PROJECT TITLE:

Hybrid Low-Cost Water Purification System Using Locally Available Materials: Modeling, Design, and Prototype Testing in Nigeria

STUDENT RESEARCHER:

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PROJECT DURATION:

Dec 2025 – May 2026

1. BACKGROUND & MOTIVATION

Many communities in Nigeria face polluted water from agricultural runoff, roadside contamination, and poorly maintained boreholes. Low-cost filtration systems exist, but they often use only one treatment method. Research suggests that combining sand filtration, charcoal adsorption, and plant-based biosorbents can significantly improve water quality. This project aims to design, model, build, and test a hybrid system suitable for Nigerian conditions.

2. RESEARCH QUESTIONS

1. Can a hybrid system (sand + charcoal + biosorbent) significantly reduce turbidity and impurities?

2. Can mathematical models predict system performance accurately?

3. How do layer thickness, particle size, and flow rate affect purification?

4. Is the system stable and deployable for a small pilot?

3. OBJECTIVES

- Perform literature review and theoretical modeling.

- Characterize local materials (density, porosity, grain size).

- Develop mathematical models (Darcy flow, adsorption isotherms).

- Construct and test a hybrid system.

- Validate predictions and produce a final full report.

4. METHOD SUMMARY

Phase 1 — Modelling & Design (Dec–Feb):

Darcy flow, adsorption modeling, CAD design, test planning.

Phase 2 — Prototype Build & Testing (March):

Source materials, build system, measure turbidity/pH/flow.

Phase 3 — Analysis & Reporting (Apr–May):

Compare models vs. data, optimize design, publish results.

5. EXPECTED OUTCOMES

- A functional hybrid purification prototype.
- Validated mathematical models.
- Documented improvements in water quality.
- A research paper, website, and optional pilot installation.

6. ETHICS & SAFETY

No culturing harmful microorganisms. Safe disposal. University deployment requires permission.

7. DELIVERABLES

- Literature review
- Material characterization data
- Modeling notebook (Python)
- CAD drawings
- Prototype dataset
- Final report
- Website
- Poster + summary