Title: Cost Effective Household-scale Greywater Treatment Solutions Applicable to Dhaka Region

Background

Bangladesh is one of the fastest urbanizing countries in the world (Asia-Europe Foundation 2021). It had an urban population of 8.78% in 1974, which increased to 23.81% in 2001 (Hossain et al. 2015), and is projected to become 64.9% by 2050 (United Nations 2025). Furthermore, Dhaka is among the fastest growing with population expected to reach 52.1 million and become the world's largest city by 2050 (United Nations 2025). This rapid growth is putting an unsustainable strain on the city's water resources.

Currently, 82% of Dhaka's water supply is extracted from groundwater (Azharul Haq 2006). This over-reliance has caused groundwater levels to drop two to three meters every year (Bin Mamoon et al. 2021). The crisis is most visible in densely populated areas like Mirpur, Sabujbagh, Tejgaon, Gulshan, and Mohammadpur where water levels are the lowest in Dhaka. Furthermore, Gulshan and Mohammadpur are experiencing the fastest rates of decline in the entire region (Bin Mamoon et al. 2021). When groundwater disappears this quickly, existing wells run dry, and the surrounding environment suffers as wetlands and surface water bodies vanish.

The irony of this crisis lies in how we use water. Out of the total water withdrawn in Bangladesh, only about 1% is actually required for direct human consumption, such as drinking (World Resources Institute 2004). The remaining 99% is often "high-quality" groundwater used for tasks that do not require drinking-grade water, such as flushing toilets or cleaning floors.

Much of this water ends up as greywater, the wastewater from showers, sinks, and laundry. Greywater makes up about 50-80% of household's total wastewater (Van de Walle et al. 2023). Yet in Dhaka, it is allowed to flow directly into the drains. By treating and reusing this greywater at household level, especially in high-decline areas like Gulshan and Mohammadpur, we can significantly reduce the demand for fresh groundwater.

Problem Statement

This study will highlight the utility of cost effective, household-scale greywater treatment as a cost-effective solution to the rapid groundwater depletion in Dhaka. Using this approach, we shall design and evaluate a modular, decentralized filtration system to enable water reuse for non-potable activities in affected residential areas.

Objectives

1. To design and develop a cost effective, modular, household-scale greywater treatment system using locally sourced, affordable materials suitable for the residential infrastructure of Dhaka.
2. To evaluate the filtration efficiency of the proposed system by measuring the reduction of key pollutants (such as turbidity, BOD, and TC) to ensure the treated water meets safety standards for non-potable uses.

3. To analyze the economic feasibility and maintenance requirements of the system to ensure it remains a practical and sustainable solution for households and commercial sites (such as hotels) in water-stressed areas like Gulshan and Mohammadpur.

Research Outcomes

1. Design and prototype of a low-cost, modular household-scale filtration unit to treat greywater for non-potable use.
2. Development of an operational manual and maintenance protocol for households to ensure the system consistently produces water safe enough for toilet flushing, floor cleaning, and gardening.

Research Methodology

The research will consist of the following phases:

Phase 1: Prototype Development

1. Component integration
    a. Pre-tank filtration: Grease trap and coarse mesh screen to remove oil, hair, lint, and large debris.
    b. MABR unit: Simplified Membrane Aerated Biofilm Reactor for biological treatment.
    c. Secondary filtration & disinfection: Fine membrane filtration followed by chlorine tablet dosing.
2. Storage and distribution: Treated water stored in a small tank; low-power pump supplies water to toilets and cleaning taps.

Phase 2: Laboratory Performance Evaluation

1. Sampling: Collection of influent (untreated) and effluent (treated) greywater.
2. Water quality testing: Analysis of turbidity, BOD, total coliforms, pH, and chlorine residuals to assess compliance with non-potable reuse standards.

Phase 3: Durability and Economic Analysis

1. Stress testing: Continuous operation (~30 days) to identify issues like clogging or pump overheating.
2. Cost-benefit analysis: Estimation of capital and operating costs; comparison with Dhaka WASA tariffs to determine payback period.

Phase 4: Final Reporting

1. Manual development: Simple user guide covering installation, maintenance, and troubleshooting.
2. Research compilation: Integration of experimental and economic findings into a final report.

Resources Required

S/N	Item	Unit	Unit Price (Tk)	Total Price (Tk)
Mechanical:				
01	Storage tanks	2	2,000	4,000
02	Booster pump	1	5,000	5,000
03	MABR membrane module	1	1,800	1,800
04	Secondary filtration cartridge	2	350	700
05	Grease trap & coarse mesh	1	2,500	2,500
06	Plumbing kit	1	3,500	3,500
Analytical & testing:				
07	Equipments (through MIST)			1,500
08	Chemicals & reagents	15	1,500	22,500
09	Electricity	840	10	8,400
Documentation:				
10	Operational manual production	5	350	1,750
Total				**51,650**

Team Members

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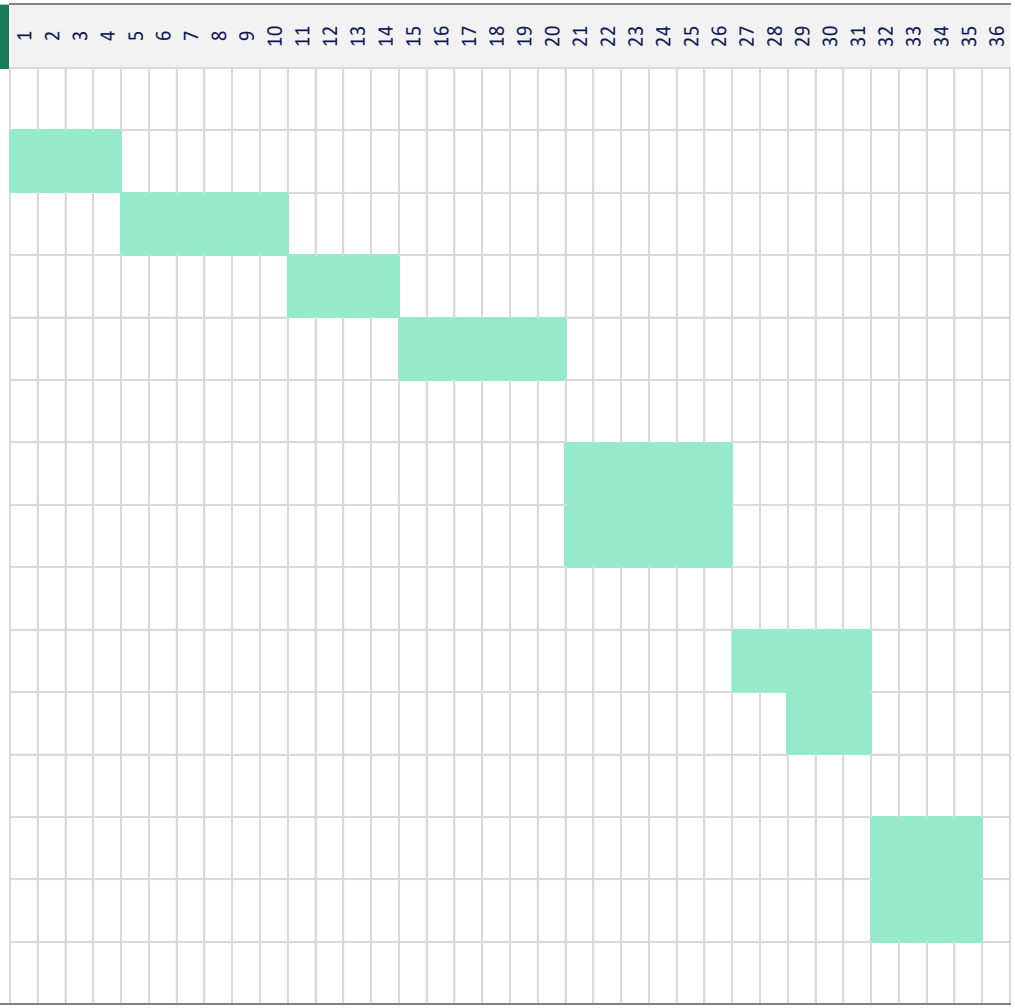
Outline Structure for Report to be Submitted

The research outcome will be presented as a report containing the following:

1. Title page: containing research title, conducting department, team members
2. Executive summary
3. Table of content
4. Chapter one: Background of the Research, Statement of Problem, Research Objectives, Scope of the Research
5. Chapter two: Research Methodology
6. Chapter three: Research Outcome
7. Chapter four: Conclusion

Tentative Time Frame

Activity	Start	Weeks
Phase 1: Prototype Development		
Planning	1	4
Build	5	6
Setup	11	4
Testing and fixes	15	6
Phase 2: Laboratory Tests		
Sampling	21	6
Water quality testing	21	6
Phase 3: Durability and Economic Analysis		
Stress testing	27	5
Cost benefit analysis	29	3
Phase 4: Final Reporting		
Manual development	32	4
Report writing	32	4



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