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EcoStream Optimization: Revolutionizing Sewage Waste Cleaning

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ABSTRACT: Water contamination poses serious threats to ecosystems and public health. This project focuses on restoring the Sambhaji Lake Naala in Solapur using sustainable techniques. Key treatments include phytoremediation with water hyacinth, microbial degradation via Bacta Cult bacteria, and filtration using no-fine concrete. Testing revealed significant improvements—BOD reduced from 46.4 to 29 mg/L, COD from 130.1 to 110 mg/L, and chloride within safe limits. The project demonstrates a low-cost, replicable model for decentralized wastewater treatment. Community involvement and eco-friendly methods make it a scalable solution for long-term environmental restoration.The system also encourages reuse of treated water for landscaping and reduces dependency on conventional sewage treatment infrastructure. This approach promotes ecological balance while aligning with sustainable development goals.

I.INTRODUCTION

Water pollution in urban drains (naalas) is a growing environmental concern, especially in areas lacking proper sewage treatment. The Sambhaji Talav Naala in Solapur has suffered from heavy contamination due to unchecked waste disposal, posing health and ecological risks.

This project presents EcoStream Optimization, a sustainable and cost-effective solution using natural and biological methods. Key components include water hyacinth for phytoremediation, Bacta Cult bioculture for organic waste breakdown, and no-fine concrete for filtration and groundwater recharge. The approach aims to improve BOD, COD, pH, and chloride levels while encouraging community participation. Its low-maintenance, electricity-free design makes it suitable for widespread use in both urban and rural settings.

Figure 1: Current Scenario Of Sambhaji Lake

Sambhaji Lake Naala, located in Solapur, has become a critical pollution hotspot due to continuous discharge of untreated domestic sewage and solid waste. The water body is densely covered with water hyacinth, which thrives on excess

nutrients, contributing to oxygen depletion and foul odor. Local residents face health hazards like mosquito breeding and waterborne diseases.

Water quality assessments show elevated levels of Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), total dissolved solids, and chloride—far exceeding permissible environmental limits. Microbiological contamination, including E. coli, further underscores the need for immediate intervention.

The *EcoStream Optimization* project directly addresses these issues by applying a low-cost, nature-based treatment approach using, bioculture, and eco-friendly filtration. This initiative is designed to revive Sambhaji Lake Naala's water quality, enhance biodiversity, and serve as a replicable model for decentralized wastewater management.

II.METHODOLOGY OF PROPOSED SURVEY

Site Selection

First, we reviewed the available literature, government reports, and internet-based case studies related to naala cleaning projects in India. After evaluating various sites for accessibility, pollution levels, and municipal cooperation, we selected Sambaji Talav Naala, located in Solapur, Maharashtra. This site was chosen due to its significant contamination levels, ease of access for sample collection, and active support from the Solapur Municipal Corporation (SMC**)**. The project aligns with local environmental restoration initiatives and offers a practical ground for applying sustainable and microbial-based cleaning techniques.

Data Collection

To conduct a proper evaluation of the pollution level and propose a sustainable solution, we collected the following materials and data:

1. Topographical Sheet of the Sambaji Talav Naala region (Scale 1:4000) – obtained from the Survey of
2. SMC

Fig no 2: Sewer Map Of Site

2. Sambaji Talav Naala Map – acquired from the Solapur Municipal Corporation (SMC)

3. Bacta Cult Bioculture Samples – provided by **WTP Degaon**, including both aerobic and anaerobic formulations.

4. Collection of Water Samples – samples were taken from multiple points along the naala for analysis of BOD, COD, turbidity, and microbial contamination.

Eco-Stream Optimization Procedure

Phase 1: Inlet & Initial Filtration

- Objective: To remove floating debris and large suspended solids.
- Design Elements:
  - Inlet grating: Stainless steel mesh (1 cm spacing) to trap large waste.
  - Settling pit (1 m × 1 m × 1 m): For sand and heavy particles to settle down before entering the filter zone.

Phase 2: No-Fine Concrete Filter Bed

- Objective: Physical filtration and slow percolation to reduce turbidity and trap fine suspended solids.
- Material Composition: Cement, coarse aggregates (10–20 mm), and water (no sand).
- Placement:
  - Installed at the bed of the naala in a layered manner.
  - Dimensions: 2 m × 1 m × 0.15 m (each slab)
  - Multiple slabs arranged in series with gaps for water flow.
- Properties:
  - Porosity: 25–30% for natural infiltration.
  - Load-bearing and erosion-resistant.
  - Allows oxygen to mix with water, promoting aerobic bacterial activity.

Phase 3: Water Hyacinth Treatment Zone

- Objective: Photo-remediation to absorb excess nutrients (like nitrates, phosphates), and trap fine pollutants.
- Design:
  - Floating raft system (Bamboo or thermocol-supported trays).
  - Coverage: 50–60% of the water surface for optimal light and oxygen penetration.
  - Root length: ~30 cm below surface to interact with flowing water.
- Function:
  - Roots absorb nutrients and heavy metals.
  - Provides habitat for aerobic microbes that naturally degrade organics.

Phase 4: Bacta Cult Microbial Treatment

- Objective: Biodegradation of organic matter, reduction of BOD/COD, and odor suppression.
- Application Method:
  - Powdered Bacta Cult (aerobic) mixed with water and poured directly into naala or storage tanks.
  - Applied weekly or based on contamination level.
- Specifications:
  - Activation rate: 95–98%
  - Working temperature range: 5°C to 45°C
  - Shelf life: 2 years
- Mechanism:
  - Bacteria feed on sewage and organic contaminants.
  - Converts pollutants into CO_2, water, and harmless biomass.

Phase 5: Outlet Collection & Quality Testing

- Outlet Chamber Design:
  - Final tank (1.5 m × 1.5 m × 1 m) with outlet mesh and overflow pipe.
  - Water stored temporarily for final inspection and post-treatment analysis.
- Water Reuse: If within permissible limits, water can be reused for:
  - Gardening and landscaping
  - Street cleaning
  - Ground recharge through pits

Fig No 3:Working Model Of Eco-Stream Optimization

III.OBSERVATIONS

Water samples from Sambhaji Lake Naala were analyzed before and after implementing the EcoStream Optimization treatment. Key parameters assessed included pH, BOD, COD, and chloride concentration. The results showed a marked improvement in overall water quality:

- Biological Oxygen Demand (BOD) reduced from 46.4 mg/L to 29 mg/L, bringing it within the permissible limit of 30 mg/L.
- Chemical Oxygen Demand (COD) dropped from 130.1 mg/L to 110 mg/L, well below the threshold of 250 mg/L.
- pH levels improved slightly from 7.08 to 7.3, indicating a healthier balance suitable for aquatic life.
- Chloride concentration decreased from 43.19 mg/L to 38 mg/L, remaining safely within acceptable environmental standards.

These results demonstrate the effectiveness of the integrated system comprising water hyacinth, Bacta Cult bioculture, and no-fine concrete slabs in reducing pollutant load.

Parameter	Before Treatment	After Treatment	Permissible Limit (IS 3025)
pH	7.08	7.3	6.5 – 8.5
BOD (mg/L)	46.4	29	≤ 30
COD (mg/L)	130.1	110	≤ 250
Chloride (mg/L)	43.19	38	45 – 155

Fig No 4: Testing Of Water Sample

IV. CONCLUSION AND FUTURE SCOPE

The EcoStream Optimization project successfully demonstrated a sustainable and cost-effective approach for treating polluted naalas using natural and biological systems. By integrating water hyacinth for phytoremediation, Bacta Cult bioculture for microbial degradation, and no-fine concrete for filtration, the treatment significantly improved water quality at Sambhaji Lake Naala. Key parameters such as BOD, COD, pH, and chloride levels were brought within permissible limits, confirming the system's effectiveness.

The model operates without electricity, requires minimal maintenance, and supports water reuse and sludge repurposing. Its low-cost, modular design makes it highly replicable in urban, semi-urban, and rural settings where centralized sewage treatment infrastructure is lacking. Beyond environmental restoration, the project promotes public health, biodiversity, and community participation, aligning well with national goals under Swachh Bharat and Jal Shakti missions.

The EcoStream Optimization model offers significant potential for future expansion and innovation. It can be adapted for use in other polluted lakes, naalas, and canals across both urban and rural regions. With the integration of IoT-based water quality monitoring and automated dosing systems, the setup can evolve into a smart, real-time water treatment unit. Additionally, treated water can be further explored for agricultural, horticultural, or industrial reuse.

There is also scope for scaling the sludge-to-brick process to promote circular construction practices. Municipal bodies can adopt this model under national initiatives like AMRUT, Smart Cities Mission, and Jal Shakti Abhiyan. With increased community engagement and policy support, the EcoStream system can become a standard decentralized solution for sustainable wastewater management in India.

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