



Seasonal Impact on Physico–Chemical Parameters of Tighra Reservoir Gwalior, (M.P.)

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CC License CC-BY-NC-SA 4.0	<p style="text-align: center;">Abstract</p> <p>Physico-chemical parameters of water essential characteristics of an aquatic water body which determine the aquatic habitat to provide suitable environment for aquatic flora and fauna. Seasonal variations in the physico-chemical parameters of water in Tighra Reservoir were studied from March 2022 to February 2023. Four different sampling sites were selected for collection of water sample. Some of the parameters were observed at the sampling station while rest other parameters were observed into laboratory as soon as possible after the collection of water. The physico-chemical parameters such as Transparency, air temperature, water temperature, pH, Total Dissolved Solid (TDS), total suspended solids, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Dissolved oxygen, Free CO₂, Alkalinity, Nitrate, Sodium and Potassium were analyzed in different seasons. The result obtained indicate the seasonal variation occur due to inflow of water from catchment which not only affected the water quality parameters also affected the reservoir biodiversity.</p> <p>Keywords: <i>Seasonal parameters, Reservoir, Biodiversity, Aquatic, Water quality</i></p>
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Introduction

Water means life and it is one of the abundantly available substances in nature, which man has exploited more than any other resources for the substance of life. Water covers about 70% of the earth's surface out of which only 2.7% of the total water is freshwater of which 1% is ice free water in the rivers, lakes and atmosphere as biological water. It has been estimated that only 0.00192% of the total water on earth is available for human consumption (Phadke and Raut, 2022). Good quality of water resources depends on a large number of physico-chemical parameters and biological characteristics. To assess that monitoring of these parameters is essential to identify magnitude and source of any pollution load. These characteristics can identify certain condition for the ecology of living organisms and suggest appropriate conservation and management strategies (Sunder and Khatri, 2015). Water pollution is increasing and becoming severe day-by-day and posing a great risk to human health and other living organisms. Assessment of water resource quality of any region is an important aspect of developmental activities of the region, because rivers, lakes and manmade reservoirs are used for water supply to domestic, industrial, agricultural and fish culture (Gaikwad *et al.*, 2021).

Water quality deterioration in reservoirs usually comes from excessive nutrient inputs, eutrophication, acidification, heavy metal contamination, organic pollution and obnoxious fishing practices. The effects of these "imports" into the reservoir do not only affect the socio-economic functions of the reservoir negatively, but also bring loss of structural biodiversity of the reservoir (Mustapha, 2008). Water quality analysis is

important to preserve and protect the natural ecosystem. The various physic-chemical and biological methods have been carried out water quality management. The studies of different water parameters are very important for understanding of the metabolic events in aquatic ecosystem. The parameters influence each other and also the sediment parameters, as well as they govern the abundance and distribution of the flora and fauna.

Study Area

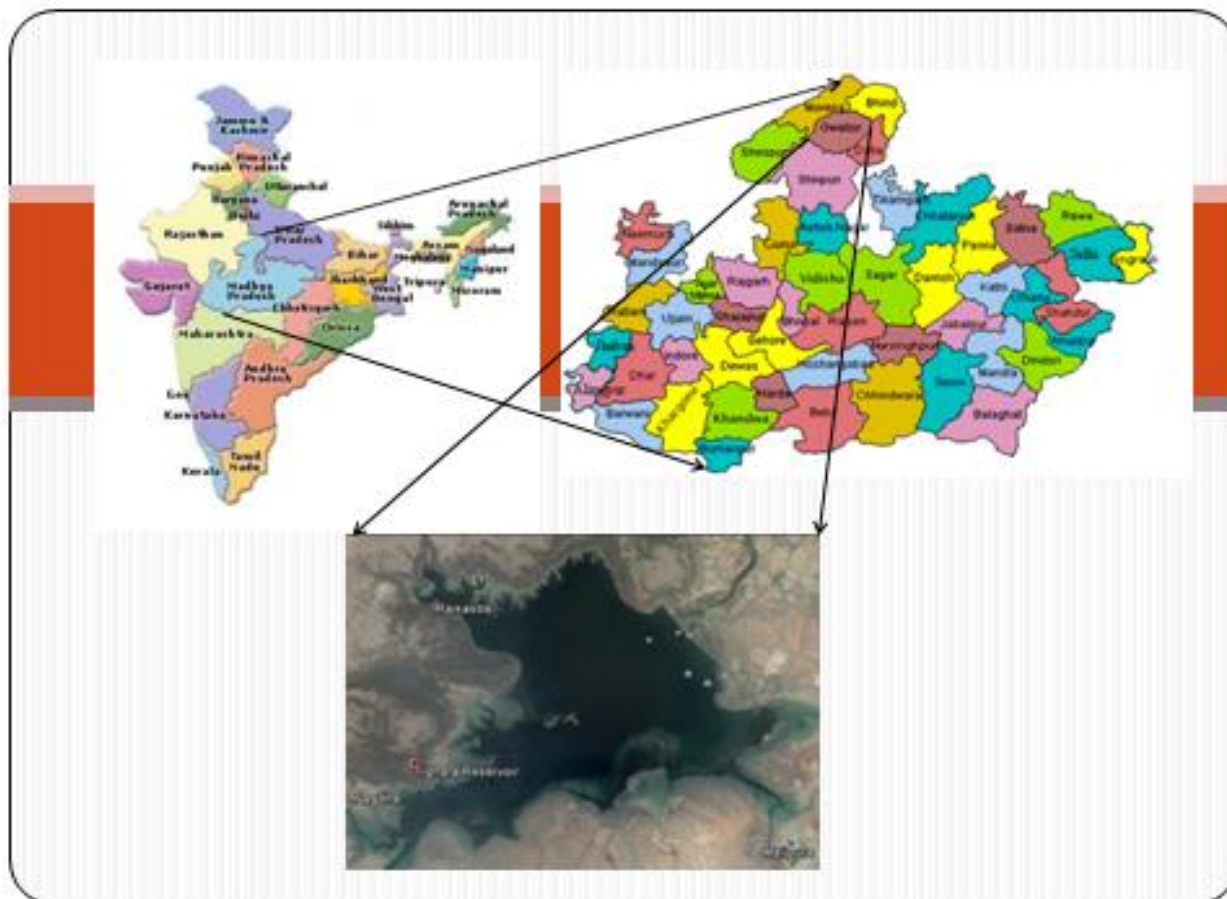


Figure 1: Tighra reservoir study area

The Tighra reservoir is situated about 20 km away in western side of Gwalior city, near Tighra village. It lies on 26° 13' N latitude and 78° 30' E longitude at an altitude of 218.58 m with maximum depth of the reservoir is 130.80 m (4600 mcf). Tighra reservoir comes under the protected area Ghati Gaun Bustard Sanctuary; it is surrounded by hills and dense forest area from three sides. The construction of the reservoir was started in the year 1910 across a seasonal rain fed Sank river primarily to fulfill the water supply of the city. The reservoir is irregular in shape having shallow embayment at its periphery. Huge amount of water extracted from reservoir for drinking purpose of Gwalior city and agricultural field of the bank of reservoir provide the breeding, sheltering and feeding ground support to large number of variety of faunal species.

Methodology

Collection of water

Present study deals with few physical and chemical parameters of the water to check the present status of water quality of sampling site. Water samples were collected in polyethylene coated wide mouth bottles having capacity of one liter were filled without disturbing the substratum to avoid the loose sediments in sample from depth of 5-10 cm below the surface of water. The samples were collected from four different sampling sites in early morning between 9 am to 11 am during first week of every month from March 2022 to February 2023. After collection of samples, the sample containers were labeled and possible efforts were made to transport them to the laboratory as soon as possible.

Methods

Physical parameters of water were analyzed at the sampling sites like atmospheric and water temperature measured using Mercury thermometer, pH was determined using pH meter and transparency by using Secchi disc at the sampling stations. The remaining chemical parameters were analyzed in laboratory after collection the sample water brought to the laboratory like Total Dissolved solids, Total suspended Solids, BOD was estimated using APHA while the COD distillery assembly was used to measure the COD. The dissolved oxygen was measured using modified Winkler's method. Free CO₂ and alkalinity were measured by titrimetric methods described in APHA. Turbidity, nitrate, sodium and potassium were recorded in the laboratory following the standard methods of Trivedi and Goel (1984) and APHA (1975).

Result and discussion

Based on monthly variations in physico-chemical parameters of Tighra reservoir, seasonal average value of four sampling stations obtained with standard error are given in Table-1. The transparency of natural water is an indicator of productivity. The extent to which light can penetrate depends on the transparency of standing water column. Further, transparency of standing water is inversely proportional to turbidity, created by suspended inorganic and organic matter (Saxena, 1987). In the present study transparency with standard error was higher 76.70 ± 1.38 cm in summer season due to sedimentation of dissolved particle in water during rain fall. Temperature is the most important physical factors, which control much natural process within the ecosystem. All the organisms possess the well dened limits of temperature tolerance. Different species are adapted for different temperatures to survive best in the nature (Kumbhar, 2017). During the present study air temperature was maximum recorded with value 33.13 ± 0.47 °C in summer season while minimum was recorded 20.62 ± 2.45 °C in winter season. The temperature directly influences some of chemical reactions in a aquatic ecosystems and it is important physical parameter (Jakhar and Rawat, 2003).

Water temperature was found low with standard 21.92 ± 0.27 °C during winter season and high with standard error 25.08 ± 1.05 °C in rainy season. It is necessary to study temperature variations in water body, in animals ecophysiological and toxicological aspects because, water density and oxygen content are temperature related and hence temperature indirectly affects osmoregulation, respiration, behavior and metabolism of the animals (Pawar and Shembekar, 2012). The variation in pH is an important parameter in water bodies since most of the aquatic organisms are adapted to a narrow range of pH and do not withstand abrupt changes. In the present study, the average pH ranged from 7.49 ± 0.10 to 7.66 ± 0.12 throughout the study period. The results show that the water of Tighra reservoir is suitable for drinking purpose and is under the standard range (Swingle, 1967). pH values also indicate that the water of Tighra reservoir is also suitable for faunal diversity.

TDS analysis has great implications in the control of biological and physical waste water treatment processes. Total solids in the most of the cases are organic in nature and pose serious problems of pollution. Higher values of TDS in summer season may be due to evaporation of water, contamination of domestic waste water, garbage and fertilizers (Garg *et al.*, 2006). The total dissolved solids were maximum during rainy season during entire study period and lower during summer season. Highest values of total dissolved solids were 860 and 890 mg/cm³ during 2011-2012 and 2012-2013 respectively. Total Suspended Solids measure the solid particles that are suspended in water. The total suspended solids at Tighra reservoir had a range from 30.19 ± 1.65 in rainy season with average value and standard error to 36.69 ± 3.93 in winter season. Nidhi and Mahor, (2024) Total Suspended Solids ranged from 4 mg/l to 76 mg/l. The higher values indicate periods of increased particulate matter, particularly towards the end.

Potassium can be found in abundance in igneous and sedimentary rocks. Potassium minerals provide resistance to weathering and disintegration, therefore its concentration in natural water is usually very low. Potassium is an essential component of plant growth. In the study area, potassium concentration ranged from 4.84 mg/L to 5.98 mg/l (Sajitha and Vijayamma, 2016). The average potassium content was found to fluctuate within a range of 1.09 ± 0.08 to 1.22 ± 0.12 mg/l with standard error respectively winter and rainy season. In water, sodium can occur naturally in rocks and soil. Our body needs it to maintain normal blood pressure levels, normal nerve, and muscle functions (Mishra *et al.*, 2014). Higher sodium was recorded with standard error 30.11 ± 1.46 mg/l in summer season and lower 21.82 ± 0.88 mg/l in rainy season.

BOD is an important chemical parameter to the oxygen required to degradation of organic matter with the microbial activities. Highest value 2.49 ± 0.10 mg/l was recorded in summer season while lower value was recorded 0.92 ± 0.13 mg/l in rainy season. Nama and Raj (2018) reported minimum value of BOD in the rainy season 3.3 mg/l. while maximum in summer 4.6 mg/l. It may be due to input of human activities of organic matters. DO is one of the important parameter in water quality assessment and it reflects the physical and biological processes prevailing in the water. Non polluted surface water is normally saturated with DO. Dissolved oxygen is extensively used as a parameter determining the water quality and to evaluate the degree

of freshness of lotic ecosystems. In the present study the maximum dissolved oxygen was recorded 9.23 ± 0.26 mg/l during, summer season and lower 7.41 ± 0.14 mg/l in the rainy season. Present result correlates with the findings of Khinchi *et al.*, (2011).

Respiratory activities of aquatic organisms and process of decomposition are important sources of CO in water bodies. Free CO is added to aquatic ecosystem by directly being mixed from atmosphere. Free CO was recorded in the range of 4.15 mg/lit to 7.57 mg/lit in Tighra reservoir. Free CO was found more during monsoon period and minimum during winter (Sharma, 2015). The mean alkalinity agreed with the range value documented by Moyle (1946) and Boyd (1981) for natural water. The alkalinity is higher with 145.38 ± 11.87 mg/l in the summer season and lower 116.81 ± 14.91 in the rainy season, when the reservoir had high water level. This could be due to low water levels with its attendant concentration of salts and the lower value in the rainy season could be due to dilution (Ibrahim *et al.*, 2009).

The turbidity of water fluctuates from 7.00 ± 2.07 in winter season to 5.77 ± 0.35 NTU in rainy season. it may be due to human activities, decrease in the water level and presence of suspended particulate matter. Suspension of particles in water interfering with the passage of light is called turbidity. Turbidity is caused by wide variety of suspended matter, which range in size from colloidal to coarse dispersion depending upon the degree of turbulence and also ranges from pure inorganic substances to those that are highly organic in nature. Turbid waters are undesirable from aesthetic point of view in drinking water supplies (Shinde *et al.*, 2011). In the present study nitrate concentration varied from higher value (0.69 ± 0.04 mg/l) was observed in summer season while the lower value (0.53 ± 0.04 mg/l) in rainy season. All organisms require nitrogen for growth and reproduction. Nitrate nitrogen in water of Indian reservoirs was found mostly in traces and seldom exceeds 0.5 mg/l. Nitrogen levels of various reservoirs of India and discussed its impact on productivity (Kumari *et al.*, 2019).

Table 1: Seasonal variation with Std. error of water quality in Tighra Reservoir

S. No.	Parameters	Unit	Summer Season	Rainy Season	Winter Season
1	Transparency	Cm	76.70 ± 1.38	58.59 ± 2.26	75.01 ± 2.14
2	Air Temp.	°C	33.13 ± 0.47	27.49 ± 0.99	20.62 ± 2.45
3	Water Temp.	°C	24.73 ± 0.57	25.08 ± 1.05	21.92 ± 0.27
4	pH	--	7.66 ± 0.12	7.57 ± 0.05	7.49 ± 0.10
5	TDS 150-250	Mg/l	174.19 ± 12.53	233.88 ± 27.36	213.56 ± 20.71
6	TSS	Mg/l	32.44 ± 3.41	30.19 ± 1.65	36.69 ± 3.93
7	BOD	Mg/l	2.49 ± 0.10	0.92 ± 0.13	1.55 ± 0.09
8	COD	Mg/l	7.40 ± 0.56	9.11 ± 0.94	4.09 ± 0.16
9	DO	Mg/l	9.23 ± 0.26	7.41 ± 0.14	8.20 ± 0.11
10	Free CO ₂	Mg/l	Nil	1.13 ± 0.15	1.67 ± 0.13
11	Alkalinity	Mg/l	145.38 ± 11.87	116.81 ± 14.91	129.75 ± 16.12
12	Turbidity (12-4)	NTU	6.23 ± 0.43	5.77 ± 0.35	7.00 ± 2.07
13	Nitrate	Mg/l	0.69 ± 0.04	0.53 ± 0.04	0.64 ± 0.04
14	Sodium	Mg/l	30.11 ± 1.46	21.82 ± 0.88	29.41 ± 0.49
15	Potassium	Mg/l	1.17 ± 0.11	1.22 ± 0.12	1.09 ± 0.08

Conclusion

Study revealed physic-chemical water quality of Tighra Reservoir fluctuated as per season due to extraction of water for drinking purpose and infiltration of water through Shankhya River as per requirement of water. Proper care and management practices by different government and non-government agencies are required to developing it as a ecological hotspot to conserve the aquatic biodiversity of reservoir. Hence application of water quality techniques for the overall assessment of the water body could be useful tools.

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