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Quality Enhancement in Environmental Research: A Temporal Study of Water Systems in a Pilgrimage-Driven Hill Region

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Abstract: *Hill regions that host large pilgrimage events often experience short-term environmental stress due to a sudden rise in human activity. Surface water systems in such areas are particularly sensitive to these temporary pressures. Understanding how water systems respond over time is essential for improving the quality and reliability of environmental research. This study presents a temporal assessment of surface water systems in the Girnar hill region of Junagadh, Gujarat, where the annual Parikrama pilgrimage attracts a large number of devotees.*

Water samples were collected from selected locations along the pilgrimage route during periods before and after the event to observe changes associated with increased human use. Standard laboratory techniques were used to analyze physical, chemical, and biological parameters, including pH, turbidity, total dissolved solids, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, and microbial presence. Comparison of results revealed noticeable changes in several parameters during the post-event period, suggesting the influence of activities such as bathing, washing, and localized waste disposal.

The study demonstrates that temporal monitoring helps identify short-term environmental changes that are often overlooked in routine assessments. Such an approach improves data interpretation and supports more accurate evaluation of environmental conditions in areas affected by mass gatherings. The findings highlight the importance of structured monitoring and informed management practices to protect water systems in pilgrimage-driven hill regions. Overall, the study emphasizes the value of simple, systematic, and event-based assessment methods for promoting sustainable management of natural water resources..

Keywords: Temporal monitoring; Pilgrimage impact; Hill ecosystems; Surface water systems; Environmental assessment

1. Introduction

Religious pilgrimages form an important part of social and cultural life in many parts of India. However, such events often bring a sudden and temporary increase in population to ecologically sensitive regions, especially hill landscapes. This rapid rise in human presence places pressure on natural resources, including water systems that are commonly used for drinking, bathing, and other daily needs.

Surface water bodies in hill regions are usually small, slow to recover, and highly responsive to external disturbances. During pilgrimage events, activities such as bathing in streams, washing utensils, and improper disposal of solid and liquid waste can influence water characteristics within a short time. Despite this, many environmental studies rely on

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routine monitoring, which may fail to capture these short-term changes. Therefore, a temporal approach that compares conditions before and after such events is necessary to improve the quality of environmental research.

The Girnar hill region in Junagadh, Gujarat, is a well-known pilgrimage site where the annual Parikrama event attracts thousands of devotees. This study aims to assess how surface water systems respond to this short-term human pressure by adopting a pre- and post-event monitoring framework.

2. Study Area

The Girnar hill region is located near Junagadh city in Gujarat and is characterized by hilly terrain, forested areas, and scattered surface water sources such as streams, ponds, and runoff channels. These water sources serve local residents as well as pilgrims during the Parikrama period. Due to the natural slope, limited water volume, and seasonal dependence, the water systems of the region are sensitive to changes in use and contamination.

The annual pilgrimage follows a fixed route around the hills, with several points where pilgrims interact directly with nearby water sources. These locations were considered important for understanding the impact of human activity on water systems.

3. Materials and Methods

Water sampling was carried out at selected locations along the Parikrama route during pre-event and post-event periods. Sampling sites were chosen based on accessibility, frequency of pilgrim use, and proximity to human activities. Clean and sterilized containers were used for sample collection, and standard precautions were followed to avoid contamination.

The collected samples were analyzed in the laboratory using established standard methods. Physical parameters such as pH, turbidity, and total dissolved solids were measured along with chemical parameters including dissolved oxygen, biochemical oxygen demand, and chemical oxygen demand. Microbiological analysis was carried out to assess microbial presence as an indicator of sanitary conditions.

4. Results and Discussion

Comparison of pre- and post-event data showed observable changes in several water quality parameters after the pilgrimage period. Increased turbidity and organic load were noted at some locations, likely due to disturbance of sediments and addition of organic matter from human activities. Microbial presence was higher in post-event samples, indicating possible contamination linked to bathing and waste disposal practices.

Dissolved oxygen levels showed minor fluctuations, which may be associated with increased organic content and reduced water circulation during peak usage. These findings highlight that even short-duration events can cause measurable changes in sensitive hill water systems. Temporal analysis proved effective in capturing these variations, which might not be evident through regular monitoring schedules.

5. Conclusion

The present study confirms that pilgrimage-related activities can lead to short-term changes in surface water systems in hill regions. A temporal monitoring approach, involving assessment before and after major events, improves the quality and clarity of environmental research by establishing clear links between human activity and environmental response.

The findings emphasize the need for planned monitoring programs and responsible management practices during pilgrimage events to protect fragile water systems. Simple preventive measures, combined with scientific monitoring, can help maintain the environmental balance of pilgrimage-driven hill landscapes. The study supports the adoption of event-based environmental assessment as an effective tool for sustainable water resource management.

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