

TECHNICAL OPTION BROUGHT SOLUTION FOR SAFE WASTE WATER MANAGEMENT IN URBAN PUBLIC TOILET AND IMPROVED GROUND WATER TABLE.

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ABSTRACT

In many parts of the world, health problems in slum area have often been caused by untreated wastewater. The objective of this paper is to determine the unhygienic situation of public toilet due to discharge water and treat the waste water to avail the health impact on slum population of Delhi city. Thus, Slum population are fully dependent on public toilet to defecate. In Public toilets manholes either connected with Sewer line or septic tank. Septic tank connected public toilet faces major challenges to dispose waste water. They have to dispose waste water in outside open drain and waste water struck out side of public toilet complex and near to the slum area. As a result, outbreak diseases such as Malaria, Dengue and Chikungunya in slum area due to stagnated waste water.

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INTRODUCTION AND CONTEXT:

India faces major challenges in improving the coverage of quality services and practices for the poorest and most marginalised groups. The urban population of India constitutes 377 million people according to 2011 census and is estimated to reach 534 million by 2026. Delhi, being the national capital, is home to around 16 million people, and it is likely to reach 27.9 million by 2026. This population growth and rapid urbanization has resulted in nearly 2 Lacs migrants along with families moving to Delhi each year in search of jobs. Most of these poor migrant families end up living in slums and constitute an estimated population of 1.87 lacs every year. Further, more than half (52 per cent) of Delhi's population resides in places such as unauthorized and resettled colonies.

According to Save the Children's baseline survey conducted in 60 slum clusters within six districts of Delhi, 87.6% of households in Delhi's South district slums (the target area for this intervention) don't take any measure to purify their drinking water. In terms of sanitation Facilities/practices, found in worst condition of existing functional public toilets without maintenance and cleanliness.

These public toilet complexes were facing waste water disposal problem. They were disposing minimum 1800 liters waste water every day in open drain. Which caused stagnated water borne diseases among the nearest community.

This situation is particularly alarming in the slums of Delhi, where every day an inexcusable number of children die/sick from easily preventable diseases resulting from stagnated water borne diseases (Like: Malaria, Dengue and Chikungunya etc.).

1. METHODOLOGY

WATER SOURCES

Wastewater (Like- Handwashing, Cloth Washing, Bathing and Cleaning) generated in the Toilet complex is channeled into a central drain that leads to the pre-treatment main wholes of the Soak well pit. Sources of wastewater generated in the toilet complex includes wastewater generated from cleaning the floors, washing of hand, cloths, and bathing. These water flow through central drain to pre-treatment main wholes and finally process for treatment and safe disposal for group water level recharging.

WATER TREATMENT PROCESS AND RECHARGING

The Wastewater disposal system is the batch type and consist of four main components. The pretreatment manhole cum drainage, balancing equalizing manhole and filter media pit. In treatment process, we are going to show local available filter media to treat waste water before discharging for Ground water recharging and additionally piloted for irrigation drain for kitchen garden.

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Fig-1



Fig-2



Fig-3

1.1 IDENTIFICATION & SAMPLING:

We conducted sanitary surveillance for each of the slum and find out the sources of stagnated water. We found that a huge amount of wastewater disposing from nearest public toilet. Which saturated without having facilities to connect waste water with sewerage system. Public toilet always equipped in slum area with male and female section separately with toilet, bathing and washing blocks. Slum population totally depend on this defecation, bathing even washing clothes. In case of women, come once to finish their domestic work to wash clothes and daily sanitation once to complex. We found that, all bathing, cleaning and washing clothes waste water was connected with separate drain and open outlet outside of toilet complex. In this condition, Wastewater get stagnated outside of toilet complex and sprayed near to slum houses. They were disposing minimum 1800 liters wastewater every day in open drain. And due to lack of drainage facilities in slum public stand water point wastewater is unable to dispose in sewer line. Which cause stagnated water borne diseases among the nearest community.

1.2 WASTE WATER ANALYSIS

Public Toilet and household wastewater can be categorized as either “black water or “greywater” depending upon the source of the water and its solids loading. Water in the toilet and cloth washing are considered as potentially contaminated by bacteria, some of which may be pathogenic (cause illness).



Diagram-1: Types of Wastewater

1.3 COMMUNITY PARTICIPATION FOR SOLUTION:

Community group meeting has conducted and understand the problem. We conducted Triggering Community Lead Water & Sanitation revolution walk in the slum and identified water stagnated places. Two major location found by community people i.e.

- Near to the toilet complex
- Around the Water Stand point

Where greywater breed mosquitoes and sprayed waterborne diseases among the Community. Community groups understand the reason for children and adults illness. Toilet disposal bathroom and wash room greywater was big challenge to disposal/drain on safer place. It wasn't possible due to lake of drainage facility near to toilet complex and less maintenance of drainage. Water Stand point exist in low laying area of slum. So, same toilet complex water stagnated around the water stand points. This critical problem was alarming diseases like Malaria, Dengue and Chikungunya in slum.

1.4 GREYWATER SAMPLING:

Greywater has a highly variable chemistry depending upon the activities of the residents and the volume of water and the chemicals used. In public toilet, Just consider for a moment what happens with body sweat, hair, skin, bacteria from the body and other bits of us that we wash down- study tell that about 2 kg of skin, hair and body exudates per person per year. The greywater, therefore,

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has not only solids and dissolved salt. Many of the chemicals we use are detrimental to plants and soil so control over the quantity that enters greywater need to be considered when greywater is to be use as an irrigation resource. It's not that we shouldn't reuse greywater, just that we must understand some of the consequences of not using it wisely. So, we collected the greywater sample to find available amount of parameters and compound in greywater.

Parameters	Average amount	Permissible Limit
pH value	9.67	6.5 to 8
Salinity	250 mg/l	3 mg/l
Sodium (Na)	1200 gms/day in public toilet complex.	Assuming 20 g per wash and in a day 60 users wash clothes



Diagram-2: Testing Report

Table-1: Testing Parameters

3.5 DEVELOPMENT OF CONCEPTUAL MODEL:

As above said in paragraphs soil control over the quantity of chemicals and compound available in greywater. By analyzing the problem and contamination triggered technique to conceptualize model to safe disposal and recycle greywater for the least environmental and health impact.

Soak pit can offer a cost-efficient opportunity for a partial treatment of waste-greywater from a primary treatment and a relative safe way of discharging it to the environment and therewith recharging ground bodies.

In addition, we pilot few places read bed technique along with soak well to manage the overload discharge on soak well. That's read bed connected with filter channel and discharge the water for irrigation of kitchen garden.

As wastewater percolates through the soil from the soak pit, small particles are filtered out of soil matrix and organic are digested by microorganism. The wastewater effluent is absorbed by soil particles and move both horizontal and vertically through soil pores. Sub-soil layers should therefore be water permeable in order to avoid fast saturation. High daily volume of discharged effluent managed in our technique by proving of read bed for irrigation. Thus, soak pits are best suited for soil with good adsorptive properties; clay, hard packed or rocky soil is not appropriate. Soak pits are use same way as leach fields, but require less space as well as less operation and maintenance. But generally can also receive less influent and the groundwater pollution me be higher than which leach field.

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3.6 DESIGN CONSIDERATION

The Soak pit consisting basically of a simple pit should be between 1.5 and 4 m deep, but as a standard practice, never less than 2 m above the ground table. It should be located at a safe distance from drinking water source (ideally more than 30 m). The soak pit should be kept away from high traffic area so that soil above and around it is not compacted. It can be left empty and lined with porous materials to provide support and prevent collapse, and left unlined and filled with coarse rock gravel. The rocks and gravel will prevent the walls from collapsing, but will provide adequate space for the wastewater. In both case, a layer of sand and fine gravel should be spread across the bottom to help disperse the flow. To allow for future access, a removable (preferably concrete) lid should be use to seal the pit until it needs to be maintained.

In implementation design, we took standard size 2 m for public toilet complex and water stand point. The structure constructed in cylindrical form and designed outer diameter 1 m. Sites are well identified and saturated at toilet complex premises and near to water stand points. Preliminary treatment of greywater has done through the main wholes and drainage. In design, this preliminary drainage finally connected with soak well pit and additional read bed connected adjacent of pit to Anaerobic and Aerobic tank and treat overloaded water for kitchen garden.

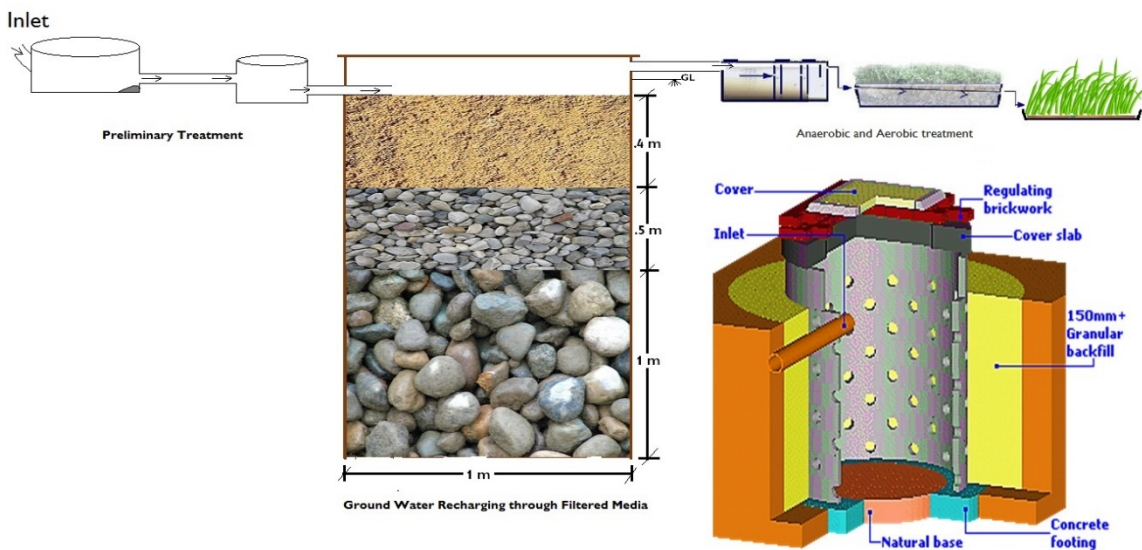


Diagram: Design & Flow process of Treatment

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3.7 FILTER MEDIA MATERIALS AND FUNCTION

- **Rock Gravel:** Rock gravel comes from sedimentary rocks. They get buried under the thousands and thousands of feet of the other rocks and turn to stone. This mostly find out near to ocean and river. We used 3-5 inches rock gravel stone to fill from bottom up to 1 m of the pit.
- **Pea/small Gravel:** Pea gravel is a small, rounded rock that got its name because the rocks are about size of a pea. In construction, we used different size- 1-3 inches small gravel stone 0.5 m of pit from filling rock gravel stone.
- **Fine Sand & Coarse sand:** Properties wise these both sands are top in percolation compare to other sand. This sand infiltrate/percolate 1.25 inches and 0.94 inches per hours. After the small gravel stone layer, mix of both sand (fine & Corse) filled up to top layer (0.4 m).

3.8 ORIENTATION OF STAFF AND MASON

- Trained Partner organization staff about function and benefit of Soak well pit.
- Developed design and construction monitoring plan and observe implementation of specification of design.
- Partner staff's organize meeting with community health volunteer and local ULBs meeting at slums.
- Conducted participatory mapping to identify local skilled mason and labour for construction.
- Organized training for skilled mason and labour on design and construction.
- Oriented skilled mason on technical trick and measures to add during construction.

3.9 CONSTRUCTION PROCESS & FUNCTION OF SOAK WELL PIT

- Identify site and cleaned properly and check seepage and moisture content of soil.
- Excavate and Dig 2 m deep and more the 1 m dia. well.
- In bottom of well, constructed 10 inch wide 2 inch ring foundation.
- Start brick masonry on foundation up to 2 m of the deep well. And keep 2 inch duck whole within the brick wall after every 12 inch of brick masonry.
- After completing of brick wall leave it one complete day for curing.
- After one day of curing filled the well 1 m from bottom with 3-5 inch size rock gravel.
- Next filled pea/small stone 0.5 m from rock gravel layer.

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- Remaining space of well/pit will filled by fine and coarse sand.
- Casted concrete slab of 1 m dia. and 75 mm thickness.
- Constructed pit/well connected with inlet and outlet section.
- From both the side (inlet & outlet) connected with 700 mm x 700 mm x 700 mm main wholes chambers.
- The inlet chambers connected with preliminary treatment drainage.
- The outlet chamber exist more adjacent 2 blocks size with 600 mm x 600 mm x 600 mm and closed with valve called as read bed with ½ slop.
- This adjacent block worked as Anaerobic and Aerobic tank and treat the water and drain for irrigation.
- Whenever, discharge from preliminary treatment drainage exceed from his basic limit then outlet valve switch on for read bed.
- In this, this water get speeded for irrigation and main water has percolated through each of the filter media and use to increase the ground water level near to same premises.

3.10 COSTING OF CONCEPTUAL MODEL

S No.	Particulars	Qty.	Unit
1	Bricks	420	Nos
2	Dust	0.4	cum
3	Cement	3.5	(50 kg bag)
4	PVC Pipe	3	m
5	River Gravel	0.8	cum
6	Small Gravel	0.4	cum
7	Sand	0.4	cum
8	RCC Cover	1	Nos
9	Manson & Labour	4	Person
10	Extra Wages and Mis.		Lumsum

Table 2: Estimation of Model



Fig 4: Estimation of Model

4 RESULT AND IMPACT.

4.5 IMPACT ON WASTE WATER MANAGEMENT

- Remove water logging problem near to slum house.
- Public toilet complex get cleaned and odourless.

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- Ground water table of bore well get recharged and worked around complete years. And its protected borewell dryness problem in summer.
- Drinking water stand point has protection and wastewater discharged by this pit.
- Kitchen gardening in toilet complex was unique model introduced. And irrigation managed by the waste discharge water after preliminary treatment.

4.6 HEALTH ASPECT AND ACCEPTANCE

As long as the soak pit is not used for raw sewage, and as the previous collection and storage/treatment technology is functioning well, health concerns are minimal. The technology is located underground and, thus, humans and animals should have no contact with effluent. It is important however, that the soak pit located at a safe distance from a drinking water source (ideally at least 30 m). There are few more acceptance:

- Constructed soak pit is odourless and not visible.
- Reduced stagnated water borne diseases.
- Reduced in breeding of mosquitos and flies.
- It accepted by most sensitive community.

5 OPERATION AND MAINTENANCE

As well sized soak pit should last between 3 to 5 years without maintenance. As we constructed in Delhi, Still well and good functioning without any maintenance. To extend the life of a soak pit, care should be taken to ensure that effluent has been clarified and or/filtered to prevent the excessive buildup of solids.

Constructed Soak pit kept away from high-traffic area so that the soil above and around it is not compacted. Particles and biomass will eventually clog the pit and it will need to be cleaned or moved. When the performance of the soak pit deteriorates, the top sand layer inside the soak pit can be excavated and refilled.

6 APPLICABILITY

A soak pit does not provide adequate treatment for greywater. It should be used for discharging pre-settled greywater and blackwater.

Soak pits was popular in rural context. But our intervention is innovative approach to introduce in urban setting. It depend on the sand adsorptive capacity, whereas clay soil as well as hard packed or rocky soils are not appropriate. They can be used in almost every temperature, although there may be problems with pooling effluent in areas where the ground freeze. This technique is not appropriate for areas prone to flooding or that have high groundwater table.

7 ADVANTAGES

- Can be built and repaired with locally available materials
- Simple technique and easy to apply for all user.

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- Covered small land areas.
- Low construction cost and zero operating cost.
- Recharging ground water table.

8 DIS-ADVANTAGES

- Preliminary treatment required to prevent clogging
- Applicable only where soil conditions allow infiltration, the groundwater table is at least 1.5 m below the soak pit.
- Difficult to implement in cold climate.
- Should be protected from high effluents compaction.

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