Decentralized Wastewater Management –
An overview of a community initiatives in New Delhi, India

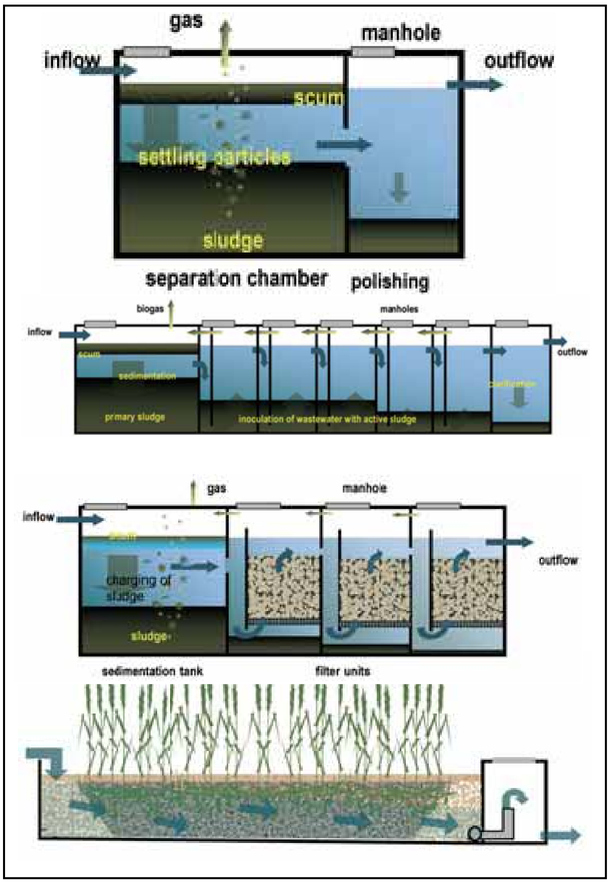
Abstract

This paper argues that centralized approaches to wastewater treatment have had limited success and there is a need to make wastewater treatment people-centric and effective through the use of decentralized systems such as DEWATS (Decentralized Wastewater Treatment Systems). The paper looks at an initiative by a Delhi-based NGO which uses natural methods for DEWATS for use in Sewage Treatment Plants (STPs) with household, colony and urban effluents. Such decentralized initiatives have met with success after broad issues such as funding were looked after. There is a need for capacity building of community institutions and participation by urban local bodies in order to scale up and replicate such innovative approaches in the future.

Introduction

Decentralized Wastewater Treatment Systems (DEWATS) is rather a technical approach than merely a technology package. In general, DEWATS are locally organized and people-driven systems that typically comprise a settler, anaerobic baffled tanks, filter beds of gravel and sand, and an open pond (See *figure 1)*. The open pond or the polishing tank recreates a living environment for the wastewater to clean itself, naturally.

Figure 1: Schematic diagram of DEWATS



The system operates without mechanical means and sewage flows by gravity through the different components of the system. Up to 1,000 cubic metre of domestic and non-toxic industrial sewage can be treated by this system *(Tency Baetens, 2004)*. DEWATS applications are based on the principle of low-maintenance since most important parts of the system work without technical electrical energy inputs and cannot be switched off intentionally (*BORDA*).

DEWATS applications provide state-of-the-art-technology at affordable prices because all of the materials used for construction are locally available. DEWATS approach is an effective, efficient and affordable wastewater treatment solution for not only small and medium sized enterprises (SME) but also for the un-served (rural and urban) households in developing countries, especially South Asia. For instance, DEWATS can operate in individual households, at the neighborhood level and even in small and big factories not connected to sewage lines. DEWATS can also treat municipal waste. The recycled water is used for irrigation or for growing plants and is absolutely safe for human use.

The need for decentralized initiatives in wastewater treatment

In India, about 12 million (7.87 %) urban households do not have access to latrines and defecate in the open. About 5 million (8.13 %) urban households use community latrines and 13.4 million households (19.49 %) use shared latrines. About 12 million (18.5 %) households do not have access to a drainage network while about 27 million (39.8 %) households are connected to open drains. The status in respect of the urban poor is even worse. The percentage of notified and non-notified slums without latrines is 17 percent and 51 percent respectively. More than 37% of the total human excreta generated in urban India, is unsafely disposed. This imposes significant public health and environmental costs to urban areas that contribute more than 60% of the country's GDP. Impacts of poor sanitation are especially significant for the urban poor (22% of total urban population), women, children and the elderly. Inadequate discharge of untreated domestic/ municipal wastewater has resulted in contamination of 75 percent of all surface water across India.

The Millennium Development Goals (MDGs) enjoin upon the signatory nations to extend access to improved sanitation to at least half the urban population by 2015, and 100% access by 2025. This implies extending coverage to households without improved sanitation, and providing proper sanitation facilities in public places to make cities open-defecation free.

The quantity of wastewater is increasing in India because of: i) Rapid urbanization, continuously widening the gap between waste generation and waste treatment; ii) Pollution of surface and groundwater water resources because of inadequate infrastructure for collection and treatment of domestic wastewater; and (iii) Inadequate financial resources and capacity for infrastructure required for treating wastewater at city levels or through a centralized approach.

Specifically in India, domestic wastewater, including sewage that is often not even collected, is a major source of pollution of surface water. This contributes to contamination of groundwater - an important or only source of drinking water for many urban and peri-urban areas. In addition, the economies of scale required for using conventional technologies would not be achieved in all settlements for various reasons, including: i) different climatic conditions; ii) topography; iii) geological conditions and water tables; iv) levels of urbanization; and v) population densities and size of settlements.

Further, centralized approaches have had limited success to make wastewater management people-centered and effective. For instance, large areas in most cities are not served by formally provided sewerage. Facilities are often overloaded and poorly maintained and the wastewater flow is often re-directed to by-pass them. Even where sewerage systems exist, they often collect only a small proportion of the wastewater produced, and the remainder is discharged to open drains or disposed of locally. Thus, in India, decentralized and low-cost wastewater treatment and waste management provide more appropriate solutions in several situations.

In India, small-scale decentralized composting plants are also found frequently at community level. Numerous initiatives have developed, in particular, as a result of the unbearable solid waste accumulation in residential areas. Such initiatives have also been taken at city level, e.g. the cities of Pune and Mumbai have adopted promising composting approaches at community level (together with primary waste collection), which are actively promoted by the authorities *(Zurbrugg et al, 2004)*.

Appropriate Wastewater Treatment Technologies in India

A single wastewater treatment technology would be inappropriate for a country like India which has several different geographical and geological regions, varied climatic conditions and levels of urbanization. It is more appropriate to address the potential of identifying appropriate solutions for different regions. In addition, the solutions for wastewater treatment are a response to several factors including: i) the volume of wastewater; ii) type of pollutants; iii) the treatment cost; iv) extent of water scarcity; and v) dilution in the water.

A significant opportunity available in India is to introduce decentralized systems through which the resources generated from the wastewater, including recycled water and manure etc., can be utilized locally at much lower costs.

Five wastewater treatment technologies, namely, i) waste stabilization ponds; ii) wastewater storage and treatment reservoirs; iii) constructed wetlands; iv) chemically enhanced primary treatment; and v) up flow anaerobic sludge blanket reactors are suitable for different situations. Each of these has some advantages and some disadvantages, especially in terms of requirements for land.

All these solutions for wastewater treatment aim at innovations across a broad range of environmental issues including: i) reuse of wastewater; ii) removal of nutrients from effluent; iii) management of storm water; iv) managing solid wastes; v) flood mitigation; and vi) tackling erosion around water bodies, including ponds, lakes and riverbank.

However, from the sustainability aspect, the selection of the appropriate solution must be balanced between simple systems that do not require use of chemicals and those that have high pathogen removal. Motivating the community as a whole to work towards effective functioning of a (local) system Is one of the critical prerequisite for DEWATS to succeed.

Innovative approaches applying DEWATS by Vigyan Vijay, NGO at NCT of Delhi

Figure 2: IIT-Delhi WWT R&D Plant

The Vigyan Vijay Foundation, based in Delhi, aims at developing appropriate technology for sustainable development through initiatives in slum development, computer education for the urban poor, and environmental sustainability. The Foundation has been involved in over 120 urban decentralized initiatives such as solid waste management, rain-water harvesting, waste-water treatment, bio-gas from kitchen waste.

Its initiatives in waste water treatment include - initiatives for decentralized treatment of waste-water and its reuse for horticultural or landscaping purpose, also leading to ground-water recharge. For instance, the Foundation established a plant in Vasant Vihar, New Delhi which helps to treat waste water to a standard sufficient for landscaping. This plant was set up in coordination with the local Residential Welfare Association and the Municipal Corporation of Delhi (MCD). The plant has a 40 KLD (Kilo-litre per day) capacity with 75-80% remediation efficiency and the water supplied meets the desired municipal standards and is supplied to 5-6 acres (25,000 sq. m.) of parks. The driver of this innovative venture was the need to build a cost-effective plant which would help to reduce the flow of waste water into the Yamuna.

Waste water Treatment Plant- WWT (Vasant Vihar drain, outer ring road)

Technical specifications of the plant are as below:

Figure 3: Vasant Vihar WWT Plant

Project Concept:
Urban waste water in open drain sourced for bio-remediation. Processed water used in parks and lawns easing the water shortage situation with benefits.

Project Design:
Waste water inflow quantity: 45 KL per day
General parameters quality at in-flow: 300 ppm
Processed water available for re-use: 40 KLD
General parameters at out-flow: <30 ppm

Project Data:
Cost of all elements (mid 2003): Rs. 8.0 lakh

Process used - simple technology: DEWATS, anaerobic, part aerobic filters, settlers.

Prospects feasible: Both for smaller and larger flows at local-level, the concept of "constructed wetlands" can be applied for very large flows at polluted river/ canal flows.

Another project deals with kitchen waste, which is remedied/ converted into manure by simple composting and remedied using a biogas plant. The plant produces energy and slurry which is used as compost. Basic specifications of this kitchen-waste based biogas plant in Delhi are shown overleaf:

Kitchen-waste based biogas plant BGP, All India Women's Conference, AIWC, 23 Bhagwan Das Road, New Delhi

Figure 4: Bio-Gas Plant at AIWC, Delhi.

Project Concept:
Kitchen and bio-wastes sourced for bio-methanation. A 2 cubic metre (cbm) Fixed Dome Deenbandhu Type biogas plant is being used. Evolved gas used in rural hut for making fruit preserves. Slurry converted into compost / manure. Herbal / medicinal plants such as *aloe-vera, brahmi*, *haldi*, flowers - *gulab*, *mogra* are used. Holistic plantation management carried out using green initiatives for self-help groups - income generation and training programs on food preservation and renewable energy concepts being used.

Project Design:
Kitchen-waste inflow quantity: 60 Kg per day
Other bio-wastes from garden: 10 Kg per day
Biogas made/Lpg equivalent 1btl: 20 Kg per month
Compost/manure evolved: 600 Kg/month

Project Data:
Cost of setting up all elements - 2000: Rs. 1.0 lakh for Holistic BWM process.

Operation of BWM process: 1 daily labour employed, others giving support.

Process - simple labour, technology: Anaerobic process in BGP with open composting.

Prospects feasible: For smaller and larger campus with hostel, mess.

Good alternative for municipal / house-hold bio-wastes, and bio-methanation process at urban landfills producing Land Fill Gas LFG, for use as energy / fuel.

Decentralized Approach for Urban Services – DAFUS

The basic philosophy behind these community based initiatives is conversion of *waste into resource* (as far as possible), by reusing or recycling, and rendering this philosophy practically possible by using less-costly methodology. While a normal STP requires large amounts of power, chemicals, and has a high-cost element, waste-water treatment (to make it up to the mark for landscaping or agriculture), is a cost-effective and sustainable initiative.

The Foundation believes that decentralized initiatives promise easy maintenance, low cost and efficiency and have proven to be successful *if the community shows interest and participates actively*. Even in instances when the power supply fails, these natural treatment plants continue to work. The concepts/methodology used in these initiatives using principles and practices of bio-remediation are sustainable and do not fail.

The ventures developed and implemented by the Foundation are in general quite cost effective. They yield benefits such as: i) reduced use of manure; ii) reduced use of fresh surface water and drawing of ground water; iii) reduced load on ground water, hence low cost of infrastructure; iv) reduced pollution of rivers; v) re-charge of rain-water effluents when clean water flows in urban drains; vi) production of biogas and manure; vii) low emissions.

The plants are usually easy to maintain and do not need highly skilled - labour. The only drawback is that the plants require space. Funds are usually raised within and by the community through contributions and are sustained. With communities/ organizations participating actively, there is also a possibility of earning carbon credits through such projects.

These micro-level projects can be scaled up to macro-level watersheds or river basins for enhanced benefits with cost-effective mechanisms. The first issue faced in scale-up (in terms of treatment of more quantity) was funding, but it was resolved due to support from residents and the MCD. Another issue is that certain urban local bodies are not keen to try out innovative practices that have worked.

All these programs and activities have been backed up by awareness and participation efforts to core-communities and other communities. Students from schools and colleges partake in these environmental programs and facilitate out-reach.

These initiatives also serve as demo-models for attending participants for various training programs on the Water and Sanitation (Watsan) sector.

The Foundation has been chosen as a partner with DEWATS Main facilitator BORDA Forum at Bangalore.

Examples of Decentralised Approach for Urban Services (DAFUS) include:

Urban Storm-water management: At certain sites old dug wells have been deployed for rain-harvesting for recharging of groundwater. These old village dug-wells amidst urban areas have proven to be very useful in conveying rain water to ground water regimes.

This is especially true for institutions where rain-water harvesting has been very useful. For instance, certain institutional campuses are adopting water-initiatives under the guidance of NGOs, such as the TATA Chemicals Township

Solid waste management: Small level interventions have been initiated and all waste is handled and safely disposed off. Bio-wastes are composted to make manure while non bio-wastes are led on the re-cycling mode. E.g. kitchen- waste from certain sectors is led for feeding for bio-methanation in biogas plants. This yields biogas for energy and compost-manure as bio-fertilizer for parks and greens.

Ecological sanitation: Eco-San approaches have been practised, in association with IIT-Delhi for development and implementation of water-less urinals, and urine used as manure for greens- parks, trees and plants. At Agra, just behind the Taj Mahal, an NGO - CURE has planned an initiative for treatment of a waste-water stream of flow 50-60 Kl per day using DEWATS.

The recycled water will be used for irrigating crops, vegetables growing in the fields and allowing cleaner effluents to be discharged into the river.

Conclusion

Given the urban sanitation situation in India, there is a need to promote decentralized initiatives in waste water treatment by providing incentives and a supporting policy environment and through capacity building of implementing institutions.

Further, there is a need to support implementation of pilots and projects which demonstrate not only the decentralized and low-cost treatment of wastewater, but also demonstrate how communities and local administration can partner to implement the interventions in ways that make the facilities more durable and long lasting.

Figure 5 : Eco- Water-literacy for youth.

Further, as decentralized and low-cost options are commonly viewed as solutions for the poor and / or for underdeveloped areas, raising of the profile of low-cost options and alternative technologies as well as of making it 'fashionable' to minimize waste going out of the premises/ buildings etc., of the private sector can go a long way in changing mindsets towards the environment and waste (*A. Dzikus, 2009*).

More specifically, there is a need for exchange of information and innovations amongst developing countries, and technical support for introducing alternative technologies and processes. Intensive capacity building programs, appropriate IEC materials, technical manuals and documentation, and sharing of best practices amongst facilitators are required urgently so that the DEWATS movement can become the default solution to the many sanitation crises that are unfolding in India.

Finally, DEWATS present a significant opportunity to change the dialogue in the waste management sector away from “flush and forget” systems to recycling in the form of “waste to resource” systems.

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