by- day and has been at an eutrophication stage now.

1.1 STUDY AREA

The Lonar Lake, situated in the Buldhana district of Maharashtra State, India, is located at 19° 58'N, 76° 31'E.Lonar Lake, often described as the geological wonder, which ranks third in the world amongst the craters created by the meteorite impact in basaltic rock. Formed some 52,000 years ago, it is today a closed basin lake that is saline and alkaline, rich in carbonates and bicarbonates [3].

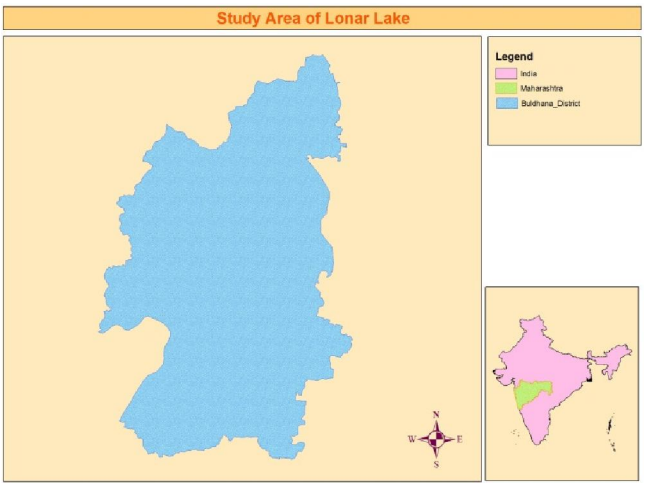

Fig. 1. Map of study area of Lonar Lake

Fig. 2. Area of Lonar Lake

2 MATERIAL AND METHODS

2.1 SAMPLING METHODS:

Four water samples were collected from four sampling site of Lonar Lake in 1liter pit bottles and carried to the laboratory. The physical and chemical parameters were analyzed as per Standard Methods for the Examination of Water and Waste Water, 17th edition, [13], [14] and [15]. Sampling was done three times in the year at morning in 2011. The pH, temperature, DO, and TDS were determined on the spot rest of the parameters were analyzed in the laboratory by standard methods.

3 RESULTS AND DISCUSSION

In this study total 4 water samples; in pre-monsoon, 4 in monsoon, and 4 in post-monsoon ware analyzed from Lonar Lake. The number of physicochemical parameters like pH, EC, temperature, colour, odor, total dissolved solids, alkalinity, dissolved oxygen, chloride, salinity, total hardness, calcium hardness, magnesium hardness, sulphate, phosphate, calcium, magnesium, fluoride, iron, manganese, sodium, potassium and nitrate were performed. In the present study the data revealed that there were considerable variations in the quality with respect to their physicochemical characteristics. Physicochemical analysis of Lonar Lake water was studied in different season (2010-2011). The average value of various water quality parameters had been mentioned in Table and represented in graphs.

It is also observed from the present study that, the colour of the lake water is also pale green to dark green which is a result of the highly dense algal population with predominating Spriulina. The odor of lake water is somewhat an offensive or objectionable. Muley and Babar noted the Offensive odor of the lake water. The pH of Lonar Lake water varies from 6.7 to 9.1and temperature 23 0C to 26 0C. The total dissolved solid is in the range of 630 to 690 and dissolved oxygen recorded in the range 1.2 to 2 mg/liter. Since the water contains dissolved and suspended constituents in varying proportions, the composition of the Lonar water is of the Na2HCO3Cl type [16]. It often has different physical and chemical properties along with biological variation. It may be the appearance of high concentration of Spriulina, which is an indicator of extremely high photosynthetic rate. If there is a moderate amount of dissolved matter, the lake will probably appear green because the phytoplankton blooms produce a green or chartreuse color [17].

Hypoxic and sub toxic conditions frequently occur in coastal waters, where low subsurface O2 levels can be generated by natural high biological productivity in the Over lying waters or by eutrophication from agricultural runoff or sewage inputs [18]. The lake has been undergoing eutrophication in recent years because of domestic sewage inputs from the fast-developing town of Lonar. Anthropogenic activities (construction, washing, bathing and alterations in the basin) are adversely impacting the lake. The long-term sustainability of this ecologically-, economically- and culturally-significant lake ecosystem rests in application of Integrated Water Resources Management (IWRM) and the 7 Principles espoused in the World Lake Vision [4]. Spirulina is well known indicator of brackish eutrophic lake water. This species dominated the Lonar lake water phytoplankton with around 92.0% composition and above. This observation is supported by the reports quoting the occurrence of this alga in large number in brackish water all over the world like many Sodic lakes in Africa, Sonachi and Simbi [19], [20]. Similarly species of Spirulina were also recorded in Lonar lakes [21]. The higher values of pH may be due to the increased in nutrients and productivity in aquatic ecosystem [22] and [23].

We also find the similar results Spirulina is well known indicator of eutrophication. This species we recorded an around 90.0%. Rest of 10 % other members of algal group are Chlorophyceae, Cynophyceae and Bacillariophyceae also found in this lake. Here we find that the cultural eutrophication of this lake is takes place. Similar results are also found to Khobragade et al. Lonar Lake is a very suitable environment for growing blue green algae like *Spirulina* by proper manipulation of the ecosystem. A review of literature revealed that it salinity were decreasing day by day. High salinity with very low dissolved oxygen level of this unique ecosystem does not support aquatic fauna like fish and zooplanktons, which are not recorded during our studies. Similar observations have been reported in the literature. There is an urgent need to undertake intensive lake basin management efforts to prevent environmental degradation of this unique lake ecosystem, which also has significant socio-religious and tourism potential [4]. Governmental agencies, unfortunately, did not recognize the potential of this lake as a basis for global scientific and tourist interest, due possibly to its remote location. There presently is no long-term perspective or planning for its conservation.

4 TABLES AND FIGURES

4.1 TABLES

Table 1. Physic-chemical parameters of Lonar Lake water samples

Sr. No.	Parameters	Post Monsoon	Pre Monsoon	Monsoon	Average
1	Odor	Objectionable	Objectionable	Objectionable	Objectionable
2	Colour	Greenish	Greenish	Greenish	Greenish
3	pH	6.74	9.1	8.55	8.13
4	Electrical conductivity	220	340	330	296.6
5	Temperature	25 ˚ C	26 ˚ C	23 ˚ C	24.6 ˚ C
6	Total Dissolved Solids(mg/L)	750	630	930	770
7	Alkalinity(mg/L)	3590	3760	3630	3660
8	Total Hardness(mg/L)	130	120	140	130
9	Calcium Hardness(mg/L)	50	20	50	40
10	Magnesium Hardness(mg/L)	80	100	90	90
11	Sulphate(mg/L)	230	154	201	195
12	Phosphate(mg/L)	0.904	0.634	1.690	1.076
13	Chloride(mg/L)	3017.5	3337	31.90	2128.8
14	Calcium(mg/L)	20.04	8.016	12.03	13.362
15	Magnesium(mg/L)	19.49	24.36	21.40	21.75
16	Dissolved Oxygen(mg/L)	2.0	1.12	1.8	1.64
17	Fluoride(mg/L)	0.2	0.21	0.2	0.203
18	Iron(mg/L)	04	12	09	8.33
19	Manganese(mg/L)	0.4	0.6	0.5	0.5
20	Salinity(mg/L)	544.61	6023.31	412.1	2326.6
21	Sodium(mg/L)	823.8	724.8	241.9	596.8
22	Potassium(mg/L)	10	11.8	9.9	10.56
23	Nitrate (mg/L)	N.D.	N.D.	N.D.	N.D.

All values expressed as mg/L except pH, EC and Temperature & N.D. Not detected.

4.2 FIGURES

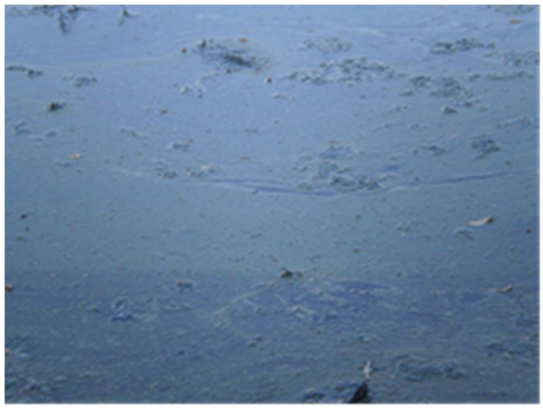

Fig. 3. Algal growth on surface of Lake

Fig. 4. Spirulina on surface lake water

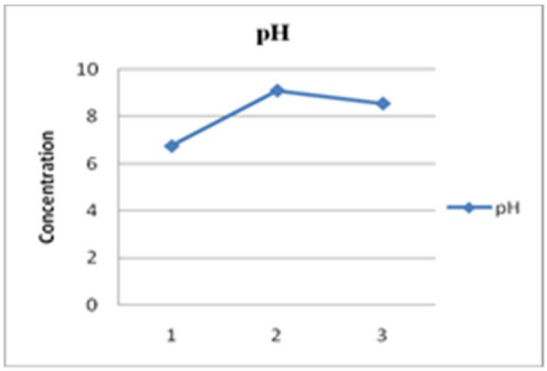

Fig. 5. Observed pH of water samples

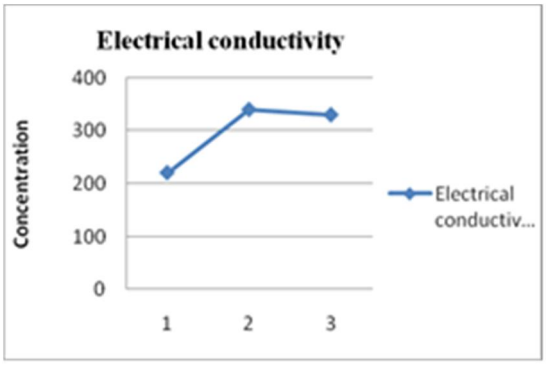

Fig. 6. Observed EC of water samples

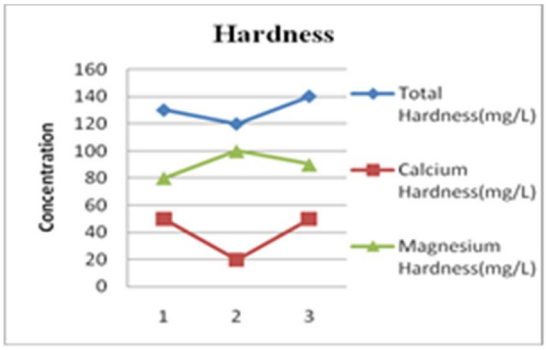

Fig. 7. Cons of Calcium, Magnesium & Total Hardness

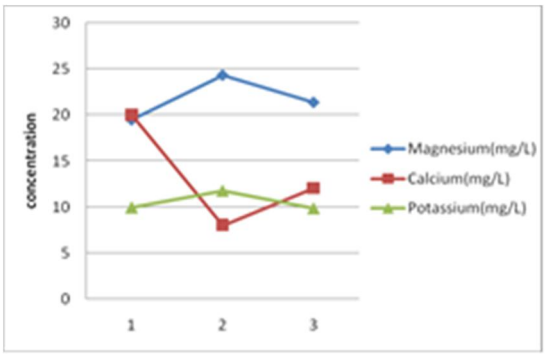

Fig. 8. Cons of Magnesium, Calcium & Potassium

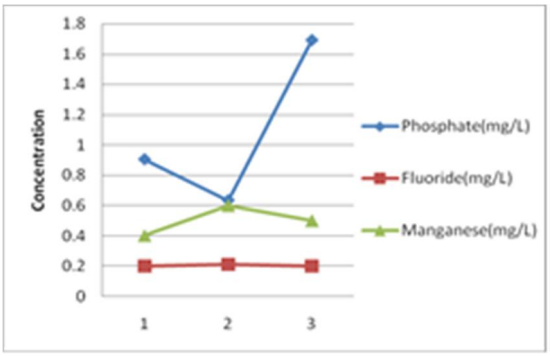

Fig. 9. Cons of Phosphate, Fluoride & Manganese

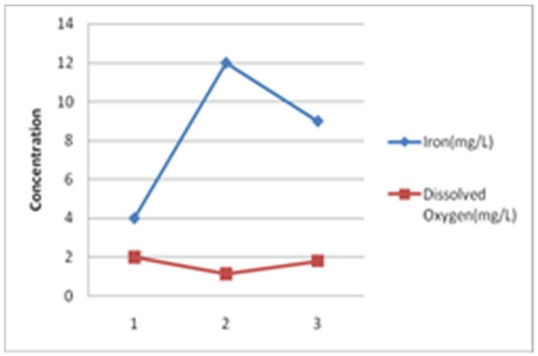

Fig. 10. Variations of Iron & D.O. in water samples

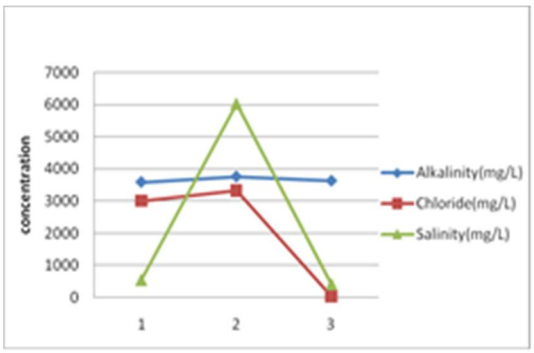

Fig. 11. Cons of Alkalinity, chloride & Salinity

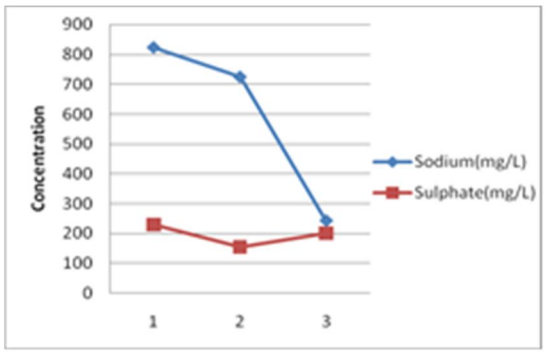

Fig. 12. Variation in Sodium & Sulphate in water samples

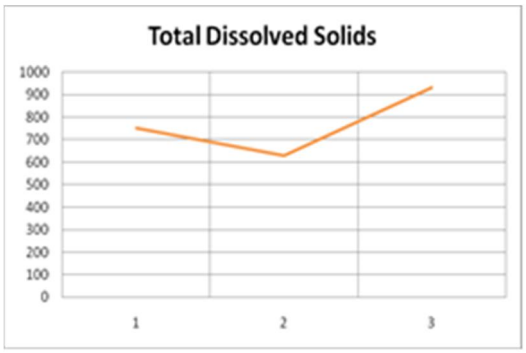

Fig. 13. Observed TDS in water samples

5 CONCLUSION

Here I find that the cultural eutrophication of this lake is takes place due to: The untreated domestic sewage and garbage coming out from Lonar town that reaches into the lake. Inside the crater, some farmers downing farming and hence the use of inorganic fertilizers, insecticides and pesticides like toxic compounds inters in lake. Simultaneously, Hygienic activities are carried out by the local people in the fresh water springs and used waste water enters in lake at last.

This *Spirulina* is amazing medicinal value like chlorophyll & lutein more than any other green plant or leafy vegetable. That can be use full for vigorous detoxification support for heavy metals and other toxins in the human body. So you can use this species for preparation of medicines for human body.

6 RECOMMENDATIONS

Recommendations will surely help to achieve the goal of conservation of Lonar Lake in future.

a) Source control or watershed/catchment treatment.
b) In-lake treatment: Algae may be destroyed in water by the addition of CuSO4. In small amounts, CuSO4 has not been shown to be toxic to man, but where fish are present in natural reservoirs, some fish may be affected.
c) Shore line treatment.
d) Public participation supported by court interventions, and
e) Education and training: By collecting this species of *Spirulina* from Lonar Lake you can use for sale to any medicinal industries preparing medicines form *Spirulina* species.

ACKNOWLEDGMENT

We are grateful to the School of Earth Sciences, Swami Ramanand Teerth Marathwada University, Nanded for providing laboratory and library facilities.

REFERENCES

[1] Sankaran S., “Environmental impact assessment of selected lakes in greater Hyderabad, Andhra Pradesh” PhD thesis, Department of Geophysics, University of Osmania, 2006.
[2] Weber C.A., “Aufbav and Vegetation der Moore Norddentschlands” Bot Jahrb, vol. 40, 1907.
[3] Thakker C.D., Ranade D. R., Current Science. Vol. 82, no 4, 2002.
[4] World Lake Vision Action Report Committee (WLVARC), International Lake Environment Committee Foundation, 2007.
[5] Brenda Wilmoth Lerner & K. Lee Lerner, Environmental Science: In Context, Volumes 1 & 2, Gale Cen gage learning, New York, 2009.
[6] William P. Cunningham & Mary Ann Cunningham, Environmental Science: A Global Concern, 10th ed. McGraw-Hill, New York, 2008.
[7] Ghanekar P. K., “Environmental Deterioration of Lonar Lake, Buldhana District, Maharashtra State”, The Deccan Volcano logical Society, Pune, Lonar Crater Lake Special Vol. No. 1, 2008.
[8] Jakhar GR, SC Bhargava and RK Sinha, “Comparative limnology of Sambar and Didwana lakes”, Geobiology, 1990.

[9] Kodarkar MS, Methodology for water analysis. Physic-chemical, Biological and Microbiological Indian Association of Aquatic Biologist Hyderabad, No. 2 pp. 50, 1992.
[10] Subba Rao, Fresh water molluscs of Indian Recent advances in fresh water, Anmol publications pvt. Ltd. New Delhi pp. 47-52, 1993.
[11] Patil S and JM Patwari, "Ground water quality from Prarava area, district Ahmednagar (M.S.)," J. Aquatic Biology, Vol. 18, No 2, pp. 85-86, 2003.
[12] D. N. Wadia, Geology of India. Macmillan and co. Limited Bombay, 1919.
[13] American Public Health Association APHA, Standard Methods for the Examination of Water and Wastewater, 1998.
[14] Trivedy R.K., Goel P.K and Trisal C.L., Practical methods in Ecology and Environmental science, Enviro media publications, Karad, 1998.
[15] Gupta OP, "Weedy aquatic plants and their Utility Menace and Management. Publ. Agro bios India vol. 31, 2007.
[16] Shaiks Md. Baberr and Prashant Wakte, "Geology and Micro ecological environment of Lonar Lake, Maharashtra, India", Springer, Environmental Geology, Draft manuscript for review, 2007.
[17] Charles R. Goldman and Alexander J. Horrne, Mc Graw- Hill International Book Company, 1983.
[18] Diaz, R. J. and Rosenberg, R., "Spreading dead zones and consequences for marine ecosystems," Science, vol. 321, pp. 926–929, 2008.
[19] Finlay, B.J., C.R. Curds, S.S. Bamforth and J.M. Bajart, "Ciliated protozoa and other microorganisms from two Ajneam Sodic lakes, Lakes Nakes and Lake Simbi, Kenya, 1987.
[20] Tuite C.H., "Standing crop densities and distribution of Spriulina and Benthic diatoms in East African alkaline and Saline Lake", Freshwater Biology, vol. 11, pp. 345-360, 1981.
[21] Shanta Satyanarayan, P.R. Chaudhari and Sharda Dhadse, "Limnological study of Lonar lake: A Unique Brackish crater lake in India" proceeding of Taal: The 12th World Lake Conference: 2061-2066, 2008.
[22] R. M. Badve, K. P. N. Kumaran and Rajshekhar C., "Eutrophication of Lonar Lake Maharashtra", Current Sci., vol. 65, No 4, pp. 347-350, 1993.
[23] Mohd Musaddiq, A. K. Fokmare and Rizwan Khan, Microbial diversity and ecology of Lonar Lake, Maharashtra, India., J.ournal of Aquatic Biologists, Hyderabad, India,vol.16, No2, pp.1-4, 2001.
[24] Howarth, R.W., "Nutrient Over-Enrichment of Coastal Waters in the United States: Steps toward a Solution", Pew Oceans Commission, 2002.
[25] Smith, V.H., "Eutrophication of freshwater and marine ecosystems: a global problem", Environ. Sci. Pollut. Res. Int. 10, 126–139, 2003.