WATER QUALITY MODEL A CASE STUDY SETRUNJI RIVER, GUJARAT

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Abstract -- The study examines the impact of human activities on the water quality of the Setrunji River in Gujarat's Saurashtra region. It highlights significant water degradation due to urbanization, agricultural runoff, and seasonal monsoon effects. Data from various points, including downstream areas like Palitana, revealed worse water quality in those regions. Key pollutants included high levels of TDS, turbidity, nitrates, and other chemical indicators. Water quality modeling showed that both point-source (residential) and non-point-source (agricultural) pollution are major contributors. The study stresses the urgent need for integrated watershed management, sustainable farming, better wastewater treatment, and regular monitoring. It concludes that community involvement and strong policy action are vital to restoring the river's ecological health.

Key word – water quality index, urbanization, water quality model

Highlights

- Calculate and analyze the WQI for Setrunji River for the last 5-year time period.
- Analyze the impact of particularly agricultural runoff, untreated sewage, and industrial effluents on river water quality.

1) INTRODUCTION

The Setrunji River, located in the Saurashtra region of Gujarat, is an important water source for a variety of uses, including drinking, irrigation, and industrial purposes. As the river flows through both rural and urban areas, it plays a vital role in supporting local communities and ecosystems. However, like many rivers across the world, the Setrunji River has experienced a noticeable decline in water quality due to rapid urbanization, and agricultural activities along its basin. affecting the river's ability to provide clean water for consumption and disrupting its ecological balance. Given the importance of the Setrunji River for the surrounding communities and the growing concerns about its deteriorating condition, it is crucial to assess the factors influencing its water quality and identify measures for its sustainable management.

The main objective of this study is to evaluate the impact of human activities on the water quality of the Setrunji River, with particular focus on understanding how urbanization, and agricultural runoff influence water quality across different sections of the river. The study covers major towns along the lower Setrunji River, including Palitana, where significant pollution levels have been observed. A comprehensive analysis of water quality parameters was carried out to identify key pollutants, seasonal variations, and the spatial distribution of water quality issues. By utilizing a water quality model, this study aims to simulate the changes in the river's water quality over time, providing insights into the cumulative effects of pollution and offering potential solutions for its improvement.

A major aspect of the study involves the development of a water quality index that simulates how pollution moves and changes throughout the river system. The model integrates data on pollution sources, hydrological conditions, and water quality parameters to simulate how the river responds to various stressors. By using this model, the study can predict how future changes in land use, population growth, or water management strategies could impact water quality. This predictive capability is essential for developing management strategies aimed at improving and maintaining the river's health. For example, the model can help identify

the impact of improved wastewater treatment on water quality or estimate the effect of sustainable farming practices in reducing nutrient pollution. The model also helps in understanding the cumulative effects of human activities over time, providing a long-term perspective on river management. The study aims to use this model to recommend measures such as the introduction of advanced sewage treatment plants, better land management practices, and increased public awareness about the importance of river conservation.

The study on the Setrunji River in Gujarat focuses on assessing and improving its water quality, which is under threat from urbanization, industrial discharge, and agricultural runoff. A key component is the development of a water quality model to evaluate pollutant levels, simulate pollution dynamics, and predict future scenarios under various environmental and human impact conditions. The research investigates spatial and seasonal variations in water quality, identifies major pollution sources, and assesses their impact. It further explores the ecological effects on aquatic life and evaluates pollution mitigation strategies such as improved wastewater treatment, sustainable farming, and stormwater management. The study also emphasizes policy development, community involvement, and stakeholder engagement to promote sustainable river management and ensure long-term ecological and human benefits.

2) STUDY AREA

The shetrunji receptacle is located in the saurashtra region of gujarat, india. It spans between 70 ° 50 ′ to 72 ° 10 ′ east longitude and 21 ° 00 ′ to 21 ° 47 ′ north latitude. Originating from the chachai hills in the gir timber of Junagadh quarter at an elevation of 380 measures, the river flows eastward and discharges into the gulf of cambay. The shetrunji swash is 182 kilometers long, with its receptacle stretching up to 227 kilometres and covering a total catchment area of 5,636 square kilometres.

- Data Station

1) Khodiyar Dam ,Dhari
2) Lowara bridge, gariyadhar
3) Shetrunji dam , palitana
4) Kharo dam, sonpari

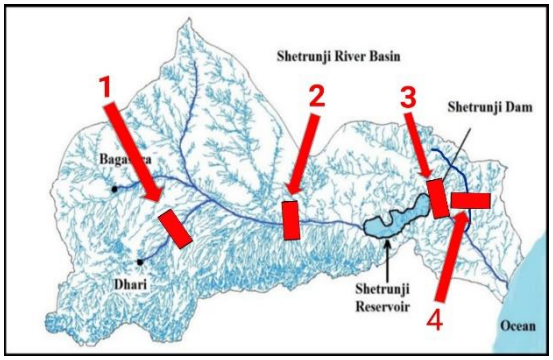

Fig 2.1 Study area map of Sabarmati River basin

- For this study four sites were chosen from the shetrunji basin Site 1 (Khodiyar Dam) is upstream, while Site 2 (Lowara bridge) and Site 3 (Shetrunji dam) is upstream, respectively and Site 4 is (Kharo Dam) downstream of the Palitana area of Sonpari, Bhavnagar city.

3) METHODOLOGY

First,we will take data from four stations on Shetrunji. We will create a model using 9 types of parameters as shown above for water quality parameters. Now, after that, we will input the data of water quality parameters of different years, pre monsoon and post monsoon, in Microsoft Excel and get the output in a clear line graph for one year. Now, we will use this data to calculate the Water Quality Index, which is a simplified weighted arithmetic method on the **Interdisciplinary Science and Public Health Open Website.** We will input the data of the water quality parameters of our station in it and note that the output we get will be only a single output. Now, we will take this WQI obtained through the graphical pre monsoon and post monsoon data of five years through the graphical output Excel sheet. As a part of the result, we will easily see what kind of water quality is at which place.

3.1 Step by step Method :-

Identification of study area

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Selection of water quality parameter

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Data collection

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Parameters wise Data input and output graphical line graph

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Input data in WQI

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Graphical output of Water Quality in river

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Locate the Impact of urbanization on shetrunji river water quality

Methodology flowchart

4) WATER QUALITY INDEX MODEL

To create the Water Quality Index, we selected the Shetrunji River basin and then took four stations on it, two of which are upstream and two of which are downstream. In this, we have considered a total of nine parameters. The data of these stations is for five years from 2020 to 2024.

Then our first step was to take graphical output of data of four stations of the same year in Microsoft Excel. Similarly, we took graphical output of all the parameters. Now by comparing the graphical output with each other, we will be able to estimate how the change occurs at which station and in which parameter. So that we will know what kind of pollution is there.

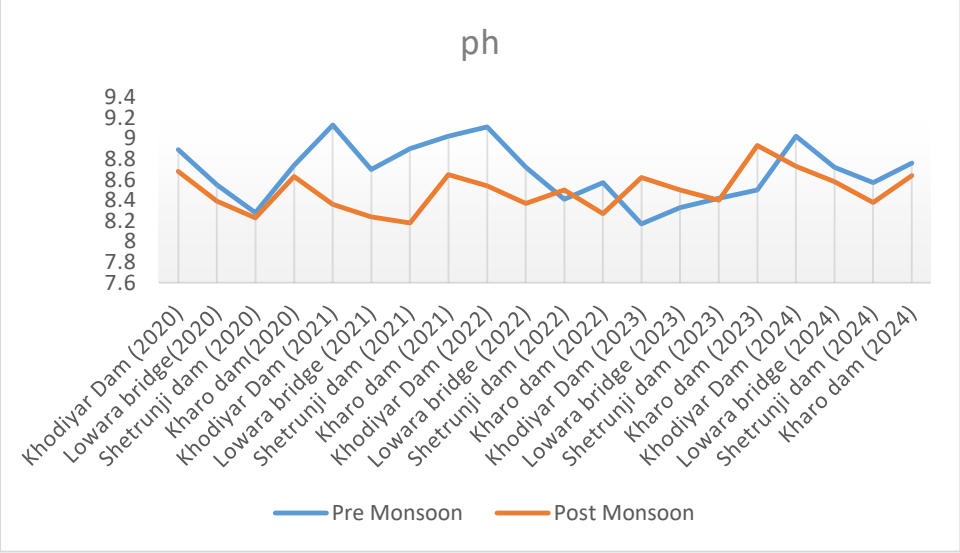

Fig 4.1 Water quality parameters: pH

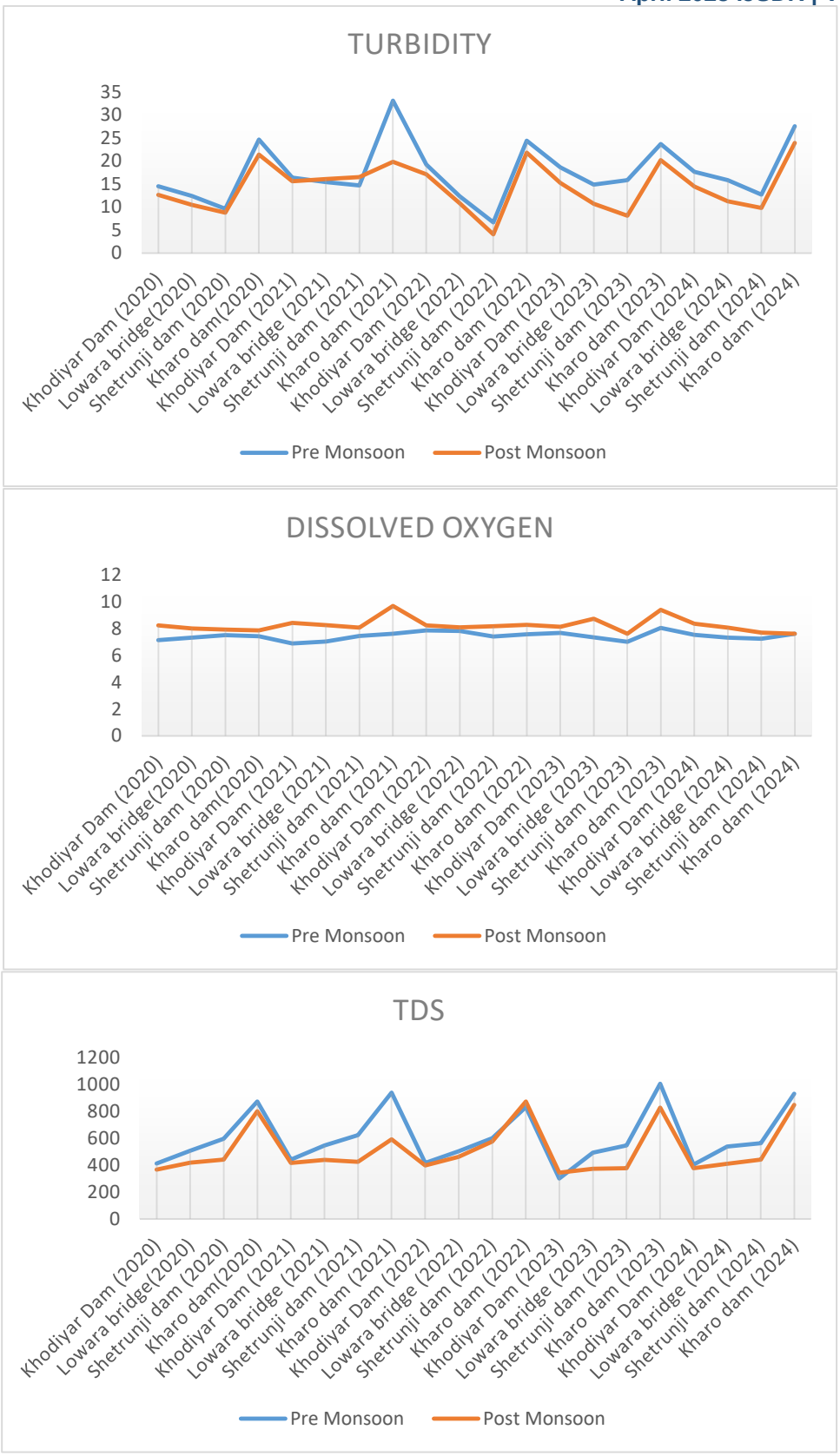

Fig 4.2 Water quality parameters: Turbidity,DO,TDS

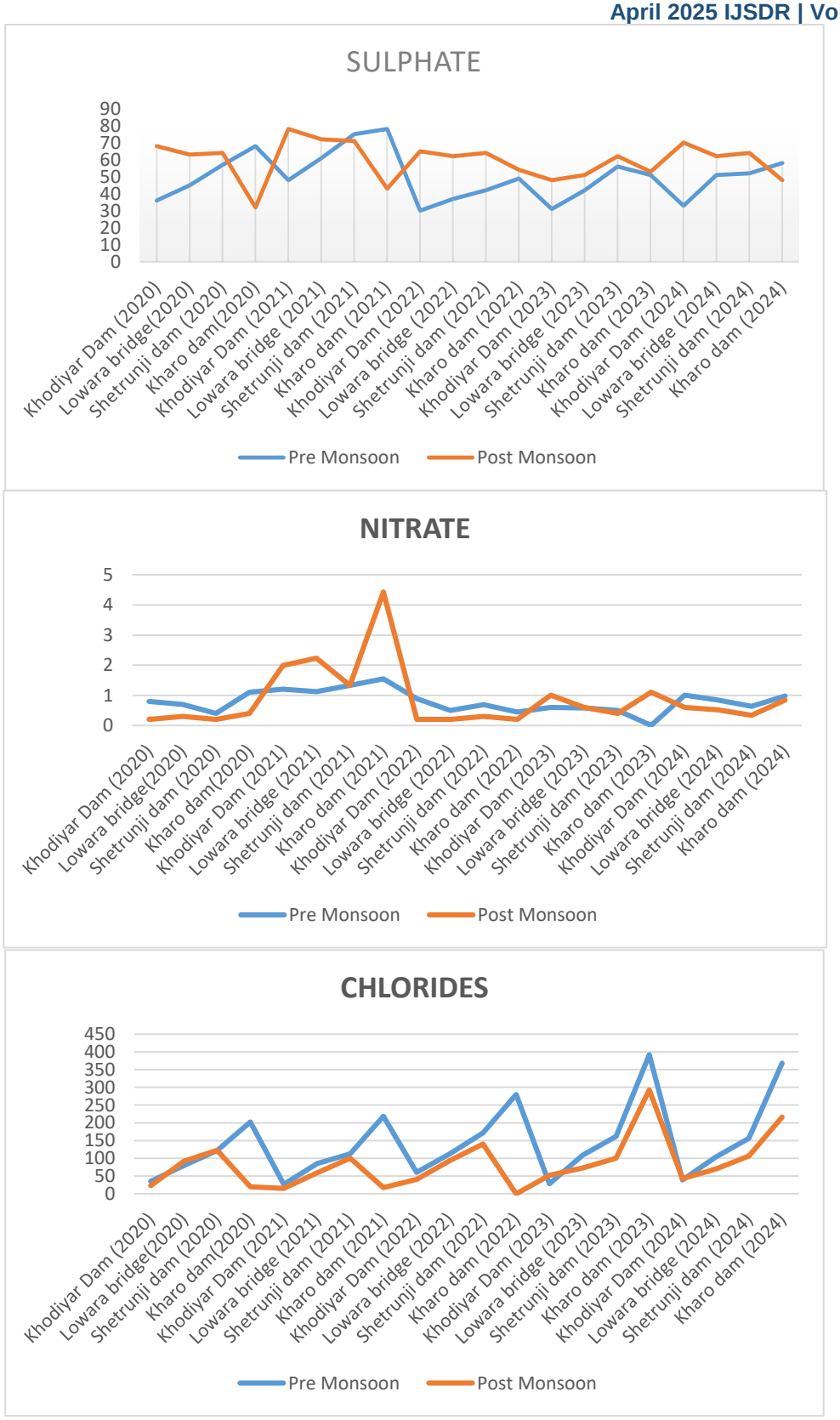

Fig 4.3 Water quality parameters: Sulphate,Nitrate,Chlorides

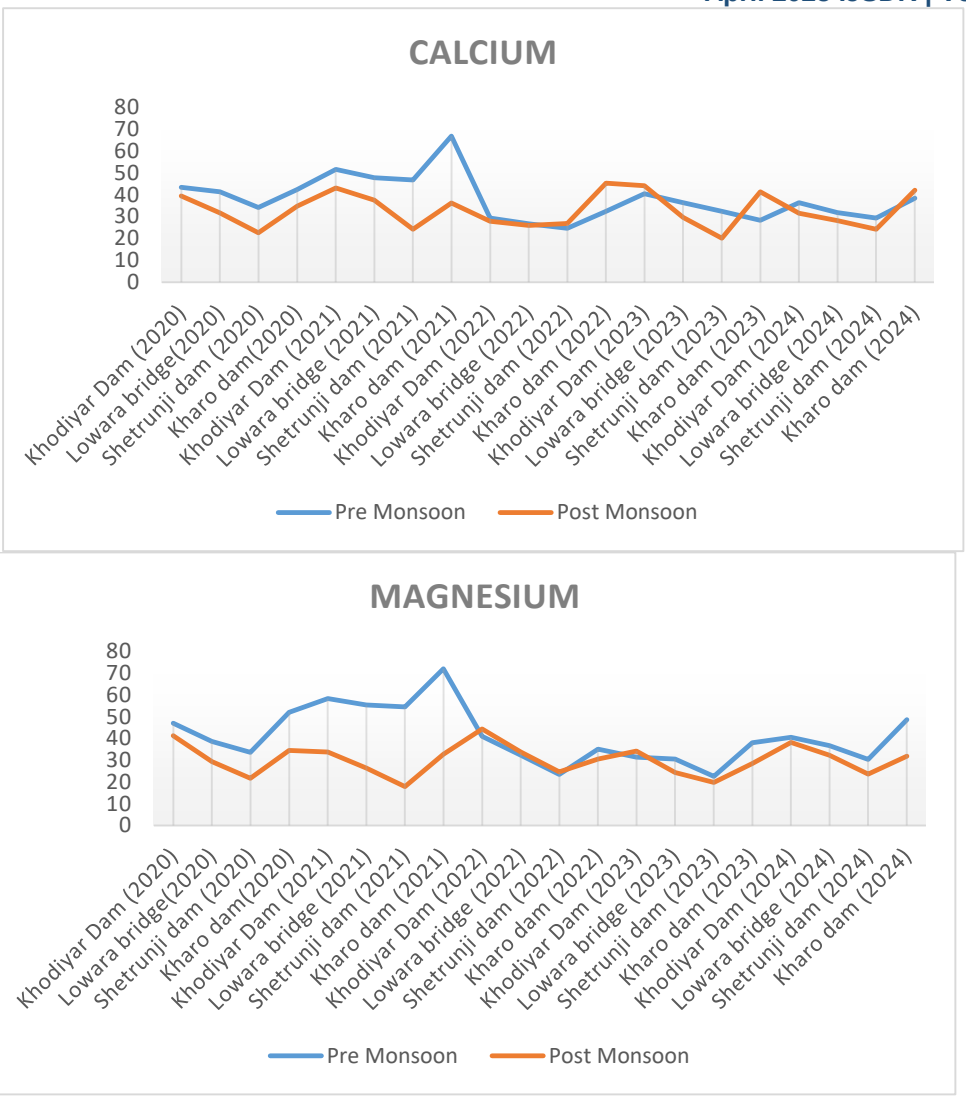

Fig 4.4 Water quality parameters: Calcium,Magnesium

5) RESULTS AND DISCUSSION

- WQI calculated for different stations of shetrunji River is represented in below. For the WQI calculated in this model, if the value as below

- **WQI < 50:** Excellent quality of water.
- **WQI 50.01 – 100:** Good quality of water.
- **WQI 100.01 – 200:** Poor quality of water.
- **WQI 200.01 – 300:** Inferior quality of water.
- **WQI > 300:** Unfit for direct use.

- Near or above 200 it indicates the strength of water is poor. This WQI shows a single parametric value as the result of all parametric quality strength aspects considering the Simplified Weighted Arithmetic Water Quality Index (WQI). In this research model, we have considered the timeline as well as upstream and downstream points of the Shetrunji River. The result at various points and for different time period shows the impact of particularly agricultural runoff, untreated sewage, and industrial effluents on river water quality. Also it is observed that there is a seasonal difference in water quality and location; also downstream quality is poor compared to upstream water quality. The result also shows the effect of exceeding a parametric value which impacts the final WQI value.

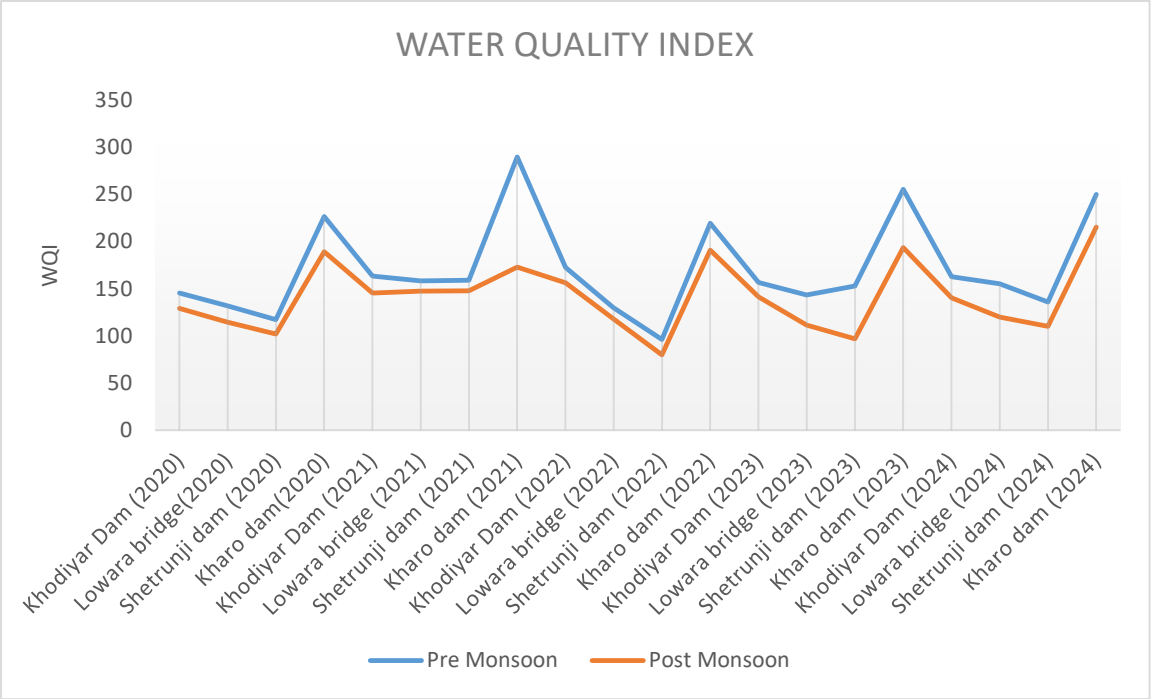

Fig 5.1 Water Quality Index

- The Kharo Dam, situated downstream of the Shetrunji Dam in Sonpari village, Palitana taluka, has consistently recorded the highest Water Quality Index (WQI) values—often exceeding 200—indicating severe pollution. From 2020 to 2024, downstream locations, especially Kharo, exhibited significantly poorer water quality compared to upstream sites like Khodiyar and Shetrunji. Seasonal analysis revealed that while upstream WQI values improved after the monsoon due to dilution, downstream sites remained highly polluted year-round, suggesting persistent contamination from urbanization and wastewater discharge. The Kharo site in particular showed alarming conditions, including high turbidity, increased organic load, and even zero dissolved oxygen (DO) levels in April—signs of extreme organic pollution and low river flow. Although water quality at Kharo has shown gradual improvement over five years, likely due to enhanced wastewater treatment and water management strategies, pollution remains a critical concern. Elevated stream temperatures have also intensified oxygen demand, further stressing aquatic ecosystems at this location.

6) CONCLUSION

- The research determined that the Shetrunji River is significantly affected by multiple sources of pollution, notably agricultural runoff, untreated sewage, and industrial discharges. The water quality model offered critical insights into the level of pollution and assisted in pinpointing the primary factors that are leading to the river's declining state. The model illustrated that the ecological integrity of the river is closely associated with human activities, including improper waste management, unsustainable farming practices, and inadequate wastewater treatment.
- To enhance the water quality of the Shetrunji River, the study suggests the adoption of several strategic initiatives:

1) Enhanced Wastewater Treatment: It is crucial to upgrade and expand wastewater treatment facilities, especially in urban, to diminish the discharge of organic matter and nutrients into the river.
2) Best Agricultural Practices: The implementation of improved agricultural methods, such as the use of organic fertilizers, effective irrigation techniques, and regulated pesticide application, can greatly decrease the nutrient runoff that leads to water quality deterioration.
3) Comprehensive Watershed Management: An integrated approach to watershed management that includes land use planning, afforestation, and groundwater recharge can help alleviate the effects of climate variability and reduce pollution.
4) The Kharo River coming from Palitana, in which the total sewage of Palitana is poured into it, so that there is more pollution in it and after Kharo Dam, it is a tributary of Shetrunji, so water is slowly released into Shetrunji so that when Shetrunji also changes in its quality data during winter and summer, as a solution to this, a headline i.e. a large sewer line on both sides of the river coming from Palitana which maintains a

constant slope along the bed slope of the river and when it meets Shetrunji, the water is first treated in the downstream side basic water treatment plan and then it meets the downstream of Shetrunji so that the water quality of Shetrunji River is maintained.

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