DECENTRALIZED WASTEWATER TREATMENT SYSTEM (DEWATS) AS A MODERN APPROACH FOR WASTEWATER MANAGEMENT IN EGYPT, REVIEW

Walid A. Attia, Ahmed S. Mohamed, Ahmed A. El-Taweel

*Structural Engineering Department, Faculty of Engineering, Cairo University, **EGYPT***

E-mail: ahmedeltaweel576@yahoo.com

ABSTRACT

The main aim of this study was to present a review about Decentralized Wastewater Treatment Systems (DEWATS) as a tool for wastewater treatment that could be applied in Egypt. In Egypt, from the south of Giza to Aswan (Upper Egypt), people live very near to the shores of the river Nile. The cities and big villages lie on River Nile and bounded with the river banks at one side and with mountains and desert from the other side. The great challenge is to save lands for domestic life and cultivation. The limited area and the finite available land between the Nile and the Mountain present difficulty for expansion and industrial and social development. Decentralized wastewater treatment systems (DEWATS) includes only such systems which are considered suitable for decentralized applications and dissemination in the case that qualified maintenance and operation cannot be expected.

Keywords: *Decentralized, Wastewater Management, Upper Egypt, River Nile*

INTRODUCTION

The population of Egypt now exceeds 90 million (CAPMS, 2013). The area of Egypt which is ready for people living does not exceed 6 % of the total area of Egypt. Rural Egypt comprises about 4627 villages and about 27000 satellites. More than 60 % of the population lives in those villages and satellites. Delta rural present population is about 20 million capita in about 2600 villages and 17000 satellites. It is expected to reach more than 40 millions in future. Delta is rich with precious agricultural lands, full of Canals, drains and roads. Those infrastructure details represent obstacles for normal traditional wastewater management systems.

An important factor to choose the proper design for any wastewater treatment plant is to use the minimum land area, with the maximum efficiency and optimum operation. Other factors to be considered in the design are the man power and the simplicity in operation and maintenance. It may also require training facilities and courses for managing the wastewater plants to keep them in optimum operation (Heymans and Parkinson, 2004).

For small communities with a few hundred homes or less, particularly where homes are not close together, there are real advantages to a decentralized wastewater treatment approach versus a centralized system. For centralized systems, the biggest capital cost in any size community is usually not the treatment plant itself, but rather the collection system, which is generally a gravity sewer. In rural areas where there are far fewer homes per mile of pipe, centralized collection systems are simply cost prohibitive. Also, many small communities do not have the resources to properly maintain a multimillion dollar centralized wastewater collection and treatment system. Another big concern is the potential for unwanted suburban sprawl and development that can negatively change the rural qualities of an area its resident's value (Dzikus, 2009).

Low Cost Technologies

Any economic study of the implementation of wastewater management plants emphasizes the urgent need for decentralized wastewater treatment units in developing countries. The only realistic approach for the time being is the use of low maintenance technology (LOWATS); we mean low maintenance wastewater treatment systems. DEWATS technologies may also be used for large centralized applications. Decentralized Wastewater Treatment Systems (DEWATS) is rather a technical approach than merely a technology package. Generically, DEWATS are locally organized and people-driven systems that typically consist of a settler, anaerobic baffled septic tank, and filter bed of gravel, sand, plantation-beds and a pond. The open pond or the polishing tank stores the remedied water and keeps it available for reuse (Hoover, 2003).

DEWATS Treatment System

Definition of "Decentralized" wastewater system

The terms "Decentralized" and "Onsite" are often interchanged. However, a "Decentralized" system also refers to the use onsite or cluster systems to treat all of the wastewater collectively generated by many homes or an entire community. Rather than operating a centralized wastewater treatment system where all sewage flows to one treatment plant, most rural communities today still use a decentralized wastewater treatment approach, traditionally with one onsite system per household, though few local leaders would ever think of their community as having a decentralized system.

Benefits of decentralized systems (Zurbrugg *et al.,* 2004)

Decentralized water and wastewater infrastructure creates the following benefits:

1. Lower costs for water supply: Costly water supply enhancements can be avoided through onsite water use efficiencies, wastewater reuse, and rainwater harvesting. Impacts of droughts can be moderated.
2. Lower costs of maintaining existing infrastructure: Flow rates in existing water and sewer systems can be reduced through decentralized efficiencies and reuse in office buildings and infill developments.

3. Lower costs for new infrastructure: New developments can be accommodated with targeted small scale infrastructure that is cheaper than centralized infrastructure.
4. Greater resilience: Small-scale treatment units are more resilient than centralized systems in hurricanes and floods, and less vulnerable to accidents and terrorism.
5. Ecological restoration: Decentralized systems can reduce the discharge of pollutants and replenish aquifers, restore stream flows and habitats.
6. Resource efficiencies: Small-scale treatment units can save on energy costs and recycle nutrients into landscaping and agriculture.
7. Community benefits: Green infrastructure has been shown to improve air quality, preserve open space, and create local jobs.
8. Private financing: Small-scale treatment units on individual properties can be financed privately, thereby saving money for municipalities.

Appropriate Wastewater Treatment Technologies in Egypt

A single wastewater treatment technology would be inappropriate for a country like Egypt which has several different geographical and geological regions, varied climatic conditions and levels of population. 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 of pollution in the water resources. The five main wastewater treatment technologies that are commonly used are as given below:

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. These are suitable for different conditions and have advantages and disadvantages, especially in terms of requirements for land, cost, remediation efficiency and other factors.

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.

Decentralized Approach for Rural and Urban Services

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 sewage treatment plants requires large amounts of power, chemicals, and

has a high-cost element, wastewater treatment (to make it up to the mark for landscaping or agriculture), is a cost-effective and sustainable initiative.

It was believed 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 initiatives developed and implemented by the Foundation are quite cost effective and 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) lower emissions and green house gases (GHGs) abatement (Metcalf and Eddy, 2003).

Role of decentralized wastewater treatment in protection of environment, public health, and water quality

1. Providing reliable wastewater treatment

Decentralized wastewater treatment systems can offer as much public health and environmental protection as centralized treatment systems. Like centralized treatment, decentralized treatment systems must be properly designed and constructed and well maintained. More than ever, these systems typically include good monitoring and backup that help prevent adverse discharges. The modern decentralized treatment system is as reliable as other wastewater treatment alternatives, and it is also a cost-effective and sustainable method of treatment for communities (Joubert *et al*., 2004).

2. Reducing conventional pollutants, nutrients, and emerging contaminants

Decentralized treatment can produce effluent quality that is equal to or higher than other wastewater disposal options. These decentralized systems use the same advanced treatment technologies as discharging systems. Since they use the treatment capacity of the soil, they achieve high quality treatment at a lower cost than other options. Cluster systems, also called community systems, allow for centralized management of the wastewater via contract by a third party – a Responsible Management Entity (RME). Communities can enter into agreements with nearby public utilities or local cooperatives to create public private partnerships to provide management for decentralized wastewater treatment.

3. Mitigating contamination and health risks associated with wastewater

Sewage pathogens cause many human illnesses, including aseptic meningitis, cholera, dysentery, encephalitis, gastroenteritis, infectious hepatitis, and typhoid fever. Using decentralized systems allows for multiple layers of treatment including, advanced treatment and disinfection which can help mitigate the risk of human exposure and disease transmission. Small systems in single family homes can include secondary treatment from a variety of treatment technologies (e.g., aerobic treatment, recirculating filters, *etc*.). Larger neighborhood systems may be designed using high-level treatment and pressure dispersal of highly treated

wastewater to utilize marginal soils. Therefore, decentralized systems can be designed to overcome the potential health risks posed by septic systems in areas often considered unsuitable for development because of limited permeability, limited vertical depths and high water tables.

Advantages of DEWATS technology

- Provides treatment for domestic and industrial wastewater
- Low initial investment costs as no imported materials or components are needed
- Efficient treatment for daily wastewater flows of up to 1000m^3
- Modular design of all components
- Tolerant towards inflow fluctuations
- Reliable and long-lasting construction design
- Low maintenance costs

CONCLUSION

Given the overall sanitation situation in Egypt, 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 and stake holders. 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 sustainable in the long run.

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 habitats at micro-level and also at a macro-level at village precincts etc., can go a long way in changing people's mindsets towards waste-minimization and up-gradation of the environment. More specifically, there is a need for exchange of information and innovations amongst rural and urban bodies and technical support for introducing alternative technologies and processes.

Intensive capacity building programs, technical manuals and documentation, and sharing of best practices amongst facilitators are required urgently so that practices such as DEWATS can provide solution to the many sanitation crisis that are unfolding.

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. In certain urban areas the processed water is taken for use as flush- water in toilets.

Finally, concept "DEWATS" presents an opportunity to change the mind-set in the waste management sector away from "flush and forget" systems to recycling in the form of "waste to resource" systems thus aspiring to conserve and optimize all natural resources such as water.

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