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Seasonal Variation in Physicochemical Parameters of Ransai Dam Water

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Abstract: *Water is one of the most essential natural resources required for the survival of all living organisms on Earth. Rapid population growth, urbanization, industrialization, and increasing anthropogenic activities have significantly increased the demand for clean and safe drinking water. Therefore, continuous monitoring and assessment of water quality in freshwater resources have become extremely important for environmental management and public health protection. The ecological condition and suitability of water for domestic and drinking purposes largely depend upon its physicochemical characteristics. Evaluation of physicochemical parameters is thus essential for understanding the quality and sustainability of potable water resources.*

The present study was undertaken to assess the physicochemical characteristics of water from Ransai Dam located in Uran, Navi Mumbai, District Raigad, Maharashtra. The investigation was carried out over a period of one year from 2016 to 2017 to evaluate the quality of water with special reference to drinking purposes. Various physicochemical parameters such as temperature, pH, dissolved oxygen, total dissolved solids, alkalinity, hardness, chloride, salinity, and other important water quality variables were analyzed and interpreted.

The results obtained during the study revealed that all the analyzed physicochemical parameters were within the permissible limits prescribed by the World Health Organization (WHO) and Indian Standards (IS) for drinking water quality. The findings indicate that the water of Ransai Dam is of good quality and suitable for potable purposes. However, increasing developmental activities and anthropogenic pressures in the Uran region may affect the water quality in the future. Therefore, regular monitoring and sustainable management practices are necessary to conserve this valuable freshwater resource.

Keywords: Physicochemical parameters, water quality, potable water, Ransai Dam, Uran, anthropogenic activities.

I. INTRODUCTION

Water is one of the most precious natural resources and forms the basis of life on Earth. It is essential for drinking, agriculture, industrial development, domestic use, ecological balance, and survival of all living organisms. Freshwater resources such as rivers, lakes, ponds, reservoirs, and dams are important sources of potable water for human populations. However, rapid industrialization, urbanization, population growth, and environmental degradation have placed tremendous pressure on available freshwater resources, resulting in deterioration of water quality in many regions of the world.

In recent decades, increasing anthropogenic activities have caused serious threats to freshwater ecosystems through pollution, sewage discharge, industrial effluents, land reclamation, deforestation, and unplanned developmental activities. Water pollution not only affects aquatic biodiversity and ecosystem functioning but also poses severe risks to human health. Therefore, regular assessment and monitoring of water quality are essential for ensuring the availability of safe and clean drinking water.

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The quality of water is mainly determined by its physicochemical characteristics. Parameters such as temperature, pH, dissolved oxygen, turbidity, alkalinity, hardness, chlorides, total dissolved solids, salinity, and nutrients play an important role in determining the suitability of water for drinking and domestic use. Changes in these physicochemical parameters may directly affect aquatic life and the ecological balance of freshwater ecosystems. Hence, the study of physicochemical properties of water bodies is of great importance for environmental monitoring, conservation, and management of water resources.

Uran is located at 18.88° N and 72.94° E on the coastal peninsula region of Navi Mumbai in Raigad district of Maharashtra. The region has experienced rapid infrastructural and industrial development over the past few decades. Uran is home to Jawaharlal Nehru Port Trust (JNPT), one of the largest container handling ports in India, handling a major share of the country's containerized cargo. In addition, several large-scale industries and infrastructural projects such as APM Terminals, DP World Port, Oil and Natural Gas Corporation (ONGC), Bharat Petroleum Corporation Limited (BPCL), Gas Turbine Power Station (GTPS-MSEB), Container Freight Stations (CFS), Navi Mumbai Special Economic Zone (SEZ), and various warehouse facilities are located in and around Uran.

The rapid urbanization and industrialization associated with these developmental activities have resulted in destruction of mangroves, deforestation, land filling, and increased population pressure in the region. Such environmental changes may directly or indirectly affect the quality and availability of freshwater resources used for drinking purposes. It has been estimated that by the year 2025, more than half of the world's population may face severe water scarcity. Therefore, conservation and proper management of freshwater resources have become an urgent necessity.

Ransai Dam serves as an important freshwater resource for the surrounding region and supports the domestic water requirements of local populations. Despite its significance, limited information is available regarding the physicochemical quality of water from Ransai Dam. Therefore, the present study was undertaken to evaluate the physicochemical parameters of water from Ransai Dam with special reference to drinking water quality. The study aims to generate baseline data for future monitoring and sustainable management of this important freshwater ecosystem.

II. MATERIALS AND METHODS

Study Area

Ransai Dam is located in Uran Taluka of Raigad district, Maharashtra, at geographical coordinates 18°53′55″ N latitude and 73°04′28″ E longitude. The dam is situated near Dighode village and serves as one of the important freshwater resources in the Uran region. Constructed in the year 1970, the reservoir has an approximate storage capacity of 10 million cubic meters (10 MCM).

Ransai Dam plays a significant role in supplying potable water to surrounding areas. The reservoir provides nearly 35 million liters per day (MLD) of water to Uran Township, Oil and Natural Gas Corporation (ONGC), defense establishments, Nhava-Sheva region, and approximately 22 villages in Uran Taluka. Owing to its importance as a major drinking water source, regular monitoring of water quality is essential for ensuring safe and sustainable utilization of the resource.

The Uran region has experienced rapid industrialization, urbanization, and infrastructural development in recent decades. Increasing anthropogenic activities in nearby areas may adversely influence the quality of freshwater resources through contamination, sewage discharge, and environmental degradation. Despite the importance of Ransai Dam as a potable water source, limited scientific information is available regarding its physicochemical water quality. Therefore, the present investigation was undertaken to evaluate the physicochemical characteristics of water from Ransai Dam over a period of one year from January 2016 to December 2016.

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Sampling Methods

Water samples were collected monthly from selected sampling locations of Ransai Dam during the study period from January 2016 to December 2016. Sampling was carried out systematically to assess seasonal variations in physicochemical parameters of the reservoir water.

Parameters such as water temperature, dissolved oxygen (DO), and pH were measured directly at the sampling site using standard field methods and instruments. The remaining physicochemical parameters were analyzed in the laboratory following standard procedures and analytical techniques recommended for water quality assessment.

The collected data were carefully recorded and interpreted to evaluate the suitability of reservoir water for drinking purposes according to World Health Organization (WHO) and Indian Standard (IS) guidelines.

III. RESULTS AND DISCUSSION

The average values of various physicochemical parameters recorded from Ransai Dam during the study period (January 2016 to December 2016) indicated that the water quality of the reservoir remained within the permissible limits prescribed for drinking water standards. The analyzed parameters reflected comparatively good water quality and favorable ecological conditions in the reservoir ecosystem.

Variations in physicochemical parameters observed during different seasons may be attributed to changes in climatic conditions, rainfall, runoff, evaporation, and anthropogenic influences. The overall results suggest that the water of Ransai Dam is suitable for potable and domestic purposes. However, continuous monitoring and proper management of the reservoir are necessary to maintain water quality and prevent future deterioration due to increasing developmental and industrial activities in the surrounding region.

Table 1. Physical Parameters of Water from Ransai Dam, Uran, Navi Mumbai

Sr. No.	Water Quality Parameter	Method Used	Observed Value	Unit
1	Temperature	Thermometer	24	°C
2	Total Dissolved Solids (TDS)	Evaporation Method	256	mg/L
3	Electrical Conductivity	Conductivity Meter / Evaporation Method	684	µS/cm
4	Colour	Visual Observation	Colourless	—

Table 2. Chemical Parameters of Water from Ransai Dam, Uran, Navi Mumbai

Sr. No.	Chemical Parameter	Method Used	Observed Value (ppm)	WHO Standard Limits (ppm)
1	Dissolved Oxygen (DO)	Winkler's Method	4.92	≥ 4
2	Free Carbon Dioxide (CO_2)	Titrimetric Method	0.72	—
3	pH	pH Meter	7.2	6.5 – 8.5
4	Total Hardness	EDTA Method	214	150 – 500
5	Chemical Oxygen Demand (COD)	$K_2Cr_2O_7$ Method	156	250
6	Biological Oxygen Demand (BOD)	5-Day BOD Test	4.1	30
7	Salinity	Titrimetric Method	54.7	—
8	Total Alkalinity	Acid Titration Method	176	200

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IV. INTERPRETATION OF WATER QUALITY

The physicochemical analysis of water from Ransai Dam revealed that all the measured parameters were within the permissible limits recommended by the World Health Organization (WHO) for potable water. The observed pH indicated slightly alkaline nature of water, while dissolved oxygen values reflected good oxygenation suitable for aquatic life. Moderate levels of total hardness, alkalinity, conductivity, and total dissolved solids suggested acceptable water quality conditions. Low BOD and COD values indicated comparatively less organic pollution in the reservoir. Overall, the findings suggest that the water from Ransai Dam is suitable for drinking and domestic purposes after standard treatment procedures.

V. DISCUSSION

In the present investigation, various physicochemical parameters of water from Ransai Dam were analyzed monthly throughout the year 2016 to evaluate the quality and suitability of the water for drinking and domestic purposes. The study revealed that the observed water quality parameters remained within the permissible limits prescribed by the World Health Organization (WHO) and Indian Standards (IS), indicating comparatively good water quality conditions in the reservoir ecosystem.

Several researchers have previously studied the physicochemical characteristics of freshwater reservoirs and dams in Maharashtra and other parts of India. Bharamal et al. (2014) conducted a preliminary investigation of water quality in Tillari Dam, Maharashtra, and reported that the water was suitable for drinking purposes. Similarly, Chaudhari et al. (2016) assessed water quality in four different dams of Amravati district and found that all the analyzed parameters were within permissible ranges. These studies support the present findings and indicate that freshwater reservoirs can maintain acceptable water quality when protected from excessive pollution and anthropogenic disturbances.

Dissolved oxygen (DO) is one of the most important parameters for determining the ecological health of aquatic ecosystems. Adequate dissolved oxygen levels are essential for the survival of aquatic organisms and for maintaining biological balance in water bodies. In the present study, dissolved oxygen concentration was found to be within acceptable limits, indicating favorable conditions for aquatic life. Earlier, Rao et al. (1999) reported dissolved oxygen levels ranging from 2.1 to 4.7 mg/L in the western and eastern zones of Kolleru Lake, Andhra Pradesh. Comparatively, the dissolved oxygen concentration recorded in Ransai Dam suggests relatively better oxygenation and healthier aquatic conditions.

Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) are important indicators of organic pollution in water bodies. Elevated BOD and COD values generally indicate increased organic matter, microbial activity, and pollution load, which ultimately reduce dissolved oxygen concentration and negatively affect aquatic organisms. In the present study, both BOD and COD values were within permissible limits, indicating low organic pollution and good water quality status of the reservoir. The comparatively low BOD value reflects lesser contamination by biodegradable organic matter, while acceptable COD levels indicate reduced chemical pollution in the dam water.

The pH of water is another important factor affecting the chemical and biological characteristics of aquatic ecosystems. The observed pH value of Ransai Dam water indicated slightly alkaline conditions and remained within the safe range recommended for drinking water standards. Similar findings were reported by Jain Pradeep Kumar (1999) during the study of Khnop Reservoir in Chhatarpur, Madhya Pradesh, where pH values ranged from 7.1 to 7.2, indicating suitability of water for drinking purposes. The pH conditions observed in the present study are favorable for aquatic life as well as human consumption.

The results of the present investigation emphasize the importance of continuous monitoring and scientific assessment of freshwater resources. Increasing urbanization, industrialization, population growth, and developmental activities in and

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around Uran may adversely affect the quality of freshwater ecosystems in the future. Therefore, regular monitoring of physicochemical parameters is essential for sustainable management and conservation of potable water resources.

Overall, the present study suggests that the water quality of Ransai Dam is suitable for drinking purposes and supports healthy aquatic life. The findings provide valuable baseline information for future environmental monitoring and water quality management programs in the region.

VI. CONCLUSION

The present study revealed that the physicochemical characteristics of water from Ransai Dam were within the permissible limits prescribed by WHO and Indian Standards for drinking water quality. The analyzed parameters indicated that the reservoir water is of good quality and suitable for potable as well as domestic purposes. Favorable levels of dissolved oxygen, pH, alkalinity, hardness, BOD, and COD also suggest healthy ecological conditions for sustaining aquatic life within the reservoir ecosystem.

Anthropogenic activities such as industrialization, urbanization, land filling, deforestation, and increasing population pressure are major contributors to environmental pollution and degradation of freshwater resources. Uran region is currently undergoing rapid infrastructural and industrial development due to port expansion, industrial establishments, and urban growth. Such developmental activities may impose significant stress on freshwater ecosystems and may affect the quality and sustainability of drinking water resources in the future.

Although the present findings indicate good water quality conditions in Ransai Dam, continuous monitoring and periodic assessment of physicochemical parameters are essential to detect any future environmental changes or pollution threats. Proper conservation strategies, sustainable water management practices, and pollution control measures are necessary to protect this important freshwater resource from degradation.

The present investigation provides baseline scientific data regarding the water quality status of Ransai Dam and will be useful for future ecological studies, environmental monitoring programs, and water resource management planning in the Uran region.

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