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SPATIAL AND TEMPORAL VARIATION OF PHYSICO-CHEMICAL PARAMETERS OF WATER IN VIKRAM TEARTH SAROVAR UJJAIN (M.P.).

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ABSTRACT
Water is an important component to human life. The major aims of the present work are to assess the quality of the water from the selected site. The present limnological investigations include analysis of various physico chemical parameters at the selected sites of Vikram Tearth Sarovar Ujjain (M.P) from Jan 2018 to Dec 2018. The present study focuses to bring awareness among the people about the quality of water by taking water samples from various locations for Physico – Chemical analysis of the water. This analysis result was compared with the WHO, ICMR, and European standards of drinking water quality parameters with the following water quality parameters namely Air Temperature, pH**,** Dissolved oxygen, B.O.D, Nitrate and Phosphate. Various chemical methods have been employed to investigate the extent level of pollution in selected water body from Ujjain. The mean air temperature ranged from 28.8℃ ± 2.1 to minimum 20.0℃ ± 3.0. The pH of the selected water body was alkaline throughout the study period. The Water in Vikram Tearth Sarovar was typically hard water type. The DO (3.8± 0.2) was minimum during summers and maximum (5.1± 0.5) during winter season. High mean values of Nitrate (6.656±1.56) and Phosphate (1.064±0.1) were recorded during summers. The mean BOD (12.7±1.6) in Vikram Tearth Sarovar was maximum during summer season. The high values of the physico chemical parameters of water were recorded in the present study in Vikram Tearth Sarovar Ujjain during the year 2018 (Jan to Dec) indicating the eutrophic nature of the pond due to increased anthropogenic activities. Thus measures need to be enforced to reduce the rate of pollution of the selected water body arising from the anthropogenic activities in the catchment of the reservoir.

Keywords; Vikram Tearth Sarovar; Pollution; Eutrophication; Anthropogenic pressures.

INTRODUCTION

Access to clean and safe water for human consumption was declared a human right by the United Nations General Assembly in July 2016 (UN, 2016). Given that anthropogenic activities and climate change are significantly altering the hydrological cycle. Degradation of water quality has become a major global issue for human development that must be addressed. Since 70% of the earth's surface is covered by water, it is definitely one of our most valuable resources. Water, they say, is life, and indeed they were right; however, a close inspection of the water shocks us terribly. Because of poor or nonexistent water quality, conservation efforts, and inadequate or nonexistent sanitation, water pollution has evolved to be a serious global issue (Gupta *et al.,* 2009). According to Adebisi (1981), understanding the physico-chemical regime of water is crucial for defining its productivity, usefulness, and other characteristics that influence species' distribution, diversity, and feeding patterns as well as their vertical and horizontal migration. The physico chemical properties of an aquatic body can be used to determine the water quality and pollution levels in addition to the type and diversity of aquatic biota (Mir *et al.,* 2004). The degree of eutrophication varies widely between lakes and ponds in general and wetlands in particular, progressing from oligotrophic to mesotrophic and eventually to eutrophic stages. Low altitude lakes and ponds, which are susceptible to a range of anthropogenic pressures, are changing at a much faster rate, with the majority of them already being categorized as eutrophic ones. High altitude lakes, which operate solely under natural forces, are oligotrophic (Zutshi *et al.,* 1980; Pandit, 1999).
The current study was conducted on a water body in Ujjain, Madhya Pradesh (India) for the year 2018 (Jan – Dec).Vikram Tearth Sarovar, being located on the Malwa Plateau of Ujjain district. The site being located at the end of the drainage system, the rigorous biotic intrusion, and cultural activities along the drainage basins are the contributory factors for their deteriorating conditions. As a result, it is important to thoroughly investigate the various physico-chemical parameters of water in this shallow water body. Therefore, this study aimed at evaluating the temporal (mainly seasonal) variation of physicochemical properties of the Vikram Tearth Sarovar.

MATERAILS AND METHODS

Vikram Tearth sarovar also known as Vikram Man sarovar is placed in Vikram University campus, Ujjain. It is also fed by seasonal rains. Vikram Tearth sarovar is located at Latitude 23°16′43″N and Longitude 75°80′53″ E, with an average elevation of 489 m. The depth of the pond is 3.50 meter 0.45 m. The average length and width of the pond is 140 and 62

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meters respectively. The pond receives huge amount of domestic sewage from government quarters located nearby to the pond.

Google Map of Ujjain (M.P)

Google Map of Vikram Tearth Sarovar

Study period: - The survey was conducted for a year (Jan 2018- Dec 2018) in the following seasons:-

- Winter - December to February,
- Summer - March to June,
- Monsoon - July to September,
- Post Monsoon- October to November.

Physico-chemical analysis of water

The methods employed for the determination of different physico-chemical parameters of water in Vikram Tearth Sarovar (Ujjain) for the year 2018 (Jan- Dec) are enumerated as follows:

Table I: Methods for physicochemical analysis

Air Temperature °C	**Mercury thermometer**
pH	**pH meter(APHA,1998)**
Total Hardness (mg/l)	**EDTA Titrimetric method**
D.O (mg/l)	**Winkler's Iodometric method (APHA,1998)**
B.O.D (mg/l)	**3 days 27°C method**
Phosphorous (mg/l)	**Stannous chloride method (APHA,1998)**
Nitrates (mg/l)	**Spectrophotometric method (APHA,1998)**

Results and Discussion

Air temperature

Air temperature depicted a distinct seasonal trend during the entire study period in Vikram Tearth Sarovar for the year 2018. The maximum mean atmospheric temperature (28.8°C ±2.1) was recorded in summer season, while as the minimum mean air temperature (20.0°C ±3.0) was recorded in the winter season. On monthly basis maximum temperature (31.00°C) was recorded in the month of May and minimum (17.00°C) being recorded in the month of December. Fall in air temperature during winter in present study in Vikram Tearth Sarovar for the year 2018 study may be attributed to shorter photoperiod/ day length, oblique incident rays and increased condensation due to higher percentage of water vapors in air. The observations are in agreement with the findings of Kour, (2002) and Zuber (2007). Higher air temperature during summer at Vikram Tearth Sarovar months may be attributed to vertical incident rays and heating up of atmosphere as a result of absorption of heat by suspended particles (Welch, 1952; Munawar, 1970) Table:2 and Fig:1 .

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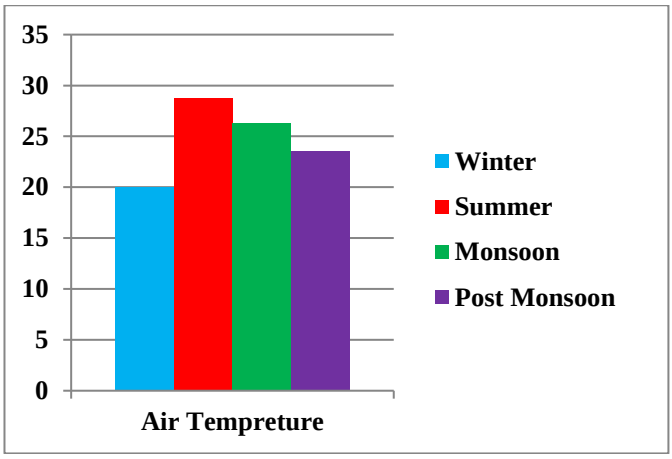

Fig I: Seasonal Variations in Air temperature (℃) of Vikram Tearth Sarovar during the year Jan-Dec 2018.

pH

The water in the selected biotope was generally on alkaline side (pH>7) during the investigation period. The maximum mean pH in Vikram Tearth Sarovar (8.7±0.1) for the year 2018 was recorded during summer season and minimum 8.3±0.1during monsoon season. On monthly basis maximum pH (8.8) was recorded in the month of May and minimum (8.0) in the month of September .When it came to pH concentration, there were only minor differences in terms of spatial and temporal variation. However, a gradual increase in pH was observed from winter to summer, which can be attributed to the removal of carbon dioxide from the water column via photosynthesis by phytoplankton and macrophytes, shifting the equilibrium between carbonic acid and less soluble carbonates and monocarbonates with proton consumption, and thus increasing pH in summer. Our Statement agrees with (Wetzel, 1973). The decrease in pH values during the monsoon season (Rainy season) is caused by the presence of carbon dioxide at the surface and its incomplete utilization by photosynthetic organisms. The statement agrees Sreenivasan (1964) Table: 2 and Fig 2.

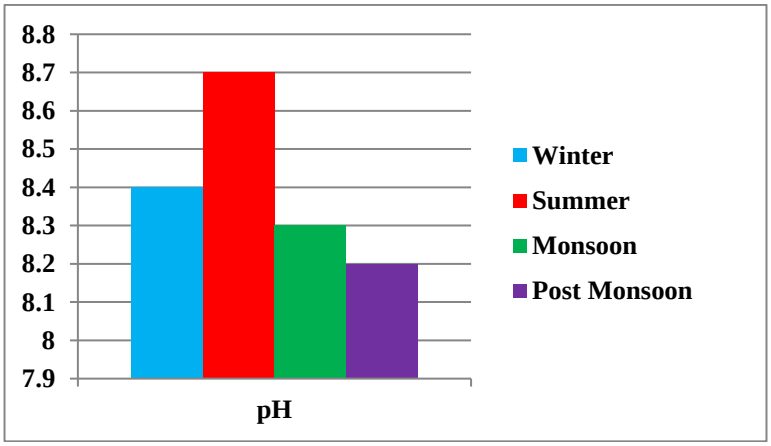

Fig II: Seasonal Variations in pH of Vikram Tearth Sarovar during the year Jan-Dec 2018.

Total Hardness

In the present study Total Hardness in (2018) in Vikram Tearth Sarovar indicated that, the average seasonal Total Hardness ranged between the maximum of 417.0 ±16.6 mg/L (summer season) to the minimum of 314.0 ±4.2 mg/L (Post Monsoon season). On monthly basis maximum Total Hardness (440.0 mg/L) was recorded in the month of May and minimum (300 mg/L) being reported in the month of September. High values of hardness in Vikram Tearth Sarovar could be attributed to high temperature, high anthropogenic activities in and around this pond and addition of sewage water from surrounding areas and use of detergents. The lower values of Total hardness in Vikram Tearth Sarovar recorded during post monsoon season were due to dilution of rainwater. Our observation is in agreement with Park and Shin (2007) Table: 2 and Fig 3.

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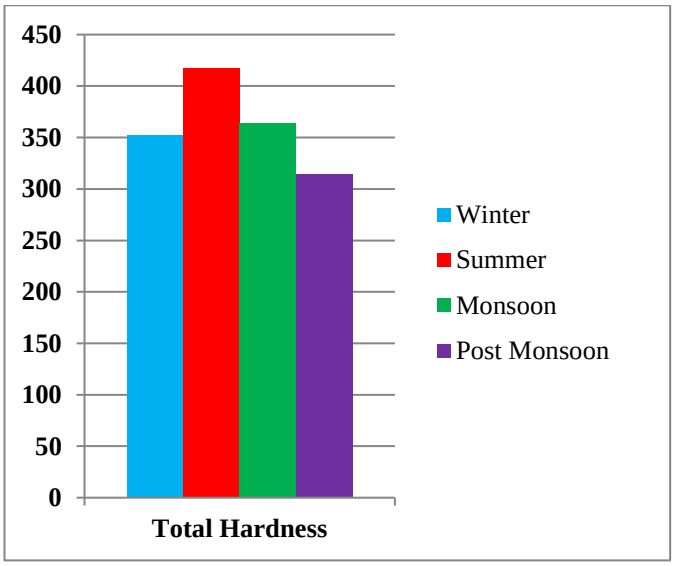

Fig III: Seasonal Variations in Total Hardness mg/l of Vikram Tearth Sarovar during the year Jan-Dec 2018.

Dissolved Oxygen

Dissolved oxygen concentration recorded in Vikram Tearth Sarovar for the year 2018 was recorded higher in winter (5.1±0.5) mg/L and lower in summer (3.8±0.2) mg/L, The low values in the summer season in Vikram Tearth Sarovar may be correlated to bacterial oxygen uptake, a faster decomposition of organic matter, and rapid rate of microorganism. The high values of DO in Vikram Tearth Sarovar during winter season may be attributed to Low biological activity and low photosynthetic activity. The findings are in conformity with the findings of Goltermann, 1966; Karne and Kulkarni (2009) Table: 2 and Fig 4.

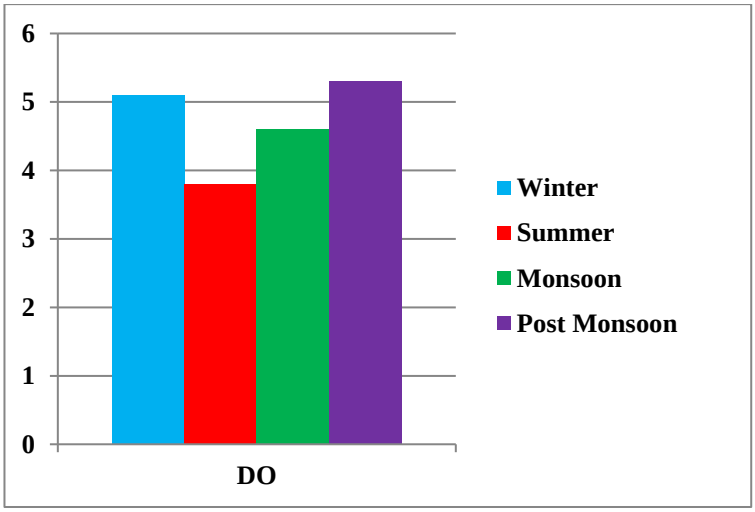

Fig IV: Seasonal Variations in Dissolved Oxygen mg/l of Vikram Tearth Sarovar during the year Jan-Dec 2018.

Biological Oxygen Demand

The average B.O.D in Vikram Tearth Sarovar for the year 2018 ranged between the maximum of 12.7 ±1.6 mg/L (summer season) to the minimum of 6.4 ± 1.3 mg/L (winter season). On monthly basis maximum B.O.D (14.5 mg/L) was recorded in the month of May and minimum (5.2 mg/L) being reported in the month of December. Higher of BOD in summer season in Vikram Tearth Sarovar Ujjain for the year 2018 were due to high rate of organic decomposition and slow values of BOD during the winter may be due to a decrease or slow down in microbial activity. Our study is in consonance with the Bhatt *et al.*, 1999; Sachidanandamurthy and Yajurvedi 2006) Table: 2 and Fig 5.

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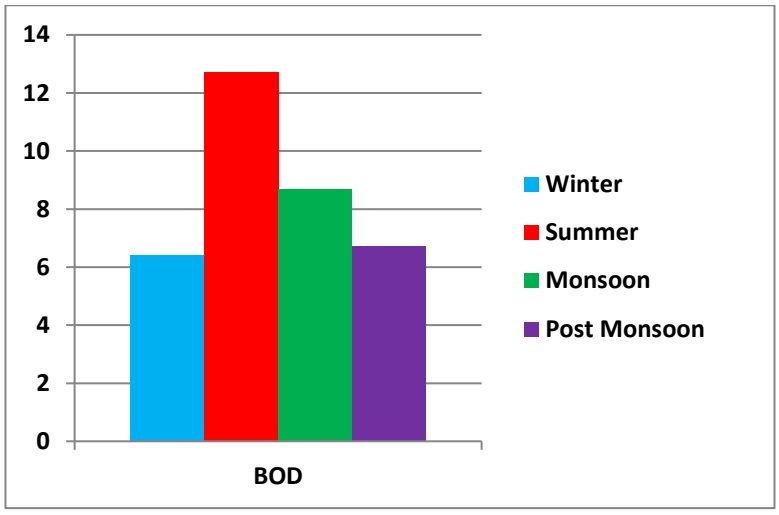

Fig V: Seasonal Variations in Biological Oxygen Demand mg/l of Vikram Tearth Sarovar during the year Jan-Dec 2018.

Nitrate

The average Nitrates in Vikram Tearth Sarovar for the year 2018 ranged between the maximum of 6.656±1.56 1mg/L (summer season) to the minimum of 1.224±0.56 mg/L (winter season). On monthly basis maximum Nitrates (8.410 mg/L) was recorded in the month of May and minimum (0.814 mg/L) being reported in the month of December. The higher concentrations of Nitrate in summer season in Vikram Tearth Sarovar indicate that this water body receives their nitrogen supply through drainage, catchment area and surface runoff and due to increased rate of decomposition of organic matter at higher temperature and formation of algal mats on the surface. Decline in nitrate values in present study during winter in Vikram Tearth Sarovar might be due to reduced rate of decomposition at low temperature and active uptake and utilization of nitrates by macrophytes. Our study is in consonance with the (Nawange, 1993, Ganai *et al.*, 2010 Sunderraj and Krishnamurthy, 1981) Table:2 and Fig 6.

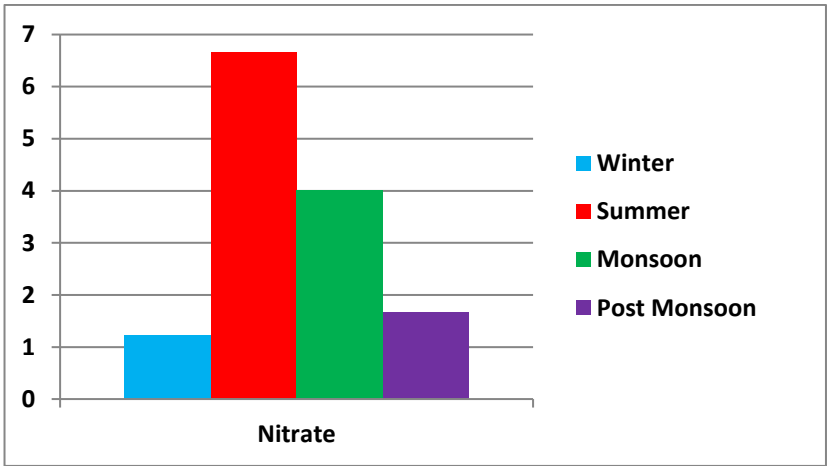

Fig VI: Seasonal Variations in Nitrate mg/l of Vikram Tearth Sarovar during the year Jan-Dec 2018.

Phosphate

Phosphate is a major nutrient that contributes to biological productivity. A perusal of data during the year 2018 of the study in Vikram Tearth Sarovar indicated that, the average seasonal Phosphorous ranged between the maximum of 1.064±0.1mg/L (summer season) to minimum 0.660± 0.1 mg/L. On monthly basis maximum Nitrates (1.262 mg/L) was recorded in the month of May and minimum (0.499 mg/L) being reported in the month of December. Increased values of Phosphorous during the summer in Vikram Tearth Sarovar in 2018 were mainly due to the regeneration of inorganic phosphorus from the organic form during decomposition and also due to increase in temperature during the summer enhance microbial activity, which consequently leads to an increase in the diffusion process of Phosphorous from the sediment to the upper layers of water. Lower phosphate levels during the winter season in the present study may be due to its utilization in macrophytic growth and sedimentation in the form of ferric complexes in soil, as well as low calcium levels in the water and low water temperature. Our observation is in agreement with (Maassen *et al.*, 2005: Khan and Siddiqui, 1974) Table: 2 and Fig 7.

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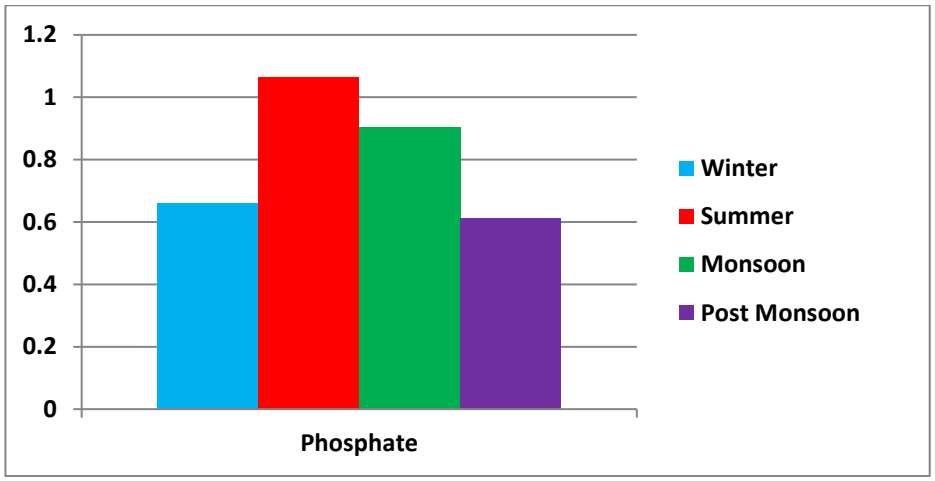

Fig VII: Seasonal Variations in Phosphate mg/l of Vikram Tearth Sarovar during the year Jan-Dec 2018.

Conclusion

This study was conducted to assess the spatial and temporal variations of physico-chemical properties of surface water for the year 2018 (Jan- Dec) in Vikram Tearth Sarovar Ujjain (M.P). The research confirmed that most of the physico-chemical parameters like BOD, DO, Nitrate, Phosphate, and Total Hardness were very high in concentration compared to the national and international standards. On the basis of the above set criteria used for the selected site under study, it can be inferred that Vikram Tearth Sarovar is facing accelerated eutrophication. In order to arrest the accelerated eutrophication in Vikram Tearth Sarovar (Ujjain), it is imperative to restore the health of this deteriorating ecosystems based on sound management tools. For this purpose active but hard management tools involving the treatment of catchment of the water body is required

Acknowledgments

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Table II; showing; Spatial and temporal variations of Physico Chemical Parameters at Vikram Tearth Sarovar Jan 2018-Dec 2018

Jan 2018-Dec 2018																				
Parameters	Winter					Summer						Monsoon						Post Monsoon		
	Dec	Jan	Feb	MEAN	SD	Mar	Apr	May	Jun	MEAN	SD	Jul	Aug	Sep	MEAN	SD	Oct	Nov	Mean	SD
AT	17.00	20.00	23.00	20.0	3.0	26.00	28.5	31.00	30.00	28.8	2.1	28.00	26.00	25.00	26.3	1.5	24.10	23.00	23.5	0.7
pH	8.4	8.5	8.5	8.4	0.1	8.6	8.7	8.8	8.8	8.7	0.1	8.6	8.4	8.0	8.3	0.3	8.2	8.3	8.2	0.1
TH	329.0	344.0	383.0	352.0	27.8	401.0	417.0	440.0	410.0	417.0	16.6	403.0	389.0	300.0	364.0	55.8	311.0	317.0	314.0	4.2
DO	5.8	5.00	4.7	5.1	0.5	4.00	3.8	3.6	4.1	3.8	0.2	4.4	4.6	4.8	4.6	0.2	5.1	5.6	5.3	0.3
BOD	5.2	6.2	7.8	6.4	1.3	11.00	13.8	14.5	11.6	12.7	1.6	9.5	8.8	8.00	8.7	0.7	7.4	6.00	6.7	0.9
N	0.814	0.995	1.865	1.224	0.56	4.650	6.450	8.410	7.115	6.656	1.56	5.440	3.885	2.681	4.002	1.38	2.110	1.220	1.665	0.62
P	0.499	0.698	0.784	0.660	0.1	0.859	1.132	1.262	1.004	1.064	0.1	0.989	0.911	0.814	0.904	0.1	0.677	0.544	0.610	0.1

***AT; Air Temperature (°C),TH; Total Hardness (mg/l), DO; Dissolved Oxygen (mg/l), BOD; Biological Oxygen Demand (mg/l), P; Phosphorous (mg/l), N; Nitrate, (mg/l).**

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