IJMRT • Volume 12 • Number 2 • July-December 2018: 117-134

URBAN SANITATION IN INDIA: IMPERATIVES FOR SEPTAGE AND FAECAL SLUDGE MANAGEMENT

A. K. Singh[*] and Shailendra Kumar[**]

Abstract: *Sanitation in India is a State subject. State-level steering committees and urban departments play the role of guidance and support to Urban Local Bodies which are responsible for final implementation of sanitation at the local level. ULBs are mandated to undertake planning, design, implementation, operation and maintenance of water supply and sanitation services in cities and towns. At the central level, the nodal Ministry of Housing and Urban Affairs is tasked with supporting implementation of the National Urban Sanitation Policy on various fronts including designing and implementing national-level strategies on linkages between public health and sanitation, clarifying institutional roles, capacity-building and training support to states and ULBs, providing financial assistance for City Sanitation Plans through existing government schemes, monitoring and evaluating projects, and mainstreaming sanitation into relevant programs on urban infrastructure and housing across various central ministries. Besides the Ministry of Housing and Urban Affairs, institutional responsibility for the full water supply and sanitation chain at the ministerial level falls between a number of ministries, commissions, and boards. This complexity also contributes at times to the failure to implement programs in the sector. There is a direct relationship between water, sanitation and health. Consumption of unsafe drinking water, improper disposal of human excreta, improper environmental sanitation and lack of personal and food hygiene have been major causes of many diseases in developing countries. India is no exception to this. Prevailing high infant mortality rate is also largely attributed to poor sanitation. The concept of sanitation was earlier limited to disposal of human excreta by cesspools, open ditches, pit latrines, bucket system etc. Today, it connotes a comprehensive concept, which includes liquid and solid waste disposal, food hygiene, and personal, domestic as well as environmental hygiene. Present paper highlights the imperatives of septage and faecal sludge management in India.*

INTRODUCTION

Proper sanitation is important not only from the general health point of view but it has a vital role to play in our individual and social life too. Sanitation is access to, and use of, excreta and waste water facilities and services that ensure privacy and dignity, ensuring a clean and healthy living environment for all. Facilities and services should include the collection, transport, treatment and disposal of human excreta, domestic wastewater and solid waste, and associated hygiene promotion (UN Habitat and Water Aid). Sanitation is one of the basic determinants of quality of life and human development index. Good sanitary practices prevent contamination of water and soil and thereby prevent diseases. The concept of sanitation was, therefore, expanded to include personal hygiene, home sanitation, safe water, garbage disposal, excreta

[*] Assistant Director, Regional Centre for Urban and Environmental Studies, Lucknow.
[**] Post Doctoral Research Fellow, Deptt. of Sociology, Lucknow University, Lucknow.

disposal and waste water disposal. Provision of basic services such as water supply, sewerage, sanitation, solid waste disposal and street lighting has traditionally been the responsibility of the local governments. These services are being provided through state government departments, state level boards, corporations etc. Public Health Engineering Department, Public Works Department, Urban Development Department, Housing Boards, Department of Local Self Government, Water Supply and Sewerage Boards etc. are some of the departments of the state government which performs municipal functions. With the passing of 74th Constitutional Amendment Act, Metropolitan Planning Committee and District Planning Committee have been formed to take up developmental activities in the concerned region in place of the parastatals. The ULB's have also been empowered to take up development functions. States have responded in diverse manner with regard to the status of parastatal agencies in the post decentralized period. Many state governments like Kerala and Karnataka have recommended the abolition of the parastatals while some have recommended for a change in their functional role like in Tamil Nadu, Uttar Pradesh, Maharashtra, West Bengal and Andhra Pradesh. The parastatal agencies have also been merged with Urban Development Department. The 74th Constitutional Amendment Act has also transferred administrative and financial process and created an enabling environment for the local bodies to undertake planning and development responsibility.

Universal access of urban sanitation to poor families is major challenge as slums and backward areas have grossly in adequate sanitation infrastructure and sanitation services as compared to the urban areas. This is because of the fact that development work was carried out in only recognized/notified slums areas by the local bodies. However, In 2005 Govt. of India under the JNNURM Mission highlighted that all existing slums are to be integrated in the mainstream of urban planning and development. Thus, with the construction of community and public toilets in the states like Maharashtra, Karnataka, Madhya Pradesh, Gujarat and Orissa accessibility of sanitation services has been increased to the urban poor. Providing environmentally safe sanitation to the people of world's second most populous nation is a challenging task. The challenges that urban sanitation sector faces mainly relate to the low priority accorded to it by the municipal governments. This task becomes more intricate in context to the country like India where introduction of new paradigms of plans, policies or projects can challenge people's tradition and belief. Around 600 million people constituting 55 per cent of country's population do not have access to safe sanitation or any kind of toilet. Open defecation is a large global problem, but it is substantially and importantly an Indian problem. About 60 per cent of the approximately 1 billion people worldwide who defecate openly live in India. Widespread open defecation has major consequences for health and human capital in India. Inadequate sanitation has a great environmental economic and health impacts in India. In order to minimize these impacts, Government of India has under taken several measures including increased investment in urban sanitation, policy initiatives, regulations, and public campaigns to improve sanitary conditions in the country. This has resulted in raising the sanitation status during the last two decades but a marked improvement is yet to be achieved.

Presently fund is available under AMRUT, Swacch Bharat Mission, Namami Gange and 14th Finance Commission for sanitation in urban centres in India. However, septage and faecal sludge management is covered under AMRUT. Sewerage connection is also been ensured under AMRUT and Namami Gange .There has been paradigm shift in urban governance in India in the recent years. The emphasis from schemes and programmes has been shifted to mission mode approach for achieving the targets and project objectives. Massive investment based programmes and schemes in mission mode approach have been implemented recently by the Ministry of Urban Development as Ministry of Housing and Urban Poverty Alleviation, Government of India. The focus of government is on development of urban infrastructure, improvement in delivery of civic services through public private partnership, implementation of reforms and improving service delivery mechanism. The government is also planning to create high quality urban infrastructure and providing smart solutions in civic services through effective use of technology and mobilizing private sectors for investment in selected cities of India. There has been larger focus on improving the sanitary conditions and eradication of open defecation in urban areas through social mobilization and construction of toilets. These schemes and programmes are expected to yield good results in the coming years. As JNNURM and subsidiary schemes has already resulted in construction of urban infrastructure and improvement in urban governance through implementation of urban reforms. The second generation of JNNURM in name of AMRUT is also focusing on urban reforms for service delivery besides creation of infrastructure.

NEED FOR SEPTAGE AND FSM

India's bigger cities have large, centralized sewerage systems with vast underground pipelines, pumping stations and huge treatment plants. These systems are expensive to build and even more expensive to operate, as they require continuous power, a large amount of water, skilled operators and extensive electro-mechanical maintenance. It is for this reason that India's 7,000+ small towns do not have such systems and are unlikely to be covered by centralized sewerage systems in the near future. According to the data released by the Central Pollution Control Board, out of the 816 municipal sewage treatment plants (STPs) listed across India, 522 are operational (64 percent), 79 STPs are Non Operational, 145 STPs are under construction and 70 STPs are proposed. The treatment capacity that is available is only for 37 percent of the total 62,000 MLD (million litres per day) of sewage that is generated in urban India. Currently on-site pit latrines, septic tanks and other such systems account for a substantial proportion of toilets in urban India – over 45 percent of urban Indian households depend on onsite facilities (Census 2011) and this proportion is increasing. Further, as urban households without toilets obtain facilities over the next few years under Swachh Bharat Mission (SBM) , it is likely that many will acquire onsite arrangements like pit latrines and septic tanks in cities at locations where sewerage systems are not available. Thus, while the containment of human waste will be largely achieved under SBM, its treatment still poses a huge challenge. In the absence of adequate safe and sustainable sanitation,

many Indian cities are already suffering the consequences, in the form of health ailments and serious pollution of water and soil resources. In contrast with the large proportion of on-site sanitation (OSS) systems, limited attention has been accorded to proper construction, maintenance management and safe disposal of faecal sludge and septage from septic tanks and pit latrines. While construction standards have been codified by the Bureau of Indian Standards, the actual construction was largely left to households to manage – in reality, the installations are subject to local practices and considerable variations are observed. In many instances for example, soak-away or drain fields are not provided. Limited capacities and resources with Urban Local Bodies (ULBs) also resulted in little regulation of maintenance and cleaning of septic tanks and pits – in many cases, households do not report cleaning for a number of years. Some ULBs have desludging equipment or there are private players providing cleaning services but the supply of desludging services is far from adequate. In many instances, faecal sludge and septage is dumped in drains and open areas posing considerable health and environmental risks. Sanitary workers also work in hazardous conditions to clean OSS pits and tanks sometime without adequate protective gear and equipment. In most Indian cities, there is limited date & information on the types and number of OSS toilets and septage disposal systems and practices. The problem of faecal sludge and septage / sewerage must be addressed in a holistic manner, with a strategy that provides for minimum needs and is appropriate and affordable for all areas and population considering the local situation. It must also address the enabling provisions in the form of suitable regulation and institutional framework, capacity building and education and awareness among all stakeholders. This policy seeks to address the efficiency of systems in place for onsite sanitation whereof the faecal sludge output needs to be managed in an environmentally safe manner including the proper engineering design, construction and maintenance of septic tanks systems, pit latrines and such other systems generating faecal sludge

Only on-site sanitation facilities and areas served by such facilities would fall under the purview of this Faecal Sludge and Septage / Sewerage Policy. It does not seek to cover network or conventional sewerage system (including treatment plants) of wastewater/sewage management. However it will address synergies 12 between FSSM and sewerage systems or municipal solid waste (MSW) management. Unless otherwise specified, the scope of this Policy extends to all the projects, programs and schemes of the Central Government that facilitate and support sanitation services, urban development and improved delivery of services in urban and peri-urban areas of India. It also covers the initiatives undertaken and/or supported by all Central Government Ministries, Departments, Agencies, Authorities and Public Sector Undertakings that have a bearing on sanitation services in urban and peri-urban areas. Further, the Policy applies to every urban local body, outgrowths in urban agglomerations, census towns as declared by the Registrar General and Census Commissioner of India, notified areas, notified industrial townships, areas under the control of Indian Railways, airports, airbases, Ports and harbors, defense establishments, special economic zones, State and Central government organizations, places of pilgrims, religious and historical

importance as may be notified by respective State government from time to time. The State Governments, ULBs, and relevant public and private utilities should take necessary steps to ensure that this Policy covers all the projects, programs and schemes related to provision of onsite sanitation services in their respective jurisdictions, irrespective of the source(s) of funding for these projects, programs and schemes.

The findings of the Census of India 2011 indicate that only 32.7 per cent of urban households are connected to a piped sewer system whereas 38.2 per cent dispose their wastes into septic tanks and about 7 per cent into pit latrines, underlining the predominance of onsite arrangements – and it is not clear how the waste is further disposed by the majority of these installations. Presently, septic tanks and pit latrines along with open defecation are major contributors to groundwater and surface water pollution in many cities in the country. One the major challenges in urban sanitation is the collection, treatment and disposal or reuse of Faecal Sludge. Adequate facilities and services for collection, transportation, treatment and disposal of faecal sludge do not exist in most Indian cities and towns. Faecal Sludge comprises varying concentrations of settleable or settled solids as well as other non-faecal matter that is collected from on-site sanitation systems, such as latrines, non-sewer public toilets, septic tanks and aqua privies. Faecal sludge from septic tanks is specifically termed as septage.

FSM should be given priority in urban sanitation programmes and there should be an increased convergence between AMRUT and SBM goals of making India ODF. Achieving ODF should not merely be restricted to the act of going for open defecation but the faecal matter should also be properly disposed to reduce its ill effects. Separate faecal sludge disposal station needs to be constructed such as SWM plants. Need to ensure that there is a reliable fee-based service for FSM at the ULB level by incorporating this requirement as a precondition for funding under SBM. The scheme should strongly incentivize the development of local service providers based on PPP models and encourage resource recovery. Skill development of personnel on plumbing, mechanical desludging of septic tanks/ pits, truck operation with immediate job placement is required.

The findings of the Census of India 2011 indicate that only 32.7 per cent of urban households are connected to a piped sewer system whereas 38.2 per cent dispose their wastes into septic tanks and about 7 per cent into pit latrines, underlining the predominance of onsite arrangements–and it is not clear how the waste is further disposed by the majority of these installations. Presently, septic tanks and pit latrines along with open defecation are major contributors to groundwater and surface water pollution in many cities in the country. One the major challenges in urban sanitation is the collection, treatment and disposal or reuse of Faecal Sludge. Adequate facilities and services for collection, transportation, treatment and disposal of faecal sludge do not exist in most Indian cities and towns. Faecal Sludge comprises varying concentrations of settleable or settled solids as well as other non-faecal matter that is collected from on-site sanitation systems, such as latrines, non-sewer public toilets,

septic tanks and aqua privies. Faecal sludge from septic tanks is specifically termed as septage. FSM should be given priority in urban sanitation programmes and there should be an increased convergence between AMRUT and SBM goals of making India ODF. Achieving ODF should not merely be restricted to the act of going for open defecation but the faecal matter should also be properly disposed to reduce its ill effects. Separate faecal sludge disposal station needs to be constructed such as SWM plants. Need to ensure that there is a reliable fee-based service for FSM at the ULB level by incorporating this requirement as a precondition for funding under SBM. The scheme should strongly incentivize the development of local service providers based on PPP models and encourage resource recovery. Skill development of personnel on plumbing, mechanical desludging of septic tanks/ pits, truck operation with immediate job placement is required (Singh *et al.*, 2017).

According to the type of toilet facility in India (Census of India, 2011), around 81 per cent of urban households have access to toilet facilities within the household premises, 6 per cent access public toilets, and 12 per cent are forced to resort to open defecation. Thus, nearly 10 million households still defecate in the open. Open defecation, and the lack of access to any kind of toilet facilities, individual or shared, is one of the biggest concerns and challenges for urban sanitation in India. Studies also indicate that the condition and type of toilets in urban areas is highly variable. Toilets, especially among poorer communities, are often dysfunctional: clogged toilets, leaking taps, broken floors or roofs (WSP-TARU, 2008). Access to improved sanitation has increased over the past two decades (from 49 per cent in 1990 to 77 per cent in 2011). While the percentage of households without access to 'basic sanitation' has decreased from 32 per cent to 17 per cent over the corresponding period , the number of households practicing open defecation or having unimproved toilets, has reduced from 72 million to 64 million.

Access to sanitation is unequal across income groups, cities and states. Indian cities can be divided into various class sizes according their population. India has a top heavy urbanization structure, where Class I size cities are home to a majority of urban households (nearly 60 per cent). While the percentage of households defecating in the open increases for smaller class size cities, the share of open defecation households is spread across all cities. While Class I and II cities account for 45 per cent of the share of open defecation households, 55per cent of these households are distributed across the others class sizes. An analysis of open defecation households across various states in India shows a pattern similar to class-wise analysis. While the eastern and central states of Chhattisgarh, Orissa, Jharkhand, Bihar and Madhya Pradesh have a large percentage of their urban population defecating in the open, they account for a small proportion of the total numbers defecating in the open. On the other hand, the top 5 states with the highest urban population account for nearly 50 per cent of open defecation urban households.

Broadly, the sanitation systems in India can be divided into two broad types: network-based systems, which refer to piped sewerage and on-site systems which

includes all other categories. It is evident that only a third of the city population is serviced by network-based systems, as apart from piped sewerage, all other categories constitute on-site systems. In a survey carried out in 300 cities, only 100 cities had sewerage systems (NIUA, 2005). The number of cities with sewerage has increased slightly, according to Census 2011. Even now, only 792 or only 10 per cent of cities have more than 50 per cent of households connected to sewerage systems, and it is in all likelihood an overestimate. The various estimates indicate that only one-third of total wastewater generated is collected (CPCB, 2009). In the national sanitation ratings carried out for 423 cities, 274 cities (65 per cent) have unsatisfactory arrangements for safe collection of human excreta. Only about 27 per cent of cities are collecting more than 80 per cent of their waste (MoUD, 2010). The sewerage systems, where they exist, are plagued by multiple problems. The sewers in most Indian cities are badly maintained: frequent blockages, siltation, missing manhole covers, gulley pits. There is hardly any preventive maintenance with repairs being made only in the case of crises (WSP-TARU, 2008). Improper disposal of solid waste also tends to block sewer lines. Sometimes, storm water enters the sewerage network, leading to inflow in excess of the capacity of the system, and hence sewer lines cannot function (Wankhade et. al, 2014).

According to Census 2011, nearly two-third of the households in India are dependent on onsite sanitation systems, the most common being septic tanks, followed by a different kind of pit latrines. While on-site systems are the most common systems, most of the policy focus has been on sewerage systems, to the neglect of on-site systems. The on-site sanitation systems are mostly constructed by households, who do not necessarily have the knowledge or resources to build these according to requisite standards. Often, on-site systems suffer from poor design and poor workmanship. While there are significant differences between cities and states in general, there are limited facilities for safe emptying of pits or desludging of septic tanks. While some urban local bodies provide these services, a majority of households enlist the services of sweepers to manually empty the pits and tanks or private mechanical emptiers (WSP, 2008). There are very few treatment facilities for faecal sludge; most of the existing treatment involves co treatment at conventional STPs. In most cases, the collected waste is dumped in the open without any treatment (AECOM & SANDEC, 2010; WSP-TARU, 2008). In general, there is little information about the performance of on-site systems, and it is not possible to estimate the quantum of faecal sludge that is safely transported and treated. It has also been a poorly regulated area, with no monitoring of either the utilities or the private players.

The sanitation systems are often only considered partially. The on-site based sanitation solutions (latrine or septic tank-based) frequently do not include excreta and faecal sludge emptying, transport or treatment services and facilities. Additionally, local business opportunities, as well as demand and potential use of waste resources, such as water, nitrogen or bio- solids, are given little attention. Failures or unsustainable solutions put huge financial burden on municipalities. In cities of developing countries, large amounts of excreta and faecal sludge collect in on-site sanitation facilities, such

as private or public latrines, and septic tanks. As opposed to industrialised countries, where excreta is disposed of via cistern-water flush toilets, city-wide sewerage systems and central wastewater treatment plants, all of which are widespread technologies in industrialised countries but unaffordable or inappropriate in developing countries. If faecal sludge is collected at all from on-site sanitation technologies, they are most often disposed of in an uncontrolled manner without prior treatment, thus, posing severe health risks and polluting the environment (SCBP, 2017).

Despite a spotlight on the plight of the urban poor and on provision of clean water for over a decade, both the number and the percentage of people without access to sanitation services continue to increase. While overall urban sanitation coverage (63 percent) may appear high and great efforts have been made in the past two decades, coverage rates are much lower for the urban poor. Hence, developing country governments and city authorities face a sanitation crisis that is becoming more critical every year. The effects of unsanitary conditions are often not confined to their sources of origin. Human and domestic waste from any area has the potential to contaminate not just the local environment, but also groundwater, lakes and rivers used by many who rely on freshwater supplies. Many cities in India source the raw water from reservoirs more than 30-50 km far away distance. Environmental pollution is not only a significant threat to the health of the urban population at large but may, in the long run, also become an immense economic burden to a city. Pollution of the urban environment is one of the major obstacles to sustained economic growth in developing countries.

Various technologies which perform the same or similar type of function are called as functional groups. When different technologies from different functional groups are clubbed together, a sanitation system is made. Careful selection of the technologies needs to be done to make the sanitation system functional. A sanitation system should consider all the products generated and all the functional groups these products are subjected to prior to being suitably dispose of. Domestic products mainly run through five different functional groups, which form together a system. All sanitation systems start with User Interface. From this the product either goes to collection and storage/treatment group or to conveyance. This mainly depends on whether there is adequate supply of water available for water based system. After conveyance the products flow in the centralised treatment function group, where the products are treated before moving on to use/disposal group. The product though collection and storage/treatment also end up into use/ disposal functional group. Depending on the system, not every functional group is required. User interface describes the type of toilet, pedestal, pan or urinal the user comes in contact with. User interface also determines the final composition of the product, as it is the place where water is introduced in the system. Thus, the choice of user interface is often dependent on the availability of water. Selection of user interface depends on the following six technical and physical criteria : (1) availability of space (2) ground condition (3) groundwater level and contamination (4) water availability and (5) climate (IWA, 2014).

The technologies which are used for the collection and storage of the products generated at the user interface. In the case of extended storage, some treatment may be provided, though it is generally minimal and dependent on storage time. All the units have to be either connected to conveyance or use/disposal function group for liquid effluent and to conveyance to solids. All the units need to be emptied regularly (depending on the design criteria) for solids. These solids in turn need to be treated or processed before use/disposal. The technical and physical criteria for choosing appropriate collection, storage and treatment technology are as follows: (1.) ground condition (2) groundwater level and contamination and (3.) climate.

Conveyance describes the way in which products are moved from one process to another. Although products may need to be moved in various ways to reach the required process, the longest and most important gap lies between on-site storage and (semi-) centralized treatment. For the sake of simplicity, conveyance is thus limited to moving products at this point. The technical and physical criteria for choosing appropriate conveyance technology/system are as follows (1) water availability (2.) ground condition (3) ground water level and contamination. Human-powered emptying and transport refers to the different ways in which people can manually empty and/or transport sludge and solid products generated in on-site sanitation facilities. It can be done by using buckets and shovels, or by manually operated pumps specially designed for faecal sludge. The advantages of manual emptying include the generation of income, low costs and the availability of tools, little or no requirement of electric energy. The large disadvantage that inheres manual emptying is the high health risk. Motorized emptying and transport refers to a vehicle equipped with a motorized pump and a storage tank for emptying and transporting faecal sludge septage and urine. Humans are required to operate the pump and maneuver the hose, but sludge is not manually lifted or transported (see also human powered and transport. Motorised emptying and transport, is fast and generally efficient. Moreover, it can generate local jobs. But large streets are required for the trucks to pass, thick or dried material cannot be pumped and garbage in pits may block the hose. Moreover, capital costs are high and spare parts may be not available locally.

Sludge and septage emptied from on-site sanitation systems need to be transferred to (semi-) centralized infrastructures for further treatment. Transfer stations or underground holding tanks act as intermediate dumping points for faecal sludge and septage when it cannot be easily transported to a (Semi-) Centralized Treatment facility. A vacuum truck is required to empty transfer stations when they are full. Sewer discharge stations are similar to transfer stations, but instead of simply being a holding tank, the stations are directly connected to the sewer transporting the sludge to a (semi-) centralized treatment facility. Transfer stations reduce transport distance, may encourage more community-level emptying solutions and prevent illegal dumping. The moderate capital costs may be offset with access permits and the construction and maintenance can create local income. However, expert design and construction supervision are necessary. The technical and physical criteria for choosing appropriate technology for treatment are as follows: (1) climate (2) availability of space (3.) ground

condition (4) ground water level and contamination. Use or disposal refers to the ways in which products are ultimately returned to the soil, either as harmless substances or useful resources. Furthermore, products can also be re-introduced into the system as new products. A typical example is the use of partially treated grey water used for toilet flushing. The conventional, centralized wastewater management concept, consisting of a water-borne wastewater collection system leading to a central treatment plant, has been successfully applied over many decades in densely populated areas of industrialized countries and has greatly contributed to improving the hygienic conditions in these areas. However, the appropriateness of this model in the context of cities in developing countries must be questioned, given their urgent need for affordable and sustainable infrastructure. A centralized wastewater management system reduces wastewater reuse opportunities and increases the risk to humans and the environment in the event of system failure. Centralized treatment systems are usually much more complex and require professional and skilled operators. Operation and maintenance of centralized systems must be financed by the local government often unable or unwilling to guarantee regular operation.

Decentralised wastewater management decreases the risk associated with system failure. The probability of simultaneous failure of many small systems is significantly lower than failure of one system serving the entire community. Decentralised treatment processes can be tailored to the quality of the wastewater stream generated by each separate subsystem and to the effluent quality required. The treatment requirements will vary considerably depending on the final destination of the treated wastewater (e. g. agricultural reuse, discharge into water bodies, infiltration). Decentralised management increases wastewater reuse opportunities by keeping the wastewater as close as possible to the generating community. Demand for treated liquid waste in developing countries often comes from urban centres for use in public parks and urban agriculture. Where wastewater is used for irrigation, it is pointless to collect the waste flows in one location for treatment and subsequently distribute the treated effluent where it is needed. Decentralised management may apply a combination of cost-effective solutions and technologies, which are tailored to the prevailing conditions in the various sections of the community. For example, a sewerage system and treatment works can be provided to highly developed and densely populated commercial and residential centres of a community. Sparsely populated housing neighbourhoods can be served by a settled sewerage system or dry sanitation systems where soil and groundwater conditions allow such options. Decentralised management allows incremental development and investment in community wastewater systems. Settled sewers can be used to upgrade already existing decentralised systems such as septic tanks if necessary. New, independent and properly sized systems can be added to serve new and well defined residential, industrial or commercial developments. In contrast, investments in centralised systems have to be made within a short time, thus burdening the local economy. Centralised systems are usually sized to handle wastewater flows planned to occur in 30"50 years. Centralised systems are initially often oversized but eventually become undersized (SCBP, 2017).

About 2.7 billion people around the world use on-site sanitation technologies that need fecal sludge management services (Strande *et al.*, 2014). The greatest numbers are in Eastern Asia with 1.1 billion people, Southern Asia with 593 million people and Sub-Saharan Africa with 439 million. These are households and communities using latrines without access to or unable to afford fecal sludge management services. Ideally, on-site sanitation technologies should be emptied in a safe and hygienic manner by well-equipped and protected workers who transport the sludge for treatment, use or disposal. Faecal sludge management aims to reduce the risk of pathogen transmission and environmental contamination through using protective measures. These are actions, often called barriers or the multi-barrier approach, to prevent or eliminate a sanitation-related risk, or reduce it to an acceptable level (WHO, 2016). If present sanitation trends continue, the number of people needing fecal sludge management services will rise to 5 billion people by 2030 (Strande et al., 2014). This number could increase even faster as water scarcity becomes more severe. Sewer systems use a lot of water to flush wastewater to a treatment facility. As water becomes less available, it will become more challenging to flush everything away through sewers. Households will have to use on-site sanitation technologies instead of being linked to a sewer system. The on-site sanitation has been considered as a temporary solution until a sewer system is constructed (Strande, Ronteltap & Brdjanovic, 2014). In a sewer system, excreta and flush water from toilets, as well as other used water from laundry, kitchens and bathing, is transported from the home by a direct connection to a system of pipes (sewers) buried deep underground. Ideally, the wastewater is sent to a treatment facility. Well-constructed and maintained sewer systems with wastewater treatment facilities can provide effective and efficient services. Sewer systems have been constructed in many parts of the world, particularly in high-income countries. However, for many low- and middle-income communities, particularly in developing countries, installing a sewer system is not a feasible option due to the complexity, high cost, and need for a piped water supply. For such communities, on-site sanitation offers a hygienic and affordable solution (Franceys, Pickford & Reed, 1992). Sanitation planners have come to realize that sewer systems are an inappropriate technology to manage excreta in many parts of low- and middle-income countries. This has led to a shift in sanitation planning. Implementers are now accepting on-site sanitation as an appropriate, sustainable, and affordable solution as long as fecal sludge emptying, transport, treatment and disposal or use services are available and managed correctly (Strande *et al.*, 2014).

On-site sanitation is often considered as a solution in only rural areas. However, on-site sanitation is also very common in urban areas. In fact, one billion people using on-site sanitation live in urban areas (Strande *et al.*, 2014). The wealthy neighborhoods are often the only parts of a city linked to a sewer system. Governments are often unwilling to invest funds to install a sewer system in lower-income neighborhoods. This can be for various reasons such as land ownership, affordability and instability. Households in these lower-income neighborhoods usually have to build their own on-site technology, like a pit latrine or septic tank. When their latrines fill up, they have to

manually empty them or pay for an informal emptying service. Fecal sludge management has only recently received the attention it deserves. In terms of experience and research, fecal sludge management is at least a hundred years behind wastewater management (Strande *et al*., 2014). There is an increasing amount of research conducted on this topic, but it is important to recognize the knowledge gap and limited experience.

There are a range of service providers for fecal sludge emptying and transport, from informal and independent individuals to formal and large companies. In some areas, services are also provided by public utilities or nongovernmental organizations (Chowdhry & Kone, 2012). It is common to see a variety of service providers working in the same region due. This is because of the complexity and accessibility of different on-site sanitation technologies and the customers' ability to pay for the services (Strande, Ronteltap & Brdjanovic, 2014). A recent survey of 30 cities in Africa and Asia found that about one-third of households manually empty their on-site sanitation technologies. While family members sometimes do this job themselves, a manual emptier is hired almost 90% of the time (Chowdhry & Kone, 2012). Manual emptying is hard and unpleasant work, and it poses serious health and safety risks if it is not carefully managed. The tools used for manual emptying are simple, usually no more than a bucket, shovel, and rope. Workers often use minimal or no personal protection, like gloves or boots, to prevent direct contact with the fecal sludge. As a result, they report injuries, skin rashes, and other diseases (Chowdhry & Kone, 2012; Opel, 2012).

Vacuum pumps are effective in emptying water-based on-site sanitation technologies, like pour flush latrines, septic tanks, and aqua privies. The pump is connected to a hose that is lowered through an access cover into the technology. The fecal sludge is then pumped into the storage tank mounted on a heavy duty truck or trailer, on lighter carts, or even human powered carts for smaller volumes (Strande, Ronteltap & Brdjanovic, 2014). Vacuum trucks are available in a wide variety of sizes and models to meet different needs. Most commonly they have a storage capacity of 200 to 16,000 litres. Conventional vacuum trucks can hold as much as 55,000 litres (Strande, Ronteltap & Brdjanovic, 2014). There are some technical limitations for using vacuum trucks. Conventional vacuum trucks can usually only suck down to a depth of 2 to 3 metres. They also must be parked within 25 metres of the on-site sanitation technology, depending on the strength of the pump (Strande, Ronteltap & Brdjanovic, 2014). As well, large vehicles are often unable to access narrow streets and poor roads, especially in unplanned and informal communities. Vacuum trucks are also designed for emptying water-based technologies, such as pour flush latrines, septic tanks, and aqua privies. Depending on the technology, the sludge can become too thick and cannot easily be pumped. In this case, it is necessary to dilute the fecal sludge with water so that it can flow more easily. However, this is inefficient and potentially costly. If water is not available, then manual emptying may be the only option to empty the technology (Tilley *et al*., 2014).

By one estimate, only 13 percent of all wastewater generated is treated in India.. Out of 350 million urban residents, about 40 percent of the urban population is

connected to sewerage systems, 47 percent is connected to septic tanks and 2 percent to other system. There are no known septage treatment facilities in the country. As a result, domestic waste contributes to 80 percent of the pollution in India's surface waters. With so many people depending on surface water for washing and drinking, waterborne diseases account for one-fifth of communicable diseases in India. The prevalence of onsite sanitation varies from state to state, with as many as 80 percent of toilets connected to septic tanks in the states of Orissa and Rajasthan. The number of septic tanks has grown quickly over the last few decades as households invest in private sanitation. Many septic tanks, even for public toilets and commercial entities, are inaccessible for desludging and maintenance.

The National Building Code of India states that septic tanks should be regularly maintained and desludged as often as every year. "Septic tanks should be cleaned when a large quantity of septage has collected in the bottom of the tank. The interval of cleaning should not normally exceed 12 months. This Code, however, does not charge any particular agency with implementation responsibility. A few cities have developed policies to implement the desludging requirement. However, most cities have not yet developed policies to regulate septage management, and ULBs are not capable enough to address this issue. Increasingly, septage management is seen as an effective way to improve water quality and public health. The NUSP shifts the national focus to onsite sanitation system and the safe collection and disposal of septage, and requires state and local governments to create sanitation plans to address septage management.

Currently on-site pit latrines, septic tanks and other such systems account for a substantial proportion of toilets in urban India–over 45 percent of urban Indian households depend on onsite facilities. Further, as urban households without toilets will obtain facilities over the next few years under Swachh Bharat Mission (SBM), it is likely that many will acquire onsite arrangements like pit latrines and septic tanks in cities at locations where sewerage systems are not available. Thus, while the containment of human waste will be largely achieved under SBM, its treatment still poses a huge challenge. In the absence of adequate safe and sustainable sanitation, many Indian cities are already suffering the consequences, in the form of health ailments and serious pollution of water and soil resources. In contrast with the large proportion of on-site sanitation systems, limited attention has been accorded to proper construction, maintenance management and safe disposal of faecal sludge and septage from septic tanks and pit latrines. While construction standards have been codified by the Bureau of Indian Standards, the actual construction was largely left to households to manage–in reality, the installations are subject to local practices and considerable variations are observed. In many instances for example, soak-away or drain fields are not provided. Limited capacities and resources with urban local bodies also resulted in little regulation of maintenance and cleaning of septic tanks and pits–in many cases, households do not report cleaning for a number of years. Some ULBs have desludging equipments or there are private players providing cleaning services but the supply of desludging services is far from adequate. In many instances, faecal sludge and septage is dumped in drains and open areas posing considerable health and environmental risks. Sanitary

workers also work in hazardous conditions to clean on site sanitation systems pits and tanks sometime without adequate protective measures and equipment. In most Indian cities, there is limited date and information on the types and number of onsite sanitation system toilets and septage disposal systems and practices.

The problem of faecal sludge and septage / sewerage must be addressed in a holistic manner, with a strategy that provides for minimum needs and is appropriate and affordable for all areas and population considering the local situation. It must also address the enabling provisions in the form of suitable regulation and institutional framework, capacity building and education and awareness among all stakeholders. This policy seeks to address the efficiency of systems in place for onsite sanitation whereof the faecal sludge output needs to be managed in an environmentally safe manner including the proper engineering design, construction and maintenance of septic tanks systems, pit latrines and such other systems generating faecal sludge. Only on-site sanitation facilities and areas served by such facilities would fall under the purview of this Faecal Sludge and Septage / Sewerage Policy. It does not seek to cover network or conventional sewerage system (including treatment plants) of wastewater/sewage management. However it will address synergies between FSSM and sewerage systems or municipal solid waste management.

Due to low level of sanitary coverage and high dependency on conventional septic tanks, the sanitary workers are found engaged in cleaning and scavenging of toilets. Moreover, sanitary workers do not get adequate instruments, equipments and materials for cleaning of community toilets and regular sweeping of roads and streets. Even, sanitary workers are not well aware about the Municipal Solid Waste Management Rules. It is a matter of great concern that even after more than six decades of independence a vast majority of people still do not has access to the basic amenities like sanitation and clean drinking water. There is no focused intervention to provide sanitary facilities to the urban poor. Thus is imperative to create infrastructure and improve delivery of basic urban services including water supply, access to toilets, drainage and solid waste disposal in slums. There is also need to provide affordable and suitable sanitary facilities to the urban poor. In absence of sever network, poor functioning of sewerage treatment plants, and poor delivery of sanitation services in urban areas, the sanitation conditions in most of towns and cities are pathetic. A large segment of slum dwellers are defecating in open in absence of toilets. Open defecation may be checked only through construction and ensuring proper maintenance of public toilets in urban centers and particularly in slums. Government alone cannot ensure universal access of sanitation to urban poor and therefore active participation and involvement of all stakeholders including community, civil society organizations, NGOs, urban local governments, women's associations is necessary in the provisioning of sanitation services to urban poor. He further said that women living in slums are more vulnerable as in absence of sanitary latrines are forced to defecate in open. Open defecation leads to harassment and sexual assault on women and girls besides increase in urinary infections as women wait till night fall for open defecation because they cannot defecate in open space in day time. In this session, 5 papers and presentations

were made. . The issue of non-availability of water in houses is cause of concern which ultimately affects the effective usage of toilets. The maintenance of public toilets has been found to be very poor besides non-existence of urinals at public places. The low level of community mobilization and sensitization towards the sanitation services to urban poor has also been reported. There has been low level of motivation among the poor regarding use of toilets as they are traditionally used to defecate in open. Thus, the role of community based organizations has to be enhanced in creating demand for sanitation services among poor.

SUGGESTIONS

- There are a variety of treatment technologies that will render seepage, waste water management and treatment of faecal sludge. Decentralized approaches and technologies may be encouraged to set up Faecal Sludge Treatment Plants at zone levels in small and medium sized cities which may be easily managed by ULBs, Residents Welfare Societies and NGOs.
- State governments should formulate and implement State Policy of Faecal Sludge Management. It is to be noted that state is pioneering state in introducing State Policy of solid Waste Management.
- For many years, private sludge operators have been providing desludging services when public agencies fail to do so. However, private septage operators do not dispose of septage in treatment facilities because they were not adequately consulted or engaged in the facility's setting and design process. By involving private sludge operators, CBOs, and sanitation workers early in the planning process, desludging, disposal of faecal sludge and treatment facilities, ULBs may create local business opportunities, build future compliance, and ensure that new facilities will be used. Thus, ULBs need to regulate the system by emplaning private sludge operators, creating helpline for regular desludging of septic tanks by citizens, fixing the user charges or linking with property tax , demarcating the points of disposal of faecal sludge after desludging by sludge operators, and ensuring the safety and security of sanitation workers while desludging of septic tanks.
- After construction of treatment facilities for faecal sludge and waste water ULBs need to educate urban households on the value and importance of regular desludging. To develop a public promotion program, cities can first survey household attitudes and concerns towards sanitation and septic tanks, which will in turn help identify target audiences and tailor key messages. Cities can then conduct the campaign, evaluate attitudes post-campaign, and further refine future promotion campaigns.
- As the nutrient and pollutant composition of septage varies by climate and by culture, ULBs will need to conduct research to determine the efficacy of different treatment systems, opportunities for improvement, and possibilities of reuse and recycling, and new treatment technologies, such as those that combine solid and

human waste composting. Engaging Engineering Colleges / Institutions in this process may also help integrate onsite sanitation management and treatment into the curriculum and produces future professionals who are able and committed to solving this critical issue of national importance.

- The ULBs need to strengthen their capability in desludging of septic tanks through adding intake capacity of Suction Machines / Volume Tanks, mechanized vehicles and provision of safety measures and equipments. The sanitary workers need to be increased for the work as it is likely to increase their workload in future through increasing community awareness and sensitization. The ULBs need to introduce a system for maintain records of community for applying for desludging of septic tanks , payments received , date of desludging so that they may be further intimated for desludging of septic tanks whenever it is due. However, it will require the survey of urban community to assess the number of septic tanks , their willingness to pay user charges and maintaining the cycle of regular desludging of septic tanks.
- ULBs may need to revise the structure of property tax while regular desludging charges may be included in sewerage charges already included in property tax . Sewerage charges are levied for those areas where piped sewer network exists , thus, desludging charges may be treate as sewerage charges in all the ULBs. Of The state.
- There is imperative need to build business models by ULBs through mobilizing SHGs, civil society organizations, NGOs, RWAs, builder's associations , private operators , retailers and other stakeholders for construction of faecal sludge treatment facilities, awareness creation for regular desludging of septic tanks, safe disposal of faecal sludge at faecal sludge treatment facilities , composting of human excreta and animal dung as well as solid wastes for conversion of compost manure and increased use of it by farmers.
- There should be more emphasis on public private partnership in the provision of sanitation services. The women's groups such as Self Help Groups, thrift and credit societies, civil societies, NGOs and other voluntary organizations should be engaged in door to door collection of garbage and refuse as well as sweeping of streets and roads. There should be active involvement of the stakeholders. Stakeholders include the local governments, local service providers, the regulator, CBOs, NGOs, Private Sector companies and administrators, people 'representatives etc. Government and NGO interventions on sanitation can only affect a small proportion of the population.
- There should be proper policy of septage and faecal sludge management as a large urban population is depending on conventional septic tanks technology for disposal of human excreta. The policy should also address the issues of appropriate technologies, regular cleaning of septic tanks, disposal of solid waste from septic tanks and provision of training and capacity building of sanitary workers engaged in cleaning of septic tanks.

- There should be regular training and capacity building programmes for the sanitary workers for their exposure towards the effective use of new technology, equipments and instruments as well existing laws and rules. In order to start a successful capacity building programme, the local service providers need to assess their own needs. This will give them ownership of the process. The capacity building programme then needs to be phased in order to fully engage the service providers.
- The sanitary workers should be provided adequate instruments, equipments and materials for sanitation work. This is the responsibility of urban local bodies. This may be ensured through the imposing user charges on sanitation services.
- Community Septic tank should be introduced in dense areas, subject to environmental considerations. In water-logging prone areas leach pit technology has proven to be ineffective and problematic.
- The primary responsibility of identification of beneficiaries, generating awareness, execution of construction work and maintenance should be entrusted to technically qualified and reputed NGOs and community based organizations so that identified beneficiaries are able to obtain proper benefit of the scheme.
- The cleaning of septic tanks may be mechanized to abolish manual cleaning. The concerned authorities need to adopt technology/ mechanized system for manhole operations with adequate safety measure and skilled training.

References

AECOM, & SANDEC. (2010), A Rapid Assessment of Septage Management in Asia: Policies and Practices in India, Indonesia, Malaysia, the Philippines, Sri Lanka, Thailand, and Vietnam Thailand.

Blackett, I., Hawkins, P. & C. Heymans (2014), The missing link in sanitation service delivery: A review of fecal sludge management in 12 cities. Washington, DC: Water and Sanitation Program, International Bank for Reconstruction and Development /The World Bank.

Cairmcross, Sandy (2003), "Sanitation in the Developing World: Current Status and Future Solution", International Journal of Environment Health Research 13, June.

Chowdhry, S. & Kone, D. (2012), Business analysis of fecal sludge management: Emptying and transportation services in Africa and Asia, Draft final report. Seattle, USA: The Bill & Melinda Gates Foundation

CPCB. (2009), Status of Water Supply, Wastewater Generation and Treatment in Class-I Cities & Class-II Towns of India. New Delhi: Central Pollution Control Board.

CSE (2011), Policy Paper on Septage Management In India, Centre for Science and Environment, New Delhi.

Franceys, R., Pickford, J. & Reed, R. (1992), A guide to the development of on-site sanitation. Geneva, Switzerland: World Health Organization.

IWA (2014), Compendium of Sanitation Systems and Technologies, IWA, London.

MOUD (2017), National Policy on Faecal Sludge and Septage Management, Ministry of Urban Development, Government of India, New Delhi.

MoUD. (2010), Improving urban services through Service Level Benchmarking Retrieved 26-08-2013, from *http://urbanindia.nic.in/programme/uwss/slb/slb.htm*

NIUA. (2005), Status of Water Supply, Sanitation and Solid Waste Management in Urban Areas. New Delhi: National Institute of Urban Affairs.

Opel, A. (2012), Absence of faecal sludge management shatters the gains of improved sanitation coverage in Bangladesh. Sustainable Sanitation Practice Journal, (13 10/ 2012).

SCBP (2017), Training Module on Integrated Waste Water Management and Septage, Sanitation Capacity Building Programme , NIUA, New Delhi and Eco- San Foundation, Pune.

Singh, U.B. *et al.* (2014), Challenges of Urban Management in New Millennium, Global Research Publications, New Delhi.

Strande, L., Ronteltap, M. & Brdjanovic, D. (2014), Faecal Sludge Management: Systems Approach for Implementation and Operation. London, UK: IWA Publishing.

Tilley, E., Ulrich, L., Lüthi, C., Reymond, P. & C. Zurbrügg (2014), Compendium of Sanitation Systems and Technologies., Eawag: Swiss Federal Institute of Aquatic Science and Technology, Dübendorf, Switzerland.

Wankhade, Kavita (2014), Sustaining Policy Momentum: Urban Water Supply and Sanitation, Indian Institute of Human Settlement, Bangalore.

Wankhade, Kavita *et al.* (2014), Urban Water Supply and Sanitation in India, Indian Institute for Human Settlements, Bangalore.

WHO (2005), "Ecosystems and Human Wellbeing", WHO, Geneva.

WSP. (2008), Review of Sewerage and Sanitation Interventions in Urban India.

WSP-TARU (2008), Review of Sewerage and Sanitation Interventions in Urban India, Water and Sanitation Program-South Asia, New Delhi.