



ISSN : 0973-7057

Seasonal variations in physico-chemical parameters of Tilaiya Dam, Koderma

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Received : 18th May, 2023 ; Revised : 19th June, 2023

DOI:-<https://doi.org/10.5281/zenodo.12030139>

Abstract- Dams are structures built across a river or a stream to hold water. They act as water reservoir. Dams are built to store water, control floods and generate electricity. Tilaiya Dam located in Koderma district of Jharkhand state was the first out of the four multipurpose dams in the first phase of Damodar Valley Corporation (DVC). It is built across Barakar river, a tributary of river Damodar. The present study deals with the physico-chemical analysis of water of Tilaiya dam so as to assess its water quality. The physico-chemical analysis of water of the dam revealed that the dam water is not polluted and is fit for aquaculture. All the parameters analysed were found within their maximum permissible limit.

Key words: Tilaiya Dam, Physico-Chemical, Analysis, Parameters.

INTRODUCTION

Fresh water is one of the most important resources needed to maintain life on the earth. 71% of the earth's surface is covered with water. Out of which 97% is present in oceans and seas as saltwater. 2.5% of the global water is present as freshwater in glaciers and polar ice caps. 0.5% of the water is available for human use.¹

Dams are structures built across a river or a stream to hold water. They act as water reservoir. Dams are built to store water, control floods and generate electricity.² Man-made dams create artificial lakes. The water stored in dams can be used for irrigation, domestic purposes, fishing etc. Dams are habitat of aquatic and semi-aquatic biota. Many aquatic diversities were found in the dam reservoirs ranging from microscopic to macroscopic level. The existence of flora and fauna in a dam water depends greatly

on the physico-chemical, biological, and radiological parameters of the dam water.³

Tilaiya Dam located in Koderma district of Jharkhand state was the first out of the four multipurpose dams in the first phase of Damodar Valley Corporation (DVC). It is built across Barakar river, a tributary of river Damodar. The dam is 1200 ft long and 99 ft high with 36 sq km of water reservoir. The dam produces 4 MW electricity.⁴ In assessing the water quality of the two studied areas, various parameters were examined. The results revealed that the water quality of Kanke dam is more contaminated and unsuitable for domestic use in comparison to Dhurwa dam. The concentrations of TDS (Total Dissolved Solids), Total Alkalinity, Total Hardness Calcium, and Chloride were higher in the water of Kanke dam as opposed to Dhurwa dam. Additionally, the Dissolved Oxygen level in Kanke dam was significantly lower than that in Dhurwa dam, indicating a higher pollution burden in Kanke dam. The

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pollution in the water of Kanke dam can be attributed to direct sewage discharge without prior treatment and encroachment in the immediate vicinity of the dam. Consequently, the water quality in Kanke dam was observed to be more compromised than that in Dhurwa dam⁵. The present study deals with the physico-chemical analysis of water of Tilaiya dam to assess its water quality.

STUDY AREA

Tilaya dam is situated in Koderma. It is spread over an area of 60 km² & the average annual rainfall is 127 cm. It lies between 85°25'56.201"E & 24°20'388" N Dam is constructed over Barakar & Son River. In due course the part of this land is developed into wetland. The catchment area is quite densely habituated and the wetland is the main source of water for day-to-day life of the people residing in the catchment area.

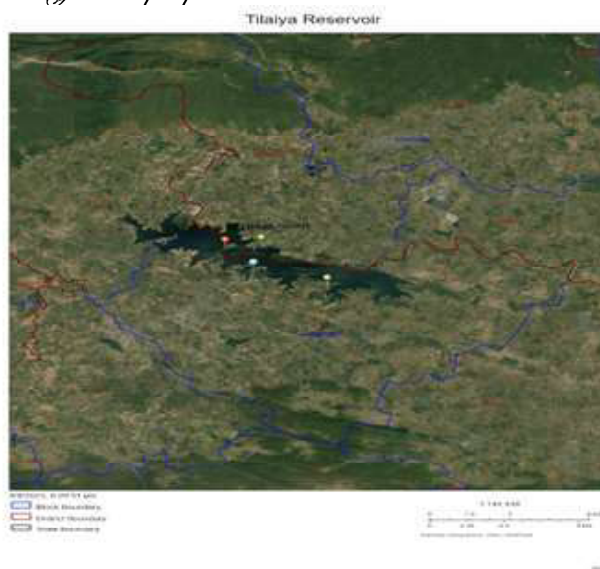


Fig. 1- Colored pin points indicating the sampling sites in Tilaiya Dam, Koderma.

MATERIALS & METHODS

Water was collected from four different sites of Tilaiya Dam. However, not much variations were seen in the values of physico-chemical parameters in the water of all the four sites. The water samples were collected in 1 L plastic bottles. Those parameters which could have changed in due course of time were analysed at the site itself. For analysis of other physico-chemical parameters, the water was preserved by the preservation procedure following AS/NZS 5667.1:1998 and was analysed at the Environmental Science Laboratory, DSPMU, Ranchi by the methods described by APHA and NEERI-2012.^{6,7} The

Table 1- Average Result of Physico-Chemical Parameters of Tilaiya Reservoir for three Seasons.

Parameters	Pre-monsoon	Monsoon	Post-monsoon	Permissible Limits of Surface Water by CPCB
Water temp. (°C)	24.3	22.7	16.9	-
pH	7.3	7.4	7.1	6.5 - 8.5
Turbidity (NTU)	5.28	7.87	5.10	5
E.C. (µS/cm)	168.3	177.8	171.7	1000
TDS (mg/L)	186.62	206.28	265.8	2000
DO (mg/L)	7.4	7.6	8.2	6
BOD (mg/L)	4.2	5.1	4.6	3
COD (mg/L)	6.2	8.1	6.8	20
Total hardness (mg/L as CaCO ₃)	72.26	78.63	71.21	600
Total Alkalinity (mg/L as CaCO ₃)	7.6	8.2	7.2	600
Fluoride (mg/L)	0.4	0.2	0.3	1.5
Chloride (mg/L)	9.3	10.5	9.1	1000
Iron (mg/L)	0.088	0.095	0.091	0.5
Phosphate (mg/L)	0.62	1.23	0.73	2
Sulphate (mg/L)	13.6	16.3	15.2	400

water samples were collected during three periods of the year 2022 i.e. pre-monsoon period (April-June), monsoon period (July- September) and post-monsoon period (October to February 2023).

RESULTS & DISCUSSION

The data obtained by physico-chemical analysis of water of Tilaiya Dam is tabulated in table 1.

Temperature

The water temperature was maximum during the pre-monsoon season and minimum during the post-monsoon.

pH

The pH of a water body affects the aquatic flora and fauna. Aquatic creatures prefer a pH range of 6.5 - 9.0. Too high or too low pH leads to death of aquatic organisms. The pH of the dam water was found within the permissible limit. The maximum pH was observed during the monsoon season (7.4) and minimum during the post-monsoon (7.1).

Turbidity

The turbidity of the dam water was found maximum during the monsoon season (7.87 NTU) and minimum during the post-monsoon season (5.10). The high turbidity during rainy season was due to surface run-offs.

Electrical Conductivity (EC)

The EC depends on the solubility of various ions present in the water body. High value of EC indicates high concentration of soluble ions in water. The EC was found highest during the rainy season (177.8 $\mu\text{S}/\text{cm}$) and the lowest was found during the summer season (168.3 $\mu\text{S}/\text{cm}$).

Total Dissolved Solids (TDS)

TDS comprises of total dissolved substances in water including inorganic salts and organic matter. The peak value of TDS in dam water was found during the post-monsoon period (265.8 mg/L) and the lowest during the pre-monsoon (186.62 mg/L).

Dissolved oxygen (D.O)

Dissolved oxygen (D.O) in water is one of the most important features in aquaculture, along with temperature and pH. Since oxygen has a direct impact on feed intake, disease resistance and metabolism, maintaining adequate D.O levels in the water is crucial for optimal production of fish.⁸ The DO of Tilaiya Dam was found maximum during the post-monsoon period (8.2 mg/L) and lowest during the pre-monsoon period (7.4 mg/L).

Biochemical Oxygen Demand (BOD)

The surface water's biochemical BOD might alter both the oxygen cycle and the oxygen balance. For aquaculture in ponds and lakes normally the BOD should lie between 5 and 20 mg/L.⁹ Oxygen depletion increases with increase in BOD. The BOD of Tilaiya Dam was found maximum during the monsoon period (5.1 mg/L) and lowest during the pre-monsoon period (4.2 mg/L).

Chemical Oxygen Demand (COD)

C.O.D is a good indicator for pond health.¹⁰ The COD of Tilaiya Dam was found maximum during the monsoon period (8.1 mg/L) and lowest during the pre-monsoon period (6.2 mg/L).

Hardness

The total hardness, calcium hardness and magnesium hardness was found within the permissible limit. All the three parameters showed their peak value during the monsoons.

Alkalinity

The alkalinity in dam water was found maximum during the monsoon period (8.2 mg/L as CaCO_3) and lowest during the post-monsoon period (7.2 mg/L as CaCO_3). The alkalinity was also found within the permissible limit.

Fluoride

Fluoride is a trace element typically present in water at levels of 0.1 to 1.5 mg/L and it was found within the permissible range. The concentration of fluoride in dam water was found maximum during the pre-monsoon period (0.4 mg/L) and lowest during the monsoon period (0.2 mg/L).

Chloride

Chloride is a common component of most waters and is beneficial to fish in maintaining their osmotic balance.¹¹ The concentration of chloride in dam water was found maximum during the monsoon period (10.5 mg/L) and lowest during the post-monsoon period (9.1 mg/L).

Iron

High concentration of iron in water leads to appearance of red spots in utensils and clothes when washed with the water of that water body. The concentration of iron in dam water was found maximum during the monsoon period (0.095mg/L) and lowest during the pre-monsoon period (0.088 mg/L).

Phosphate

Surface water with high phosphate levels suffer from green water and blanket weed. If phosphate levels are kept low, the growth of algae in a pond will be restricted.¹² The concentration of phosphate in dam water was found maximum during the monsoon period (12.3 mg/L) and lowest during the pre-monsoon period (6.2 mg/L).

Sulphate

Fish tolerate a wide range of sulfate concentrations, and levels of sulfate above 500 mg/L are a concern only if the water is used for other purposes, such as watering cattle.¹³ The concentration of sulphate in dam water was found maximum during the monsoon period (16.3 mg/L) and lowest during the pre-monsoon period (13.6 mg/L).

CONCLUSION

Analysis of water quality parameters is important to understand the interactions between parameters and effects on shrimp and fish feeding, their growth and health. A single water parameter alone may not tell much, but several parameters together can reveal dynamic processes taking place in the pond or lake. The physico-chemical analysis of water of the dam revealed that the dam water is not polluted and is fit for aquaculture. All the parameters analyzed were found within their maximum permissible limit. However, construction of roads along the across the dam may alter the parameters. Rapid urbanization may lead to pollution of the dam water.

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