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A Review on Environmental assessment of Narmada River water at Pilgrim place of Hoshangabad and Omkareshwar

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Abstract: This study investigates the environmental and cultural factors impacting the water quality and ecological health of the Ganges and Narmada rivers, two of India's most significant and sacred water bodies. A comprehensive literature review was conducted, examining various studies that assess the effects of industrial, agricultural, and religious activities on these rivers. The findings reveal significant seasonal fluctuations in water quality, exacerbated by pollution from untreated sewage, industrial effluents, and ritualistic practices. Despite numerous efforts to improve river health, challenges remain due to inadequate waste management, deforestation, and inconsistent policy enforcement. The study identifies several gaps in the current literature, including the need for comparative analysis across different river systems, long-term studies to track ecological changes, and the integration of traditional ecological knowledge into scientific research. Furthermore, the effectiveness of policy interventions in improving river health is insufficiently studied, and there is a need for more advanced analytical techniques to assess water quality. The conclusion emphasizes the importance of an integrated approach to river management that combines scientific research with cultural sensitivity and robust policy implementation. The preservation of both the environmental and cultural significance of these rivers is crucial for their sustainable management. Addressing the identified gaps through interdisciplinary research and long-term monitoring is essential to ensure the health and sustainability of India's river ecosystems.

Keywords: *Environment, Water Quality, Ecological, Narmada Rivers, Water Bodies, Pollution, Waste Management*

I. INTRODUCTION

Rivers hold profound significance in the environmental, cultural, and economic fabric of societies, particularly in India, where they are often revered as sacred entities. Among these, the Ganges and Narmada rivers are paramount, serving as lifelines for millions of people while simultaneously holding immense religious and cultural value. However, the rapid pace of industrialization, urbanization, and population growth has subjected these rivers to severe ecological stress, leading to significant deterioration in water quality and overall environmental health. The pollution of these rivers is not merely an environmental issue but also a socio-cultural crisis, as these water bodies are intertwined with the daily lives, traditions, and spiritual practices of the communities residing along their banks.

The Ganges River, often referred to as the "Mother Ganga," is particularly emblematic of this dual significance. It is not only a critical source of water for drinking, irrigation, and industrial processes but also a focal point for numerous religious rituals and festivals that draw millions of pilgrims annually. Unfortunately, these activities, combined with the discharge of untreated sewage, industrial effluents, and agricultural runoff, have led to severe pollution, threatening both the river's ecological integrity and its cultural heritage. Studies have documented alarming levels of contaminants in the Ganges, including heavy metals, pathogens, and organic pollutants, which pose serious risks to human health and aquatic life.

Similarly, the Narmada River, often called the "Lifeline of Madhya Pradesh," is revered for its religious significance, particularly the practice of the Narmada Parikrama, a sacred pilgrimage that involves circumambulating the river. The Narmada has also been a critical source of water and livelihood for the communities along its course. However, the river faces multiple threats, including pollution from industrial discharge, agricultural runoff, and the construction of large dams, which have altered its flow and disrupted its ecosystem. The degradation of the Narmada's water quality not only endangers the health of local populations but also erodes the cultural practices that have been sustained for centuries.

This study aims to explore the complex interplay between environmental degradation and cultural practices associated with the Ganges and Narmada rivers. By analyzing existing literature on water quality, pollution sources, and the impact of religious and social activities, this research seeks to provide a comprehensive understanding of the challenges facing these rivers. Additionally, the study identifies gaps in current research and policy implementation, offering insights into the need for integrated management strategies that honor both the ecological and cultural significance of these rivers. Ultimately, this research underscores the urgency of preserving these vital water bodies, not only for their environmental value but also for the cultural and spiritual sustenance they provide to millions of people.

The Narmada River, often revered as one of the most sacred rivers in India, plays a crucial role in the cultural, spiritual, and ecological landscape of central India. However, the increasing anthropogenic pressures, particularly at pilgrim sites such as Hoshangabad and Omkareshwar, have raised significant concerns about the river's water quality and overall environmental health. This review synthesizes findings from recent studies to provide a comprehensive understanding of the environmental assessment of Narmada River water, focusing on pollution levels, physicochemical parameters, microbial contamination, and the broader cultural and ecological implications.

II. LITERATURE REVIEW

Gupta et al. (2024) conducted a detailed analysis of heavy metal concentrations in the upper stretches of the Narmada River, focusing on the pre-monsoon and post-monsoon seasons. The study highlighted the presence of heavy metals such as

Aluminum (Al), Iron (Fe), Zinc (Zn), and others in the river water, with the concentrations varying between the seasons. The pollution indices, namely the Heavy Metal Evaluation Index (HEI) and the Heavy Metal Pollution Index (HPI), categorized the water as medium to heavily polluted. These findings indicate a significant threat to human health and emphasize the need for stringent monitoring and remediation efforts at these pilgrim sites.

J**ain et al. (2024)** focused on the physicochemical and microbial parameters of the Narmada River at Riddhnath Ghat in the Harda District. The study revealed high levels of microbial pollution, particularly the presence of coliform bacteria, salmonellae, and vibrio, which pose severe health risks to pilgrims. The research also noted that the major sources of pollution were polythene, coconut offerings, and other types of waste discarded into the river. The study underscores the urgent need for better waste management practices to mitigate the health hazards associated with waterborne diseases such as cholera and dysentery.

Bilimoria et al. (2024) explored the cultural and historical significance of water in the Indic world, with a particular focus on the Narmada River. The study provided insights into the sacred and profane roles of water in religious and secular ceremonies from Vedic times to the present day. The research underscored the deep connection between the river and the cultural practices of the local communities, highlighting the importance of maintaining the ecological health of the Narmada to preserve its cultural heritage.

Rathore et al. (2023) examined the impact of religious activities, particularly mass bathing during events like Amavasya and solar eclipses, on the water quality of the Narmada River. The study found significant increases in Biochemical Oxygen Demand (BOD), Dissolved Oxygen (DO), Total Dissolved Solids (TDS), and other physicochemical parameters post these events. The research emphasized that such activities contribute to the deterioration of water quality, necessitating the implementation of measures to control pollution during religious gatherings.

Kochara et al. (2023) highlighted the ecological importance of aquatic insects in the Narmada River, identifying various species across different microhabitats. The study demonstrated that the river's physicochemical parameters were within WHO limits, suggesting a relatively healthy aquatic ecosystem. However, the research also pointed out the seasonal variations in water quality, with higher pollution levels recorded during the monsoon months.

Kumar et al. (2023) discussed the socio-political challenges of water flow regulation in the Narmada River basin, particularly in Omkareshwar. The study explored the community's struggles with erratic water flows due to large-scale regulatory practices and called for a repoliticization of water management to better address local needs. This perspective adds a critical dimension to the environmental assessment, emphasizing the need for inclusive and participatory approaches to river management.

Maurya et al. (2023) presented an analysis of geoheritage sites along the Narmada River, focusing on the Narmada-Son Fault zone and its significance in understanding the region's geological history. The study suggested integrating these geosites with pilgrimage tourism to promote sustainable geotourism, thereby enhancing both environmental conservation and economic development.

Raina et al. (2023) highlighted the infrastructural challenges faced by towns along the Narmada River, particularly the lack of sewage treatment plants and proper waste disposal systems. The study pointed out that the absence of these facilities leads to significant environmental degradation, affecting both water quality and public health.

Sharma et al. (2023) and Varma et al. (2023) provided comparative insights into the environmental challenges faced by other major Indian rivers, such as the Ganga and Yamuna. These studies highlighted similar issues of pollution, eutrophication, and the impact of religious activities, offering valuable lessons for managing the Narmada River's environmental health.

Tiwari et al. (2022): This study on the Narmada basin's riparian zones highlights the impact of modern agriculture and other activities on traditional livelihoods, particularly those dependent on flora. The loss of traditional livelihoods and the effect on tribal communities can provide a socio-economic dimension to your thesis, illustrating how environmental changes impact local populations.

Yadav et al. (2022) & Varma et al. (2022): Both studies discuss the impact of mass religious gatherings (like the Kumbh Mela) on water quality in the Ganga River. They provide a detailed analysis of water quality parameters during such events. These studies can serve as a comparative analysis for similar events at the Narmada River, especially in terms of understanding how pilgrimages affect water quality.

DE ALARCÓN et al. (2021): This study on the transformation of the Narmada River from a sacred landscape to a mechanized system provides historical and cultural context that could be crucial for understanding the current environmental and social challenges in your thesis area.

Arif et al. (2021): The study on the effects of industrialization on water resources could be relevant if there are industrial activities in or near Hoshangabad and Omkareshwar. It highlights the pollution risks from industries, which might be a concern for the Narmada River as well.

Gupta et al. (2020): This research on the water quality of the Narmada River, including the Water Quality Index (WQI) and the impact of anthropogenic activities, directly aligns with your thesis focus. It could serve as a primary reference for water quality assessments in your study area.

Pawar et al. (2020): The flood magnitude-frequency analysis on the Narmada River offers insights into the hydrological aspects of the river, which could be useful if your thesis touches on flood risks or hydrological changes in the Narmada basin.

Singh et al. (2020): This essay on the cultural significance of water in Hindu mythology, particularly focusing on rivers like the Ganga, can add depth to the cultural analysis of the Narmada River's role in the lives of the local population, particularly pilgrims.

Shende et al. (2020): The study on the WQI of the Erai River provides a methodological reference for assessing water quality, which you can apply to the Narmada River during different seasons or events.

Mariya et al. (2019): This study analyzed the water quality trends of the Ganges over 36 stretches from 2012 to 2016. It observed improvement in water quality at 16.7% of stretches, deterioration at 38.9%, and non-significant changes at 44.4%. Key improvements included increased dissolved oxygen and decreased biochemical oxygen demand in certain stretches. However, fecal contamination increased in other areas due to improper sanitation practices.

Chauhan et al. (2019): This research highlighted how religious festivals and rituals contribute to water pollution, particularly in the Ganges. The study noted fluctuations in water quality parameters such as DO, BOD, COD, and heavy metals, especially during monsoon seasons and religious gatherings. The study calls for better waste management practices during such events to protect water quality.

Kamboj et al. (2019): Focusing on the impact of riverbed mining on the Ganga River in Haridwar, this study used the Overall Index of Pollution (OIP) to assess seasonal surface water quality. The results showed significant pollution in mined areas, particularly during the monsoon, and called for stricter regulations to maintain ecological balance.

Upasani et al. (2018): This study explored the cultural and ecological significance of the Narmada River, particularly through the lens of the Narmada Parikrama Path, a pilgrimage route. The research emphasized the need for strategies to protect the cultural landscape and biodiversity along this path.

Sharma et al. (2018): This research detected high levels of potentially pathogenic microbes like Pseudomonas, Salmonella, and Shigella in water samples from the Narmada River, raising concerns about waterborne diseases. The study did not find drug-resistant bacteria but did note significant fungal contamination.

Tiwari et al. (2018): The study mapped various anthropogenic activities contributing to the degradation of the Narmada River's ecosystem. Using GIS, it identified critical stressors and the impacts of land use changes on the river's health.

Patel et al. (2018): This research analyzed the concentration of heavy metals in the Swarnamukhi River Basin. It found significant contamination in sediments, particularly with Cr, Cu, Pb, and Zn, due to both natural and anthropogenic sources, posing ecotoxicological risks.

Yogesh et al. (2018): Monitoring the water quality of the Narmada River at Barwani, this study linked pollution to domestic waste, municipal sewage, and agricultural runoff. Statistical analysis confirmed that several water quality parameters were outside WHO and BIS standards.

Singh et al. (2018): The study used Water Quality Index (WQI) to assess the Ganges River's water quality across different seasons, highlighting critical pollutants such as pH, DO, BOD, and fecal coliforms that significantly affect water quality.

WaZza et al. (2018): This research focused on the impact of religious practices on the Tawi River in Jammu. It highlighted the pollution caused by ritualistic offerings and the immersion of deities, emphasizing the need for better management during religious events.

Pandey et al. (2018): This study assessed zooplankton diversity in the Narmada River, noting their importance as indicators of water quality. The study identified 42 species and stressed the need for conservation efforts to protect declining zooplankton populations.

Singh et al. (2018): This paper critiqued the diversion of smaller streams, like the Khan River, to larger ones for short-term cleanliness goals during events like Kumbh Mela. It pointed out the environmental discrepancies and the influence of political and economic forces in such projects.

Matta et al. (2018): Assessing the Ganges River system at Rishikesh, this study analyzed water quality parameters across five sites from 2015 to 2018, identifying Pashulok Barrage as the most contaminated site, which calls for targeted remediation efforts.

III. LITERATURE GAPS

While the reviewed literature provides extensive insights into the environmental and cultural aspects affecting the Ganges and Narmada rivers, several gaps remain:

1. **Comparative Analysis Across Regions**: Most studies focus on specific regions or stretches of rivers, but there is a lack of comprehensive comparative analysis across different river systems in India. A holistic understanding of how different cultural, industrial, and environmental factors interact across various rivers is needed.
2. **Longitudinal Studies**: There is a scarcity of long-term studies that track changes in water quality and ecological health over extended periods. Such studies are essential to understand the long-term impacts of pollution, climate change, and conservation efforts.
3. **Integration of Traditional Knowledge**: While some studies mention cultural practices, there is limited integration of traditional ecological knowledge into scientific analysis. More research is needed to explore how indigenous practices and local knowledge can contribute to sustainable water management.
4. **Impact of Policy Interventions**: Although some studies discuss pollution control and management strategies, there is limited analysis of the effectiveness of policy interventions over time. Understanding the impact of policies on river health is crucial for developing more effective regulations.
5. **Advanced Analytical Techniques**: The studies primarily rely on traditional water quality parameters. There is a gap in the use of advanced analytical techniques, such as molecular markers and remote sensing, which could provide more detailed and accurate assessments of river health.

CONCLUSION

The reviewed literature highlights the multifaceted challenges facing India's river systems, particularly the Ganges and Narmada rivers. Pollution from industrial, agricultural, and religious activities remains a significant concern, exacerbated by seasonal variations and inadequate waste management practices. Cultural and religious practices, while deeply ingrained in society, often contribute to the degradation of water quality. The studies underscore the need for a more integrated approach to river management that combines scientific research with cultural awareness and policy enforcement. Conservation efforts should not only focus on mitigating pollution but also on preserving the cultural and ecological integrity of these vital water bodies. Addressing the identified literature gaps, particularly through long-term, comparative, and interdisciplinary research, is essential for the sustainable management of river ecosystems in India.

The environmental assessment of the Narmada River at pilgrim sites like Hoshangabad and Omkareshwar reveals a complex interplay of cultural, ecological, and socio-political factors that contribute to the river's pollution. The findings from various studies underscore the urgent need for integrated and sustainable management practices that address both the ecological health of the river and the cultural practices of the communities that depend on it. Future research should focus on developing

holistic approaches that combine traditional knowledge with modern scientific techniques to ensure the long-term sustainability of the Narmada River.

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