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"Comprehensive Assessment and Integrated Water Treatment Strategy for the Restoration of the Panchganga River, Maharashtra"

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Abstract :

The plan to restore the Panchganga River involves pinpointing pollution sources, improving wastewater treatment, and implementing sustainable measures to reduce contamination. This approach seeks to enhance water quality, benefiting local communities and the surrounding environment. The project's goal is to evaluate the water quality of the Panchganga River, develop a suitable treatment system, and assess financial viability under a Public-Private Partnership model. It involves water sampling, treatment system planning, cost analysis, and examining PPP options to sustainably improve water quality. The Panchganga River, essential to Kolhapur, is severely polluted due to industrial, agricultural, and domestic waste. This project intends to evaluate the river's water quality, identify the sources of pollution, and design a customized treatment system with a focus on long-term financial sustainability, possibly through a Public-Private Partnership (PPP). The goal is to provide a sustainable solution that restores the river, benefiting both the local community and the environment.
Keywords – Quality of water, Treatment System, Financial Analysis, PPP(Public Private Partnership.)

Introduction

The Panchganga River in Kolhapur, Maharashtra, is historically and culturally significant. Its name, meaning "five rivers," reflects its formation from the convergence of the Kasari, Kumbhi, Tulsi, Bhogawati, and Dhamani rivers at Prayag Sangam near Kolhapur. For many years, the river has been essential for agriculture and drinking water, supporting the cultivation of crops like sugarcane, rice, and vegetables along its fertile banks. Many consider its waters sacred, and it features prominently in local myths and traditions. Unfortunately, rapid industrialization, urban growth, and agricultural runoff have severely polluted the river in recent years, endangering both the ecosystem and public health. Ongoing efforts aim to clean and protect the river, preserving this vital resource that has long been central to Kolhapur's culture and way of life.

The Panchganga River in Kolhapur is severely polluted due to industrial waste, agricultural runoff, and untreated sewage. This contamination has rendered the water unsafe for consumption and harmful to the river's ecosystem. High levels of harmful bacteria and chemicals, particularly during the monsoon, pose significant health risks to both wildlife and local communities.
Though efforts like sewage treatment plants and awareness programs have been introduced, they have not been sufficient due to challenges with funding and coordination. To restore the river, more stringent regulations, improved waste management, and greater community involvement are essential to reduce pollution and safeguard this vital resource.

Study Area

The study area focuses on the Panchganga River as it flows through Kolhapur City in Maharashtra. Kolhapur, located at 16º 42' N latitude and 74º 14' E longitude in the western part of the state, sits at an elevation of 1,870 feet above sea level and covers an area of 66.82 square kilometers. With a population of approximately 779,000, Kolhapur relies heavily on the Panchganga River as a vital water source. However, the river is significantly affected by pollution from domestic sewage, industrial discharge, and agricultural runoff. Key pollution sources include sewage outlets and industrial zones along the river. This project aims to evaluate these pollution sources and implement water treatment measures to restore the river's health, ultimately providing cleaner water for Kolhapur.

Methodology

The project's goal is to evaluate the water quality of the Panchganga River, design an effective water treatment system, perform a financial analysis, and assess the feasibility of a Public-Private Partnership (PPP) model for the treatment plant.
Water Quality Assessment will include sampling at five sites: Tawade Hotel, Bapat Camp, Bhosalewadi, Kasaba Bawada, and Shivaji Pool. These samples will undergo testing for parameters such as pH, Total Solids, Chloride, Alkalinity, and Hardness to assess their suitability for drinking. Results will be compared to national drinking water standards and documented in a report.
Treatment System Design encompasses preliminary and secondary treatment phases. The preliminary stage includes screening, grit removal, and flow equalization to filter out debris and stabilize water quality. In the secondary phase, biological processes like activated sludge or biofiltration will treat contaminants. Additional filtration and disinfection may be added to achieve safe drinking water standards.
Cost Estimation and Financial Analysis will involve calculating initial and ongoing operational costs, estimating long-term expenditures, and assessing financial feasibility using indicators such as Net Present Value (NPV) and Internal Rate of Return (IRR). Potential funding sources, including government grants, will also be evaluated.
PPP Model Feasibility will consider options such as Build-Operate-Transfer (BOT) or Build-Own-Operate-Transfer (BOOT), analyzing each model for associated risks, stakeholder responsibilities, and community benefits. This approach aims to integrate private sector efficiency while ensuring public access to clean water.
Overall, this methodology provides a structured plan for enhancing water quality and sustainability, from initial analysis to system implementation and financing.

Literature Review

1. Pawar, D. H. (2012). River Water Pollution, An Environmental Crisis: A Case Study of Panchganga River of Kolhapur City. *International Journal of Environmental Dynamics (IJED)*, 9(1).
In his 2012 study, D.H. Pawar investigates the critical pollution levels in the Panchganga River in Kolhapur City, primarily attributed to the discharge of untreated industrial effluents and sewage. Through a combination of field surveys and laboratory tests, the research evaluates water quality based on key indicators such as pH, dissolved oxygen (DO), and total dissolved solids (TDS). The results indicate a serious decline in water quality, which has detrimental effects on local ecosystems, public health, and agriculture. The paper also proposes several approaches for mitigating pollution and promoting the restoration of the river's ecological balance.

2. Gaikwad, S. S., et al. (2014). Qualitative Analysis of Surface Water of Panchganga River (MS), India. *Bio Life*, 2(3), 970-981.
The study conducted by Sanindhar Shreedhar Gaikwad and Nitin Anandrao Kamble (2014) monitored the water quality of the Panchganga River from March 2011 to February 2012 by analyzing various physicochemical parameters at multiple sites. The results showed that the water quality was poor across all tested locations, with Water Quality Index (WQI) values indicating significant levels of pollution. The study emphasizes the urgent need for intervention to reduce pollution and safeguard the health of the river's aquatic ecosystem.

3. Thorvat, A. R.., et al. (2012). A Study on the Physico-Chemical Characteristics of Panchaganga River in Kolhapur City, MS, India. *International Journal of Environmental Sciences*, 2(8), 76-79.

The study by Thorvat A.R. and colleagues (2012) examines the water quality of the Panchaganga River at four different locations in Kolhapur City between October 2009 and March 2010. The research explores the impacts of waste disposal from sewage, agricultural runoff, and industrial effluents on the river. Using the Water Quality Index (WQI), the study finds that Station-1 shows moderate pollution and requires treatment, while Stations 2, 3, and 4 are severely polluted and unsuitable for drinking. Overall, the physicochemical parameters indicate significant water pollution across all sites.

4. Mangalekar, S. B., & Samant, J. S. (2015). Evaluation of Water Quality of Panchganga River with Reference to Waterborne Diseases. *International Journal of Scientific Research*, 4(10), 2277-8179.
The study by Mangalekar S.B. and Samant J.S. (2015) evaluates the water quality of the Panchganga River from 2010 to 2012, focusing on nine physico-chemical parameters and fecal contamination. The analysis revealed consistently poor water quality, as indicated by Water Quality Index (WQI) values frequently falling below 50. Furthermore, high levels of fecal contamination were detected. A local survey highlighted a clear connection between the declining water quality and an increase in waterborne diseases, such as gastroenteritis, hepatitis, and fever, underscoring the significant health risks associated with the river's pollution.

5. Kamble, P. S. (2020). Valuation of Panchganga River Ecosystem Services in Urban Kolhapur District of Maharashtra (India). *Advances in Economics and Business*, 8(6), 346-361.
The research by Prakash S. Kamble (2020) estimates the annual economic value of the Panchganga River's ecosystem services at Rs. 5459.41 lakh, highlighting its crucial role in supporting agriculture, industry, and domestic needs in Kolhapur District. The study provides a comprehensive economic valuation of the river's contributions, while also noting that non-economic factors—such as cultural, ecological, and social values—are more important in determining the river's overall significance than strictly economic considerations.

6. Patil, V. A., et al (2023). Study on the impact of textile industry effluents of Ichalkaranji city on the water quality (Water quality of Panchganga River at Ichalkaranji). *GIS Science Journal*, 10(6).
In February 2023, Virgonda A. Patil, Sneha P. Madnaik, and Shruti S. Khot conducted a study to evaluate the water quality of the Panchganga River at four sites, from Ichalkaranji to Shirol. The results revealed severe pollution at Station I, primarily due to untreated textile industry effluents, with moderate pollution levels observed at Stations II, III, and IV. The study compared these findings to IS 10500 (2012) standards and assessed the Water Quality Index (WQI). The pollution was found to cause significant environmental issues, including the growth of water hyacinths and the presence of dead fish, indicating severe degradation of the river's health.

7. Dhawal, S. J., & Raut, P. D. (2017). Assessment of physico-chemical characters and heavy metal distribution along the Panchganga River, MS, India. *World Journal of Pharmacy and Pharmaceutical Sciences*, 6(8), 1823-1836.
The study by Dhawal S. J. and Dr. Raut P. D. (2015-2016) investigated the physico-chemical parameters and distribution of heavy metals at three sites along the Panchganga River: Piral, Kolhapur, and Narsobawadi. The research revealed escalating pollution levels downstream, which worsened from the monsoon to summer seasons. Key parameters such as Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) exceeded permissible limits, while heavy metals like iron (Fe), cadmium (Cd), and chromium (Cr) were found above the BIS safety thresholds. The findings underscore the significant degradation of water quality and the urgent need for pollution control measures.

The Panchganga River in Kolhapur City, Maharashtra, faces severe pollution issues due to untreated industrial discharges, agricultural runoff, and domestic wastewater. Multiple studies have assessed the river's declining water quality, with findings based on key physicochemical parameters like pH, dissolved oxygen (DO), and total dissolved solids (TDS) showing consistently high levels of contamination (Pawar, 2012; Gaikwad & Kamble, 2014; Thorvat et al., 2012). This pollution is associated with serious environmental threats and health risks, including waterborne illnesses and ecological disturbances (Mangalekar & Samant, 2015). Given the river's economic and cultural importance, there is a pressing need for pollution control and ecological restoration measures (Kamble, 2020). Overall, the research points to the necessity of implementing comprehensive strategies to improve water quality and protect the river's ecological integrity.

Gap Analysis :

Identified research gaps include:

1. Absence of Treatment System Design: Current studies focus on testing and basic remedies but lack a detailed treatment system plan.

2. No Financial Feasibility Analysis: There is little evaluation of the costs and economic feasibility of implementing a treatment system.

3. Unexplored Potential of the PPP Model: Research has yet to explore the possibility of using a Public-Private Partnership model to improve feasibility and efficiency.

4. Lack of Customized Solutions: Existing solutions are generalized, without adjustments for unique characteristics of various river water sources.

5. No Long-Term Impact Assessment: Studies do not assess the long-term effectiveness or sustainability of the solutions.

Addressing these gaps could help create a more sustainable and effective approach to river water treatment.

Proposed Objectives :

1) To assess the water quality of the Panchganga River.

2) To design and develop a feasible treatment system incorporating preliminary & secondary treatment systems.

3) To prepare an estimation and costing of project with financial analysis.

4) To create a feasibility analysis of the PPP model for the proposed water treatment plant.

Future Scope of the Study :

This project provides a strong base for restoring the Panchganga River and suggests several future directions:
1.Addressing New Pollutants: Investigating emerging contaminants such as microplastics and pharmaceuticals will help tackle evolving pollution challenges.
2.Cost-Effective Treatment Solutions: Developing affordable treatment methods would increase the scalability and accessibility of the project's approach.
3.Community Engagement: Future projects could include public awareness programs to promote sustainable practices and reduce local pollution sources.
4.Application to Other Rivers: The methods developed here could serve as a model for restoring other polluted rivers in India and internationally.
In conclusion, future efforts can focus on advanced technology, community engagement, and adapting the framework to other areas, further strengthening river restoration initiatives.

Discussion :

The Panchganga River, which once supported agriculture, drinking water, and local ecosystems in Kolhapur, is now severely impacted by pollution from industrial, agricultural, and domestic sources. Chemical runoff, untreated sewage, and industrial waste have left the river water unsuitable for consumption and harmful to its ecosystem. While some measures have been taken to address this issue, they have often been limited in scope, highlighting the need for a more comprehensive and organized approach to river restoration.

Existing studies have largely focused on documenting pollution sources and levels, but there is still a lack of long-term, coordinated solutions for improving water quality. This research seeks to address that gap by starting with a detailed assessment of water quality across

selected sites in Kolhapur, accounting for seasonal fluctuations and newer pollutants. This analysis will identify key pollutants and their sources, creating a solid foundation for developing targeted treatment options.

Based on this assessment, the project will design a treatment system tailored to the specific pollutants in the Panchganga River. The treatment approach will involve preliminary processes like screening and grit removal, followed by biological filtration to remove dissolved contaminants. This two-stage process is essential for handling the range of pollutants present and will aim to meet drinking water standards.

The project will also include a detailed cost and financial feasibility study, an area that previous research has often overlooked. The analysis will consider both upfront and ongoing costs, with financial metrics such as Net Present Value (NPV) and Internal Rate of Return (IRR) to assess the long-term viability of the treatment system.

Lastly, the study will evaluate the potential for a Public-Private Partnership (PPP) model, which could make the project more effective and financially sustainable. Through models like Build-Operate-Transfer (BOT) and Build-Own-Operate-Transfer (BOOT), the project intends to leverage private sector efficiencies while ensuring access to clean water for the public. This approach could also attract additional funding and expertise, making pollution control efforts more scalable.

In conclusion, this project offers a comprehensive framework that begins with water quality assessment, moves through treatment system design and financial planning, and explores PPP models. By addressing these gaps, the project aims to create a sustainable, long-term solution to benefit both Kolhapur and the river's ecosystem.

Conclusion :

The Panchganga River, once vital for Kolhapur's agriculture, drinking water, and natural habitats, is now severely polluted due to industrial, agricultural, and household waste. Although there have been previous efforts to address this, a lasting solution is still lacking. This project seeks to bridge this gap by evaluating the river's water quality in Kolhapur, pinpointing key pollutants and their sources, and developing a customized treatment system.

Our strategy combines physical and biological processes to achieve safe water quality standards, along with a financial feasibility study to ensure the approach remains viable over time. By considering Public-Private Partnership (PPP) models like Build-Operate-Transfer (BOT), we aim to secure both funding and expertise, enhancing the project's impact and scalability.

Overall, this project offers a comprehensive plan to restore the Panchganga River, providing a sustainable, long-term solution that will benefit the local community and environment. The Panchganga River, essential to Kolhapur, is severely polluted due to industrial, agricultural, and domestic waste. This project intends to evaluate the river's water quality, identify the sources of pollution, and design a customized treatment system with a focus on long-term financial sustainability, possibly through a Public-Private Partnership (PPP). The goal is to provide a sustainable solution that restores the river, benefiting both the local community and the environment.

References : 1) Pawar, D. H. (2012). River Water Pollution, An Environmental Crisis: A Case Study of Panchganga River ofKolhapur City. International Journal of Environmental Dynamics (IJED), 9(1).2) Gaikwad, S. S., & Kamble, N. A. (2014). Qualitative Analysis of Surface Water of Panchganga River (MS), India. Bio Life, 2(3), 970-981.

3) Thorvat, A. R., Sonaje, N. P., Mujumdar, M. M., & Swami, V. A. (2012). A Study on the Physico-Chemical Characteristics of Panchaganga River in Kolhapur City, MS, India. International Journal of EnvironmentalSciences, 2(8), 76-79.

4) Mangalekar, S. B., & Samant, J. S. (2015). Evaluation of Water Quality of Panchganga River with Reference to Waterborne Diseases. International Journal of Scientific Research, 4(10), 2277-8179.

5) Kamble, P. S. (2020). Valuation of Panchganga River Ecosystem Services in Urban Kolhapur District ofMaharashtra (India). Advances in Economics and Business, 8(6), 346-361.

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