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Influence of catchment characteristics and anthropogenic activities in changing ecosystem properties of freshwater tropical lake Pichola in Rajasthan, India

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Abstract

Freshwater has become one of the most polluted water sources in recent years as a result of astounding developments. As a result, the water quality of these water resources is a constant issue, leading to an increase in the demand for lake water quality monitoring. Regular monitoring of freshwater bodies not only checks water from further deterioration, but also provides a scope to assess the current investments for pollution prevention and control. The current study aims to investigate the effects of alterations, whether direct or indirect, that occurred over lake Pichola, a dry tropical lake of Udaipur, southern Rajasthan, with reference to changes in its water quality caused by several anthropogenic activities in recent years. Several water samples were collected from the periphery of this lake in 2017 and were analysed. The generated data was compared to Lake Badi of Udaipur which has less anthropogenic interference and taken as control lake or in ideal condition.

Keywords: Water pollution, Water quality indicators, Climate change, Anthropogenic activities, Water quality index

Introduction

Freshwater ecosystems play an important role in the Earth's environment. These ecosystems provide essential ecosystem services such as freshwater, nutrient cycling, and habitat for a wide range of plant and animal species. Freshwaters are vital goods and services to society, as well as carbon cycling with local and global climate regulators (Buisson *et al.,* 2008). Lake catchment is one of the major determinants of lake water chemistry and has an effect on lake quality, species community structure and composition (Schindler, 1987). In any rational formulation and deciding quality of water, an adequate knowledge of existing nature of physicochemical parameters, magnitude and source of pollutants must be known, for which monitoring of hydrographical parameters and pollutants is essential (Ficetola, 2020). In view of the significance of freshwater ecosystems for survival and species diversity, the importance of recovery of aquatic ecosystems and preservation of their habitat is essential (Hillebrand *et al.,* 2008).

The CCME Water Quality Index (CCME, 2001) provides a practical technique for combining and communicating detailed water quality data. The Index is made up of three parts: Frequency refers to the number of times specific recommendations are breached; scope refers to the number of metrics that do not meet water quality criteria; and amplitude refers to the degree to which the requirements are not satisfied. The index generates a number between 0 and 100.

$$\text{CCMEWQI} = 100 - \frac{\left(\sqrt{F1^2+F2^2+F3^2}\right)}{1.732}$$

The water quality index rating for lake suggests excellent (95-100), good (80-94), Fair (65-79), marginal (45-64) and poor (0-44).

Study area

The lake Pichola is located in Udaipur, Rajasthan, India with coordinates 24.5752° N, 73.6859° E. Lake Pichola covers an area of 696 hectares with maximum depth of 10.5m. The lake is surrounded by hills, palaces, temples, ghats, hotels and other encroachment activities. Lake Badi located in Udaipur, Rajasthan has its coordinates as 24.5482° N, 73.7292° E and covers an area of 155 hectares with depth of 10m. The lake is surrounded by forests and hills. The study was carried out for the year 2017 and data was collected for three consecutive months of pre-monsoon and post-monsoon.

Results and discussion

In lake Pichola, seasonal variations were observed in the lake parameters (FIG 1; FIG 2). Electrical conductivity varied from 384 µs/cm in the pre-monsoon season to 495 µs/cm in the post-monsoon season. Natural processes and human activities are major reasons for rise in EC (Li *et al.,* 2018). Total hardness got a high rise from 230 mg/l to 480 mg/l after the monsoon. The rise in hotel discharges near lakes and use of detergents are responsible for increasing hardness (Scheffer *et al.,* 2001). Total dissolved solids also increased from 253 mg/l to 330 mg/l in the lake. There was a small rise in alkalinity from 270 mg/l to 315 mg/l.

The nitrate and phosphate concentrations were highly influenced after the rainfall as it increased from 14.5 mg/l and 18.3 mg/l to 27 mg/l and 30 mg/l respectively. Nearby agricultural runoff, atmospheric deposition, tourist activities are responsible for nitrate and phosphate concentrations in lake (Zhang *et al*, 2019). The dissolved oxygen increased from 7 mg/l to 7.5 mg/l and biological oxygen demand decreased from 2.93 mg/l to 1.65 mg/l (Kratina, 2017). The organic carbon concentration was increased from 1.7 mg/l to 2.65 mg/l. The statistical analysis performed by one way ANOVA test showed significant values for EC, hardness, nitrate and DOC in lake Pichola (FIG 6).

In lake Badi, no such major variations were observed between the pre and post-monsoon study (FIG 3; FIG 4). In Badi, a minor increase was observed in turbidity, conductivity, Total dissolved solids, alkalinity and dissolved oxygen whereas hardness, nitrate, phosphate, biological oxygen demand and organic carbon were slightly decreased. ANOVA results showed significant values only for Nitrate in lake Badi (FIG 6).

The Water quality index rating for lake Pichola was observed to be 57 which showed marginal values for lake quality whereas the rating was 89 for lake Badi showing the lake in a good condition (FIG 5).

Conclusion

The study showed major variations in the water quality of pre-monsoon and post-monsoon study period for lake Pichola. Most of the parameters were significantly affected in the lake. The major reasons observed were changes in the catchment areas of the lake due to natural or anthropogenic disturbances. Also, the rise in tourist and encroachment activities in recent years near the lake is leading to deterioration of lake quality. Lake Badi showed no such significant variations due to low anthropogenic activities and catchment disturbances in region as compared to lake Pichola.

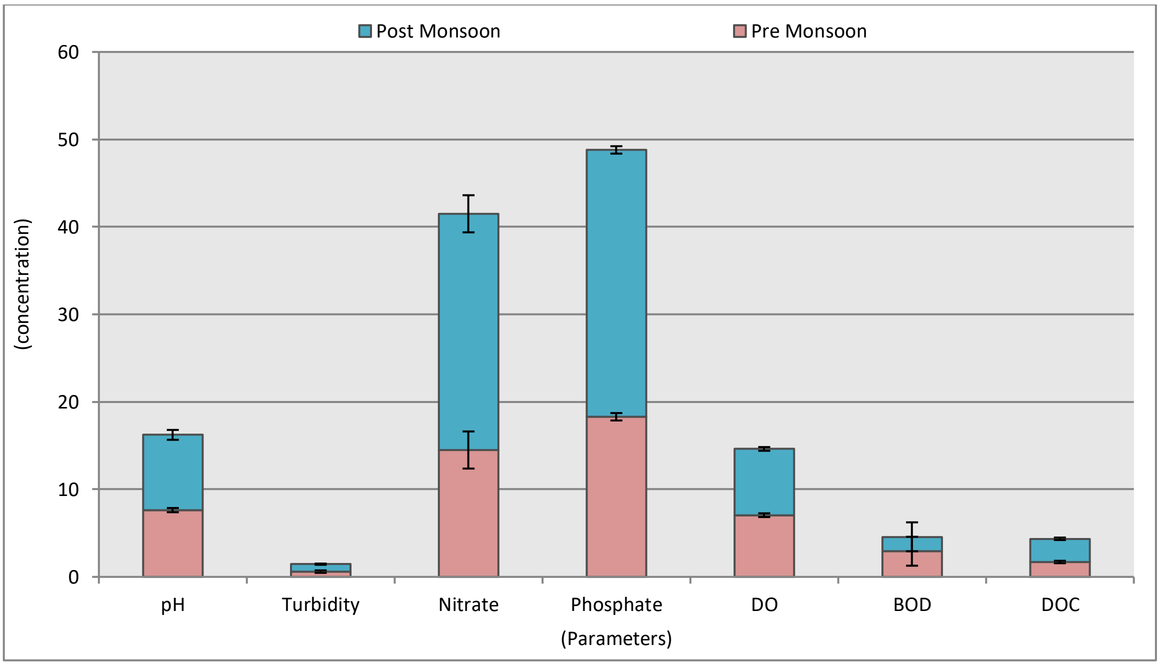

FIG 1: Graph showing mean ± 1 SD values of water quality parameters of lake Pichola for year 2017

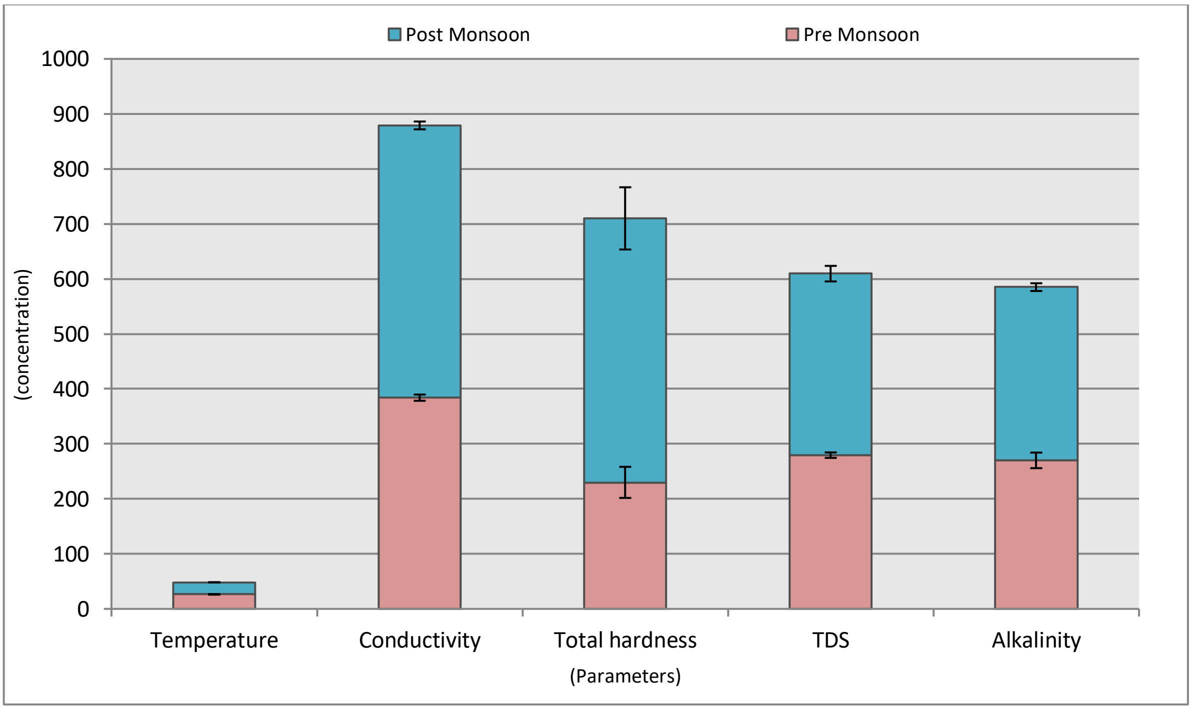

Fig 2: Graph showing mean ± 1 SD values of water quality parameters of lake Pichola for year 2017

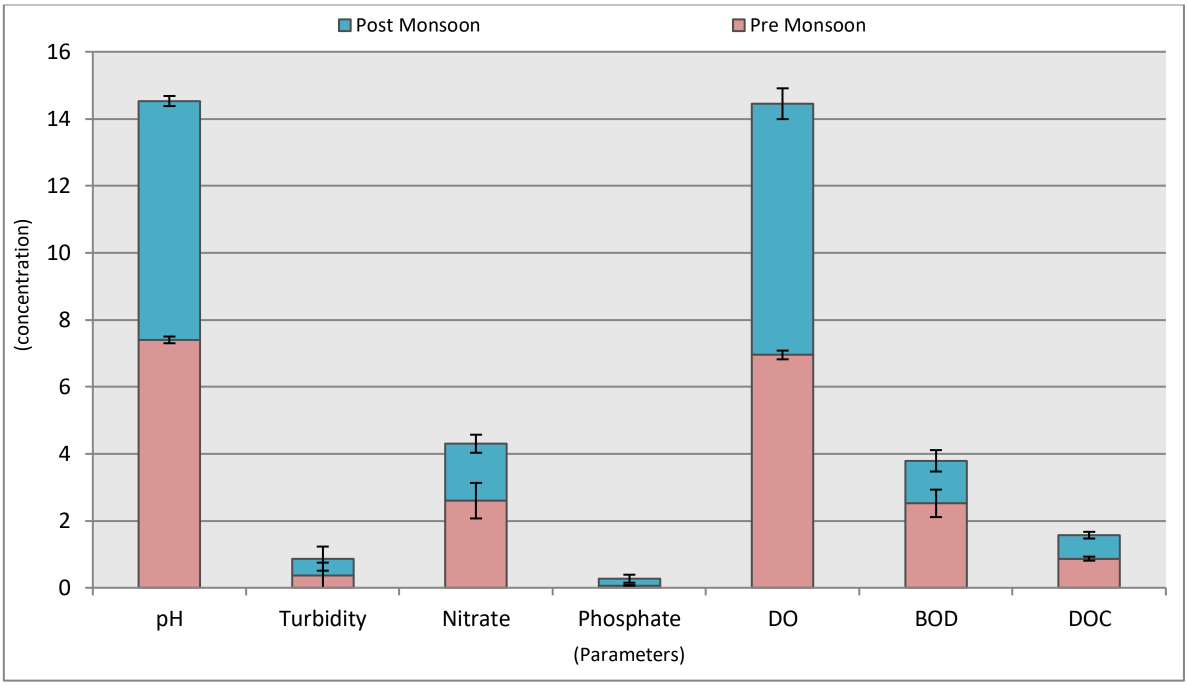

Fig 3: Graph showing mean ± 1 SD values of water quality parameters of lake Badi for year 2017

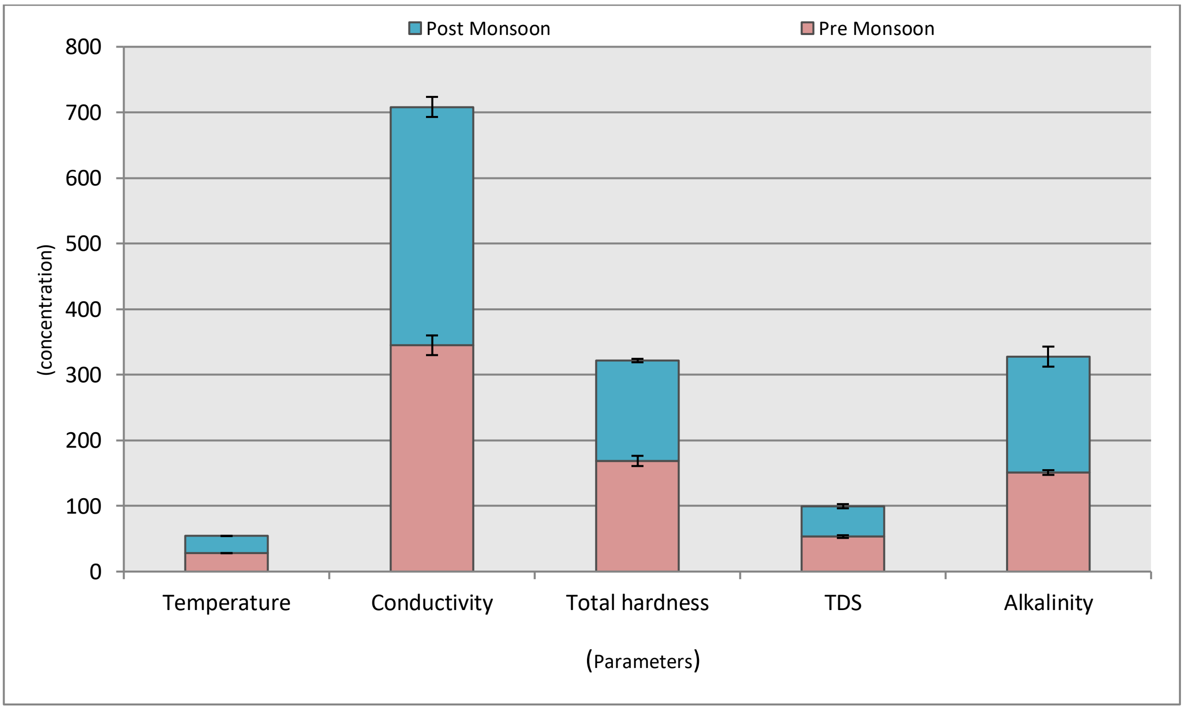

FIG 4: Graph showing mean ± 1 SD values of water quality parameters of lake Badi for year 2017

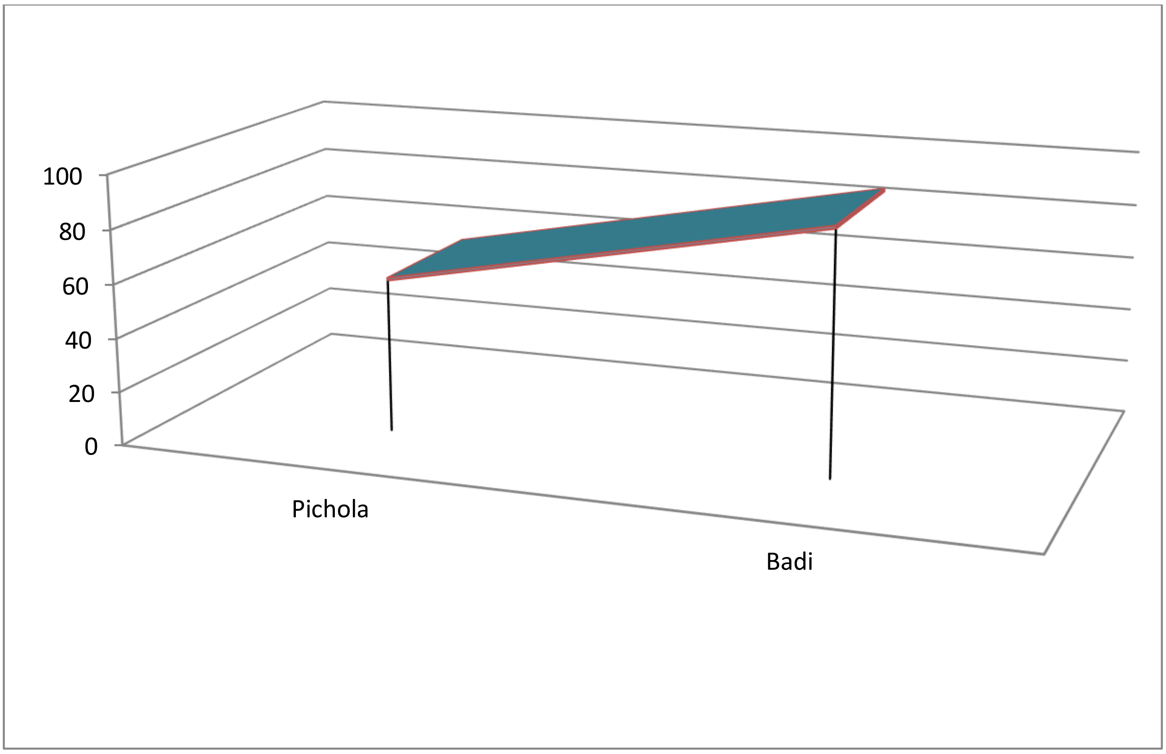

FIG 5: Graph showing water quality index for lake Pichola and Lake Badi

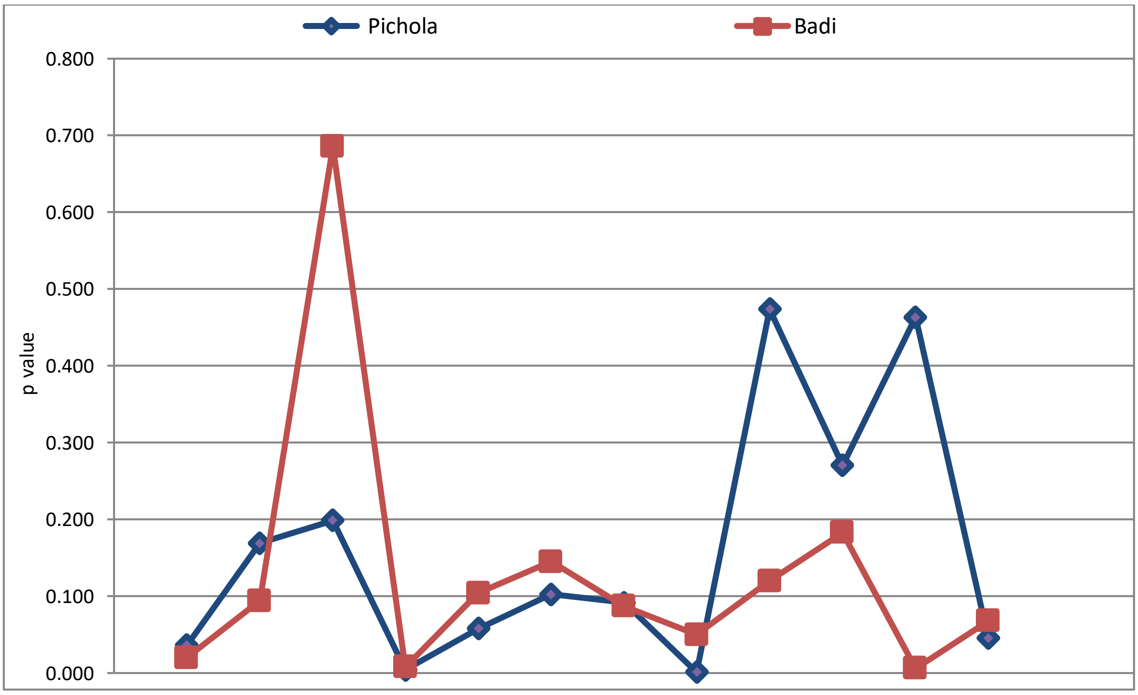

FIG 6: ANOVA values of water quality parameters between pre monsoon and post monsoon study period of both the lakes

References

APHA (2017). *Standard methods for the Examination of water and waste water* 23rd Ed. America Public Health Association, Washington DC, USA.

Buisson L., Thuiller W., Le S. & Lim, P. (2008). Climate change hastens the turnover of a freshwater fish fauna. *Glob. change bio.*, 14(10): 2234-2247.

Canadian Council of Ministers of the Environment (CCME): 2001, 'Canadian Water Quality Guidelines for the Protection of Aquatic Life: CCME Water Quality Index 1.0', Technical Report, *Canadian Council of Ministers of the environment* Winnipeg, MB, Canada.

Ficetola G., Mazza G. & Padoa-Schioppa E. (2020). Freshwater ecosystems and climate change. *Curr. Opi. in Env. Sustain.*, 47:36-42.

Hillebrand H., Bennett M. & Cadotte M. (2008). Consequences of dominance: a review of evenness effects on local and regional ecosystem processes. *Ecology*, 89(6): 1510-1520.

Kratina P., Greig H. & Thompson P. (2017). Rainfall-induced changes in freshwater ecosystems: an introduction. *Freshwater Bio.*, 62(8), 1321-1325.

Li Y., Yang X., Li S., Li Z. & Gao, J. (2018). Impacts of tourism on freshwater ecosystems: A review. *J. of Env. Manag.*, 220: 1-9.

Scheffer M., Carpenter S., Foley J., Folke C., & Walker B. (2001). Catastrophic shifts in ecosystems. *Nature*, 413(6856): 591-596.

Schindler D. (1987). Detecting ecosystem responses to anthropogenic stress. *Canad. J. of Fish. and Aqua. Sci*, 44(6): 6-25.

Verma A., Kumawat A., Purohit A., Meghwal S., Karki D. & Kandara A. (2022). Variations of water quality indicators in closed tropical freshwater systems towards selected climatic and anthropogenic disturbances. *Eco., Env. & Cons.*, 28:S566-S571.

Zhang J., Li X., Wu X., Guo H. & Li F. (2019). Effects of land use/cover change on surface water quality in the upstream catchment of Miyun Reservoir, China. *Env. Sci. and Pollu. Res.*, 26(24).

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