

# Faecal Sludge Management: A Study with Reference to New Delhi, India

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**Abstract**—*Faecal sludge management has been a major talk of the day in the developing countries. Many developed countries have adapted to the use of suitable technologies to efficiently manage the faecal sludge generated by using various decentralized measures. New Delhi the capital city of India has achieved a 56% efficiency in managing its faecal sludge generated. The Swachh Bharat Abhiyan has initiated the building of public latrines and toilets in order to avoid open defecation, but it is also important to manage the waste generated in the pit latrines periodically as excess of untreated waste would lead to contamination of soil, release of harmful gases and will degrade the groundwater as well. In this study the integrated approach for the faecal sludge management will be highlighted. The inter relationship between planning, technology and management play a major role in the treatment and management of the faecal waste. This paper will also discuss upon the market for the potential faecal sludge products and the type of resource recovered, the fuel potential of faecal sludge and the various innovations and technologies that are involved in the waste to product conversion. Various institutions also play a vital role in formulating the policy that lie behind the implementation of the faecal sludge management in the various parts of the world.*

**Keywords:** *Faecal sludge management, contamination, innovations.*

## Introduction

Delhi is the capital city of India and is one of the fastest growing economies in the world. It is also the largest commercial center in northern India. It is also emerging as a world-class metropolis and has a population of 16,787,941 and population density of 11,320 persons per square kilometers (CSE, 2016). The location of the city in its coordinate system is between the latitudes of 28°24'17" and 28°53'00" North and longitudes of 76°50'24" and 77°20'37" East. It has an area of 1493 square kilometers. The river Yamuna is the main source of drinking water for the people of Delhi.

Delhi experiences a semi-arid climate, with hot summers average rainfall and medium winters. It receives an annual average precipitation of 711 mm mostly during the span of June to September. Delhi had been also rated as the second most polluted city in the world as per Indian Express publication (CSE, 2016).

The National Urban Sanitation Policy (NUSP) has aimed to promote behavioral change, raise awareness and eradicate the idea of open defecation (CSE, 2016). It has also aimed at achieving a city wide sanitation plan and provide 100% safe confinement, transport and treatment of faecal waste. NUSP also highlights the importance of having a facility for hygienic disposal and treatment of faecal waste and also to have an on-site system of having septic tank and pit latrines.

Solutions for effective and sustainable faecal sludge management are of a growing need in developing nations. The importance of the faecal sludge from the market and sustainability perspective can be achieved by the use of right technology that cater to a situation and the timely operation and maintenance procedures are undertaken. This paper provides the approach that need to be undertaken to successfully achieve faecal sludge management in a city like Delhi that has a mixed population rich and poor residing in both urban and rural localities. It also provides an insight that faecal sludge collected is more than just waste or human by-product. It is a very resourceful material in terms of fuel and manure.

## What is faecal sludge?

Faecal Sludge (FS) comes from onsite sanitation technologies, and has not been transported through a sewer. It is raw partially digested, a slurry or semisolid, the results from the collection, storage or treatment of combinations of excreta and blackwater, with or without greywater (Strande, Ronteltap and Brdjanovic, n.d.). Some of the examples of the on-site technologies are pit latrines, septic tanks, dry toilets, ablution blocks without sewage lines, aqua privies. Faecal sludge management includes collection, storage, treatment, transport and safe end-use or disposal of faecal sludge. As a matter of fact, the challenge arises in faecal sludge management as faecal sludge varies in consistency, concentration and quantity.

## Why faecal sludge management is needed in a city like New Delhi?

As per India-today magazine the current urban population of 410 million people in India will grow to 814 million by 2050 and that Delhi is one of the most populous city in India (Delhi becomes world second most populous city, 2014). It is a common perception that onsite technologies satisfy the treatment needs of rural areas, but in reality, around one billion of the onsite facilities are in the cities across the world (Strande, Ronteltap and Brdjanovic, n.d.). Most part of India being in a lower-middle income class there is no proper management of the waste that is generated in its on-site facilities. This leads to accumulation of faecal sludge and has a huge impact in the sense of sanitation and hygiene. Due to the increasing population, residential areas the already existing sewer lines are outdated and are ineffective in many cases leading to no treatment of the faecal waste in many facilities. Hence there is a need for a de-centralized treatment technology for the faecal sludge generated in these on-site facilities that are not connected to the sewer lines.

### Treatment of faecal sludge

It is necessary to treat the faecal sludge as it can cause a huge up-rift regarding health and environmental impact. One needs to understand that there are different levels of treatment that needs to be performed depending upon the end-use. One of the major operation to be performed after collection of the faecal sludge is de-watering. De-watering is quite a bit advantageous as water is heavy and voluminous, water in the faecal sludge is polluted and may lead to ground water contamination, also after de-watering the solid sludge recovered can be used as a resource for many purposes as a base for fuel or for composting. Some of the dewatering technologies include settling thickening tanks, sludge drying beds and planted sludge drying beds.

Treatment exists in the form of physical, chemical and biological mechanisms. One must be familiar with what kind of treatment mechanism must be used for solid liquid separation, stabilization, nutrient management and pathogen reduction. Some examples are: Dewatering and aeration are physical process. Addition of lime and urea in a process stage come under the chemical process. Sludge decay in the presence of micro-organisms, decomposition with help of organisms like black soldier fly larvae come under the biological process of treatment.

### Resource Recovery

The end products at the various treatment stages can be used a resource for various purposes. The dewatered and dried sludge can be used as soil conditioner, compost, fertilizer, solid fuel as well as building material. Plants in the planted sludge drying beds can be used as animal feed. Effluents can be used for irrigation purposes as they would contain organic nutrients in the form of nitrogen, potassium and phosphorous. Biogas, biodiesel and syngas obtained from the various anaerobic digesters can be used as fuel. Insect larvae can be used as animal feed. While char obtained can be used as solid fuel and as soil conditioner.

**Table 1: Options for resource recovery.**

Resources	Treatment Product	Product Type
Energy	Solid fuel	Pellets, briquettes, powder
Energy	Liquid fuel	Biogas
Energy	Electricity	Conversion of biogas or gasification of solid fuel
Food	Protein	Black soldier flies, fish meals
Food	Animal fodder	Plants from drying beds, dried aquaculture plants
Food	Fish	Grown on effluent from faecal sludge treatment
Material	Building materials	Additive to bricks, road construction
Nutrients	Soil conditioner	Compost, pellets, digestant, black soldier fly residual
Nutrients	Fertilizer	Pellets, powder
Nutrients	Soil conditioner	Untreated sludge, dewatered sludge from drying beds
Water, Nutrients	Reclaimed water	Effluent from faecal sludge treatment

### The need for an integrated approach

According to census of India, 2011, a population of 1,785,390 is residing in 6,343 slums in Delhi of which 30% are dependent on onsite sanitation measures, 16.3% have access to underground sewerage network and the rest depend

on community toilets and some resort to open defecation(CSE, 2016).

Due to the poverty level in this area one cannot rely on high end technologies for the fecal sludge management in these situations. Hence there is a high need for integrated

approach for faecal sludge management where in Government support, socio-cultural acceptance, legal and regulatory framework, financial arrangements, institutional arrangements and skill and capacity building need to work together to enable the operation of faecal sludge management economically and sustainably.

Institutions play a major role in faecal sludge management in a city like Delhi. The Ministry of Urban Development (MoUD) is the nodal ministry for policy and guideline formulation and implementation for urban water supply in sewerage sector(CSE, 2016). The ministry's responsibilities include broad policy formulation, institutional and legal frameworks, setting standards and norms, monitoring, promotion of new strategies, coordination and support to state programme through institutional expertise and finance(CSE, 2016). The Delhi Jal Board (DJB) is responsible for supply of potable water in the National Capital Territory and is also responsible for sewerage services including development of network and collection, treatment and disposal of sewage. It is responsible for project planning, capital investment, project execution as well as operation and maintenance.

The expected outputs of the integrated approaches are numerous, some of which are necessary are: to formulate plans and measures to reduce inequity in urban poor, capacity to meet service needs and demand targets, monitoring and reporting access to the services like collection and transportation of faecal sludge on a regular basis and storage and treatment of the collected faecal sludge. Some other outputs can be Expansion of service through simulating demand for the service, strengthening service provider roles and service standards.

The outputs would lead to service outcomes like increase in sanitation facilities community toilets/ public toilets. There are three types of community toilets provided by Delhi Urban Shelter improvement board (DSUIB) that are: Mobile toilet vans, prefabricated toilets and conventional toilets. These toilets are outsourced to various NGO's for operation and maintenance.

Integrated approach can only be complete if the local people are involved in the action of making the operation of sanitation and hygiene as a success. There is an urgent need for the people of the people in need for the on-site faecal sludge management to know the benefits of the operation and the ultimate goal of achieving an overall sustainability. Hence it is necessary for the locals to be educated about the need for sanitation and hygiene as to how it would help in various ways and also promote a healthy way of living. The NGO's can form a city sanitation task force and the main aim would be to have a funded and actionable city sanitation plan taking in account the various constraints involved.

The various ways in which the treated sewage is used in the National Capital Territory is shown in the table.

**Table 2: Treated domestic sewage supply for various purposes (CSE 2016).**

Sl. No.	Details	Units of treated sewage reused (MLD)	Percentage of treated sewage reused
1	Treated effluent supplied from Keshopur STP for irrigation purposes	135	56.60
2	From Okhla STP to CPWD and irrigation department for horticulture/irrigation purpose	166.5	29.60
3	From Coronation Pillar STP for DDA golf course at Bhalswa, Gammon India for construction purposes. Minor irrigation department at Palla	54	70.59
4	From Rithala STP to PPCL for their plant at Bawana and NDPL for their plant at Rohini	121.5	62.79
5	From Vasant Kunj to Sanjay Van	22.5	100
6	From Mehrauli STP to Garden of Seven Senses	9	66.67
7	From Delhi Gate and Sen Nursing Home STP to PPCL	18	83.16
8	From Nilothi STP to Flood Control and Irrigation Deptt. for Irrigation purposes	72	100
9	From Dwarka STP to DDA for Irrigation purposes	36	50
10	From Commonwealth Games Village STP to Common Wealth Games Complex for non-potable purposes	4.5	100
	<b>Total</b>	<b>639</b>	<b>51</b>

## Conclusion

Faecal sludge management is the rising need of an hour in today's world in the urban-rural localities of the world to promote safe and sustainable WASH initiative. It creates a healthy environment and safe living standards for the living communities. Apart from that fecal sludge has end product has a huge market as the resources recovered from the treatment stages of the faecal sludge has various end use in various forms. It creates an opportunity for the use of the biofuel for various purposes and hence increasing the usage of renewable energy, a key element towards achieving sustainability.

Delhi is a metropolitan city with an ever rising population that needs to have various de-centralized treatment facilities for faecal sludge extracted at the various onsite sanitation facilities that are not connected to the common urban sewerage network. As a large part of Delhi still reside in slums there is a need for the onsite fecal sludge management procedure. The storage, collection, treatment and disposal are the key operations to be undertaken in the faecal sludge management. For the same reason an integrated approach is required for the FSM as just building a costly treatment facility would be ineffective in a long run. The integrated approach gives an opportunity to the various government bodies and the service providers to get involved in the management and also help create and expand the market for the fecal sludge end product. Even the involvement of the people plays a vital role in successfully implementing the action of FSM. This holistic approach will lead to the perfect link between planning, technology and management in achieving environmental sustainability and healthy standards of living which would ultimately lead to development index of the nation to rise.

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