Environment and Public Heath Disaster from the lens of Sludge Management in India

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Abstract

The goal of any sanitation policy is to eliminate direct or indirect contact with feces. To ensure this objective, UNDP has framed sanitation ladder so that all member countries can design their sanitation policy to attain SustainableDevelopment Goal (SDG) 6.2. Developed counties have invested on offsite sanitation system but Low Middle IncomeCountries (LMIC) have opted for mix of offsite and onsite sanitation methods. Onsite sanitation can be considered as safe sanitation, if the partially digested sludge is disposed in safe manner. 'Swach Bharat Mission (SBM)', the recent public policy on sanitation has motivated households for the construction of toilet. The toilets constructed through SBM are improved toilets which mean the risk of fecal contamination is lower. Rural India is predominated with Onsite sanitation methods; it can be considered safe only if thesufficient provisions for fecal sludge management are provided. If the waste from septic tank is disposed in the open/ponds/rivers then the end result would beenvironment and health disaster. The present sewage treatment plants are run by the government and they donot accept the sludge from the septic tanks. The state run provisions for transportation and treatment of sludge generated from septic tanks are not sufficiently available. The current study examines the facilities of sludge management in India and the risk with present sludge management facilities.

Keywords: *On-Site Sanitation, Offsite Sanitation, Sludge Management, Safe Sanitation, SDG 6.2*

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1. Introduction

The concept of sanitation starts from providing access to toilet and ends with safe disposal of toilet waste. This means sanitation is not just providing safe options to defecate but if the waste from the toilet is added to natural resources, the objective sanitation can't be fulfilled. Public health has high close association with Personal hygiene and environment hygiene(PEARSON, JOANNA, 2008),(WaterAid, 2016). To maintain the personal hygiene, it is necessary to eliminate fecal-oral contamination and to maintain environment hygiene, it is necessary that the human/animal waste is disposed in such manner that it will not create any pressure either on natural water bodies or soil or air (through emissions). The global importance for sanitation was started with Millennium Development Goals (MDG) in 2000. The seventh goal, third section (7C) of the MDG highlighted the significance of environmental sustainability through fixing the target of reducing the percentage of population without sustainable access to safe drinking water and sanitation by fifty percent by the year 2015 (United Nations, 2000). The member countries of United Nations worked in this direction and by 2015, open defecation has reduced significantly at global level hence the concept of sanitation has further enhanced while framing goal 6 of SDG(UNDP, 2019). The SDG 6.2 is focused to provide sanitation facilities to all without any discrimination. The concept of sanitation is monitoredthrough sanitation ladder (framed by UNDP and WHO). The first target in this hierarchy is giving access to improved toilet and ends with safe disposal of toilet waste(Dasgupta et al., 2021). The objective of safe sanitation is to protect human health by breaking the cycle of disease and protecting the environment. This can be achieved by ensuring that everyone is using the toilet and the waste from the toilet is disposed in a safe manner. If the toilet waste is not disposed in safe manner (toilet waste is ended up in the natural water bodies or barren land), then the true objective of sanitation can't be achieved. It is necessary to provide safeguard to environment, human and aquatic life. Theway it will be helpful to achieve climate mitigation and adaptation. Climate change is a bigger challenger for the entire world. Lack of sanitation and wastewater management has direct association with emissions. With a planned approach climate change policies should be associated with sanitation policy(Dickin et al., 2020). With sharp increase in population and urbanization, the problem of waste disposal (including solid waste) is becoming a challenge. Unsafe disposal of toilet waste can be a major source of various community infection spread. To tackle the problem of toilet waste, developed countries

have invested heavily on the development of sewage lines and sewage treatment plants, but developing countries can not invest heavily on sludge management. They are still struggling in providing safer options for defecation.As a result, Globally around 80 percent of untreated wastewater returns to the environment (UnitedNations, 2016). The larger proportion of world population is living in developing or LMIC, hence it is necessary to develop some cost-effectivemethods to solve the problem of safe disposal of toilet waste so that LMIC can adopt these. Presently in most of the LMIC, sludge is collected manually from the latrines;this sludge is then transported to central collection points and then to STPs for the treatment. This process of sludge management requiresmany stakeholders so standardization and monitoring isdifficult. After collecting sludge at central collection point, it has to be treated. For treatment some of the countries have developed sufficient capacity through decentralized sewage treatment plants but most of the developing countries are lacking this facility.In this entire process, there are high chances of leakagese.g, for cleaning of septic tank and transportation of sludge, safety gears and training to sanitation workers is necessary. After transportation, there should be sufficient capacity in the treatment plant for safe disposal of this waste.In case of India, STPs do not have sufficient capacity to treat sludge generated from septic tanks.

2. Objective

The study is focused to examine the health and environmental impact of unsafe disposal of toilet waste in South-Asian countries, and how can these impact be mitigated. The study will further examine the different methods of toilet waste disposal among Indian householdsbased on location (Rural vs urban).

2.1 Comparative Position of India with other South Asian Economies for Toilet Waste Management

The toilet waste management is not yet received attention from the policy makers. The impact of MDG 7c and SDG 6.2 is mainly focused to provide improved toilets but to make sanitation policy sustainable, it is necessary to provide options for better use of toilet waste. There are two methods for fecal sludge management; onsite sanitation and offsite sanitation (WSP & GoI, 2008). Offsite sanitation requires huge investment and for the LMIC, it is not possible to invest heavily on centralized sewage lines. Construction and maintenance of STPs/sewer pipeline is practically difficult in shorter span of time for any LMIC (Sljbesma, 2008). Hence, septic tanks are considered as safe method for

sludge management (Dasgupta et al., 2021). But septic tank has its limited capacity and these have to be cleaned after some interval. The problem arises if the provisions for treatment of sludge from septic tank are sparsely available. Let's first understand how the South Asian LMIC are planning for provision for safely managed sanitation. World Health Organization (WHO) and United Nations International Children's Emergency Fund (UNICEF) collaborate to develop a platform which helps nation to compare and analyze their progress on SDG 6. This portal provides a comparativeanalysis with the data provided by the government of member nations like National Family Healthcare Surveyin India and international agencies. The comparative progress at regional and global levels helps nation toimprove. This data base is known as Joint Monitoring Program (JMP) which publishes global updates on water and sanitation since 1990.

Table 1: Sanitation Facility Type: India and its Neighboring Countries (%)

	Improved latrine and other	Septic tank	Sewer	Sewage Treated	Faecal Sludge treated
India	34.63	36.16	12.58	3.96	0
Nepal	29	53.76	4.95	2.05	0
Pakistan	21	30.41	27.28	NA	NA
Bangladesh	49	20.08	9.35	2.92	0
Afghanistan	49	8.82	3.15	NA	NA

Source: JMP (2020)

India, Nepal and Bangladesh have data on treatment of wastewater generated through toilets connected with sewers (Offsite sanitation). However all the countries don't have data on fecal sludge treated (waste generated through toilets connected with septic tank/pit latrines or on-site sanitation) or they do not have any such facility. Pakistan has 27 percent toilets connected with the sewers but the information for sewage treatment is either missing or the STPs do not have sufficient capacity to treat the sewage collected. The dependency on septic tank toilets is highest in Nepal followed by India and Pakistan but the information on sludge treatment from septic tank is totally missing. This shows that these LMIC are still focusing on providing safe defecation options. Along with the availability of toilets, there is need to develop the

awareness/ options or capacity for fecal sludge management. Due to low government revenue, constructing sewage lines can be challenging, it is still necessary to provide safe options for sludge/sewage disposal. This can be possible with the combined efforts by government and private sector.

2.2 Sewage and Fecal Sludge Management in India

It is overambitious to construct the sewage lines in the villages for any LMIC. Hence it is a wise decision of GOI to choose onsite sanitation system (toilets with septic tanks). To provide a sustainable solution to developing countries, on-site sanitation system has emerged. Onsite sanitation methods are considered safe and hence these are considered for highest level in sanitation ladder (safely managed sanitation). Onsite sanitation system can be possible with different toilet designs, but only few of them are sustainable in themselves and capable enough to decompose the human waste naturally. With the constant technology intervention, there are few toilets construction designs which don't require any external method for waste disposal. But others require regular cleaning and the waste from these toilets needs proper disposal mechanism. Let's understand the type of toilet design opted by Indian households.

Table 2 : Household Peferences for Toilet Design, NFHS-V (2019-21)

	Rural (%)	Urban (%)	All India (%)
Flush to piped sewer system	2.9	25.6	10.4
Flush to septic tank	40.2	53.2	44.5
Flush to pit latrine	14.9	7	12.3
Flush to somewhere else	0.6	1.4	0.9
Flush, don't know where	0.1	0.4	0.2
Ventilated Improved Pit latrine (VIP)	0.8	0.5	0.7
Pit latrine with slab	6.2	3.5	5.3
Composting toilet/twin pit	5.9	1.1	4.3

Source: (NFHS 5, 2021)

The above table shows the toilet construction design by the Indian households based on waste disposal method. Just 1 percent households have toilets with soak pit. These pits are connected with open drains. These open drains are connected withmain drain

and transport the septic to STPs, but sometime these open drains are ending in disposal of sludge in unsafe manner. The basic difference between improved and unimproved toilets is of drainage facility from the toilet. Unimproved toilets either have soak pit or connected with open drains so the toilet waste is either seeped in the ground water or it is routed to low-lying areas or some to natural water bodies. The situation becomes worse in those areas where households have flush/pour flush toilets connected with open drains or open fields. Hence unimproved toilets have high negative health and environment externalities. It is appreciable effort of GOI that most of the toilet constructed under SBM is of improved toilet construction design. Majority of rural as well as urban households have toilets connected with septic tanks. The improved toilets can be categorized into two; toilets connected with onsite sanitation system and toilets with offsite sanitation system.

2.3 Onsite Sludge Management

On-site sludge management can be defined as a system where latrine is connected with a deep pit/ septic tank which has storage facilities of fecal matter. It is constructed within the dwelling or its immediate surroundings. The idea of on-site sanitation system is more suitable for developing countries as it does not require the grid of sewage lines in the entire area so even a remote village or a small cluster of houses can have safer option for sanitation. Another benefit of this method is it does not create pressure at one area(WSP & GoI, 2008). The treatment of fecal material is done into a comparatively smaller scale so it will increase the efficiency. Onsite sanitation system can be categorized into two; self-sustain toilet where there is no need to empty the pit (for example composting toilet or twin pit toilets) and other category is the toilet which is connected to one pit with limited capacity.

The self-sustain toilet design under onsite sanitation is twin leach pit/composting latrines/ Ventilated improved toilets. But these toilet designs are not popular among Indian households and only 11 percent choose twin pit (NSS 76 round, 2018) which has reduced to 5 percent (NFHS-V, 2019-21). The reason could be space as it requires more land and planning from the starting. If a new toilet is going to be constructed then such method can be adopted but it is difficult to alter the existing toilet to become self-sustain toilet. Twin pit toilets are such toilets which are self-sustainable toilets in

nature. Fecal sludge can be converted into manure and extracted by the household himself (without any technical help). This manure is highly useful for plants. This solution is best if the household has some extra space and toilet construction is planned from the scratch. The existing toilet is difficult to be converted in this design. These are the improved pit latrines with two pits, interlinked through Y-junction to pour flush toilet(Verma et al., 2020). Fecal sludge or popularly known as Septage can be understood as slurry that contains both solid human waste and liquid waste (black water). This Septage is collected in one pit for some months and when this pit gets filled, another pit is used to collect the fecal matter. Meanwhile, the collected Septage in the first pit can be decomposed to have manure through the natural process. This toilet design requires more water as the waste has to move through one pit to another. GOI has also motivated households, particularly rural households to adopt this toilet design but due to its requirement of space and water, it is not a popular choice. Besides twin-pit toilets, the other option for on-site disposal is in-situ containment systems. In this design, the human waste is segregated in two columns/ compartments. The liquid from raw sewage will be evaporated with time and the solid waste will be decomposed to a greater extent. This does not require emptying of sludge. Hence, no fecal sludge management (FSM) services will be required in the area (Department of Drinking Water and Sanitation, Ministry of Jal Shakti, 2021).

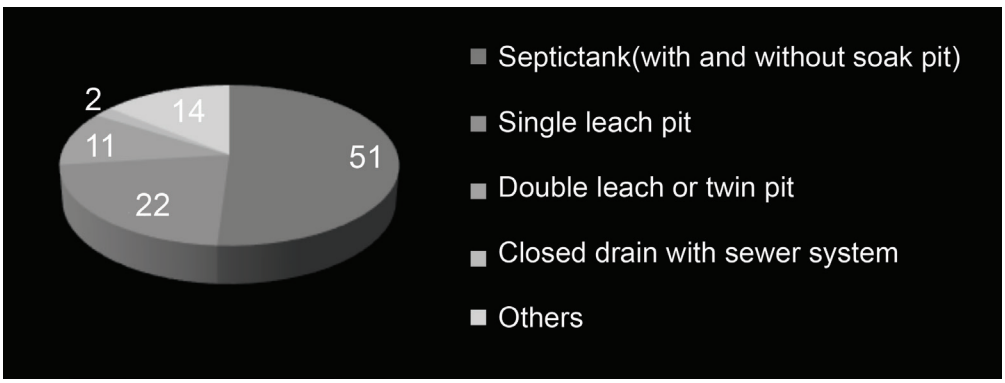

Figure 1 : Methods of Toilet Drainage System in India (In %)

Source: NSS 76 Round (2018-19)

Most of the toilets constructed under SBM has septic toilets. 44 percent of rural and 53 percent of urban households have toilet connected with septic tank. Majority of the households have access to toilets connected to septic tank which is a part of onsite sanitation toilet design. The toilets with the single pit need de-sludging after a certain time interval. The time required to clean the septic tanks depends on number of people using toilet and the depth of the septic tank. These septic tanks have limited capacity, after the filling of the septic tank; sludge has to be removed to make these septic tanks reusable (Department of Drinking Water and Sanitation, Ministry of Jal Shakti, 2021). This way, the onsite sanitation system has total three steps: collection of sludge from the septic tanks, transportation of this sludge safely to the treatment site and finally disposal of sludge in safe manner. The third step can be extended to reuse of the residual of this sludge. From the perspective of sanitation ladder, it is considered as safer option for sludge management but this requires regular cleaning. If the country has infrastructure for transportation and disposal of sludge then septic tank can be proven as most cost friendly method for safe sanitation.

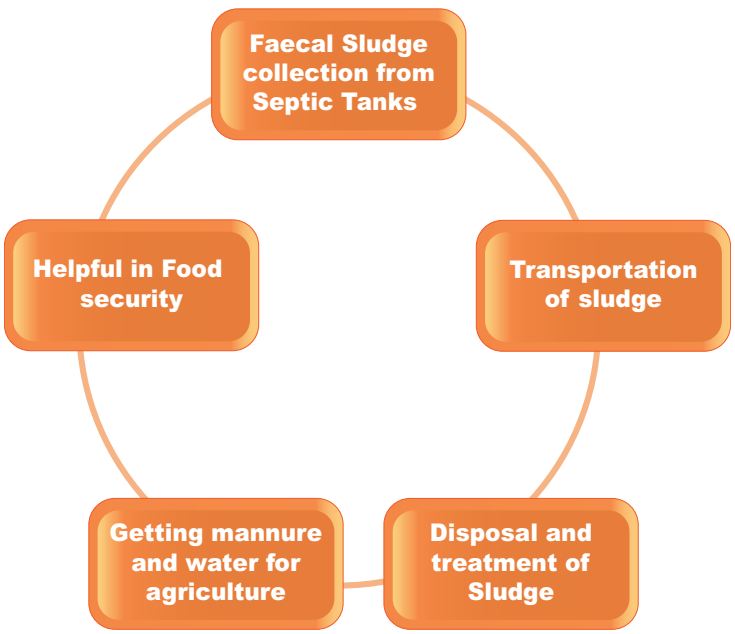

Figure 2 : Steps for Sludge Management in Onsite Sanitation System (Septic Tanks)

For any low-middle income country, on-site sanitation solutions are the most practical way to deal with sludge management. The onsite sanitation system can only be considered safe and free from externalities when this sludge can be collected through suction trucks, transported safely to sewage treatment sites. Ideally, a septic tank system should be cleaned every one and half year with the flexibility of up to three years as per the Central Public Health and Environmental Engineering Organization guidelines(Ministry of Urban development Governmnet of India, 2013). If the STPs are not accepting the sludge transported by private companies, then they also have to dispose of it in an unsafe manner. Most of the on-site sanitation systems are emptied manually without any safety gears(Ingole, 2016). In the year 2018, Dalberg advisors (supported by Bill and Melinda gates foundation) conducted a survey on the different challenges faced by sanitation workers in India. As per their estimate 5 million workers are working in this industry, although their definition of sanitary workers has different nine categories but directly or indirectly this was the estimates of people associated in this profession. In the year 2019 Ministry of Social Justice and Empowerment, Government of India (GOI) has estimated that total 54,130 people working in manual scavenging work. Although manual scavenging is banned by Supreme court of India under Prohibition of Employment as Manual Scavengers and their Rehabilitation Act, 2013 (MS Act, 2013) but the workforce who is engage in cleaning the septic tanks without proper training and safety gear are no better than manual scavengers. After the collection of sludge, it is importance to know where these private contractors dispose of the sludge.

Table 3 : Place of Disposal of Sludge from the Septic Tank

S.No	Area of disposal for sludge	Rural (%)	Urban (%)	All India (%)
1	treatment plant	2.8	6	4.5
2	buried in a covered twin leach pit/single pit	7.6	6.3	7.0
3	uncovered pit/open land/ pond/river etc.	20.1	10.1	15.0
4	not known	39	64.1	51.8
5	other places	30.4	13.4	21.8
	Total	100	100	100.0

Source: NSS 76 round (2018)

If the toilet waste travels through open drains and finally dumped in pond or river, then there will be deeper health and environment issues. 20 percent of rural households have accepted that their toilet waste is ended in either to barren/open land or river or ponds. Such access and use toilet can only be beneficial for social security but these toilets are as dangerous as open defecation and do not create any positive externalities. More than 50 percent of the households are not aware about the area where the desludging of their septic tank has been taken place. The probable reason for that most of the households has got their toilet constructed recently under SBM. The newly constructed toilets have not yet reached the capacity of the septic tank. Till now, the government has not drafted any solution for cleaning of the septic tanks. Out of the remaining households, just 11.5 percent of households are opting for safe options for disposal of the sludge. These households who have transported their sludge to a sewage treatment plant and have twin pits can be considered as safe disposal. 15 percent of households are opting for desludging in the barren land or in the freshwater source, which is extremely harmful and has high negative externalities. Such kind of measure creates complex obstacles for grey-water management as well. Rural India is majorly dependent on on-site sanitation methods, which require cleaning of septic tanks/ desludging at a regular interval. Most of the toilets constructed under SBM are flush toilets with small pit which means these toilets have limited capacity to store the sludge and needs to be cleaned after small interval of time.

Table 4 : Frequency of Cleaning of Septic Tank

	once or more in a year	once in 2 years	once in 5 years	once in 10 years	not known	others
Rural	12.6	20.1	33.0	21.0	7.3	6.1
Urban	18.1	18.0	27.7	21.9	8.8	5.6
Total	15.4	19.0	30.3	21.4	8.1	5.8

Source: NSS 76 round (2018)

The frequency to clean of the pit depends on different factors like; number of members using the latrines, depth of the pit and the ground water level. In case the ground water level is high then pit needs to be cleaned more frequently. If the toilet is shared and a greater number of people are using it then also it need to be cleaned more frequently. If the pit is around 3 feet, then it has to be cleaned frequently. From the data,

it has been observed that there are high number of households who need to get the pit cleaned once in five years. Even if the frequency of Cleaning of septic tank is high then also it is equally safe if the cleaning is done by some responsible agency.

To understand the deeper understanding of impact of septic tank on environment, a question is asked in NSSO 76 round on the pace of disposal of sewage from the household toilet. Although the total sample size become small as most of the toilets constructed through SBM will not require cleaning till now.

Table 5 : Agencies Hired for Emptyingthe Septic Tank (in %)

	Panchayat/ municipality / corporation	Private agency	Privately hired labor	By household members	others	Not Known
Rural	5.4	35.8	49.2	5.7	0.7	3.2
Urban	23.2	43.7	27.3	1.5	1.7	2.5
Total	14.5	39.9	38	3.6	1.2	2.8

Source: (NSS 76 round, 2018)

Majority of the households either have to depend on private agency or the hired labour for the cleaning of the septic tank. Though in the urban area, municipality is responsible for this work and in rural area panchayat has the responsibility. (WaterAid, 2020)But due to a limited capacity of the civic agency or low technical expertise among the local government bodies, the household have to choose private agencies for this work. These private agencies mostly belong to the unorganized sector which doesn't have suction trucks or the option to dispose sludge in STPs. They don't provide sufficient safety gears to the sanitation workers and hence there are high chances of the health hazards to these workers.

Due to these insufficient options for sewage management, there are high chances of getting fecal matter in the grey-water(NITI AYOG, 2021). Currently there is no monitoring system by the local government or any government department on these private agencies. Even the local governments hire these private agencies when there is need for emptying/desludging septic tanks by local government. If some Public-private partnership model can be developed where government can provide their own

standards for transportation and disposal of sludge, then there is possibility that safely managed sanitation can be achieved even with on-site sanitation system. Sustainable Sanitation a Catalyst for any human settlement, to break the vicious cycle of disease, it is necessary to save the fresh water resources from the waste water/ sludge. If this is backed with potential to transform waste into resource, then the entire system can become finically viable as well.

2.4 Offsite Sanitation System

To treat the sewage at a central point, human waste needs to be transported to this central point. For this purpose, underground sewage pipelines have to be installed. These pipelines are connected to each house so that the sewerage of entire area can be accumulating at point for its safe treatment. The pipelines have to high maintenance, sometime choked due to plastic waste, low efficiency of STPs is another problem. Centralized sewage system is a challenge for all low-middle income countries. For a low- middle-income country, it is difficult to construct sewage pipelines for all regions because of high fixed cost. Which result in low coverage of central sewage lines; for example, India has just 4% central sewage lines . GOI has adopted the National Policy on Fecal Sludge and Septage Management (2017) to improve sludge treatment opportunities. This policy is specifically focused on on-site sanitation facilities, so it covers the areas which are not covered with sewers. For better connectivity of sewers, their maintenance 'Atal Mission for Rejuvenation and Urban Transformation (AMRUT 2.0)', was launched on 1 October 2021. The objective of this program is to provide Sewerage management in the cities with the population more than one lakh, but the problem can't be solved by providing the drainage solution only to cities. If he sewage treatment plants can become financially independent, then only it is possible to make sanitation a sustainable policy. In the previous chapter, it was observed that at all India level, only 11 percent sewage is treated in urban India, while this sewage treated is as low as 0.3 percent among rural India (JMP, 2020).

2.5 Making Sewage Treatment Cost Effective

Human waste is totally bio-degradable and thus can be decomposed in a natural way with small interventions. But with increase in population and usage of acid as toilet cleaner, need for waste management become highly important, particularly for cities

and town(Sundaravadivel & Vigneswaran, 2001). If this human waste is not tackled in a planned way, it can become a root cause behind water pollution, methane emissions or different health problems to the human and animals. The same wastewater and excreta can also be utilized as a raw material to generate energy/ biogas/ manure(Yeasmin et al., 2017). With the systematic planning, it can be converted as a valuable resource; it can add nutrition to the plant or provide electricity with cost efficiency. Bio-organic waste has tremendous potential to produce green energy in the form of bio-gas which can be converted into heat/ commercial electricity. This can be particularly efficient in public toilets or community toilets(Pickford et al., 1998). The energy produced can be supplied to the grid or used in the vicinity. This will promote food security through organic manure as well. This is a renewable source so it will reduce the dependence on fossil fuel(Dickin et al., 2020). This holistic approach which considers human excreta and wastewater as a valuable resource is known as sustainable sanitation. The objective of sustainable sanitation is to provide a futuristic solution which is economically viable and socially acceptable. To ensure the safe disposal of toilet waste, the SDG target has stretched to SDG 6.3, with the aims to save water resources from the discharge of untreated wastewater(World Health Organization and UNICEF, 2021). Natural water bodies are necessary for the human and animal survival and if untreated wastewater discharges into that, it disturbs the entire eco-system. Sustainable sanitation approach focuses to overcome the drawbacks of conventional approaches. This way Sustainable sanitation can help in mitigate the effects of climate change.For villages in LMIC, Decentralized wastewater treatment systems can be highly usueful. These are small-scale water treatment facilities, designed to treat and dispose of wastewater on-site, rather than relying on a centralized sewer system. These small machines can be installed for a small cluster. These is a cost-effective method which require less energy compared to centralized wastewater treatment plants. The chances of errors will be less.for example, if a centralized STP become dysfunctional due to some technical glitch, the city managementgot hampared. Small digestor/treatment machine is easy to manage. These decentralized sludge treatment plants uses natural processes such as aerobic and anaerobic digestion,and sand filters to treat wastewater. Other Simple and low-cost treatment technologies such as constructed wetlands, bio-filters, and vermin-filters can also be used to treat wastewater in villages.Treated wastewater can be used for agriculture, which reduces the demand for freshwater for farms.However, it is

important to ensure that the treated wastewater meets the necessary standards and does not pose a health risk to consumers. This treated water can be discharged into nearby water bodiesto recharge groundwater recharge. These small scale technologiescan be used in the urban resident societies, which can supply treated water back to toilets in the flush. To make these technology popular, these can be installed with public private partnership. Private companies bring in their expertise and investment, while the government provides the necessary regulatory framework and infrastructure support. PPPs can help in reducing the financial burden on the government and ensure better project management. All such methods can be popular when people have sufficient awareness about health problems due to lack of sludge management. Awareness among users can be created through awareness campaigns, regulatory measures, and financial incentives. Bigger institutions like industries or group housing societies can be motivated through strict policies to install on-site treatment systems and dispose their wastewater independently, but along with strong policy, it is important to make sewage treatment cost-effective through innovation. This way, a holistic approach is required which involveinnovative technologies, partnerships, and incentives. It is important to move towards sustainable sanitation practices that not only ensure proper waste disposal but also utilize the potential of wastewater as a valuable resource.

3. Conclusion

Accessibility to toilet is definitely an important factor to reduce open defecation and visible faeces but just access to toilet is not likely to eliminate the health and environment externalities.Swachh Bharat Mission has made significant progress in improving sanitation coverage in India, still there is a long way to go in terms of achieving universal access to safely managed sanitation. Ongoing investment in sanitation infrastructure, behavior change campaigns, monitoring and evaluation will be critical to sustaining the gains made till now.

If the capacity/ provisions for sewage treatment/fecal sludge management are not development then in the coming years, there will be huge dependency on the private agencies to clean the septic tanks. At present there is no monitoring how these private agencies are disposing the sludge. There is need to create/ train sanitation entrepreneurs who can use the organic waste to generate energy. This way sludge can be used as a resource instead of polluting the natural water bodies/soil or create

emissions. Waste disposal is a complex problem for any developing country. For India, it can become more dangerous due to high density of the population. If electricity or energy can be produced from this waste then the entire sewage treatment process can become cost effective andself sustainable. The country can gradually switch from public owned sewage treatment plants to PPP model in sewage treatment so that the capacity of sewage treatment can be increasedThis dimension of sanitation needs technological interventions, few provisions are made in the Budget of 2023-24 but still developing sludge treatment infrastructure is neglected. Safe disposal of toilet waste needs immediate attention otherwise fecal-oral diseases can't be reduced. Stable and long-term financing and planning is essential for sustaining ODF status. Short-term and one-time planning, without a future roadmap will result in high health expenditure and incomplete shield from the sanitation benefits. Poor sanitation has the potential to undo most of the positive impacts generated so far in achieving the targets of SDG6 as well as all other SDGs. Safe sanitation implies that the entire sanitation chain needs to function in a safe and sustainable manner. If there is any loose point in one part of this chain, the entire investment will be waste. There are high chances of market failures in this chain. PPP model in sewage treatment can be helpful in increasing the capacity and coverage of decentralized sewage/sludge treatment in villages and cities, however there are chances of market failures which need to be addressed to ensure sustained private and public sector involvement in fecal sludge management facilities. In lack of monitoring it would be difficult to increase the efficiency of decentralized treatment plants.Private agencies usually work only for profits. They are not concerned for environment or public health. Hence they should be monitored regularly. To increase the efficiency of these companies, there is need to develop options for resource generation from toilet waste.. Otherwise the organized sector will not show interest in this sector. Public sector options require huge funds so the time to develop fecal sludge management methods will be long . There is need to address these market failures to develop a sustained and long-term involvement of the public and private sector which implies a significant development for fecal sludge management facilities.

4. Limitation of the Study

India has recently increased the access to toilet. Most of the toilets constructed in villages during SBM are improved toilets with septic tank. These septic tanks will take

3 years (on average) to fill itscapacity. Most of the households have not yet require the cleaning of septic tank and those who have done through private agencies are not aware about the disposal of sludge by the agency. There is no official data availableon sludge disposal methods by these private agencies. Another study is required to investigate the methods of sludge disposal by professional agencies in different states.

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