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Limnological study of Hanuman temple pond of Shahdol municipality, M.P

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Abstract
Hanuman temple pond associated with Vishnu temple is located very close to the municipality area of Shahdol. Physicochemical characteristics of water and sediment, productivity, plankton count, coliform count and correlation coefficients of various parameters were analysed for a period of one year from June 2016 to May 2017. It showed that the water characteristics such as conductivity, turbidity, colour, pH, total alkalinity, chloride, total hardness, silicate, phosphate, nitrate, iron, sodium and potassium; primary productivity, plankton count, and sediment characteristics such as pH, organic matter, potassium and nitrate registered higher values during non-rainy season. Coliform count recorded higher value during monsoon season. From the correlation study, it was inferred that several characteristics of water, sediment and primary productivity were interrelated. Comparison of water characteristics with BIS [4] for drinking and swimming water showed that the pond water was mainly contaminated with coliform bacteria. However, the physico-chemical characteristics indicated that it could be used as a potential water source for drinking, swimming and for secondary production after proper treatment.

Keywords: limnology, temple pond, Shahdol

1. Introduction
Temples are centers of worship for Hindus. Hindu temples in Madhya Pradesh and other states of India have in their vicinity certain ponds which are holy and called temple ponds. Ponds are found inside the temples or outside the temples. Temple management imposes restrictions over misuse of these holy ponds, therefore they remain comparatively clean. Temple devotees use the holy water for washing their limbs, sometimes they make a holy dip into the water, people believe that it can wash all their sins away. However, temple ponds located outside temples are used by people for bathing and even washing clothes. Literature review showed that only a few studies (Mishra, *et al.* 2009 [14], Tewari, *et al.* 2010 [25], Sirajudeen, *et al.* 2014 [24], Kumar and Kumar 2015) [11] are available on temple ponds of Shahdol. Limnological features of one such temple pond, the Hanuman pond, were undertaken in the present study.

2. Materials and Methods
Hanuman temple pond is located outside the Vishnu temple with in the municipality area. This pond has a retaining wall and a compound wall above the ground. The pond has an area of 4250 m^2 and depth of 190 cm as on September 2016. There are three bathing ghats. The pond is used for washing and bathing by temple devotees and local community.
Water and sediment samples were collected fortnightly from the pond during June 2016 to May 2017 and analysed for various physico-chemical characteristics of water following Trivedy and Goel (1984) [26], APHA (1985) [2] and Adoni (1985) [1]. Sediment characteristics were analysed following Krumbein and Pettijohn (1938) [10] and Piper (1950) [20]. Primary productivity was measured using dark and light bottle method (Michael, 1969) [13] and plankton analysis was carried out by drop count method (Adoni, 1985) [1]. Coliform counts were made using tests mentioned in Mackie and McCartney (1996) [12]. Fortnightly data obtained were compiled to get the seasonal and annual mean, standard deviation, correlation (r) and significance of 'r' (Gupta, 2000) [9].

3. Results and Discussion
Table 1 shows the seasonal and annual mean ± S.D of water and sediment characteristics, primary productivity, plankton and coliform count of Hanuman temple pond during June 2016 to May 2017. pH of both water (7.94 ± 0.52) and sediment (7.75 ± 0.52) remained on the alkaline side. The pond also recorded higher phytoplankton count (117904 ± 94717). Nandan and Patel (1992) [15]; Verma and Mohanty (1995) [27]; Dwivedi and Pandey (2002) [8]; Puttaiah (2002) [21]; Sedamkar and Angadi (2002) [23] opined that higher pH value promoted the growth of phytoplankton.
Physico-chemical characteristics of water such as conductivity, turbidity, colour, pH, total alkalinity, chloride, total hardness, silicate, phosphate, nitrate, iron, sodium and potassium registered higher values during non-rainy season. Sediment characteristics such as pH, organic matter, potassium and nitrate also registered higher values during non-rainy season. Textural analysis of sediment showed that the sediment of Hanuman pond belonged to the 'sandy loam' soil class.
Higher primary productivity was recorded during non-rainy season as reported by (Chennakrishanan, *et al.* 2008) [7], (Sathya, *et al.* 2009) [22] and (Bhadja and Vaghela 2013) [3]. Higher productivity of non-rainy season might be due to the comparatively higher pH, total alkalinity, total hardness,

chloride and nutrient content during the same season. Phytoplankton count also registered higher value during non-rainy season. This result gains support from the similar observations of (Peter, 1974) [19], (Boyd and Tucker, 1998) [6] and Perona *et al.* (1999) [21]. The total and faecal coliforms registered higher values during monsoon season followed by pre-monsoon and post-monsoon. Odum (1971) [16]; Kavita Sahni and Pooja Sulotiya (2011) [4] and (Singh, 2014) [11] also recorded higher coliform count during monsoon season.

Table 1: Seasonal and annual mean ± S.D of water and sediment characteristics, productivity, plankton and coliforms of Hanuman pond during June 2016 and May 2017.

S. No.	Parameters	Rainy season	Non-rainy season	Annual
1.	Temp. (°C)	30.87±1.10	30.39±1.47	30.63±1.34
2.	Transparency (cm)	74.84±17.60	57.01±13.71	65.93±17.67
3.	Conductivity (mmhos)	0.37±0.06	0.43±0.08	0.40±0.09
4.	Turbidity (NTU)	5.93±2.83	8.63±4.70	7.28±3.97
5.	Colour (pt scale)	52.92±14.00	83.33±29.44	68.13±27.12
6.	pH	7.86±0.23	8.01±0.51	7.94±0.52
7.	Free CO_2 (mg/l)	2.33±1.34	1.83±2.99	2.08±2.21
8.	DO (mg/l)	5.42±0.71	3.67±0.98	4.54±1.22
9.	Total alkalinity (mg/l)	68.75±9.93	83.75±31.70	76.25±23.71
10.	Chloride (mg/l)	50.77±16.30	63.75±18.95	57.26±18.16
11.	Total hardness (mg/l)	68.88±7.60	71.67±29.10	70.27±20.33
12.	Ca hardness (mg/l)	18.64±3.57	20.38±10.74	19.51±7.67
13.	Mg hardness (mg/l)	14.75±4.04	13.74±3.21	14.24±3.51
14.	Silicate (mg/l)	5.16±1.76	9.00±5.02	7.08±4.13
15.	Sulphate (mg/l)	17.83±7.02	13.50±3.08	15.67±5.64
16.	Phosphate (mg/l)	0.03±0.01	0.05±0.02	0.04±0.01
17.	Nitrate (mg/l)	0.04±0.02	0.06±0.05	0.05±0.07
18.	Iron (mg/l)	0.03±0.01	0.04±0.02	0.03±0.01
19.	Sodium (mg/l)	6.42±2.51	8.25±1.72	7.33±2.31
20.	Potassium (mg/l)	0.83±0.67	6.17±3.05	3.50±3.49
21.	TDS (mg/l)	240.00±30.97	173.33±24.21	206.67±43.76
Sediment characteristics				
22.	pH	7.52±0.56	7.98±0.40	7.75±0.52
23.	Organic matter (%)	9.37±3.87	12.62±5.63	11.00±4.90
24.	Potassium (mg/g)	0.02±0.01	0.03±0.02	0.03±0.01
25.	Total phosphorus (mg/g)	0.31±0.07	0.30±0.04	0.30±0.06
26.	Nitrate (mg/g)	0.22±0.06	0.28±0.08	0.25±0.07
27.	Texture Sand (%)	59.85±4.63	52.71±5.57	56.28±6.13
	Silt (%)	34.93±4.41	41.38±6.07	38.16±6.08
	Clay (%)	5.23±2.21	5.82±1.97	5.52±2.02
Productivity				
28.	GPP ($gC/m^3/hr$)	0.17±0.06	0.34±0.11	0.06±0.14
29.	NPP ($gC/m^3/hr$)	0.08±0.03	±0.16±0.08	0.12±0.09
30.	CR ($gC/m^3/hr$)	0.09±0.05	0.18±0.06	0.14±0.06
Plankton				
31.	Phytoplankton (Units/litre)	65841±37856	169967±108622	117904±94717
32.	Zooplankton (Units/litre)	317±16.68	938±130.09	627±59.92
33.	Coliforms	Monsoon	Post monsoon	Pre monsoon
34.	Total (MPN/100 ml)	17400±847	2250±0.4	12600±4807
35.	Faecal(MPN/100 ml)	580±480	38.5±10	260±28

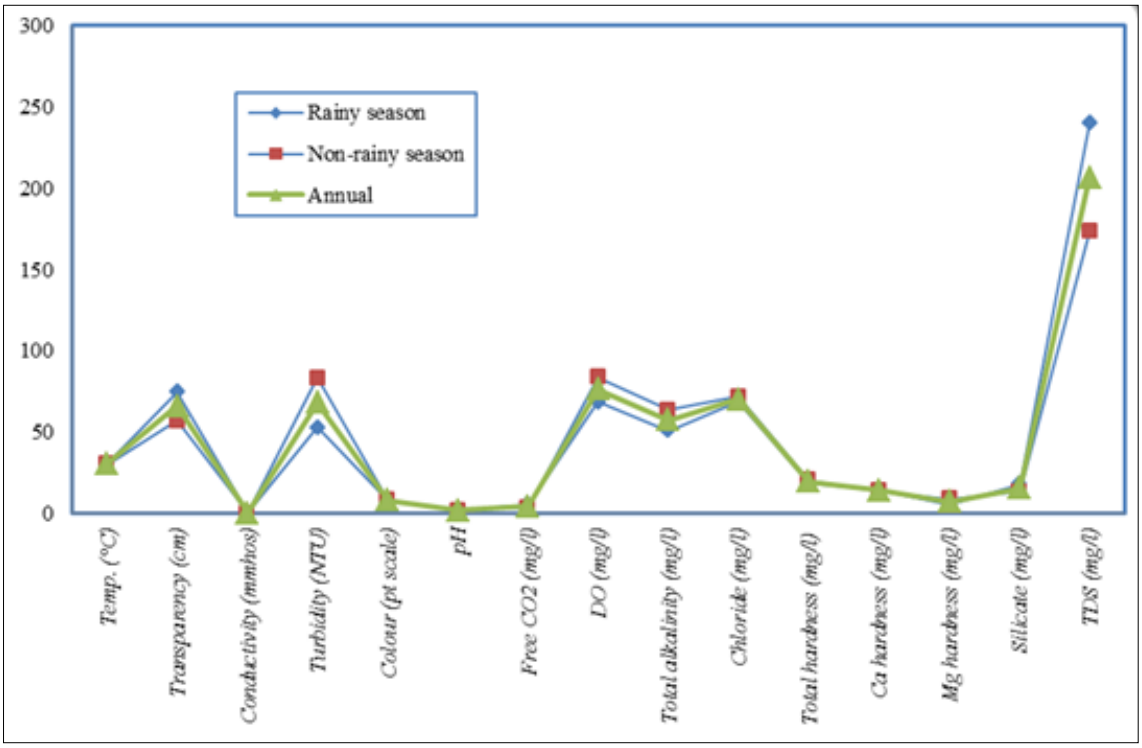

Fig 1: Seasonal and annual mean of water and sediment characteristics, productivity, plankton and coliforms of Hanuman pond during June 2016 and may 2017.

Certain significant correlations between water and sediment characteristics were obtained: pH of water recorded significant positive correlation with conductivity (0.90), colour (0.65), sediment pH (0.58) and sediment potassium (0.65); Chloride of water recorded significant positive correlation with conductivity (0.94), and negative correlation with dissolved oxygen (-0.67) of water; significant positive correlation was recorded between sediment organic matter and sediment phosphate (0.66); sediment phosphate and sediment potassium (0.66); sediment nitrate with gross primary productivity (0.90) and net primary productivity (0.80). The interactions and interrelationships of various parameters seemed to contribute to the characteristics of the pond besides the influences of seasonal changes. From the investigation, it could be concluded that the favourable physico-chemical characteristics of water and sediment promoted secondary production through higher primary productivity and phytoplankton count.

When the annual means for physico-chemical and bacteriological characteristics of water were compared with the desirable limits of BIS (1991 and 1993) [4, 5] for drinking water and swimming pool, all the tested parameters except colour and coliform count were within the desirable limits. Therefore, the pond water could be used as a water source for drinking and domestic purposes after proper treatment especially disinfection.

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5. References

1. Adoni AD. Workbook on limnology. Indian MAB committee, Department of Environment, Government of India, 1985.
2. APHA. Standard methods for the examination of water and waste water. American Public Health Association. 16th Edn, Washington DC, 1985.
3. Bhadja P, Vaghela A. Status of river water quality of Saurashtra, Gujarat, India. Int J Adv Biol Res. 2013; 3(2):276-280.
4. BIS. 10500 Specification for drinking water. Indian Standard Institution (Indian Bureau of standard), New Delhi, 1991.
5. BIS. Quality tolerances for water for swimming pools. IS 3328: Bureau of Indian Standards, New Delhi, 1993.
6. Boyd CE, Tucker CS. Pond aquaculture water quality management. Kluwer Academic Publishers, London, 1998.
7. Chennakrishanan C, Stephen A, Manju T, Raveen, R. Water quality status of three vulnerable freshwater lakes of Suburban Chennai, India. Ind J Environ Ecoplan. 2008; 15(3):591-596.
8. Dwivedi BK, Pandey GC. Physico-chemical factors and algal diversity of two ponds Girija Kund and Maqubara pond, Faizabad, India. Pollut. Res. 2002; 21(3):361-370.
9. Gupta SC. Fundamentals of statistics. Himalaya Publishing House, New Delhi, 2000.
10. Krumbein WC, Pettijohn FT. Manual of sedimentary petrograph D. Appleton Century Company, New York, 1938.
11. Ravindra Kumar Jha, Arvind Kumar. Physico-chemical studies on Kamla River Water, IJARCSSE. 2015; 5(5):1411-1415.
12. Mackie, Mc Cartney. Practical microbiology. Longman

Singapore publishers, Singapore, 1996.
13. Michael RG. Seasonal trend in physico-chemical factors and plankton of freshwater fish pond and their role in fish culture. Hydrobiologia. 1969; 33(1):144-160.
14. Mishra, Deepti, Mudgal, Manish, Khan, Mohd Akram, Prabha Padmakaran and Chakradhar, B. Assessment of ground water quality of Bhavnagar region (Gujarat). Journal of Scientific & Industrial Research. 2009; 68:964-966.
15. Nandan SN, Patel RJ. Ecological studies of algae. Ashish publishing house, New Delhi, 1992.
16. Odum EP. Fundamentals of ecology. 3rd ed. Toppan Company, Ltd., Japan, 1971.
17. Pandey J, Pandey U, Tyagi, HR. Nutrients status and Cynobacterial diversity of tropical freshwater lake. J Environ Biol. 2000; 21(2):133-138.
18. Perona E, Bonilla I and Mateo P. Spatial and temporal changes in water quality in a Spanish river. Sci Total Env. 1999; 241:75-90.
19. Peter AK. Sources and classification of water pollutants in industrial pollution. Edlrving Sax. Van Nostrand Reinhold Company, 1974.
20. Piper CS. Soil and plant analysis, Interscience publisher, Inc. New York, 1950.
21. Puttaiah, E.T. Limnological studies on Maralur pond, Tumkur, Karnataka. Proc. Nat. Seminar on Ecology & Conservation of Wetlands. 2002, 39-41.
22. Sathya, R. and Shankar, P. Status of lake water quality in Karavetti. J Basic Appl Biol. 2009; 3(1&2):36-41.
23. Sedamkar E, Angadi SB. Primary productivity of two fresh water bodies of Gulbarga, India. Nature Environ. Pollut. Tech. 2002; 1(2):151-157.
24. Sirajudeen J, Yahith R. Abdul. Water quality assessment of groundwater resources between Tamilnadu and Pondicherry states, India. World Journal of Pharmacy and Pharmaceutical Sciences. 2014; 3(7):881-893.
25. Tewari, Anurag, Dubey, Ashutosh and Trivei, Aviral. A study on Physico-chemical characteristics of ground water quality. J Chem. Pharm. Res. 2010; 2(2):510-518.
26. Trivedy RK, Goel PK. Chemical and biological methods for water pollution studies. Environmental publications, Karad, 1984.
27. Verma JP, Mohanty RC. Phytoplankton of Malyanta pond of Laxmisagar and its correlation with physico-chemical parameters. Pollut. Res. 1995; 14:243-253.