- **Project ID:**
- **Project Title:** ***BioSmart Filter: A Prototype for AI Powered Biodegradable Sewage Treatment (Prototype)***
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a. INTRODUCTION:

This research in environmental science and electronics focuses on the development of a smart, low-cost, biodegradable sewage filtration system. The increasing problem of water pollution due to untreated sewage requires innovative solutions, especially for rural and underserved communities.

This project aims to design a multi-layer filter using biodegradable materials like coconut coir and banana fiber, integrated with electronic sensors and AI-based prediction to monitor water quality and filter efficiency in real-time.

This system combines sustainable materials with smart monitoring to improve access to clean water while reducing environmental impact.

b. SELECTION OF PROBLEM AND BACKGROUND INFORMATION:

Untreated sewage is a significant contributor to river and groundwater pollution in India and many developing regions. Traditional filtration systems are expensive, use non-biodegradable materials, and lack smart monitoring.

Biodegradable materials like banana fiber and coconut coir have natural filtering properties. Pairing them with low-cost electronics (pH, turbidity, and TDS sensors) and AI models can offer a sustainable and scalable sewage treatment solution.

This innovation addresses both the environmental challenge of water pollution and the technological gap in real-time monitoring and predictive maintenance.

c. OBJECTIVE OF RESEARCH:

Statement of the Problem:
Can biodegradable materials effectively filter sewage water, and can AI monitoring increase the efficiency and predictability of small-scale sewage treatment systems?

Plan for The Experimental Design:

- Use biodegradable materials (coconut coir, banana fiber, sand) as filters.
- Embed electronic sensors to measure **pH, turbidity, and TDS**.
- Use Arduino and ESP8266 for data logging and cloud upload.
- Train an AI model (e.g., Decision Tree) to predict filter saturation and maintenance needs.

Variables:

• **Independent Variable: Filter material type and thickness**
• **Dependent Variable: Water quality (pH, turbidity, TDS) after filtration**
• **Controlled Variables: Flow rate, initial contamination level, sensor calibration**

d. HYPOTHESIS:

A multi-layer biodegradable filter system using materials like **banana fiber and coconut coir**, monitored through **AI-analyzed sensor data**, will effectively purify sewage water and provide timely alerts for maintenance, creating a sustainable and smart filtration solution.

e.PROCEDURES

DESIGN OF STUDY:

INDEPENDENT VARIABLE: **Type and thickness of biodegradable filter materials**
DEPENDENT VARIABLE: **Water quality (pH, turbidity, TDS)**
CONTROLLED VARIABLES: **Flow rate, contamination level, environment temperature**

MATERIALS:

- Coconut coir
- Banana fiber
- Sand
- 4 PVC/glass filter columns
- Arduino Uno/Nano
- ESP8266 Wi-Fi module
- pH sensor
- Turbidity sensor
- TDS sensor
- Water container with simulated sewage
- Data logging software (e.g., Google Sheets / ThingSpeak)
- Laptop for AI model training
- Gloves, masks, waterproof casing

PROCEDURE:

Filter Construction:

- Prepare 3-layer filters:
  - Top: Coconut coir

- Middle: Fine sand
- Bottom: Banana fiber
- Fit layers into vertically oriented transparent containers.

Electronic Setup:

- The **pH, turbidity, and TDS sensors** require analog input. Since the ESP8266 has only one analog pin, an **Arduino Uno** is used to read multiple sensor values.
- Connect the sensors (pH, turbidity, TDS) to the **analog pins of Arduino Uno**.
- Use **serial communication (TX/RX)** to send sensor readings from Arduino to the ESP8266 module.
- The ESP8266 handles **Wi-Fi connectivity and cloud data upload** (Google Sheets / ThingSpeak).
- Calibrate sensors using distilled and contaminated water.
- Power the system using a **USB power bank** or 5V adapter, with waterproof casing for safety.

Testing & AI Data Collection:

- Pour simulated sewage water into filters.
- Record sensor readings before and after filtration.
- Log data continuously over time to build dataset.
- Train AI model using sensor data to predict:
  - When filter quality drops below threshold
  - When maintenance is required

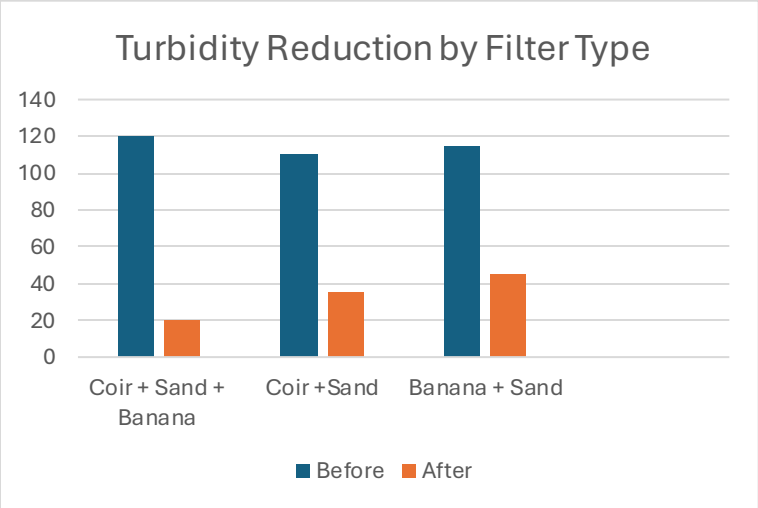
EXPERIMENTAL PLAN:

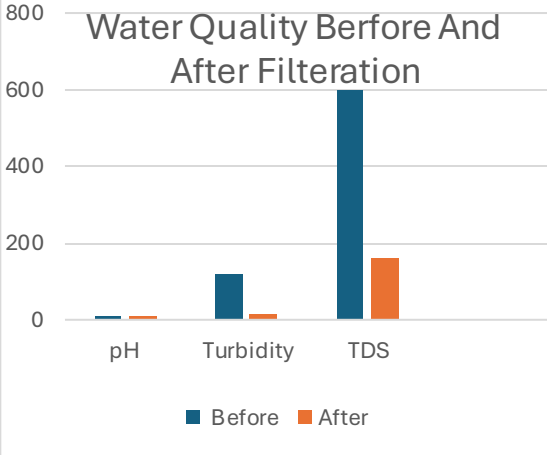
Sample No.	Filter Type	pH (Before)	pH (After)	Turbidity (NTU)Before	Turbidity After	TDS Before	TDS After	AI Prediction
1	Coir + Sand + Banana							
2	Coir + Sand							
3	Banana + Sand							

DATA TO BE ADDED AFTER ANALYSIS

g. DATA ANALYSIS:

- **Compare** pre- and post-filtration values for:





DATA TO BE STORED AFTER ANALYSIS

- pH
- Turbidity
- TDS

f. RISK AND SAFETY:

RISKS:

- Electrical components near water
- Exposure to potentially contaminated water

PRECAUTIONS:

- Use **simulated sewage water** (non-hazardous)
- Use **waterproof enclosures** for electronics
- Wear **gloves and masks** during handling
- Maintain **distance from power sources**

h. BIBLIOGRAPHY:

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